



Wireless CO₂ (Carbon Dioxide) Gas (P4511-CO) User manual



Rev. WL111CO2-12-2023

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

The wireless CO₂ Gas sensor can measure carbon dioxide in the air.

The wireless CO₂ Gas sensors can measure carbon dioxide in the air or in enclosed spaces such as botanical gardens or animal farms. It is also a sensor that can measure the amount of carbon dioxide generated by the respiration of small organisms such as insects using experimental tools such as Erlenmeyer flasks. Additionally, the sensor has a display window so you can immediately check the measured values, and measurements can be made by remotely connecting to a smart device or PC wirelessly or wired without a separate interface.

Suggested experiments

- Yeast respiration
- Monitoring CO₂ changes in a plant terrarium during photorespiration and photosynthesis in light/dark
- Measuring CO₂ levels (respiration) from small animals and insects
- Measuring CO₂ levels during cellular respiration of peas or beans
- Breathing according to temperature

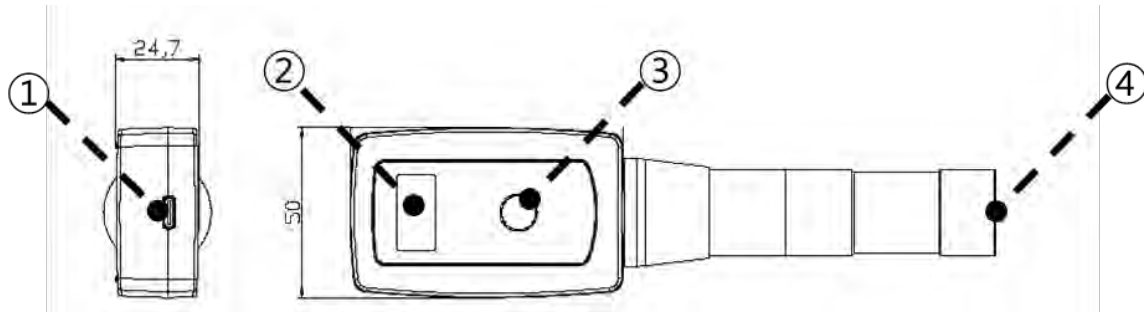
Composition

The wireless CO₂ Gas sensor consists of the following.

- Wireless CO₂ gas sensor (P4511-CO)
- USB-A/C cable
- Booklet

Function of wireless sensor

Structure



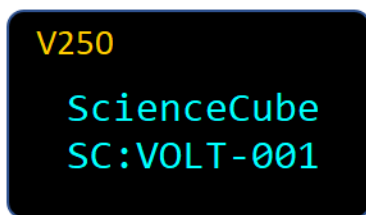
- ① USB port : Connect the sensor to a PC and use it for experiments or charging.
- ② OLED Display : Displays measured sensor values, sensor type, sensor ID, and remaining battery level.
- ③ Power/Function Button : It has functions such as power ON/OFF, measurement sensor change and calibration, etc.
- ④ Sensing element: Contains a sensor to detect CO₂ gas and is protected from contamination by a membrane filter.

Important : The sensor tube can never be placed into any liquids. The sensor is intended only for measuring gaseous, not aqueous, CO₂ concentration.

Power/Function Button

Status	Turn	Action	Description
When the power is off	Click once	■	A short press turns the sensor on.
	Long click	■■■■■	A long press changes the mode and turns on the sensor.
When it's on	Double click	■■■	1) A user calibration (if the sensor has a calibration function) is performed and U0 or UC is displayed above the device. 2) Sensor with flip function rotates the screen 180 degrees so text is clearly visible.
	Long click	■■■■■	Turns off.

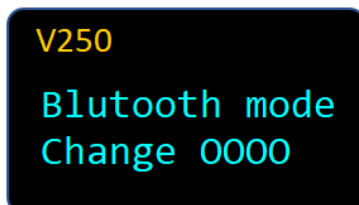
Start screen



V250 : Displays the sensor's firmware version.

SC:OOOO-001 : When you search for a Bluetooth device, the device name will be displayed. (Sensor name and 3-digit serial number)

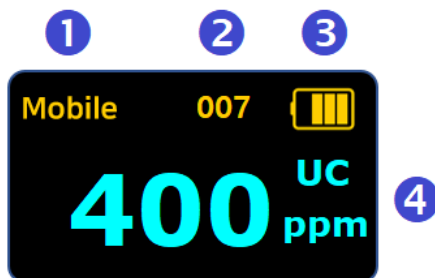
Mode change



When you press and hold the power button and turn it on, the Bluetooth connection mode changes to **Mobile** or **PC** with the following message.

See last page for more information.

Measurement screen

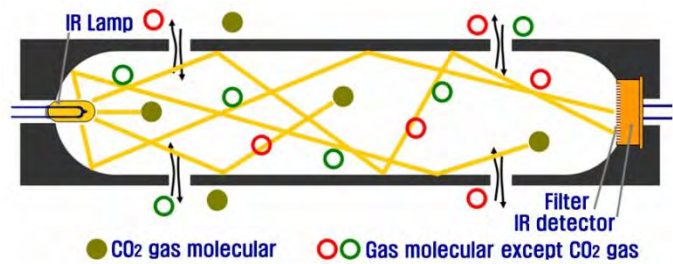


① Connection mode	Mobile : Connecting Android or iOS PC : Connecting to Windows PC  : Connected via USB cable ※ A long press changes the mode and turns on the sensor.
② Sensor-ID	This is the sensor's unique number and is displayed along with the sensor name in the device name when connected via Bluetooth.
③ Battery	Check the battery status, and when charging via USB, the display will change to charging.
④ Value	1) Displays sensor measurement values and units in real time. 2) If user calibration is used, U0 or UC will be displayed above the units. 3) For sensors with multiple ranges , the current range is displayed. 4) For multiple sensors , the values for each sensor type are displayed.

How it Works

Using an NDIR (Non Dispersive Infra-Red) type optical detector, the amount of infrared rays absorbed by carbon dioxide molecules is recorded and measured in the range of 0 to 5,000 ppm.

The sensor uses a hot metal filament as an infrared source (IR), which is located at one end of the sensor tube. At the other end of the sensor tube is an infrared sensor that measures how much radiation gets through the sample without being absorbed by the carbon dioxide molecules.



The detector measures infrared radiation absorbed in the narrow band centered at $4.26\ \mu\text{m}$. The greater concentration of the absorbing gas in the sampling tube, the less radiation will make it from the source through the sensor tube to the IR detector. When the temperature of the infrared sensor rises, a voltage is generated, This voltage is amplified by the circuit and read. CO₂ gas diffuses through the membrane filter in the sensor probe and moves in and out of the sensor probe. While the sensor is collecting data, the IR source blinks and takes a new reading once every second.

Calibration

For many measurements it will not be necessary to calibrate the CO₂ gas sensor. The sensor has measurement range between 0 to 5,000 ppm.

In most cases, this calibration is sufficient. For more accurate measurements, however, the sensor can be calibrated at one known CO₂ level using the button on the wireless sensor. For most measurements, there is no need to calibrate the CO₂ gas sensor.

However, for more accurate measurements, you can use the sensor's calibration function to calibrate the sensor at known CO₂ levels.

[User Calibration]

Although there are differences depending on temperature, humidity, atmospheric pressure, and region, the average CO₂ concentration in the Earth's atmosphere is approximately 400 ppm. Under typical outdoor or well-ventilated indoor conditions, assume 400ppm and use this as the calibration point.

- Connect your wireless CO₂ gas sensor to Science#.
- Allow the sensor to warm up for at least 10 minutes while collecting data.
- Once the readings are stable, press the Calibrate button. The measured value changes to approximately 400 ppm and "U0" is displayed above the unit.
- After approximately 3 minutes, the reading should stabilize to a value of approximately 400 ppm.
- If the reading is significantly lower or higher than 400ppm, press the button again to repeat the process. .

Storage and maintenance

- The CO₂ sensor needs to warm up for 10 minutes anytime power is interrupted.
- The sensor can not take readings at a CO₂ concentration higher than 5,000ppm. Once the CO₂ concentration reaches this level the sensor will continue to display a reading of 5,000 ppm, until the actual level drops below 5,000 ppm again.
- Even though the sensor responds rather quickly to change in CO₂ concentration, remember that gas has to diffuse through the filter in the sensor probe before any changes in concentration can be detected. Since diffusion of gases is a fairly slow process, there is resulting delay in the readings. Wafting air toward the sensor tube speed up this process.
- We recommend leaving the slit rubber stopper on the sensor probe.
- The sensor is designed to operate between 20°C and 30°C. The sensor can be used outside of this temperature range; however there will be a loss in accuracy of readings, even if the 1-point calibration at the lower level or higher temperature is done. Allow enough time for the sensor to stabilize at the desired operating temperatures.

Specifications

Item	Description
Range	0 ~ 5,000 ppm
Resolution	1 ppm
Sampling Time	Max. 100Hz (0.01 sec.), (Typical 1Hz)
Condition	Recommend 20 to 30 °C, ~85%RH
Wireless Connection	Bluetooth 5.0 or Classic 2.1
Wired Connection	USB-C
Battery	700mAh Li-Polymer rechargeable
Charging Time	within 2 hours
Operating Time	Approximately 4 hours after full charge (depending on usage conditions)
EMC	CE : EN 61326-1, EN 55011, EN 55032, EN 301

CAUTION: Do not use the instrument beyond the measurement range or in conditions that exceed the short-term exposure limits. Prolonged exposure beyond the maximum permissible range can cause serious damage to the sensor.

How to install Science#

● Install Windows PC version

Online installation file (approximately 39MB)

<http://www.koreadigital.com/url/updates/sciencesharppc/setup.exe>

* Internet connection is required during installation

Offline installation file (approximately 340MB)

http://www.koreadigital.com/url/updates/sciencesharppc/setup_full.exe

* Installation does not require an Internet connection, but contains large content

● Install from a mobile smart device (Smartphone or Tablet PC)

1. Download Science# to your smart device (Refer to QR codes below)
2. Connect using Bluetooth (See Science# documentation or refer to next page)
3. Run Science#
4. When you connect the sensor, the measurement is displayed on the Science# screen



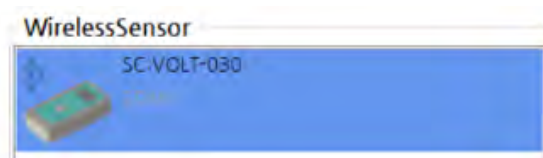
Features

- Up to four wireless sensors can be connected to a PC or smart device at the same time.
- It supports dual-mode Bluetooth, allowing you to connect not only smart devices but also desktop and laptop PCs to conduct experiments using the **Science#** application.
- It can be connected to a PC through a USB port and experiments can be performed using the **Science#** program.

How to connect Wireless Sensor to Science# program

● Windows PC

1. Install and run Science# (Refer to previous page for installation method)
2. Power on the sensor
3. Click the  [Connect] icon and select [Bluetooth Interface] from [Select Interface]
4. [Add Bluetooth or other device] → [Bluetooth] → Add sensor number after checking the number on the backside of sensor
5. When you see like the picture, click on Wireless Sensor and connect



● Android or iOS (Smartphone or Tablet PC)

1. Install and run Science# (Refer to previous page for installation method)
2. Power on the sensor
3. Click the  [Connect] icon and select [Bluetooth Interface]
4. After selecting the device search, check the sensor number on the backside and connect



If you experience any connection issues, check Bluetooth mode on the sensor. Please refer to the next page for instructions on how to change it.

How to switch to Bluetooth mode for Android and iOS

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

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 that Bluetooth Low Energy is used.

How to switch to Bluetooth mode for Windows

For Windows computers, Bluetooth Classic technology is used for wireless communication. Before you start to use the sensor for measurement you have to pair it. If you are asked for a PIN, enter either "1234" or "0000".

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.

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