HOBO® State Data Logger (UX90-001x) Manual

onset®

The HOBO State/Pulse/Event/Runtime data logger records state changes, electronic pulses and mechanical or electrical contact closures from external sensing devices. Using HOBOware®, you can easily configure the internal magnetic reed switch or the external sensor to monitor and record data in a wide variety of applications, such as energy consumption, mechanical equipment operation, and water and gas flow. This compact data logger also has a built-in LCD screen to monitor logging status, battery use, and memory consumption. There are two models of the HOBO state logger: the UX90-001 has 128 KB of memory while the UX90-001M has 512 KB.

HOBO State Data Logger

Models: UX90-001
UX90-001M

Included Items:

- 2.5 mm input cable
- Command™ strip
- Double-sided tape
- Hook & loop strap
- Magnet with 2 screws

Required Items:

- HOBOware 3.3 or later
- USB cable (included with software)

Accessories:

- Wattnode kWh transducers
- Power & Energy Meter (T-VER-E50B2)
- Water Flow Meter Sensor (T-MINOL-130)
- U-Shuttle (U-DT-1)

Additional sensors and accessories available at www.onsetcomp.com.

Specifications

Internal Sensor

Maximum State, Event, Runtime Frequency	1 Hz
Preferred Switch State	No magnet present (normally open)

External Input

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External Contact Input	Electronic solid state switch closure or logic driven voltage output
Range	0 to 3 V DC (USB powered), 0 to 2.5 V DC (battery powered)
Maximum Pulse Frequency	50 Hz
Maximum State, Event, Runtime Frequency	1 Hz
Pulse, Event Lockout Time	0 to 1 second in 100 ms steps
Solid State Switch Closure	Input Low: < 10 KΩ; Input High: > 500 KΩ
Internal Weak Pull-Up	100 KΩ
Input Impedance	Solid state switch closure: 100 KΩ pull up

Logger

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Resolution	Pulse: 1 pulse, Runtime: 1 second, State and Event: 1 State or Event
Logging Rate	1 second to 18 hours, 12 minutes, 15 seconds
Time Accuracy	±1 minute per month at 25°C (77°F) (see Plot A)
Battery Life	1 year, typical with logging intervals greater than 1 minute and normally open contacts
Memory	UX90-001: 128 KB (84,650 measurements, maximum) UX90-001M: 512 KB (346,795 measurements, maximum)
Download Type	USB 2.0 interface
Download Time	10 seconds for 128 KB; 30 seconds for 512 KB
Logger Operating Range	Logging: -20° to 70°C (-4° to 158°F); 0 to 95% RH (non-condensing) Launch/Readout: 0° to 50°C (32° to 122°F) per USB specification
LCD	LCD is visible from: 0° to 50°C (32° to 122°F); the LCD may react slowly or go blank in temperatures outside this range
Size	3.66 x 5.94 x 1.52 cm (1.44 x 2.34 x 0.6 in.)
Weight	23 g (0.81 oz)
Environmental Rating	IP50
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

Specifications (continued)
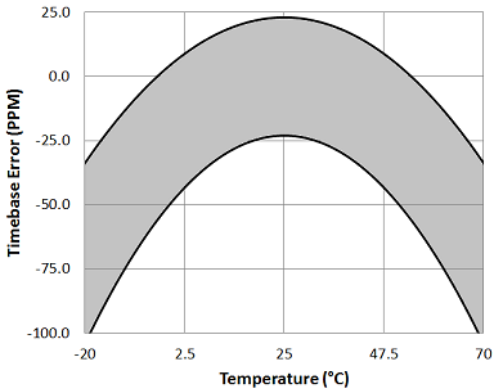
Plot A: Time Accuracy

Logger Components and Operation
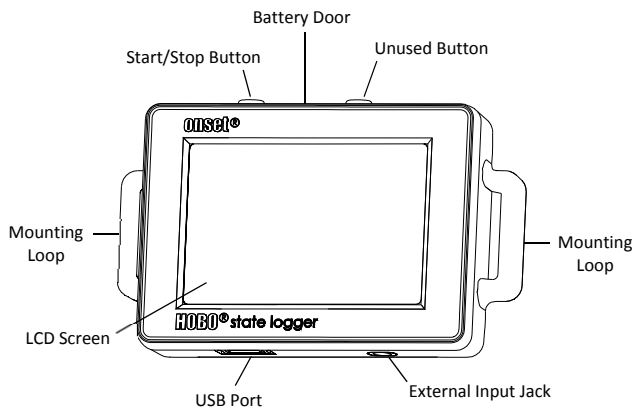
Start/Stop Button: Press this button for 3 seconds to start or stop logging data. This requires configuring the logger in HOBOware with a push button start or stop (see *Setting up the Logger*). You can also press this button for 1 second to record an internal event (see *Recording Internal Logger Events*) or to turn the LCD screen on if the option to turn off the LCD has been enabled (see *Setting up the Logger*). Note that the other button on the top of the logger is not functional for this model.

Battery Door: Open the battery door (not visible in the diagram) on the top of the logger to access the logger battery (see *Battery Information*).

Mounting Loops: Use the two mounting loops to mount the logger with the hook-and-loop strap (see *Mounting the Logger*).

External Input Jack: Use this jack to attach the 2.5 mm input cable to an external sensing device (see *Using the Input Cable*).

USB Port: Use this port to connect the logger to the computer or the HOBO U-Shuttle via USB cable (see *Setting up the Logger* and *Reading Out the Logger*).

LCD Screen: This logger is equipped with an LCD screen that displays details about the current status of the logger.

The following table lists the key symbols shown on the LCD screen:

LCD Symbol	Description
START	The logger is waiting to be launched. Press and hold the Start/Stop button for 3 seconds to launch the logger.
STOP	The logger has been launched with a push button stop enabled; press and hold the Start/Stop button for 3 seconds to stop the logger. **Note**: If you also launched the logger with a push button start, this symbol will not appear on the display for 5 minutes.
(battery indicator)	The battery indicator shows the approximate battery power remaining.
MEMORY ■■■■▫	If the logger has been configured to stop logging when memory fills, the memory bar indicates the approximate space remaining in the logger to record data. In this example, the logger memory is almost full.
MEMORY ▫▫■▫▫	If the logger has been configured to never stop logging (wrapping enabled), then a single block will blink starting at the left and moving right over time. Each block represents a segment of memory where the data is being recorded. In this example, the middle block is blinking.
(switch open)	The switch is open or off.
(switch closed)	The switch is closed or on.
(switch pulse)	The logger is configured to record pulse or event data.
LOGGING	The logger is currently logging.
05:38M-S	**Time display when logger is logging:** This shows the total amount of time the switch has been closed or on since logging began, ranging from seconds to days. This example indicates the switch has been closed or on for a total of 5 minutes and 38 seconds. The logger must be launched with the LCD set to show "Time" for this symbol to display. **Time display when logger is stopped:** This indicates the logger has been configured to start logging on a particular date/time. The display will count down to the start date/time until logging begins. In this example, 5 minutes and 38 seconds remain until logging will begin.
24o/o	This shows the percentage of time the switch has been closed or on since logging began. This example indicates the switch has been closed or on for a total of 24% of the time since logging began. The logger must be launched with the LCD set to show "%" for this symbol to display.
StoP	The logger has been stopped.

Notes:

- You can disable the LCD screen when logging. Select "Turn LCD Off" when setting up the logger as described in the next section. When this option is enabled, you can still temporarily view the LCD screen by pushing the Start/Stop button for 1 second. The LCD will then remain on for 10 minutes.

- When the logger has stopped logging, the LCD screen will remain on until the logger is offloaded to a computer or HOBO U-Shuttle (unless launched with the "Turn LCD Off"

option). Once the logger has been offloaded and disconnected from the computer, the LCD will turn off automatically after 2 hours. The LCD will turn back on the next time the logger is connected to the computer.

Setting up the Logger

Use HOBOware to set up the logger, including selecting the start and stop logging options, configuring the sensors, and entering scaling factors as necessary. It may be helpful to set up the logger to start at a specific date/time or with a push button stop and then bring it to the location where you will mount it to connect any external devices and test the connections before logging begins.

1. **Connect the logger and open the Launch Logger window**. To connect the logger to a computer, plug the small end of the USB cable into the side of the logger and the large end into a USB port on the computer. Click the Launch icon on the HOBOware toolbar or select Launch from the Device menu.

> **Important:** USB 2.0 specifications do not guarantee operation outside the range of 0°C (32°F) to 50°C (122°F).

2. **Configure the sensor.** Choose either the internal or external sensor. Enter the name and select the state description as necessary or select the sensor type.

   The internal sensor can be configured to log:

   * **State.** This records how long an event lasts by storing the date and time when the state or switch changes (logic state high to low or low to high). The logger checks every second for a state change, but will only record a time-stamped value when the state change occurs. One state change to the next represents the event duration.

   * **Runtime.** The logger checks the state of the switch once every second. At the end of each logging interval, the logger records how many seconds the line was in the logic low state.

   The external channel can be configured to log state or runtime as described above or the following:

   * **Pulse.** This records the number of pulse signals per logging interval (the logger records a pulse signal when the input transitions to the logic low). There are built-in scaling factors you can select for supported devices and sensors, or you can set your own scaling when you select raw pulse counts. Click the Advanced button to adjust the maximum pulse frequency and lockout time as needed. **Note:** Setting maximum pulse frequency to 50 Hz will reduce battery life.

   * **Event.** This records the date and time when a connected relay switch or logic low transition occurs (the logger records an event when the input transitions to the logic low). This is useful if you need to know when a switch closes, but the duration of the closure is not important. Click the Advanced button to adjust the lockout time to debounce switches as needed.

3. **Configure optional filters as necessary.** Click the Filter button to create additional filtered data series based on the sensor configuration. Any filtered series will be automatically available upon reading out the logger.

4. **Set the units to display on the LCD screen.** For State and Runtime sensors, select either Time or %. For external sensors, you can either use the default units or enter your own units up to three characters.

5. **If the logger is configured to record pulse or runtime, choose a logging interval from 1 second to a maximum of 18 hours, 12 minutes, and 15 seconds.**

6. **Choose when to start logging:**

   * **Now.** Logging begins immediately.

   * **At Interval.** Logging will begin at the next even interval (available when logging pulse or runtime).

   * **On Date/Time.** Logging will begin at a date and time you specify.

   * **Push Button.** Logging will begin once you press the Start/Stop logging button for 3 seconds.

7. **Choose when to stop logging:**

   * **When Memory Fills.** Logging will end once the logger memory is full.

   * **Never (Wrapping).** The logger will continue recording data indefinitely, with newest data overwriting the oldest.

   * **Push Button.** Logging will end once you press the Start/Stop logging button for 3 seconds. Note that if you also choose Push Button to start logging, then you will not be able to stop logging until 5 minutes after logging begins.

   * **Specific Stop Time.** Logging will end at a date and time you specify.

8. **Select any other logging options as desired and click Start to finish the launch configuration.** The status of the launch will be displayed on the LCD screen, unless you select the option to "Turn LCD off."

Using the Magnet (Internal Sensor)

The logger contains an internal reed switch that can be used with the included magnet as the input to the logger. This configuration can be used to determine when a door or window is open or closed. The magnet must be oriented as shown below, positioned to the right side of the logger when the LCD screen is facing up.
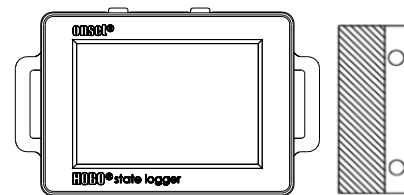
Using the Input Cable (External Sensor)

The 2.5 mm input cable included with the logger can be used to measure contact closures and allows the logger to be mounted remotely from the contacts. Connect the contacts to the black and white wires, and plug the other end of the cable into the external input jack on the bottom of the logger. Do not connect the contacts to any other devices or cables.

If the external sensor was configured to record raw pulse counts or events in HOBOware, there is also an option to

specify lockout time. This can prevent false readings from mechanical contact closure bouncing. For more details on setting lockout time, see the HOBOware Help.

Determining Logging Duration Data

The logger's storage capacity and logging duration depends on the interval between state changes and events. The longer the interval between state changes, the more memory is needed to store each data point. The following table shows how memory capacity is affected by the amount of time between events:

Time Between Events	Approximate Total Data Points	Approximate Logging Duration (1 Year Battery Life)	Logger Part Number
1 to 15 seconds	84,650	23.51 hours to 14.7 days	UX90-001
	346,795	4.01 to 60.21 days	UX90-001M
16 seconds to 4.25 minutes	63,488	11.76 to 187.38 days	UX90-001
	260,096	48.17 days to 2.1 years	UX90-001M
4.26 to 68.25 minutes	50,790	150.49 days to 6.6 years	UX90-001
	208,077	1.69 years to 2.7 decades	UX90-001M
68.26 minutes to 18.2 hours	42,325	5.5 years to 8.8 decades	UX90-001
	173,397	2.25 to 36.03 decades	UX90-001M

Notes:

- Typical battery life is 1 year when state or event changes are at 1 minute or greater intervals.
- The logger can record battery voltage data in an additional channel. This is disabled by default. Recording battery voltage reduces storage capacity and is generally not used except for troubleshooting.

Setting Maximum Pulse Frequency

When recording raw pulse counts, the logger dynamically adjusts its memory use from 4 to 32 bits instead of a typical fixed width. This results in the ability to store more data using less space, which in turn extends logging duration. The default pulse rate is 4 Hz; the maximum pulse frequency is 50 Hz. You can adjust this rate in HOBOware (see the HOBOware Help for details). Decreasing the rate will increase logging duration.

The following table shows examples of how pulse rate and logging interval affect logging duration.

Logging Interval	Pulse Rate (Hz)	Number Bits Required	Approx. Total Data Points	Approx. Logging Duration	Logger Part Number
1 min	4	8	126,976	88 days	UX90-001
			520,192	361 days	UX90-001M
1 min	50	12	84,650	58 days	UX90-001
			346,795	240 days	UX90-001M

Reading Out the Logger

There are two options for reading out the logger: connect it to the computer with a USB cable and read out it with HOBOware, or connect it to a HOBO U-Shuttle (U-DT-1, firmware version 1.15m030 or higher) and then offload the data files from the U-Shuttle to HOBOware. Refer to the HOBOware Help for more details.

Recording Internal Logger Events

The logger records the following internal events (different from state/event changes) to help track logger operation and status:

Internal Event Name	Definition
Host Connected	The logger was connected to the computer.
Started	The Start/Stop button was pressed to begin logging.
Stopped	The logger received a command to stop recording data (from HOBOware or by pushing the Start/Stop button).
Button Up/Button Down	The Start/Stop button was pressed for 1 second.
Bad Battery	The battery level dropped below 2.7 V (recorded even when the battery channel has been disabled).
Good Battery	The battery level rose to 2.9 V or above after a Bad Battery event was marked.
Safe Shutdown	The battery level dropped below 2.5 V; the logger performs a safe shutdown.

Mounting the Logger

There are several ways to mount the logger using the materials included:

- Attach the Command strip to the back of the logger to mount it a wall or other flat surface.
- Use the double-sided tape to affix the logger to a surface.
- Insert the hook-and-loop strap through the mounting loops on both sides of the logger to mount it to a curved surface, such as a pipe or tubing.

Protecting the Logger

The logger is designed for indoor use and can be permanently damaged by corrosion if it gets wet. Protect it from condensation. If the message FAIL CLK appears on the LCD screen, there was a failure with the internal logger clock possibly due to condensation. Remove the battery immediately and dry the circuit board. It is possible to dry the logger with a hair dryer, but do not let the board get too hot. You should be able to comfortably hold the board in your hand while drying it. **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" in the FAQ section on onsetcomp.com.

Battery Information

The logger is installed with a 3V CR2032 battery (HRB-TEMP). Expected battery life varies based on the temperature where the logger is deployed and the frequency (the logging interval and the rate of state changes and/or events) at which the logger is recording data. A new battery typically lasts 1 year with logging intervals greater than 1 minute and when the input signals are normally open or in the high logic state. Deployments in extremely cold or hot temperatures, logging intervals faster than 1 minute, or continuously closed contacts may reduce battery life.

The logger can also be powered by the USB cable when the remaining battery voltage is too low for it to continue logging. Connect the logger to the computer, click the Readout button on the toolbar, and save the data as prompted. Replace the battery before launching the logger again.

To replace the battery:

1. Open the battery door on the top of the logger.

2. Use the tab on the built-in battery removal tool inside the compartment to remove the battery.

3. Place the circular battery removal tool around the negative side of the new battery with the tab up. Insert the new battery with the positive side facing out. The LCD should display "HOBO" briefly after correctly installing the battery.
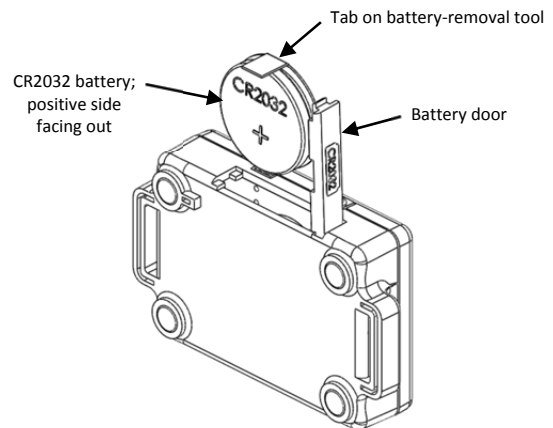
WARNING: Do not cut open, incinerate, heat above 85°C (185°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.

HOBOware provides the option of recording the current battery voltage at each logging interval, which is disabled by default. Recording battery life at each logging interval takes up memory and therefore reduces logging duration. It is recommended you only record battery voltage for diagnostic purposes. Even with the channel disabled, a bad battery event will still be recorded.