# HEART RATE SENSOR BT48i

## USER'S GUIDE





**CENTRE FOR MICROCOMPUTER APPLICATIONS**

https://www.cma-science.nl

## Short description

The Heart rate sensor BT48i provides a simple way to study the heart's function. Unlike an electrocardiograph (EKG), which monitors the electrical signal of the heart, this sensor monitors the flow of blood through the veins.

The cardio clip consists of a small infrared LED, which illuminates the tissue and a light sensitive detector, which detects the amount of light transmitted from the tissue.

As the heart forces blood through the blood vessels, the amount of blood changes with time. The sensor measures the light level transmitted through the vascular tissue and the corresponding variations in light intensities that occur as the blood volume changes in the tissue. The measured signal is amplified, inverted and filtered. The sensor is equipped with an amplification knob that allows amplifying the signal when it is too weak.
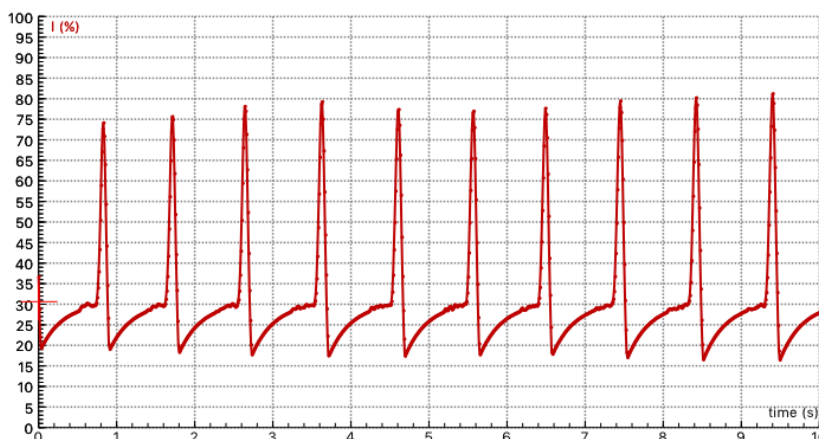
The Heart rate sensor can be directly connected to analog BT inputs of CMA interfaces. The sensor cable BT - IEEE1394 needed to connect the sensor to an interface is not supplied with the sensor and has to be purchased separately (Order Code BTsc_1).

## Measurement procedure

- Insert the jack plug from the cardio clip into the jack socket at the side of the sensor box.
- Attach the clip to either the fingertip or to the ear lobe. You can also place the clip on the web of skin between the thumb and index finger.
- Check if the recorded signal is strong enough. If this is not the case you may use the amplification knob to amplify the signal.
- Stay still as any muscle movements will influence the signal.
- Wait until the signal stabilizes and start recording data.

The recorded pulse waves show details of the pumping action of the heart. Example of a measurement is shown in the figure. The blood flowing through the earlobe rises at the start of the heartbeat. This is caused by the contraction of the ventricles forcing blood into the arteries. In the Coach program you can determine

the heart rate by analyzing the time between peaks, or counting the number of beats per minute by using the heart rate sensor as counter with a threshold of e.g. 35%.

Heart rate varies between individuals. At rest, an adult man has an average pulse of 72 per minute. Athletes normally have a lower heart rate than less active people. Children have a higher heart rate (approx. 90 beats per minute), but also show large variations. The heart rate rises during exercise and returns slowly to the rest frequency after exercise. The rate at which the pulse returns to normal can be used as an indication of fitness.

***Notes:***
- The Heart rate sensor cannot be used during exercises. The body's movement would cause shifting of the ear clip and erroneous readings.
- The ear and clip should be shaded from strong light.
- The Heart rate sensor is not appropriate for medical or research applications. Specifically, it may not be used for patient diagnosis.

## Sensor recognition

The Heart rate sensor 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 Heart rate 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 Heart rate sensor BT48i is supplied calibrated. The output of the Heart rate sensor is linear with respect to voltage. The supplied calibration function is:

$$I(\%) = 20 * V_{out}(V)$$

The CMA Coach program allows selecting between the calibration supplied by the sensor memory (EEPROM) or the calibration stored in the Coach Sensor Library.

## Suggested experiments
- Measurements of the heart rate of different individuals.
- Measurements of the heart rate before and after exercises.
- Measurements of the recovery time: how fast a person's heart rate returns to its normal performance after exercise.
- Measurements of the heart rate before and after drinking coffee (or Coca-Cola).
- Simultaneous measurements of heart rate, EKG and heart sounds with sound sensor to register heart tones.

## Technical Specifications

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| *Sensor kind* | Analog, generates an output voltage between 0 and 5 V |
| *Amplitude* | Each heartbeat gives a peak. If the peak is less than 0.2 V the ear clip should be repositioned. |
| *Resolution using 12- bits 5V AD converter* | 0.125% |
| *Calibration function* | $I(\%) = 20 * V_{out}(V)$ |
| *DC-level* | 1.5 V |
| *Frequency response* | Band-pass filter 2.4 – 12 Hz |
| *Supply voltage* *Supply current* | 5 V DC 12 mA |
| *Ear Clip* | An infrared LED and a light sensor |
| *Connection* | IEEE1394 connector for BT-IEEE1394 sensor cable. Sensor cable **not** delivered with the sensor. |

## Warranty:

The Heart rate sensor BT48i is warranted to be free from defects in materials and workmanship for a period of 12 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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