WORKING WITH CMA WIRELESS SENSORS

USER GUIDE VER. 2.0

cma-science.nl

1. Introduction

CMA Wireless Sensors can measure directly, without the need for an interface. Each sensor features a colour OLED screen that displays both battery level and sensor readings, making these sensors suitable for use as standalone measuring devices.

The sensors can transmit measured data wirelessly via Bluetooth or through a wired connection via USB, offering flexibility across multiple platforms. They are compatible with a wide range of devices, including computers, tablets, and smartphones.

Equipped with a large battery capacity and an intelligent power-saving feature that automatically powers down when not in use, the sensors can operate for an average of 12 hours before needing to be recharged. Each sensor also has its own processor and ADC converter, ensuring accurate communication of calibrated measurement values.

2. Bluetooth communication

CMA Wireless Sensors are equipped with a Bluetooth Dual Mode Module which features **Bluetooth® Classic** (BR/EDR) and **Bluetooth® Low Energy**. You must select the appropriate Bluetooth mode depending on the device being used. Bluetooth® Classic mode must be used for Windows computers, while Bluetooth® Low Energy mode for Mac computers and mobile devices (Android and iOS). The selected mode is indicated in the top-left corner of the sensor's display: **PC** for Classic and **Mobile** for Low Energy.

To switch modes:

- turn off the sensor,
- press and hold the power button until the message 'Bluetooth mode Change Mobile/PC' appears,
- release the button.

Each sensor has a unique Bluetooth identification code on the backside, enabling you to select and connect this specific sensor in the Coach software - especially important when multiple sensors are present in the classroom.

When using Bluetooth® Classic mode, the sensor **must be paired** through Windows Settings. This **pairing is not required** for Bluetooth® Low Energy mode, where the sensor can be used directly in the Coach software on Mac computers and mobile devices.

The maximum communication resampling frequency via Bluetooth is 100 samples

per second (100 Hz).

3. USB communication

Wireless sensors can also be used via USB with Windows and Mac computers.
To establish a USB connection, use the provided USB cable: plug the USB-C connector into the sensor and connect the other end to a USB port on your computer. When the sensor is connected via USB, the USB symbol appears in the top-left corner of the display, and the sensor is automatically added to the Wireless Sensors panel in the Coach software.

When measuring via USB, some sensors can achieve a higher sampling frequency of up to 1000 Hz. These are the Current Sensor W08, Force/Acceleration Sensor W22, Gas Pressure Sensor W24, and Voltage Sensor W60.

4. Powering sensors

Each sensor has a power button to turn it on and off. It is powered by a built-in rechargeable battery, which allows for an average usage time of about 12 hours. To extend battery life, the sensor automatically powers down after a few minutes of inactivity (no power connection and no communication).

Most sensors use a Li-Poly 3.7 V, 700 mAh battery, except for the Motion Detector, which has a Li-Poly 3.7 V, 2000 mAh battery. The battery level is displayed in the top-right corner of the sensor's screen. When the battery level is critical, the gauge shows an empty battery icon. In this case, use the provided cable to connect the sensor to a USB port for charging. A fully discharged battery takes up to 2 hours to charge completely (4 hours for the Motion Detector).

One of the factors that affects battery life is the storage temperature. Avoid storing the sensor in very cold or very hot environments.

To replace the battery, **only use** the approved rechargeable batteries provided by CMA. Follow the CMA instructions when you need to replace the battery.

5. Software

You can use the Wireless Sensors with the Coach 7 or Coach 7 Lite (free) program on Windows and Mac computers, as well as the Coach 7 and Coach 7 Lite (free) app on mobile devices (Android and iOS). Support for Wireless Sensors was introduced in Coach version 7.10 and further enhanced in version 7.11. This manual specifically describes the functionalities of the wireless sensors in Coach version 7.11.

For the latest installations, please check the CMA website at https://cma-science.nl/downloads.en or use the QR code displayed here.

6. Getting started with Wireless Sensors

Power on: Press the power button to turn on a Wireless Sensor.

Bluetooth Identification: The sensor briefly displays its Bluetooth identification code, which is also printed on the sticker located on the bottom of the sensor box.

Display Information: After powering on, the display shows:
the Bluetooth mode: 'Mobile' or 'PC'.
the battery level, and
the measured value.

Direct measurement: The sensor can now be used as a standalone measuring instrument. It displays the current measured values but does not store them.

Switching between sensors/ranges: If the sensor consists of multiple sensors (e.g. Light/Color/UV sensor W32) or multiple ranges (e.g. Magnetic Field sensor W34), briefly press the power button to toggle between sensors/ranges, and the displayed values will change accordingly.

Power off: To turn off the sensor, press and hold the power button for 3 seconds. To conserve battery life, the sensor will automatically power down after a few minutes of inactivity (no power connection and no communication).

7. Data Collection Using Bluetooth Connection

With Apple computers and Mobile devices

Important: **Do not pair** the sensors; simply use them directly in the Coach software.

- Turn on the Wireless Sensor.
- Ensure your sensor is set to Mobile mode.
  If the display shows 'PC' in the top-left corner, switch to Mobile mode. Turn off the sensor, then press and hold the power button until 'Bluetooth mode Change Mobile' appears. Release the button to set the mode to Mobile (Bluetooth Low Energy).
- Launch the Coach 7 or Coach 7 Lite program/app.
- Select a Measurement Activity for Wireless sensors from the Dashboard.
  You may also use a measurement activity designed for another interface then choose **Use with Wireless sensors** when opening it, or right-click the interface panel and select **Change interface** in the activity.
- On opening of the Activity Coach starts searching for wireless sensors that are turned on and in Mobile mode. Any detected Bluetooth sensors will be listed.
- Select the sensor(s) you wish to connect to from the list. If necessary, check the Bluetooth ID on the sensor's bottom label to confirm the correct one.

- Once the sensor is connected, a Bluetooth symbol will appear in the top-left corner of the sensor's display, and the sensor icon(s) in Coach will show the measured values.
- Now you are ready to begin taking measurements with the sensor.

With Windows computers

Before using a sensor for measurements in Coach, you **must pair it** following the steps outlined below.

- Turn a Wireless Sensor on.
- Ensure your sensor is set to PC mode.
  If the display shows 'Mobile' in the top-left corner, switch to PC mode. Turn off the sensor, then press and hold the power button until 'Bluetooth mode Change PC' appears. Release the button to set the mode to PC (Bluetooth Classic).
- Pair your sensor.
  - Open Windows Settings and navigate to **Bluetooth and other devices**. Click on **Add Bluetooth or other devices** and select **Bluetooth device**.
  - Windows will search for available Bluetooth devices and display a list of discovered devices, including the wireless sensors and their Bluetooth IDs.
  - Select the sensor you wish to connect to. If necessary, verify the sensor's Bluetooth ID, which can be found on the bottom label of the sensor.
  - Once the connection is established, Windows will indicate that the sensor is paired and ready for use.
  - Click **Done** to finalize the pairing. The sensor will now appear in the list of paired Bluetooth devices.
- Launch the Coach 7 or Coach 7 Lite program/app.
- Select a Measurement Activity for Wireless sensors from the Dashboard.
  You may also use a measurement activity designed for another interface then choose **Use with Wireless sensors** when opening it, or right-click the interface panel and select **Change interface** in the activity.
- On opening of the Activity Coach starts searching for wireless sensors that are turned on and in PC mode. Any detected Bluetooth sensors will be listed, even if they are not paired.
- Select the sensor(s) you wish to connect to from the list. If necessary, check the Bluetooth ID on the sensor's bottom label to confirm the correct one. If the sensor was not paired yet Coach will force you to pair the sensor first via Windows Settings.
- Once the sensor is connected, a Bluetooth symbol will appear in the top-left corner of the sensor's display, and the sensor icon(s) in Coach will show the measured values. If the selected sensor is not active the icon will not show any values, you must first turn the sensor on and then connect it again.
- Now you are ready to begin taking measurements with the sensor.

8. Data Collection using USB connection

- Turn on the Wireless Sensor.
- Connect the sensor to a USB port using the provided USB cable.
- Launch the Coach 7 or Coach 7 Lite program.
- Select a Measurement Activity for Wireless sensors from the Dashboard.
  You may also use a measurement activity designed for another interface then choose **Use with Wireless sensors** when opening it, or right-click the interface panel and select **Change interface** in the activity.
- On opening of the Activity Coach starts searching for 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.
- Once the sensor is connected, a USB symbol will appear in the top-left corner of the sensor's display, and the sensor icon(s) will show the measured values.
- Now you are ready to begin taking measurements with the sensor.

Notes:

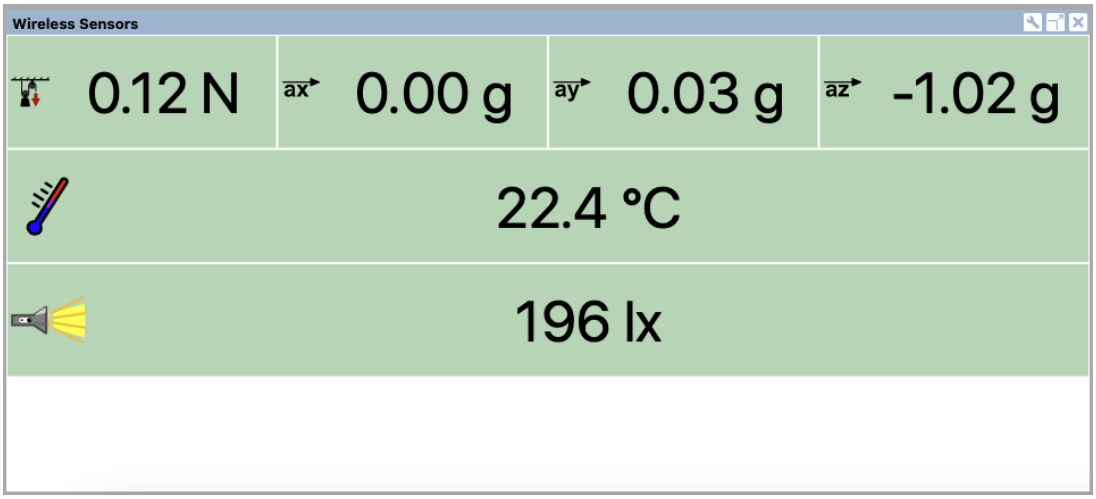
– You can use up to 4 wireless sensors simultaneously.

– It is possible to combine sensors that communicate via Bluetooth and sensors that communicate via USB in a single measurement. When using such combination, the maximum communication resampling frequencies is 100 Hz.

9. Using Wireless Sensors for measurement in Coach[1]

To measure with wireless sensors, the interface selected in the Coach Activity must be set to Wireless Sensors. If the setup steps described below are followed correctly, the connected sensors - their icons and measured values, will automatically appear on the Wireless Sensors panel.

The Wireless Sensors panel supports connecting up to four wireless sensors at once.



The Force/Acceleration, Temperature and Light sensors
connected and displayed on the Wireless Sensors panel in Coach.

[1] The steps here describe the procedure in Coach version 7.11.

1. Turn on the wireless sensors you wish to use and set them to the appropriate Bluetooth communication mode or connect them via USB.
2. Open a Measurement Activity for Wireless Sensors. You have several options:
   A. Click the Measurement button on the Dashboard and select the option **Measurement with Wireless Sensors**.
   B. Open a Measurement Activity created for a different interface, and if that interface is not detected during the opening process, select the option **Use with Wireless Sensors.**
   C. Open a Measurement Activity created for a different interface. Right-click its panel in the Activity and select **Change Interface.** Then, choose **Wireless Sensors** from the list.
   D. (*Only for Author user mode*) Create a new Measurement Activity, select as interface: **Wireless Sensors**.
3. When the Activity for Wireless Sensors is opened, Coach begins searching for wireless sensors. All detected sensors, whether connected via Bluetooth or USB, will be displayed in a list.
4. Select the sensors you wish to use. The connected sensors, along with their icons and measured values, will appear on the Wireless Sensors panel.
5. If the activity was saved with a specific sensor setup, Coach will attempt to match the connected sensors to those used in the activity. If a match cannot be made, the stored sensor will remain greyed out. Please note that sensors connected via USB will always be automatically added to the panel. If you do not wish to use them, you must disconnect them from USB.
6. You are now ready to begin your measurement and use the Coach software as you would with any other sensors. However, please be aware of some limitations of the wireless sensors, which are explained in the next section.

Important:
For certain wireless sensors, such as the Light/Color/UV sensor W32 (a multiple sensor) or the Magnetic Field sensor W34 (a multiple range sensor), the sensor type or the sensor range cannot be changed while the sensor is connected and measuring in the Coach software. To select a different sensor or range, you must first disconnect the sensor in Coach by right-clicking the sensor icon and selecting **Remove**. After that, change the sensor or range by pressing the power button on the sensor, and then reconnect it in Coach.

10. Limitations of Wireless Sensors compare to other sensors in Coach

Due to the characteristics of wireless sensors, Coach does not provide some options that are available for other types of sensors. The following limitations apply for wireless sensors:

- The sensors are not compatible with older Chromebooks (Chrome OS 103.0.5060.132). These Chromebooks have a Bluetooth 4.0 module, while the sensors use BLE 4.2. This issue does not occur with newer versions of Chromebooks (Chrome OS 129.0.6668.112). On these devices, you can use the wireless sensors in Coach.
- Event-based measurement mode cannot be used, only Time-based and Manual measurement modes are supported.
- Calibration of sensors is not possible, as they provide already calibrated values. Coach allows for shifting the default calibration by right-clicking the sensor icon and selecting 'Set to Zero' or 'Set to Value'. Please note that this adjustment is not communicated to the sensor; the modified values will be displayed in Coach but will not reflect on the sensor's display.
- There are no additional sensor ranges available.
- Conversion via the 'Use as' option is not possible. This means wireless sensors cannot be defined as counters or one-bit sensors for interval and frequency measurements.
- The sensors support a limited number of communication resampling frequencies.
  - Via Bluetooth: 2, 5, 10, 20, 40, 50 and 100 Hz.
  - For some sensors, additional sampling frequencies are available via USB: 200, 250, 500, and 1000Hz. The sampling frequency does not depend on the number of connected sensors.

Note: *CMA Wireless Sensors are intended for educational purposes only. They are not intended for industrial, medical, research, or commercial applications.*

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