

## AIR QUALITY MONITOR

### DESCRIPTION

The Sensor IT Air Quality Monitor provides detailed, real-time data on CO<sub>2</sub> levels informing the user when a room needs ventilation to improve the air quality and reduce the risk of COVID-19 infection. This is achieved through a graphical dashboard showing a number of parameters that include:



- ☞ Carbon Dioxide Concentration (CO<sub>2</sub>) in Parts Per Million (PPM)
- ☞ Air Temperature in Celsius or Fahrenheit degrees
- ☞ Air relative humidity (%)
- ☞ Air Pressure (hPa) or Volatile Organic Compounds (VOC – Air Quality Index)

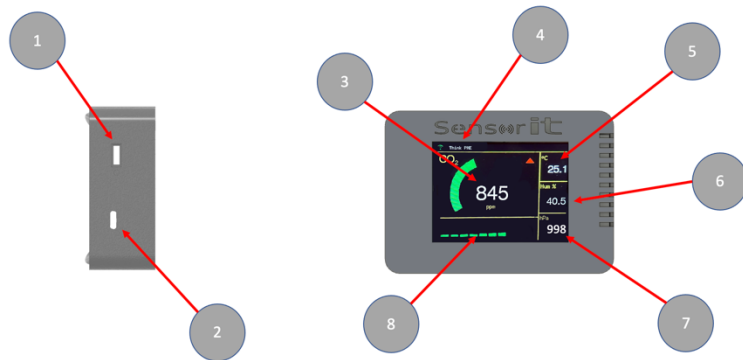
The Monitor also displays a historical data on CO<sub>2</sub> concentration, taking a sample every six minutes, covering a period one hour in total.

### HOW TO USE IT

The device needs to be continually connected to a 5V USB power supply able to provide a minimum current of 1A. It is recommended that the device is kept turned on 24 hours a day in order to allow the self-calibration process to run its course.

**IMPORTANT: Do not connect a power supply with a voltage higher than 9V or permanent damage can be caused to internal components**

### CONNECTIONS AND LCD DISPLAY



1. ON/OFF Switch
2. USB Power Adapter
3. CO<sub>2</sub> measurement, including graphical display
4. WIFI Connection Indicator
5. Air Temperature measurement
6. Air Relative Humidity measurement
7. Air Pressure measurement (SITPDCO2MON0100WFA) / Volatile Organic Compounds – VOC (SITPDCO2MON0110WFA)
8. CO<sub>2</sub> readings historical data over the last hour (samples every 6 minutes)

### SELF-CALIBRATION

This device automatically calibrates itself once installed. This feature eliminates one of the biggest concerns surrounding CO<sub>2</sub> sensing: sensor drift and maintenance.

#### How it Works

In open spaces, levels of CO<sub>2</sub> are generally very low, at around 400 to 500 ppm. Inside buildings people are the major source of CO<sub>2</sub>. When a building is unoccupied for 4 to 8 hours, CO<sub>2</sub> levels will tend to drop to outside background levels. This is especially the case if the building operational schedule includes a pre-occupancy purge of fresh air into the building prior to the start of the day.

This device utilises the computing power in the sensor's on-board microprocessor to remember the lowest CO<sub>2</sub> concentration that takes place every 24 hours. The sensor assumes this low point is at outside levels. The sensor is also smart enough to discount periodic elevated readings that might occur if, for example, a space was used 24 hours per day over a few days. Once the sensor has collected 14 days' worth of low concentration points, it performs a statistical analysis to see if there have been any small changes in the sensor reading over background levels that could be attributable to sensor drift. If the analysis concludes there is drift, a small correction factor is made to the sensor calibration to adjust for this change.

**NOTE:** It is important to note that this device is designed for use in applications where spaces are periodically unoccupied for 4 hours per day or more so that indoor concentrations can drop down to typical outside levels. If this is not possible, device re-calibration every 2-3 years is recommended.

### CO<sub>2</sub> GRAPHICAL DISPLAY (PPM)

The colour display, by default, follows the pattern presented below.



It is possible to configure the above thresholds through the Air Quality Monitor Web Setup Application (see below)

### VOLATILE ORGANIC COMPOUNDS

This parameter is only presented by model SITPDCO2MON0110WFA, and it is provided as a unitless value from 0 to 500. Values of 125 or less are considered a good air quality.

### SENSOR IT OPEN DESIGN

Sensor IT's Open Architecture Design (SOAD) introduces a new and innovative concept for Internet of Things devices, bringing a new level of adaptability and customisation to everything we design and manufacture whereby they can be customised to meet particular and specific requirements, as required by our customers.

The Air Quality Monitor can be customised to:

- ☞ Add LCD customisation, including language, colours, or graphical design in general
- ☞ Include additional sensors
- ☞ Include wireless connectivity, including LPWAN (IoT) protocols (LoRa®, Sigfox®, NB-IoT®, etc), WIFI or Bluetooth
- ☞ Modify enclosure to specific requirements
- ☞ Integrate into a cloud-based Dashboard

## CARBON DIOXIDE AND AIR QUALITY

### PRINCIPLES

Carbon Dioxide (CO<sub>2</sub>) is a gas found in the atmosphere that is released through, amongst others, a human natural process such as respiration. In a fully or partially enclosed environment, such as a bar, restaurant, classroom or hospital waiting area, concentrations of Carbon Dioxide increase from what is considered a normal open-air concentration, around 400ppm (ppm=Parts Per Million), to higher values, which can provide an indication of the indoor Air Quality, and hence the level of ventilation that the room is subject to.

The carbon Dioxide Concentration in a room filled with persons after a time t can be calculated using the following formula:

$$c = \left(\frac{q}{nV}\right) \left[1 - \left(\frac{1}{e^{nt}}\right)\right] + (c_0 - c_i) \left(\frac{1}{e^{nt}}\right) + c_i$$

Where:

- c = carbon dioxide concentration in the room (m<sup>3</sup>/m<sup>3</sup>)
- q = carbon dioxide supplied to the room (m<sup>3</sup>/h)
- V = volume of the room (m<sup>3</sup>)
- e = the constant 2.718
- n = number of air shifts per hour (1/h)
- t = time (hour, h)
- c<sub>i</sub> = carbon dioxide concentration in the inlet ventilation air (m<sup>3</sup>/m<sup>3</sup>)
- c<sub>0</sub> = carbon dioxide concentration in the room at start, t = 0 (m<sup>3</sup>/m<sup>3</sup>)

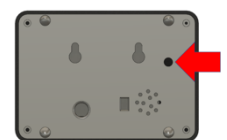
Scientific calculations aside, and solely based on CO<sub>2</sub> concentrations measured in ppm, the following table provides a good indication of the levels that should be expected in confined spaces:

CO <sub>2</sub> Concentration (ppm)	Air Quality
350-400	Normal background concentration in outdoor ambient air. This concentration can only be achieved with extremely good ventilation
400-600	Concentrations typical of occupied indoor spaces with very good air exchange
600-900	Good air quality. If possible, it is recommendable to keep the concentration closer to the lower limit
900-1,200	This concentration indicates that the air is starting to get stale and needs ventilation
1,200-2,000	Poor air quality. Rooms with this concentration should be ventilated with fresh air as quickly as possible
2,000-5,000	Very poor air quality. The room urgently needs fresh air

### RESET DEVICE

The Air Quality Monitor configuration settings, which include:

- ☞ Access Point password
- ☞ API username
- ☞ API password
- ☞ API URL



Can be reset following the next steps:

- ☞ Power the device off
- ☞ Push the reset button located at the back of the device, accessible with a pointy object, such as, for instance, an unfolded paper clip
- ☞ Power the device on, while still pressing the reset button, until the initial splash screen disappears
- ☞ Release the reset button

### SPECIFICATIONS

Parameter	Value
Operating Temperature	-10°C – 60°C
CO <sub>2</sub> Measuring Range	0-2,000 ppm
CO <sub>2</sub> Accuracy	400-2,000 ±30 ppm ±3%
CO <sub>2</sub> Temperature Dependence	5ppm per °C or 0.5% of the reading per °C, whichever is greater
CO <sub>2</sub> Reading Update	Every 10 seconds
Temperature Operating Range	-40-60°C
Temperature Accuracy	At 25°C, ±0.5°C
	0-65°C, ±1°C
Air Humidity Operating Range	0% - 100%
Air Humidity Accuracy	±3%
Air Pressure Operating Range (SITPDCO2MON0100WFA)	300 – 1,100 hPa
Air Pressure Accuracy (SITPDCO2MON0100WFA)	±1 hPa ≈ 0.75Hg mm
Volatile Organic Compounds (SITPDCO2MON01010WFA)	0-500 (Air Quality Index 0 – 500)

For further information, please get in touch with us on:



<https://www.sensorit.co.uk>

[info@sensorit.co.uk](mailto:info@sensorit.co.uk)

## WIFI CONNECTION SETUP

The Air Quality Monitor is configured through a Web Setup Application, served by the monitor itself. To access the device, and, consequently, the Web Application, clients first need to connect to the device when it acts as an Access Point, i.e., behaving as if it was a router, behaving in the same way as those installed at home or at an Internet Café. This is represented by the diagram below.

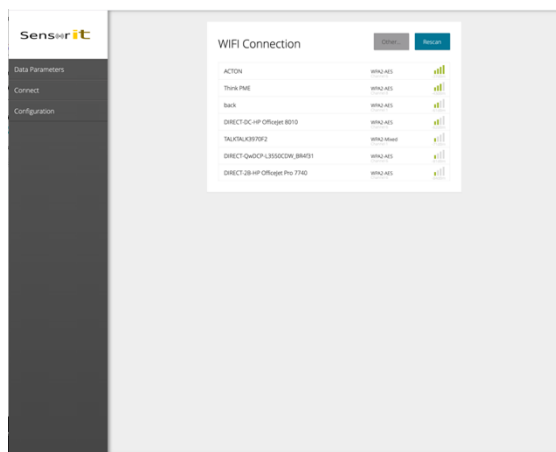


### CONNECTING TO THE AIR QUALITY MONITOR

The Air Quality Monitor only acts as an Access Point immediately after being powered up and stays in that state for only one minute. Once this minute lapses with no clients attempting to connect to it, it automatically exits the Access Point functionality. When the device is in Access Point mode, it displays a **Setup Active** message next to the wireless icon on the upper left corner of the display.

To connect to the Air Quality Monitor when the Access Point functionality is active, search for a WIFI network with an SSID (Network Identifier) name of **Sensor IT Setup**. Once you select this network on your client device, you will be prompted for the access password. By default, use **password** as the connection credentials.

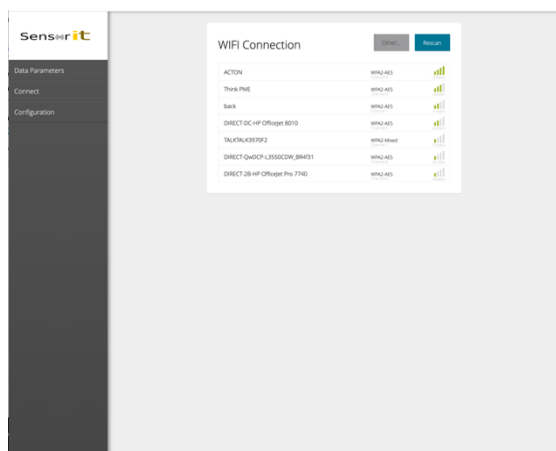
Once successfully connected to the Sensor IT Setup network, open a standard browser on your client device and type the following literal on the url field: **10.10.10.1**. This will connect to the Air Quality Monitor Web Setup Application, which will automatically start searching for available WIFI networks within range and display the result. A similar result as below will be displayed (available networks will change)



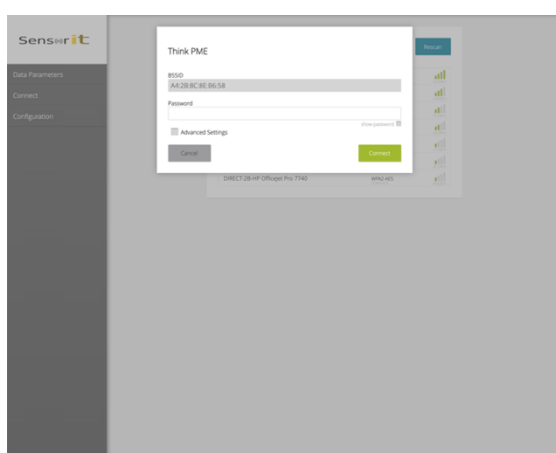
### CONFIGURING THE AIR QUALITY MONITOR

#### Connecting to a WIFI Network

To connect the Air Quality Monitor to a WIFI network, click on the **Connect** menu option of the Web Application. Once selected, the device will automatically scan for available networks and will display those available through a screen like the one below:



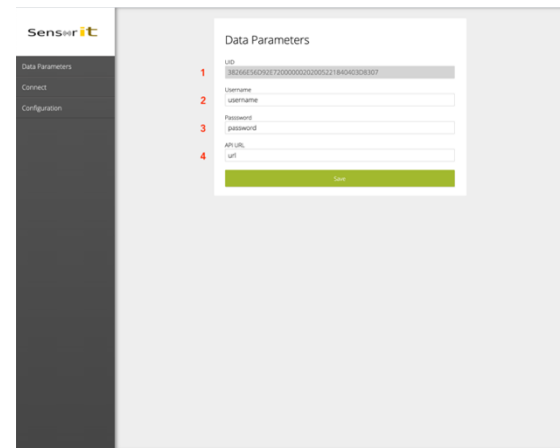
To re-scan for wireless networks and refresh the screen, click on the **Scan** button. To connect to a network, select it with the mouse pointer. The device will bring up a screen like the one represented below, prompting us to enter the selected network access credentials. Click on **Connect** once this has been introduced:



**NOTE:** once the device attempts to connect to a wireless network, it will stop the Access Point functionality and interrupt the connection with the browser. The device will display the WIFI network it is connected to on the upper left corner of the display

#### Connection Data Parameters

The **Data Parameters** Web Application menu option allows for the configuration of several parameters related to how the Air Quality Monitor functions, as described below.

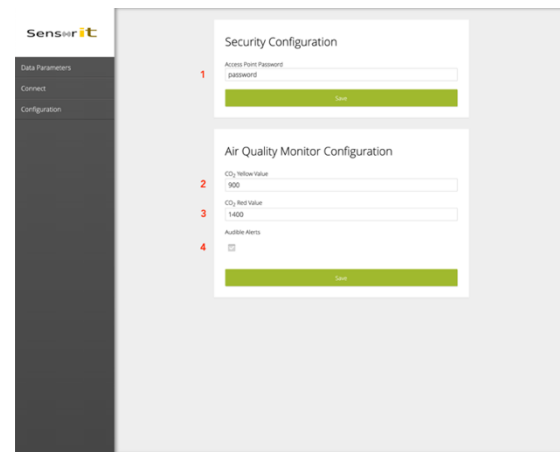


Option	Description	Possible Value	Default Value
1	The <i>UID</i> field displays the Air Quality Monitor Unique Identifier. This is used to uniquely identify the device within the Dashboard. This is a non-modifiable field, displayed for information only	-	-
2	The <i>Username</i> field is part of the username/password credential the Air Quality Monitor will use to send data to the Dashboard	valid username	-
3	The <i>Password</i> field is part of the username/password credential the Air Quality Monitor will use to send data to the Dashboard	valid password	-
4	The <i>API URL</i> field contains the uniform resource locator, or web address, used to send data to by the Air Quality Monitor	valid url	-

It is important to note that all Data Connection Parameters need to be properly configured for the Air Quality Monitor to be able to send data to the Dashboard, prior to an access to a WIFI network being configured. Data Parameters new values will not be saved until the **Save** button is clicked.

#### Device Configuration

There are several configuration parameters that affect how the device works that can be modified through the Web Application. This can be done by selecting the **Configuration** option of the menu, represented below:



The options that can be configured are numbered in the screen shot above, and are described in this section:

Option	Description	Possible Value	Default Value
1	The <i>Access Point Password</i> field is used to change the password needed to connect to the Air Quality Monitor from a WIFI client to access the Web Setup Application	Any	password
2	<i>CO<sub>2</sub> Yellow</i> value represents the value (in ppm) beyond which the Air Quality Monitor Carbon Dioxide gauge will turn yellow	0-2000 <sup>(1)</sup> (1) Value needs to be lower than CO <sub>2</sub> Red	900
3	<i>CO<sub>2</sub> Red</i> value represents the value (in ppm) beyond which the Air Quality Monitor Carbon Dioxide gauge will turn red	0-2000 <sup>(2)</sup> (2) Value needs to be higher than CO <sub>2</sub> Yellow	1400
4	<i>Audible Alerts</i> activates or deactivates an audible beep when the Carbon Dioxide concentration detected by the Air Quality Monitor crosses the threshold from green to yellow (one beep) or yellow to red (three beeps)	On/Off	On

For each group of parameters, there is a separate **Save** button that needs to be clicked to save the new entered values.

### LED INDICATORS

LED	Description	Behaviour	State
GREEN	WIFI Connection Status	Off	No Connected
		Fast Blink	Connected
		Slow Blink	IP Address Acquired
YELLOW	Access Point Status	Off	Off
		Fast Blink	Active. No clients
		Slow Blink	Clients Connected