

MOTION DETECTOR W36

USER GUIDE



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Short description

CMA Wireless Motion detector W36 is a sonar device that emits ultrasonic pulses, which reflect off an object. The sensor measures the time it takes an ultrasonic pulse to travel from the sensor to the object and determines the distance from the object based on the measured time and the speed of sound. The minimum range of the sensor is 0.15 m and the maximum range is 6 m. While the sensor is operating, a slight clicking sound from the sensor will be heard.

The sensor is supplied with a steel rod, which can be screwed into a mounting thread on the sensor. The rod can be used for clamping into a suitable holding device, e.g. a retort stand.

The power button on the top of the sensor allows you to turn the sensor on/off. The sensor is equipped with an OLED color display which shows some sensor information and the measured by the sensor values. This makes the sensor suitable to use as an independent measuring instrument.

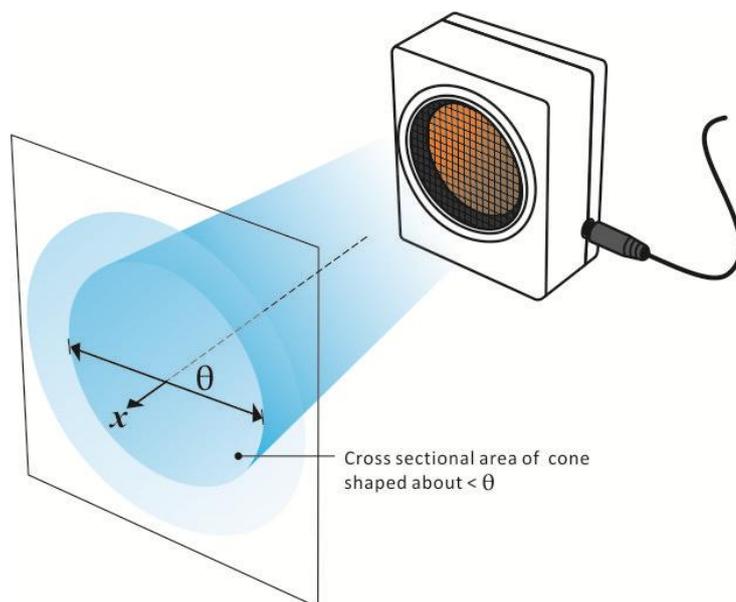
The sensor can be used wirelessly via Bluetooth or wired via USB with the Coach 7 or Coach 7 Lite programs/apps on computers (Windows and Mac), Chromebooks and mobile devices (Android and iOS).

Practical information

The Motion sensor emits short bursts of ultrasonic sound waves from the gold foil of its transducer. These waves fill a cone-shaped area about 15° off the axis of the centerline of the beam. The detector then "listens" for the echo of these ultrasonic waves returning to it.

The minimum distance between the object and the Motion sensor should be 0.15 m. Note that the motion sensor will report the distance to the closest object that produces a sufficiently strong echo. Objects such as chairs and tables, in the cone of ultrasound, can be picked up by the detector.

For accurate measurements, the object should have a flat front perpendicular to the line between the sensor and the object. Note that the maximum detection distance of 6 m depends on the size, shape, orientation and surface of the reflecting object. This maximum distance can only be reached under ideal conditions, i.e. for a large, flat surface (e.g. a wall) that is perpendicular to the detector. For smaller objects or objects that are not very flat, the maximum detection distance will be smaller.



The measurement input range also depends on the sampling rate. Keep in mind that increasing the sampling rate may lead to a lower maximum range.

Tips on getting good results with the Motion Detector

The most frequently reported problem with the motion sensor is that it does not work beyond a certain distance. Here are some things to check if you have problems:

- Check for a stationary object (chair, table, etc.) in the cone of the ultrasound. This object may be detected when you are trying to study an object further away. Even small objects can cause such problems. If you have trouble with a stationary object causing unwanted echoes, try placing a cloth over it. This minimizes sound reflection.
- Also, note that the cone of the ultrasound beam extends downward from the centerline. This can cause problems if you are using the sensor on a horizontal surface. In these cases, aim the Motion sensor slightly upward or place it somewhat higher above the surface.
- If there is another source of ultrasonic waves in the same frequency range, (like a motor, fan, air track blower, the sound made by air exiting the holes of an air track, and even students making loud noises), this can cause erroneous readings.
- If the room in which the Motion sensor is being used has a lot of hard, sound-reflecting surfaces, you can get weird effects caused by the ultrasound bouncing around the room. Standing waves can be set up between the sensor and a sound reflector. Try placing a cloth horizontally just in front of and below the detector. This sometimes helps eliminate ultrasound that is "skipping" into the sensor.
- Try changing the sampling rate. Sometimes reflected ultrasound pulses can cause erroneous readings that may disappear at other measurement frequencies.
- If you are studying the movement of people, have them hold a large, flat object (e.g. a large book) as a reflector. If you have an irregular reflecting surface, sometimes the waves will be reflected back to the transducer, and sometimes not. The result will seem erratic.

Calibration

The Motion detector W36 uses a digital timer. The resolution of the sensor is 0.001 m. When working with the Coach program the pre-defined calibration can be shifted by using the **Set to Value** option.

Software

You can use the Motion detector W36 with Coach 7 or Coach 7 Lite (free) program on computers (Windows and Mac) or Coach 7 and Coach 7 Lite (free) app on mobile devices (Android and iOS). For Chromebooks, we offer a special Android app. The support for wireless sensors is added starting from Coach version 7.10.



Check the CMA website for the latest installations.

https://cma-science.nl/downloads_en

Collecting data without software connection

- Turn the Motion detector on by pressing its power button.
- The sensor briefly displays its Bluetooth identification code. This code is also printed on the sticker located on the bottom label of the sensor box.
- Then the display shows:
 - the Bluetooth mode, ‘Mobile’ or ‘PC’.
Mobile indicates Bluetooth Low Energy mode which should be used when working with mobile devices (Android, iOS), Chromebook and Apple computers.
PC indicates Bluetooth Classic which should be used for Windows computers.
 - the battery level, and
 - the current measured value.
- Now you can use the sensor as an independent measuring instrument.
- To turn off the sensor press and hold its power button for 3 sec. To save its battery the sensor automatically turns off after a few minutes of inactivity (no connection to power, no communication).

Collecting data via the Bluetooth connection

Mobile devices, Chromebooks, and Apple computers

For mobile devices (Android, iOS), Chromebooks and Apple computers Bluetooth Low Energy technology is used for wireless communication. For these devices **do not pair** the sensor just use it directly in the Coach software.

- Turn the Motion detector on.
- Ensure your sensor is set to Mobile mode.
If the display shows in the top-left corner ‘PC’ first you must set the sensor to the Mobile mode. Turn off the sensor. Then press and hold the power button until the text ‘Bluetooth mode Change Mobile’ is shown, then release the button. The mode is set to ‘Mobile’, meaning Bluetooth Low Energy is used.
- Start the Coach 7 or Coach 7 Lite program/app.
- Select the Dashboard Activity ‘Measurement with Wireless sensors’.
- On opening of the Activity Coach starts searching for sensors which are turned on and in the Mobile discovery mode. The found Bluetooth sensors appear in the

list.

- Select the Motion detector you want to connect to. If needed check the sensor's Bluetooth ID which is located on the sensor's bottom label.
- When the connection is established the Bluetooth symbol appears in the top-left corner of the sensor's display and the sensor icon appears showing the measured distance values.
- Now you are ready to use the Motion detector for your measurement.

Windows computers

For Windows computers, Bluetooth Classic technology is used for wireless communication. Before you start to use the sensor for measurement in Coach you have to **pair** it.

- Turn the Motion detector on.
- Ensure your sensor is set to PC mode.

If the display shows in the top-left corner 'Mobile' first you must set the sensor to the PC mode. Turn off the sensor. Then press and hold the power button until the text 'Bluetooth mode Change PC' is shown, then release the button. The mode is set to 'PC', meaning Bluetooth Classic is used.

- Pair your sensor.
 - Go to the Windows Settings **Bluetooth and other devices** and select **Add Bluetooth or other devices**. Select **Bluetooth device**.
 - Windows looks for Bluetooth devices and after a while lists discovered devices. The wireless sensors are listed with their Bluetooth IDs.
 - Select the sensor you want to connect to. If needed check the sensor's Bluetooth ID which is located on the bottom label of your sensors.
 - When the connection is successfully established Windows indicates that the sensor is paired and ready to go.
 - Click **Done** to accept it. The sensor appears in the list of paired Bluetooth devices.
- Start the Coach 7 or Coach 7 Lite program.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- Coach starts searching and displays the list with detected sensors, even if they are not paired.
- Select the Motion detector you want to connect to. If needed check the sensor's Bluetooth ID which is located on the sensor's bottom label. If the sensor was not paired yet Coach will force you to pair the sensor first via Windows Settings.
- When the connection is established the Bluetooth symbol appears in the top-left corner of the sensor's display and the sensor icon appears showing the measured distance values.
- Now you are ready to use the Motion detector for your measurement.

Collecting data via the USB connection

For computers (Windows and Mac) the Motion detector can also be used as a USB sensor.

- Turn the Motion detector on.
- Use the provided USB cable to connect the sensor to a USB port.
- Start the Coach 7 or Coach 7 Lite program.
- Select the Dashboard Activity 'Measurement with Wireless sensors'.
- The connected USB sensor should be detected automatically, and its icon appears on the first empty sensor position in the Wireless sensors panel.
- When the connection is established the USB symbol appears in the top-left corner of the sensor's display of the sensor icon shows measured data.
- Now you are ready to use the Motion detector for your measurement.

Charging a battery

An internal rechargeable battery (Li-Poly 3,7 V, 2000 mAh) powers the sensor. The battery symbol located in the top-right corner of the sensor's display shows the battery level. When the battery level becomes critical, the battery gauge shows an empty battery. Use the provided cable to connect the sensor to a USB port for charging. A fully discharged battery requires up to 2 hours of charge time to become fully charged again. To prolong battery life, automatic power down turns the sensor off after 5 minutes of inactivity.

To replace the battery, use **only** the approved rechargeable batteries provided by CMA.

Suggested experiments

The Motion detector can be used for studying a variety of motions including:

- walking toward and away from the sensor,
- simple harmonic motion, such as a weight hanging on a spring,
- Newton's laws of motion,
- acceleration due to gravity - free fall, objects dropped or tossed upward,
- motions of a dynamic cart.

Technical Specifications

<i>Sensor kind</i>	Digital timer
<i>Measuring range</i>	0.15 to 6 m
<i>Resolution</i>	0.001 m
<i>Aperture (top angle/2)</i>	15° with respect to the central axis
<i>Ultrasound frequency</i>	50 kHz
<i>Uncertainty</i>	± 1%
<i>Maximum sampling rate</i>	100 Hz
<i>Display</i>	OLED 0.96" (128*64 px)
<i>Battery</i>	Li-Poly Rechargeable Battery (3,7 V 2000 mAh)
<i>Battery life after full charge</i>	Approximately 22 hours Battery life varies by use, configuration, temperature, and many other factors; actual results will vary.
<i>Connection</i>	Bluetooth 5, Low Energy (Mac, Android, iOS) Bluetooth 2.1, Classic (Windows) USB 2.0 (type C)
<i>Bluetooth ID</i>	W36MOTI-xxx
<i>Sensor dimensions</i>	66 x 80 x 36 mm

Warranty

The Motion detector W36 is warranted to be free from defects in materials and workmanship for a period of 3 years 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.

The sensor battery is consumable and is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase.

Discard batteries according to local regulations.



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

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