

VOLTAGE SENSOR W60

USER GUIDE



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Short description

CMA Wireless Voltage sensor W60 is designed for exploring the basic principles of electricity. With a wide input voltage range of -15 to +15 V, this sensor can be used to measure voltages in AC and DC circuits. The sensor is equipped with two 4-mm banana plugs and two additional alligator clips are delivered with the sensor. The sensor has differential inputs, which means that measurements can be done directly across circuit elements without the constraints of common grounding. It can be used to measure positive potentials, as well as negative potentials.

The sensor should be connected parallel to a circuit element to measure the potential difference across the element. The sensor is provided with over-voltage protection and voltages up to ± 30 V (related to ground) will not damage the sensor. It never can be used for higher voltages or 220 V.

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

CAUTION: NEVER use high voltages or household AC.

- The Voltage sensor is used to measure the potential difference between the ends of an electrical component and is therefore connected across (i.e. in parallel) the component.
- Make sure you observe the correct polarity i.e. connect the black lead from the Voltage Sensor to the negative terminal of the cells, otherwise, the sensor will give readings with the wrong sign.
- The Voltage Sensor(s) can be used in conjunction with a Current sensor(s) anywhere in a circuit.
- For reasons of accuracy, if more than one Voltage sensor is being used in a circuit, ensure they share common earth (connect their black leads to each other).

Calibration

The Voltage sensor W60 converts measured voltage values to digital values. It uses 14-bit analogue-to-digital conversion resulting in a resolution of 0.002 V. The sensor is supplied with a factory calibration in volts (V). 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 Voltage sensor W60 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

Working with Sensor

- Turn the Voltage sensor 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 side 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 Voltage sensor 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'.
- 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 Voltage sensor 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 voltage values.
- Now you are ready to use the Voltage sensor 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 Voltage sensor 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 Voltage sensor 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

voltage values.

- Now you are ready to use the Voltage sensor for your measurement.

Collecting data via the USB connection

For computers (Windows and Mac) the Voltage sensor can also be used as a USB sensor. When using this connection, the sensor can measure with a higher sampling frequency of up to 1000 Hz.

- Turn the Voltage sensor 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 and the sensor icon shows measured data.
- Now you are ready to use the Voltage sensor for your measurement.

Charging a battery

An internal rechargeable battery (Li-Poly 3.7 V, 700 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 Voltage sensor can be used in various experiments such as:

- charging and discharging capacitors,
- characteristics of a light bulb and a diode,
- measurements of internal resistance and EMF,
- measurements in series and parallel electrical circuits,
- together with a Current Sensor, it can be used to explore the relationship between the current and the voltage in electrical circuits.

Technical Specifications

<i>Sensor kind</i>	Digital, on-sensor digital conversion, 14-bit resolution
<i>Measuring range</i>	-15 .. +15 V (differential)
<i>Resolution</i>	0,002 V
<i>Sensitivity</i>	Typical ± 0.01 V, Min ± 0.005 V @ $< \pm 1.0$ V, Max ± 0.03 V
<i>Max. voltage protection</i>	± 30 V
<i>Input impedance</i>	$5.3 \pm 1.5\%$ M Ω at 25°C
<i>Zero offset</i>	Zero-voltage offset drift: typical ± 1 mV at 25°C
<i>Maximal sampling rate</i>	Bluetooth: 100 Hz USB: 1000 Hz
<i>Display</i>	OLED 0.96" (128*64 px)
<i>Battery</i>	Li-Poly Rechargeable Battery (3,7 V 700 mAh)
<i>Battery life after full charge</i>	Approximately 12 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>	W60VOLT-xxx
<i>Sensor dimensions</i>	Housing: 80 x 50 x 25 mm; Electric cords: 30 cm

Warranty

The Voltage sensor W60 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.*