SOUND SENSOR
BT80i

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

https://cma-science.nl

Short description

The Sound sensor BT80i[1] is a microphone followed by an amplifier. The microphone is mounted at the end of the plastic tube and connected to the amplifier with the 3.5 mm jack connector. The microphone measures variations in air pressure in the range between -45 .. 45 Pa. Additionally, by using the calibration provided in the Coach software the sensor can measure Sound Level in dB, in the range between 40 .. 110 dB. When you use the sound sensor make sure the sound wave is in the correct range to produce good wave patterns. If the sound is too loud, the wave pattern will be "clipped off" at the top or bottom. In such a case move the microphone further from the sound source, or turn down the volume of the sound.

The sound sources that can be used with the microphone are tuning forks, electronic keyboards, and musical instruments. You may also investigate a human voice or a whistle. Because of the high sensitivity, the sensor is very much suited to detect short pressure pulses. This offers the possibility to measure the speed of sound.

The microphone of the Sound sensor can be replaced by the CMA Stethoscope to record the heart rate and the echoes of the beat in the circulation. The stethoscope is not delivered with the sensor and has to be purchased separately (CMA article BT80st).

The Sound sensor can be directly connected to the analog BT inputs of the CMA interfaces. The sensor cable BT - IEEE1394 needed to connect the sensor to an interface is not supplied with the sensor and has to be purchased separately (CMA article BTsc_1).

Sensor recognition

The Sound sensor BT80i has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces. If your Sound sensor is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

Calibration

The CMA Sound sensor BT80i is supplied calibrated. The output of the sensor is linear with respect to the measured air pressure:

$$p(Pa) = 4.5 * V_{out} (V).$$

Additionally Coach offers the sensor calibration in dB. This calibration is based on the procedure of determining the average sound pressure p (root mean square average) and calculating the sound pressure level in decibels from:

[1] A new model sold starting from September 2019.

$$L_p = 20 \log (p/p_0) \text{ where } p_0 = 2.5 \times 10^{-5} \text{ Pa.}$$

The Coach software allows selecting the calibration supplied by the sensor memory (EEPROM) or one of calibrations stored in the Coach Sensor Library. For better accuracy the pre-defined calibration can be shifted.

Suggested experiments

The Sound sensor with the microphone can be used in a variety of experiments with sound waves such as:

- measure sound waveforms (sound frequency and amplitude),
- demonstrate beat patterns,
- compare waveforms from various musical instruments,
- measure the speed of sound through air and other materials,
- display the frequency spectrum e.g. Fourier transform of a sound signal.

The Sound sensor with the stethoscope can be used:

- to record heartbeats,
- together with a ECG sensor and/or heart rate sensor different measurements of the heart can be compared to analyse the entire heart cycle and the blood flow.

Technical Specifications

Sensor kind	Analog, generates an output voltage between -10 .. 10 V **Note:** When no sound is detected the output is 0 V.
Measurement ranges *Air pressure* *Sound level*	 -45 .. 45 Pa (0.45 mbar) 40 .. 110 dB
Resolution using *12 bit AD converter*	22 mPa (0.22 μbar)
Frequency range	20 Hz - 20000 Hz
Calibration function	p (Pa) = 4.5 * V_{out} (V)
Current requirement	< 5 mA
Connection	IEEE1394 connector for BT-IEEE1394 sensor cable. Sensor cable **not** delivered with the sensor.

Warranty:

The Sound sensor BT80i is warranted to be free from defects in materials and workmanship for a period of 24 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

Note: *This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.*

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