Wireless Humidity

(P4517-HU)

User manual

Rev. WL117H-12-2023

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

The be wireless humidity sensor measures the relative humidity and temperature of the air and displays the dew point.

The wireless sensor consists of an integrated circuit containing a polymer-based capacitive humidity sensor and a bipolar junction transistor-based silicon bandgap temperature sensor. It is a semiconductor circuit that digitally displays measured values according to various relative humidity and temperature changes.

The sensor is contained within a perforated aluminum probe and senses through airflow and circulation. Typical reaction time is approximately 15 seconds in slowly flowing air at 25°C.

You can measure by remotely connecting to a smart device or PC wirelessly or wired.

Suggested experiments

- Measurement of evaporation rate according to humidity
- Observation of optimal growth condition by relative humidity in greenhouse, etc.
- Comparison of static electricity generation according to humidity

Composition

The wireless humidity sensor *consists of the following:*

- Wireless humidity sensor (P4517-HU)
- 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.

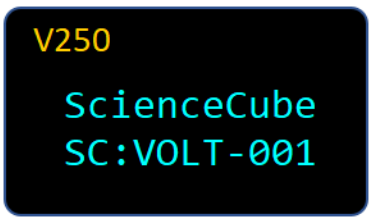
④ Sensing part : Contains sensors that detect humidity and temperature and is protected with a metal mesh.

Caution : Do not use the sensor near fire or explosive gases. Chemical vapors can block the polymer layer used for capacitance, causing permanent damage to the sensor.

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	Click once	■	Change sensor type or range. (Multiple sensor or multiple range sensor only)
	Long click	■■■■■	Turns off.

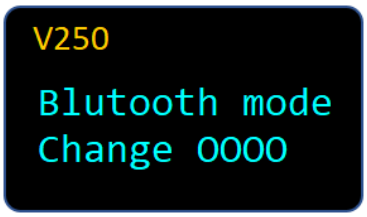
Start screen



V250 : Displays the sensor's firmware version.

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

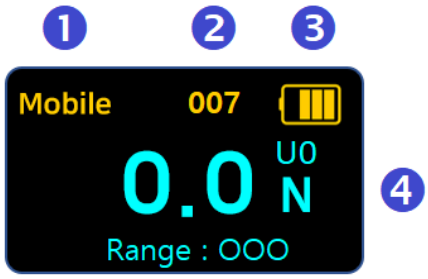
Mode Change



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



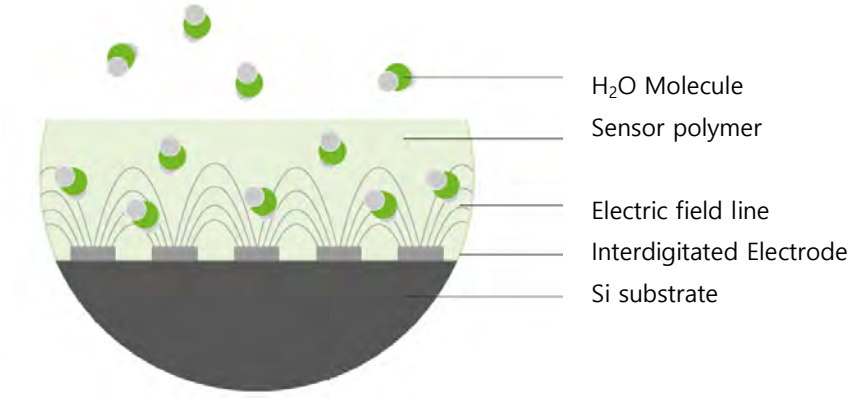
①**Connection mode**	**Mobile** : Connecting Android or iOS **PC** : Connecting to Windows PC : Connected via **USB** cable ※ A long press changes the mode and turns on the sensor.
②**Sensor-ID**	This is the sensor's unique number and is displayed along with the sensor name in the device name when connected 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) For **multiple sensors**, the values for each sensor type are displayed.

Multiple sensor screen

How it Works

Polymer-based capacitive humidity sensors are implemented with interconnected capacitor electrodes. If the space between capacitors is filled with a dielectric material that reacts well to moisture, the dielectric constant changes depending on humidity, and the electric capacitance at both ends of the electrodes also changes, allowing humidity to be inferred.

Due to the capacitive nature of these sensors, they typically have different accuracies from 0 to 80%RH and from 80 to 100%RH.



The figure above is a cross-sectional view of a capacitive humidity sensor manufactured through the CMOS process. Using a Si substrate, a thin film is used as a dielectric between the electrodes. Relative humidity may have errors depending on temperature and saturation, and generally has the following distribution.

Dew point

The dew point of a given body of air is the temperature to which it must be cooled to become saturated with water vapor. This temperature depends on the pressure and water content of the air. When the air is cooled below the dew point, its moisture capacity is reduced and airborne water vapor will condense to form liquid water known as dew. When this occurs through the air's contact with a colder surface, dew will form on that surface.

Dew point can be calculated using the following equation:

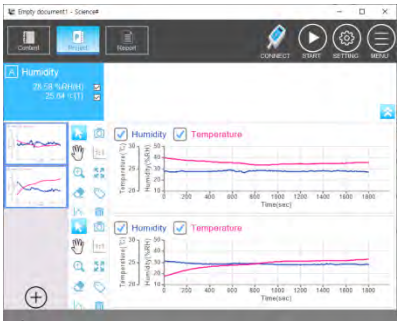
$$T_d(T, RH) = T_n \frac{\left(\ln\left(\frac{RH}{100}\right) + \frac{m\,T}{T_n + T}\right)}{m - \left(\ln\left(\frac{RH}{100}\right) + \frac{m\,T}{T_n + T}\right)}$$

T_d : Dew point temperatue [°C]
T : Actural temperature [°C]
RH : Actural relative humidiy [%]
m : 17.62
T_n : 243.21

Using the Sensor

Using ScienceCube wireless humidity sensors, you can perform experiments such as:

- Measurement of evaporation amount according to humidity
- Comparison of static electricity generation according to humidity



Science# experiment screen

Transpiration rate measurement experiment

Specifications

Item		Description
Range	**Humidity**	0 ~100 %RH
	Temp.	-40 ~ 60 °C
Resolution	**Humidity**	0.1 %RH (When using ***Science#***, 0.01 %RH)
	Temp.	1 °C (When using ***Science#***, 0.01 °C)
Sampling Time		Max. 100Hz (0.01 sec.), (Typical 1Hz)
Condition		-40 ~ 60℃, 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 12 hours after full charge (depending on usage conditions)
Dimension		115 x 50 x 25mm 65g (2.3 oz)

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

GET IN ON Google Play

Download on the App Store

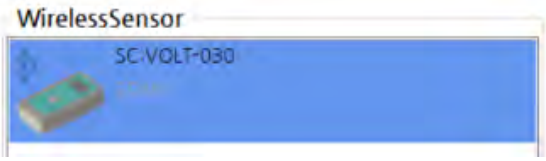
Features

- 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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