Edu-Logger Motion
Logger Sensor Guide
900-223

Edu-Logger motion logger sensor 900-223

The Edu-Logger motion sensor can be used for any science experiment or activity which requires accurate distance, velocity, or acceleration readings such as in the fields of Physics, Mechanics, Physiology, Biology, etc.

The sensor comes pre-calibrated so you can start experimentation right out of the box using this guide.

The motion sensor uses an ultrasonic transducer to both transmit an ultrasonic wave, and to measure its echo return. Objects in the range of 0.15 to 6 meters can accurately be measured to give distance, velocity, and acceleration readings using this method.

Hundreds of possible experiments that can be done with the 900-223 sensors are: gravity experiments, ball drops, momentum, impulse, conservation of energy, kinetic vs. potential energy, and many more.

The motion sensor can collect data using the following units of measure:
- Meters (m): The SI distance unit
- Meters/second (m/s): The SI velocity unit which measures the distance traveled over time.
- Meters/second^2 (m/s^2): The SI acceleration unit which measures the change in velocity over time.

For best results:

The 900-223 motion sensor has a working range between 0.15m and 6.0 meters, results may be inconsistent outside of this range. Ultrasonic waves that are emitted from the sensor and spread out in a cone pattern at about 15° around the point of reference.
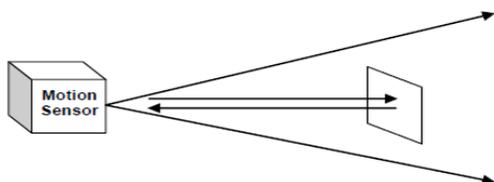
- If possible, attach the sensor to something stable to avoid movements which can give skewed readings.
- If you get poor readings, another object in the foreground or background that is within the cone that may be reflecting the ultrasonic waves to add noise to the experiment.
- Use objects which are at least 10cm x 10cm when tracking specific targets.
- For smaller targets we recommend starting the object closer to the sensor, for larger objects we recommend starting farther away.
- When testing in areas with many hard surfaces; the waves may bounce around and create extra noise for the detector. This can cause irregular graphs. To reduce the noise level try covering some of the surrounding surfaces with a soft material to dampen sound such as cloth or foam.
- When using the motion sensor to detect an individual's movements; trying carrying the sensor

instead of pointing the sensor at one self. For example to measure a student's velocities have them walk or run with the sensor while pointing it at the wall.

- Make sure your motion sensor is not mounted near a computer, monitor, or television.
- Sometimes other sources of sound (such as fans, motors, etc can affect results).
- Try various sample rates until the cleanest data is observed, slow rates may provide better results for certain experiments.

Distance, velocity, and acceleration graphs:

During motion experiments it is often beneficial to show distance, velocity, and acceleration all on the same graph. Using the Edu-Logger software it is very easy to plot all three graphs at once:

1. Use one of the following guides located in the "Quick start procedure" section of the instruction manual to connect the motion sensor to your chosen device.
2. Once your motion sensor has been detected; click the motion sensor icon and change the range to "Distance"
3. Ensure the "Speed & Acceleration" button is selected; it will have a pink color when selected.
4. Collect data.
5. Click the motion sensor icon again.
6. This time click on the pink "Speed & Acceleration" button, this will cause the data to change into table form on the right.
7. Underneath the graph select the "Graph" button to see the data in graphic form.
   Note: The velocity and acceleration graphs are assigned colors; to view which is which you can

click the motion sensor icon again and this time the words "Speed" and "Acceleration" will be colored according to the graph.

Quick start procedure:

PC or Mac Computer

Materials needed:
- 900-223 Motion Sensor
- 900-213 USB Module
- USB to mini USB cable (included with the 900-213 module)

Your motion sensor needs to be connected to a 900-213 module. The 900-213 module then connects to a computer via a USB to mini-USB cable. Please note that you cannot plug the motion sensor directly into the computer.

Resident PC software and browser based application can be downloaded for free at www.edulab.com as well as a full software user guide.
Note: Make sure not to download and install both types of software they will conflict on the computer.

Procedure:

1. Install the Edu-Logger software
2. Connect the 900-213 module to the PC or Mac
3. Connect the motion sensor to the 900-213 module (they directly plug together). Please note there is no calibration required for this sensor.
4. Open the Edu-Logger software.
5. Once a motion sensor logo appears on the left side of the screen the probe has been automatically identified and you can begin experimentation.

6. If the motion sensor is not automatically identified then click the "Search for sensors" icon to find the sensor.
7. Click on the "On-line experiment" button; this will open a graph below.
8. Click on the "Module setup" button located on the motion sensor icon in the module window to change the sensor settings if need be.
9. Click on the "experiment set up" button to change the experiment settings if need be (experiment duration for example).
10. The motion sensor will give a live reading in the box to the left of the screen while plugged in.
11. To run an experiment and collect data click "Run experiment".
12. To end data collection early, click "Stop experiment".

Tablet, smart phone device

Materials needed:

- 900-223 Motion Sensor
- 900-268 WiFi module
- 900-215 Battery

Your motion sensor needs to be connected to a 900-268 module. The 900-268 module will create a closed Edu-Logger WiFi network which will stream the Edu-Logger data to a device of your choosing. Once your device is wirelessly connected to the Edu-Logger network you can run experiments and collect data through a browser of your choosing.

Procedure:

1. Connect the motion sensor directly to the left side 900-268 (no wires required).
2. Connect a 900-215 module to the right side of the 900-268 module.
3. Although not required, we recommend plugging the 900-215 to an outlet using a USB to mini USB charger (such as a typical cell phone charger). The 900-268 module will run for 15-75 minutes (depending on the sensor) without being plugged in.
4. The 900-268 can be powered directly using a mini to USB cord and plugging it into your computer or a wall charger. Please note this function is only available on 900-268 units with the USB icon on the cover.
5. For further 900-268 instructions or the 900-268 quick start guide please visit: www.edulab.com
6. The 900-268 indicator lights will flash; take no action until the LED to the far left turns blue; this can take up to one minute.
7. Take your tablet or smart phone, go to the WiFi settings and select the Edu-Logger network which matches the 900-268 Module ID found on the back of the 900-268 device. (Edu-LoggerXXXX for example).
8. Give your device about 20 seconds to connect to the 900-268.
9. Once the device is connected, go to your browser and type the website **wifi201.com** into the URL bar, then wait for 30-60 seconds.
10. You will see a "Control mode" icon in the browser, click on this icon.
11. The browser will then load a new screen and begin to auto detect the sensor(s); this can take a minute. (You can stop the search when the sensor is found.)
12. If the browser does not auto detect the sensor(s), select "Search for sensors".

13. Once the sensor is found you will see an icon on the left side of the screen for the motion sensor. The icon will display real time data.
14. Click on the "Module setup" button located on the motion sensor icon in the module window to change the motion probe settings if need be.
15. Click on the experiment set up button to change the experiment settings if need be (Experiment duration for example).
16. To run an experiment and collect data, select "On-Line" experiment, then select "Run".
17. If you have a newer generation 900-268 (with the USB icon on the cover) this can be used as a 900-213, meaning you can tether the probes directly to the computer using the 900-268. To engage operation in this fashion, press 3 times on the panel key. Repeating this operation will return the unit to WiFi mode.

Operation with Edu-Logger viewer

Materials needed:
▪ 900-223 Motion Sensor
▪ 900-272 Viewing Module
▪ 900-215 Battery

Procedure:

1. Connect the motion sensor to the left side of the viewer.
2. Connect the 900-215 module to the right side of the viewer.
3. The 900-272 will auto detect the sensor and you will see it appear on the left side of the screen.
4. Once the sensor appears it will be monitoring data in real time.
5. To run an experiment and collect data click the run button (little green person).

Off-line experiments

(Off-line experiments are for when you do not have a sensor connected directly to a computer, tablet, smartphone, or Edu-Logger viewer).

Materials needed:

- 900-223 Motion Sensor
- 900-215 Battery

Materials needed to configure your offline experiment:

- 900-213 Module or 900-268 module or 900-272 Module
- USB to mini USB cable (included with the 900-213 module).

Procedure:

1. Connect the motion sensor directly to the left side of a charged 900-215 module.
2. When ready to collect data press the "Start/Stop" button on the motion sensor, a red light will turn on for the duration of the experiment.
3. To change the experiment settings first connect to your chosen device (PC, Mac, tablet, smart device) and select the "Module setup" button. (For more information on how to change the experiment settings view quick start procedure section for your chosen device in this document.)
4. After the experiment has concluded (when the "Start/Stop" button is pressed again or the data collection period ends) connect the sensor to your chosen device. (full instructions in each device's quick start procedure section)

5. Open Edu-Logger software.
6. Click the "Off-line experiment" button.
7. Click the "Load data from sensors" button.
8. Select which experimental data to upload. (5 experimental runs can be stored at one time on the 900-223 motion sensor)

Restoring sensor's factory default settings:

Procedure:

1. Connect the 900-213 to a PC, Mac, tablet, or smart device.
2. Connect the motion sensor to a 900-213 module (they directly plug together). Please note there is no calibration required for this sensor.
3. Open the Edu-Logger software.
4. Click the "Tools" icon.
5. Click the "Restore sensor's factory defaults" on the menu.
6. If prompted to clear the graph, click either the "Off-line experiment" or "On-line experiment" (whichever you are using).
7. Click "Clear experiment results".
8. Resume from step 4.

Included with sensor:

- Edu-Logger 900-223 motion sensor guide (this document).
- Attached metal ultrasonic wave emitter.

Sensor specifications:			
	Distance	**Velocity**	**Acceleration**
Range and operation modes	0.25–6.0 m	±10 m/s	±100m/s^2
ADC resolution	13 bit		
Resolution	1mm	0.02 m/s	0.08 m/s2
Max sample rate (S/sec)	100		

Sensor features:

- Fully digital data.
- Rugged plastic ergonomic case.
- Push button switch to Start/Stop experiments in off line mode.
- LED indicator of experiment status (blinks while collecting data).
- Pre-calibrated sensing equipment.
- Metal ultrasonic wave emitting/detecting cone with wire mesh covering.
  Note: Edu-Logger products are intended for educational use.

- Videos, literature and other probes can be found at
  www.edulab.com

Technical background:

The philosophy behind Edu-Logger's plug and play technology is based on each sensor's ability to store its own data due to an internal flash memory chip and micro-controller in each plastic Edu-Logger body. This technology allows the sensor to collect and then store the digital data in the correct scientific units (^{o}C, ^{o}F, Lux, %, ppm, for example).

The sensor is pre-calibrated at the factory. The built-in software in the logger can be upgraded at any time using software.

The ultrasonic transducer is a device that can convert pulse train to transmitted ultrasonic pulses that can sense and convert back to electronic pulse train by another similar ultrasonic transducer or by itself.

The ultrasonic transducer is based on ceramic crystal, which is cut in a certain way and is placed between two metal plates.

The crystal is characterized by the piezoelectric effect. Electrical field changes between the plates create mechanical vibrations in the crystal.

The crystal has a resonance frequency. The mechanical vibrations and electrical reactions depend on this resonance frequency.

12

Supplying pulses to the crystal of the ultrasonic transducer in a rate according to its frequency, causes it to vibrate and to transmit these pulses as an acoustic sound. This sound cannot be heard because it is above the hearing frequency range. Usually it is at 40 KHz.

The acoustic sound can be converted back to electronic pulses by another ultrasonic transducer or by the the transmitter when it stops transmitting. The acoustic pulses vibrate this transducer and these vibrations are turned into voltage pulses.

The speed of the ultrasonic wave is 300 m/s because it is a sound wave. For distance measurement a burst of the transducer frequency wave is sent and the system measures the time between the sending and the receiving.

$S = 300 * t$

Velocity is calculating by calculating the difference between two successive distances divided by the time between the samples (according to the sampling rate).

Acceleration is calculating by calculating the difference between two successive velocities divided by the time between the samples (according to the sampling rate).

The motion sensor uses a very sophisticated method that enables it to measure long distance range with a low power of pulses, which enables to use it also battery operated.

Maintenance and storage:

- Never submerge the Edu-Logger plastic body in any liquid.
- Do not allow liquid into the motion sensor's body.
- After use, gently wipe away any foreign material from the motion sensor.
- Store in a box at room temperature out of direct sunlight.

Warranty:

We promise to deliver our sensor free of defects in materials and workmanship for a period of 3 years from the date of purchase. Our warranty does not cover damage of the product caused by improper use, abuse, or incorrect storage. Sensors with a shelf life such as ion selective proves have a warranty of 1 year. Should you need to act upon the warranty please contact your distributor. Your sensor will be repaired or replaced.

Thank you for using Edu-Logger!

Flexible, simple, fast, forward thinking.
W: www.edulab.com
E: info@edulab.com

V10012013