



The HOBO Motor On/Off data logger records motor on and off conditions by detecting the AC magnetic fields given off by a rotating motor using its internal sensor. A second external input can be used to detect a variety of external contact closure type inputs. Using HOBOWare®, you can easily configure the logger for equipment monitoring in a wide variety of applications. This compact data logger has a built-in LCD screen for checking status, battery usage, and memory consumption. You can also use the LCD screen to quickly calibrate the logger's motor sensor near the motor to be monitored or you can set calibration to preset sensitivity levels with HOBOWare. There are two models of the HOBO Motor On/Off data logger: the UX90-004 has a memory capacity of 128 KB while the UX90-004M has 512 KB.

Specifications

Internal Motor Sensor

AC Magnetic Field Threshold	> 40 mGauss at 60 Hz
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External Input

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 State and Runtime Frequency	1 Hz
Solid State Switch Closure	Input Low: < 10 K Ω ; Input High: > 500 K Ω
Internal Weak Pull-Up	100 K Ω
Input Impedance	Solid state switch closure: 100 K Ω pull up

Logger

Resolution	Pulse: 1 pulse, Runtime: 1 second, State and Event: 1 State or Event
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	UX90-004: 128 KB (84,650 measurements, maximum) UX90-004M: 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 8.48 x 1.52 cm (1.44 x 3.34 x 0.6 in.)
Weight	30 g (1.06 oz)
Environmental Rating	IP50



The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

HOBO Motor On/Off Data Logger

Models: UX90-004
UX90-004M

Included Items:

- Command™ strip
- Double-sided tape
- Hook & loop strap

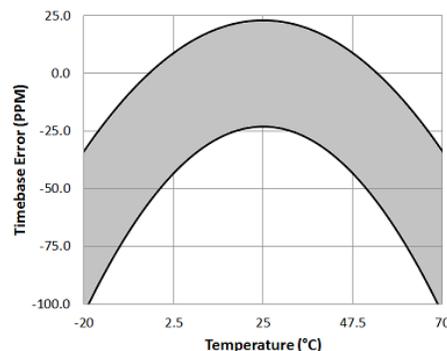
Required Items:

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

Accessories:

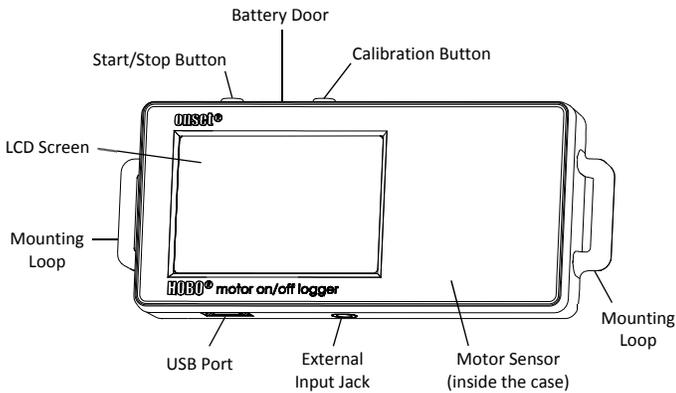
- Voltage Input Cable (CABLE-2.5-STEREO)
- AC Current Switch (CSV-A8)
- U-Shuttle (U-DT-1)

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



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*).

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*).

Calibration Button: Press this button to calibrate the logger for the motor you will be monitoring. See *Calibrating the Motor Sensor* for more details.

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

Motor Sensor: This built-in sensor located inside the logger case monitors motor on and off conditions.

External Input Jack: Use this jack to attach a supported sensor (see *Connecting External Sensors*).

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 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.
	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.
	The motor is off (internal sensor).
	The motor is on (internal sensor).
	The switch is open (external sensor).
	The switch is closed (external sensor).
CALIBRATE	The logger can be calibrated. See <i>Calibrating the Motor Sensor</i> for more details.
	This shows the signal strength of the motor being monitored. In this example, the signal strength is at full scale. See <i>Calibrating the Motor Sensor</i> for more details.
LOGGING	The logger is currently logging.
	Time display when logger is logging: This shows the total amount of time the motor has been on or switch has been closed since logging began, ranging from seconds to days. This example indicates the motor has been on or the switch has been closed 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.
	This shows the percentage of time the motor has been on or the switch has been closed since logging began. This example indicates the motor has been on or the switch has been closed 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 or Calibration 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 and enter the name and select the state description as necessary. The 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 line once every second. At the end of each logging interval, the logger records how many seconds the line was in the logic low state.
- 3. Choose a calibration method with the Advanced settings.** The default method is to calibrate the logger using the calibrate button on the logger after it is launched. If you need to specify the sensitivity used for calibration, then click the Advanced button and select either a maximum or minimum level. See *Calibrating the Motor Sensor* for more details.
- 4. 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.
- 5. Set the units to display on the LCD screen.** Select either Time or %. For external sensors, you can either use the default units or enter your own units up to three characters.

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

7. Choose when to start logging:

- Now.** Logging begins immediately.
- At Interval.** Logging will begin at the next even interval (available when logging runtime only).
- 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.

8. 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.

- 9. 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.”

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	UX90-004
	346,795	4.01 to 60.21 days	UX90-004M
16 seconds to 4.25 minutes	63,488	11.76 to 187.38 days	UX90-004
	260,096	48.17 days to 2.1 years	UX90-004M
4.26 to 68.25 minutes	50,790	150.49 days to 6.6 years	UX90-004
	208,077	1.69 years to 2.7 decades	UX90-004M
68.26 minutes to 18.2 hours	42,325	5.5 years to 8.8 decades	UX90-004
	173,397	2.25 to 36.03 decades	UX90-004M

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.

Connecting External Sensors

Use the 2.5 external input jack (CABLE-2.5-STEREO) to connect a supported sensor that measures mechanical contact closures.

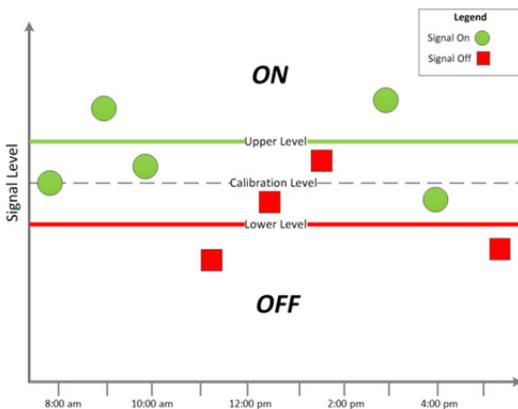
Calibrating the Motor Sensor

Each time you launch the logger, you should calibrate it to the AC magnetic field that you will be monitoring. This ensures the logger is accurately determining when the motor switches between ON and OFF states. There are two calibration methods available: auto-calibration (button calibration) or preset calibration via HOBOWare.

Auto-calibration is used to calibrate the ON and OFF threshold of the logger to achieve reliable readings in an environment where ambient conditions are unknown prior to deployment. In the auto-calibration process, the AC magnetic field is measured via a built-in analog-to-digital converter and the resulting value is used to generate a calibration threshold. **Note:** Auto-calibration (button calibration) must be done at the location where the logger will be deployed.

Preset values are used when motor levels are known in advance and deployment speed is critical.

In addition, the logger has a built-in hysteresis level of $\pm 6.25\%$ to prevent the sensor from toggling between ON and OFF when the AC magnetic field level is near the calibration threshold. The following plot shows how the logger handles hysteresis. The logger interprets the signal, or motor, as ON until it drops below the lower level of the calibration threshold. Once it switches to off, the signal will not switch back to ON until it bypasses the upper limit of the calibration level.



When auto-calibrating from the logger (button calibrating):

1. Deploy the logger near the motor to be monitored. Turn the motor on.
2. Press the Calibrate button for 1 second. The LCD screen will display the signal strength of the motor. The signal strength should ideally be at least 3 bars. Orient the logger as necessary to increase the signal strength.

3. Press the Calibrate button for 3 seconds while “HOLD” appears on the LCD screen. The logger will count down to the auto-calibration and then display either “PASS” or “FAIL” after calibration is complete.
4. If the auto-calibration fails, position the logger closer to the motor and then repeat these steps.

If you cannot manipulate the motor, you can set the calibration level in HOBOWare (from the Launch Logger window in HOBOWare, click the Advanced button). The weaker the AC magnetic field, the higher the sensitivity needs to be to record changes between ON and OFF conditions. Therefore:

- If the logger is in a weak magnetic field, select “Set to maximum sensitivity,” which has a threshold set to approximately 40 mGauss.
- If the logger is in a strong magnetic field, select “Set to minimum sensitivity,” which has a threshold set to approximately 100 mGauss. For motors with low and high settings, use the low setting for calibration.

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).
Internal Calibration	The logger was calibrated via auto-calibration (button calibration).
Host Calibration	The logger was calibrated via HOBOWare.
Calibration Failure	Calibrating the logger has failed.
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:

- Use the four built-in magnets on the back of the logger to mount it to a magnetic surface.
- 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 mounting loops on both sides of the logger to mount it to a curved surface, such as a pipe or tubing.

Deployment Guidelines

Be sure to secure the logger as close to the motor being monitored as practical. Minimize any unwanted vibrations when the motor being monitored is off.

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.

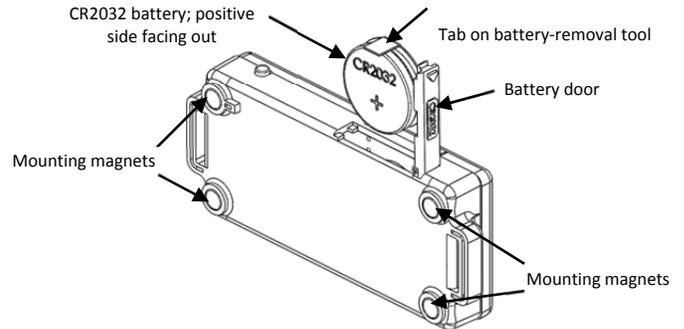
Battery Information

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.