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## Sound Sensor

Product Number: ENSND320



### Overview

The human ear is capable of detecting an enormous range of sound intensities. However our sound perception is not linear – experiments show that a noise we perceive to be twice as loud as another is actually 10 times louder. For this reason sound is measured on a logarithmic scale (one that shows exponential increases). This means that if one sound is 10 decibels higher than another it sounds twice as loud, but in order to sound twice as loud as that – 20 decibels – it will have to be 100 (10 x 10) times more intense. The Sound Level sensor measures sounds in decibels (dB) within two ranges, the first from 45-80 dB and the second from 65-110 dB. It is ideal for measuring environmental noises and room acoustics.

This sensor includes a special voltage filter to filter out any noise that may come from the data logger's voltage line. There are three amplifying stages to this sensor and it automatically switches between stages, for maximum range and flexibility.

The Sound Level sensor can be connected to all types of Einstein™ data loggers.

### Typical experiments



#### Chemistry

- Measuring Sound Level
- Investigating Environmental Noises
- Investigating Room Acoustics

## How it works

The Sound Level sensor consists of a microphone and electronic circuits. The microphone detects the small air pressure variations associated with sound and changes them into electrical signals. These signals are then processed by amplifying and filtering the signal to the required levels. For Sound Pressure Level (SPL) measurements the signal is averaged over certain period of time and converted into decibels (dB SPL). The results are calibrated by measuring the instantaneous signal vs. its average (offset removal).

## Sensor specification

Range:	45 to 80 dB 65 to 110 dB
Accuracy (at 23° C, ±5°C):	±3 dB
Resolution (12-bit):	0.05 dB
Recommended Sampling Rate:	10 or 25 samples per second
Response Time:	20 ms
Frequency:	31.5 Hz to 8000 Hz
Operating Temperature:	0°C to 50°C (32°F to 122°F)
Operating Humidity:	Maximum 90% RH (0°C to 35°)

**Note: sensor cables sold separately**

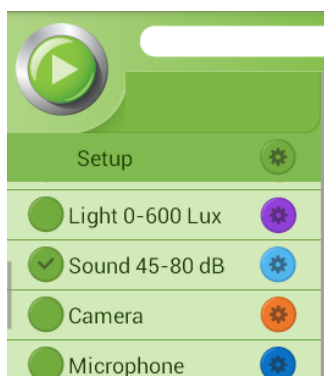
## Calibration

The Sound Level sensor requires no calibration.

## 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. MiLAB™ will automatically detect the sensor and show it in the Launcher View

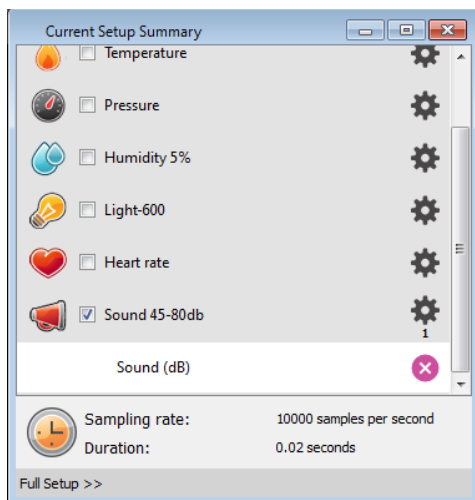


5. Make sure the icon next to the sensor is checked (●) to enable it for logging

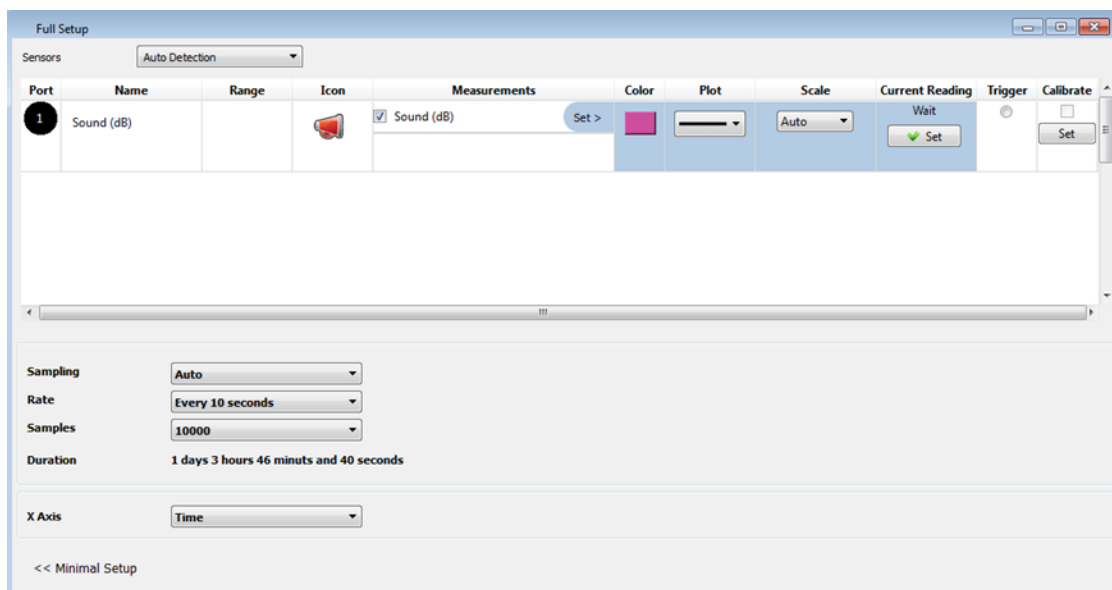
### MiLAB™ Desktop


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. MiLAB™ will automatically detect the sensor and show it in the Current Setup Summary window



5. Click Full Setup, located at the bottom of the Current Setup Summary window to program the data logger's sample rate, number of samples, units of measurement, and other options



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

## Experiment set up

For reference, the chart below lists a number of common locations and sound sources and their average decibel ratings:

Sound Source	Sound Level (dB)
Library	40
Normal conversation	60
Noisy office	80
Subway train	100
Rock concert	120
Night club	110
Car horn at a distance of a few meters	110

## An example of using the Sensor

### Sound Level at a School

In this experiment we will map the sound levels at a school

1. Choose several locations in the school. Make sure to include locations where different activities take place.
2. Take readings with the sound sensor at each of these locations at different times of day (if using the einstein™ Tablet+ the Location sensor can be used to automatically map out your locations).
3. Prepare a map of your school noting the different sound levels at different times

## Troubleshooting

If the Sound sensor isn't automatically recognized by MultiLab4/ MiLAB, please contact Fourier Education's technical support.

## 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)

## 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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