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## Distance Sensor

Product Number: ENDST-D020



### Overview

The Distance Sensor measures the distance between the sensor and an object in the range of 0.2 to 10 m from it. The sensor can sample data at up to 50 times per second, making it excellent for motion and movement experiments.

The Distance Sensor can be connected to all types of einstein™ data loggers. It can be used for various Physics experiments.

### Typical experiments



#### Physics

- Investigating dynamic cart motions on a track
- Studying motion graph matching
- Investigating simple harmonic motion, such as a mass hanging on a spring
- Measuring free fall acceleration

## How it works

The Distance Sensor works on the same principle as a sonar system. An ultrasonic loudspeaker and microphone are located inside the sensor's case. The loudspeaker broadcasts ultrasonic pulses or inaudible sound waves which echo off the closest object in range. When the sound waves echo back to the sensor they are picked up by the microphone. Using the time difference between the sound waves' broadcast and reception the sensor then calculates the object's distance.

## Sensor specification

Range:	0.2 m to 10 m
Accuracy:	3mm at 2 m 8mm at 10 m
Resolution (12-bit):	2.5 mm
Recommended Sampling Rate:	25 samples per second
Receiver Viewing Angle:	$\pm 15^\circ$
Features:	Reports position, velocity and acceleration
Data Logger Input Type:	Digital

**Note: sensor cables sold separately**

## Technical Notes

- It is highly recommended that this sensor operate while the einstein™ LabMate or Tablet is plugged in to a power source.
- Make sure the target object is no closer than 20 cm from the sensor.
- To improve sensor readings, add a large flat surface to the target to reflect the ultrasonic waves. If the reflecting surface is irregular it may interfere with the sound reflection.
- Make sure there are no foreign objects between the sensor and the target. Note the sensor's ultrasonic waves are broadcast in a cone shape so remove objects within  $15^\circ$  of a line between the sensor and the target.
- When the sensor is in operation it emits a humming noise.

## Equipment List

- Distance sensor
- Mounting Rod

The mounting rod can be screwed into the bottom of the Distance sensor.

## Calibration

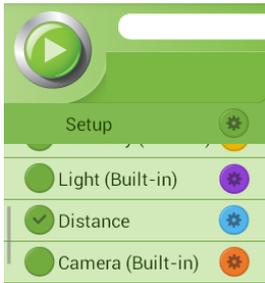
The Distance sensor is shipped fully calibrated.

## Data logging and analysis

### MiLAB™

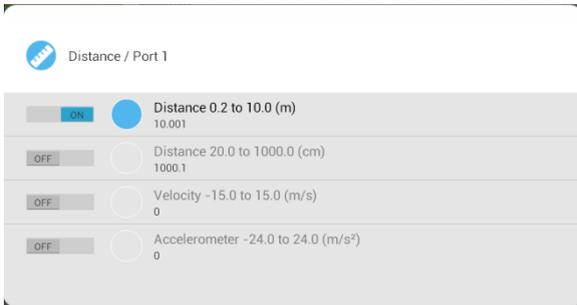
1. Take your einstein™ Tablet OR pair your einstein™ LabMate with your Android or iOS tablet via Bluetooth
2. Insert the sensor cable into one of the sensor ports

## 3. Launch MiLAB



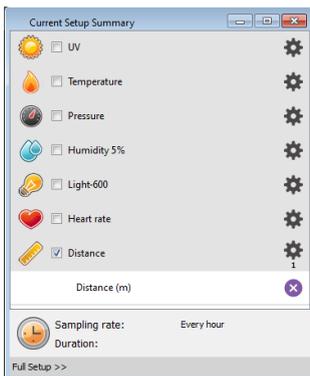
4. In Launcher View, make sure that there is a checkmark ( ✓ ) next to the Distance sensor

5. Tap on the Settings icon to set the sensor's range and other options

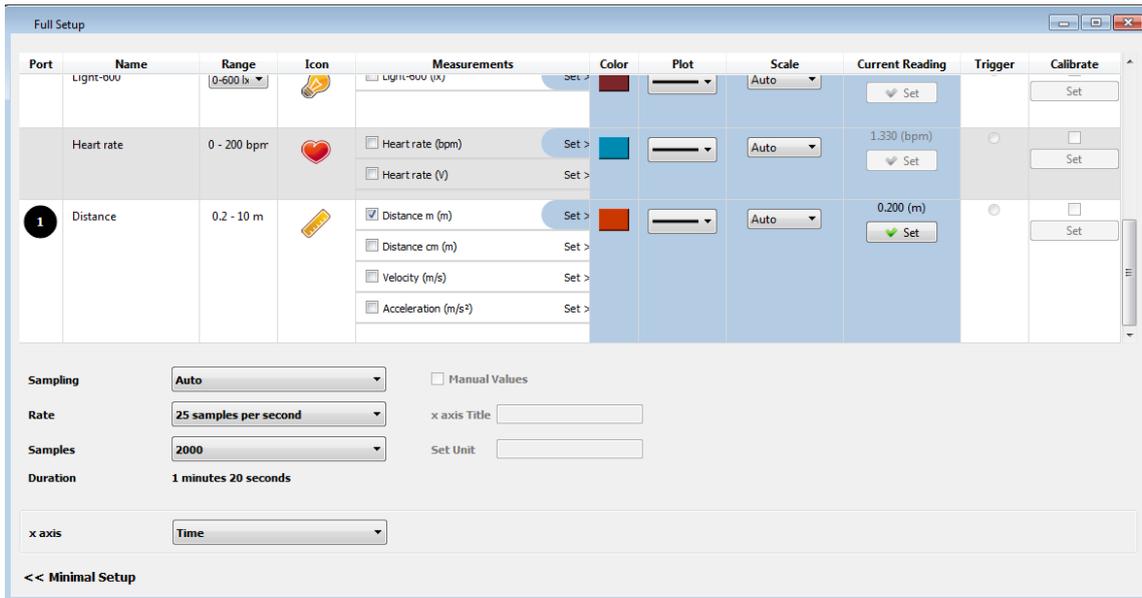


## MiLAB™ Desktop

1. Pair your einstein™LabMate with your PC, MAC, or Linux machine via Bluetooth, or connect it via the USB cable (found in the einstein™LabMate™ box)
2. Insert the sensor cable into one of the sensor ports
3. Launch MiLAB™
4. In the Current Setup Summary box make sure there is a checkmark by the Distance sensor



5. Click on Full Set up in the Current Setup Summary Box to set various options for the sensor



6. Click the Run button (  ) on the main toolbar to start logging

## Example of using the Distance sensor

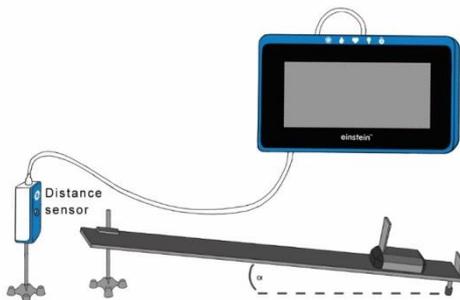
### Motion on an Inclined Plane

When a body is placed on an inclined plane it will move with constant acceleration. If the plane is friction free the acceleration of the body up the plane will be equal to the acceleration down. In this experiment we place a cart on an inclined plane and explore the properties of the motion.

### Additional Equipment

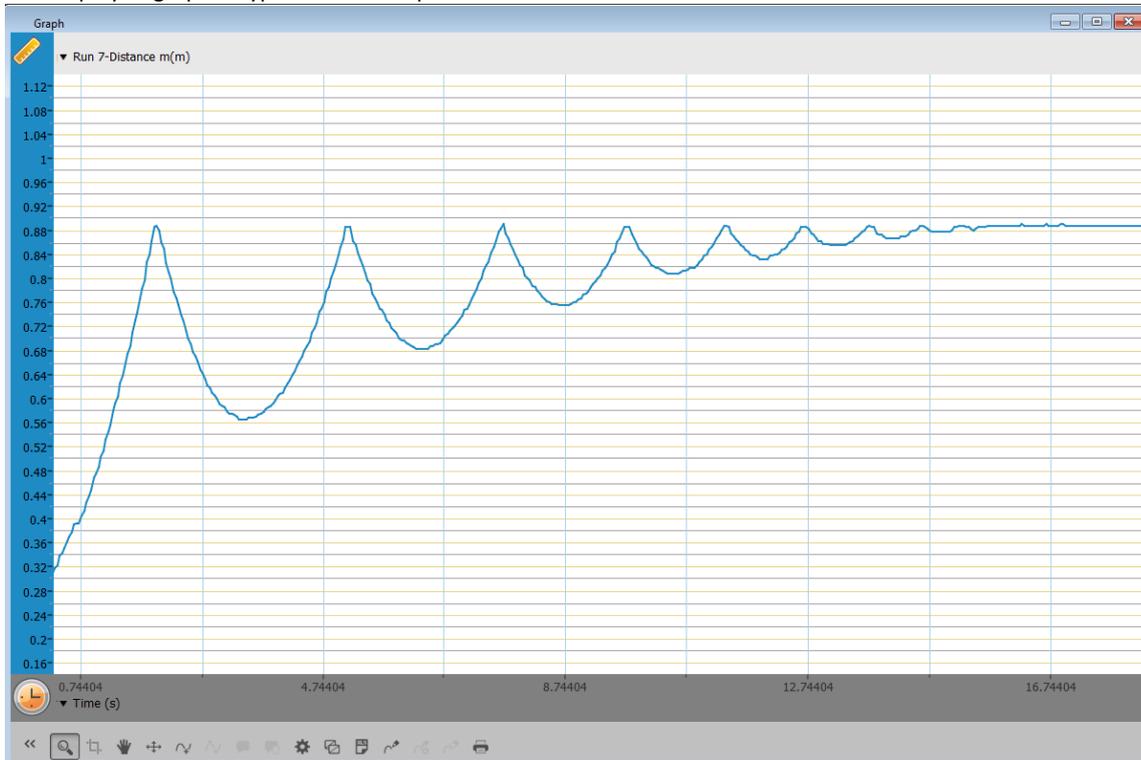
In addition to the Distance Sensor you will need:

- Cart
  - Square piece of cardboard 10 x 10 cm (*flag*)
  - Inclined plane (as friction free as possible)
  - Laboratory stand or books to vary height of inclined plane
1. Place the Distance sensor at the upper end of the inclined plane.
  2. Place a stopper at the bottom of the plane. The stopper should not block the line of sight between the sensor and the cart.
  3. The distance between the cart and the stopper during the motion should be more than 50 cm.
  4. Program the sensor to log data according to the following setup: 25 samples per second and a total of 2000 samples
  5. Connect the Distance sensor to the data logger
  6. Assemble the equipment as shown below.



7. Set height of inclined plane at ~5 cm. Record the height in data table.
8. Hold the cart at the top of the inclined plane.
9. Start recording. Release the cart when you hear the clicking of the sensor. A graph of the results will appear automatically. (The cart may jump several times before the end of the measurement).
10. Save your results.

The displayed graph is typical for this experiment.



*Position of cart vs. time*

## Technical support

For technical support, you can contact the Fourier Education's technical support team at:

Web: [www.einsteinworld.com/support](http://www.einsteinworld.com/support)

Email: [support@fourieredu.com](mailto:support@fourieredu.com)

Phone (in the US): (877) 266-4066

## Copyright and Warranty

All standard Fourier Systems sensors carry a one (1) year warranty, which states that for a period of twelve months after the date of delivery to you, it will be substantially free from significant defects in materials and workmanship.

This warranty does not cover breakage of the product caused by misuse or abuse.

This warranty does not cover Fourier Systems consumables such as electrodes, batteries, EKG stickers, cuvettes and storage solutions or buffers.

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