User Manual [Ver 1.0]

Air Quality Monitoring System (CS-AQMS1)

Please use this Manual for the best user's experience

Last updated: March 7, 2024

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Disclaimer

CS-AQMS1 is designed only to monitor particulate matter, gases, temperature, relative humidity, and barometric pressure; it does not monitor the quality of the accompanying products, goods, or commodities, but does not monitor CS-AQMS1 quality.

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1 Introduction

1.1 Description

CredoSense Air Quality Monitoring System (CS-AQMS1) is a cutting-edge solution designed for the precise measurement and continuous logging of various air quality parameters in your surroundings. It is equipped to monitor a wide spectrum of particulate matter (PM 1, 2.5, 4, and 10), along with an array of gases, including CO, CO_2, O_3, CH_4, SO_2, NO_2, NO_x, H_2S, CH_2O, VOC, and TVOC.

The CS-AQMS1 operates on a cloud-based platform, suitable for both indoor and outdoor use. To ensure secure data storage, a backup microSD card is integrated into the device, mitigating potential issues arising from power failures or internet connectivity disruptions. Once power is restored or the internet connection resumes, the stored data is seamlessly uploaded to the cloud server. The CS-AQMS1 is available in four distinct models (Table 1), each offering unique features.

Table 1: CS-AQMS1 available version.

#SL	Model	Connectivity	Sensors
1	CS-AQMS1-W	WiFi	PM; Temp., RH, & BMP
2	CS-AQMS1-WL	WiFi, 4G LTE	PM; Temp., RH, & BMP
3	CS-AQMS1-WG	WiFi	PM; Temp., RH, & BMP; Gas sensors
4	CS-AQMS1-WLG	WiFi, 4G LTE	PM; Temp., RH, & BMP; Gas sensors

Users have the flexibility to choose up to three gas sensors for a CS-AQMS1.

1.2 Application of CS-AQMS1

Some of the key important applications of the CS-AQMS1 are listed below:

- **Traffic Management:** Monitoring air quality near roadways for effective traffic control and pollution reduction.
- **Smart Cities:** Integrating air quality data into urban planning for sustainable and healthy city development.
- **Healthcare:** Ensuring clean air in hospitals and clinics to protect patients and staff from airborne contaminants.
- **Industrial Compliance:** Managing emissions and ensuring workplace safety in industrial settings.
- **Occupational Safety:** Protecting workers in construction and mining from harmful particulates and gases.
- **Research and Studies:** Conducting environmental research and tracking long-term trends for scientific insights.
- **Emergency Response:** Rapidly assessing air quality during disasters to implement timely evacuation and safety measures.
- **Agriculture:** Assessing air quality's impact on crops and maintaining optimal conditions in greenhouses.

2 Unboxing

Figure 1 illustrates the contents included in the package upon customer unboxing. Items are listed as follows:

a) CS-AQMS1 Device

b) Temperature and relative humidity probe

c) 5V, 4A power adapter (AC to DC)

d) Mounting bracket for the probe

e) Zip tie (4 pcs)

f) Double-sided foam tape

g) Screw (6 pcs)

h) microSD card

i) Royal plug (6 pcs)

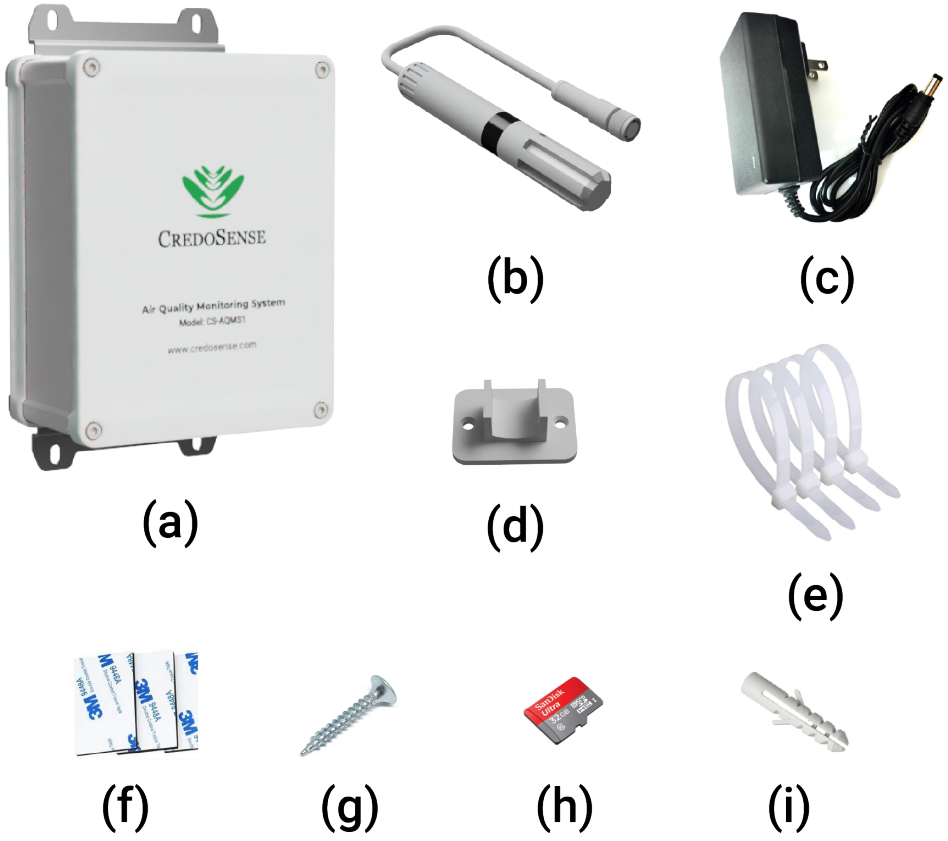

Figure 1: Devices and accessories a customer will receive upon unboxing.

3 System Components

3.1 CS-AQMS1 Annotation

Figure 2 provides a visual representation of the configuration and placement of diverse components within the structure.

Figure 2: Annotated CS-AQMS1 Structure and Component Overview

3.2 LED Status

Table 2, displays the various LED blink patterns that a user may encounter while operating CS-AQMS1, along with their corresponding meanings.

Table 2: Summary of LED blinks and its interpretation

No. of LED blink/second	Interpretation
0	Initialize device
1	Normal Operation
2	No internet connection
3	Sensor error
4	Internal backup storage is full

4 Technical Specification and Key Features

4.1 Technical Specification

4.1.1 Particulate Matter Measurement

Measurement range	0 to 1000 µg/m^3.
Mass conc. measurement	PM1, PM2.5, PM4, and PM10
Measurement resolution	1 µg/m^3.
Sensor lifetime	10 years.
Mass conc. accuracy	PM1 & PM2.5: 5% (0-100 µg/m^3), 10% (100-1000 µg/m^3). PM4 & PM10: 25% (0-1000 µg/m^3).
Operating range	Temperature: -20 to 50°C. Relative humidity: 20-99% (non-condensing). Barometric pressure: 300-1200 mbar.
Startup time	< 60s.
Response time	< 30s.
Storage	Temperature: -40 to 70°C. Relative Humidity: 0-99%.
Acoustic emissions level	24 dBA at 0.2m.
Long term acoustic emission level drift	+0.5 dB(A)/ year.

4.1.2 Temperature, Relative Humidity, and Barometric Pressure

Operating range	Temperature: -40 to 85°C. Relative humidity: 0 to 99% (non-condensing). Barometric pressure: 300 to 1200 mbar (30 to 120 kPa).
Accuracy	Temperature: Typical ±0.1°C (0-60°C), max. ±0.3°C (-40 to 85°C). Relative humidity: ±1% typical and 2% max (0-90%) and ±3% (91-100%). Barometric pressure: ±1 mbar (0 to 65°C).
Resolution	Temperature: 0.01°C. Relative humidity: 0.01%. Barometric pressure: 0.01 mbar.
Response time	Temperature: 2s. Relative humidity: 4s. Barometric pressure: 1s.

4.2 Gas Sensor Specification

4.2.1 Volatile Organic Compound (VOC)

Sensor output	0-500 VOC Index.
Response time (τ63%)	< 10s
Device-to-device variation	$<$ ±15 VOC Index points.
Repeatability	$<$ ±5 VOC Index points.

4.2.2 Nitrogen Oxide (NO_x)

Sensor output	0-500 NO_x Index.
Response time (τ63%)	$<$ 30s
Device-to-device variation	$<$ ±50 NO_x Index points.
Repeatability	$<$ ±10 NO_x Index points.

4.2.3 Carbon Dioxide (CO_2)

Range	400-5000 ppm.
Accuracy	±(50 ppm + 2.5% of reading): 400 - 1000 ppm. ±(50 ppm + 3% of reading): 1001 - 2000 ppm. ±(40 ppm + 5% of reading): 2001 - 5000 ppm.
Repeatability	±10 ppm.
Response time	60 s.
Additional accuracy drift after five years	± (5 ppm + 0.5 % of reading)

4.2.4 Carbon Monoxide (CO)

Measurement range	0-1000 ppm.
Maximum overload	1000 ppm.
Accuracy	$\leq$ 2 ppm.
Response time	$<$ 30s.
Repeatability	$<$ 1%.
Lower detectable limit (LDL)	$\leq$ 2 ppm.
Resolution	0.1 ppm.
Expected lifetime	$>$ 5 years in air.
Temperature range	-40°C to 55°C.
Pressure range	800 to 1200 hPA.
Operating humidity range	15-95%.
Cross sensitivity	Hydrogen (20 ppm in 100 ppm concentration).

4.2.5 Ozone (O_3)

Measurement range	0 - 5 ppm.
Maximum overload	10 ppm.
Accuracy	$\leq$ 0.05 ppm.
Response time	$<$ 60s
Repeatability	$<$ 2%.
Lower detectable limit (LDL)	$\leq$ 0.05 ppm.
Resolution	0.01 ppm.
Expected lifetime	$>$ 24 Months.
Long-term drift	$<$ 1% / month.
Temperature range	-20°C to 40°C.
Pressure range	800 to 1200 hPA.
Operating humidity range	15-95%.
Cross sensitivity	Sulfur Dioxide (1 ppm in 5 ppm concentration).

4.2.6 Sulfur Dioxide (SO_2)

Measurement range	0 - 50 ppm.
Maximum overload	100 ppm.
Accuracy	≤ 1 ppm.
Response time	< 60s
Repeatability	< 1%.
Lower detectable limit (LDL)	≤ 1 ppm.
Resolution	0.1 ppm.
Expected lifetime	> 3 years in air.
Long-term drift	< 1% / month.
Temperature range	-40°C to +55°C.
Pressure range	800 to 1200 hPA.
Operating humidity range	15-95%.
Cross sensitivity	Chlorine (-1 ppm in 10 ppm concentration) Nitric Oxide (< -3ppm in 25 ppm concentration) Hydrogen Cyanide (< 5ppm in 10 ppm concentration)

4.2.7 Formaldehyde (CH_2O)

Measurement range	0 - 5 ppm.
Maximum overload	10 ppm.
Accuracy	≤ 0.05 ppm.
Response time	< 120s
Repeatability	< 1%.
Lower detectable limit (LDL)	≤ 0.05 ppm.
Resolution	0.01 ppm.
Expected lifetime	> 3 years in air.
Long-term drift	< 1% / month.
Temperature range	-20°C to +55°C.
Pressure range	800 to 1200 hPA.
Operating humidity range	15-95%.
Cross sensitivity	Hydrogen Cyanide (< 1 ppm in 20 ppm concentration) Hydrogen (< 3 ppm in 100 ppm concentration) Sulfur Dioxide (<1 ppm in 10 ppm concentration)

4.2.8 Hydrogen Sulfide (H_2S)

Measurement range	0 - 100 ppm.
Maximum overload	200 ppm.
Accuracy	≤ 1 ppm.
Response time	< 20s
Repeatability	< 1%.
Lower detectable limit (LDL)	≤ 1 ppm.
Resolution	0.1 ppm.
Expected lifetime	> 3 years in air.
Long-term drift	< 1% / month.
Temperature range	-40°C to 50°C.
Pressure range	800 to 1200 hPA.
Operating humidity range	10-95%.
Cross sensitivity	Chlorine (-1.5 ppm in 10 ppm concentration)

Carbon Monoxide (3 ppm in 50 ppm concentration)
Hydrogen (3 ppm in 100 ppm concentration)
Nitrogen Dioxide (-2.2 ppm in 10 ppm concentration)

4.2.9 TVOC

Measurement range	0 - 1000 ppm.
Maximum overload	2000 ppm.
Accuracy	$\leq$ 1 ppm.
Response time	$<$ 300s
Repeatability	$<$ 1%.
Lower detectable limit (LDL)	$\leq$ 1 ppm.
Resolution	0.1 ppm.
Expected lifetime	$>$ 3 years in air.
Long-term drift	$<$ 1% / month.
Temperature range	-40°C to 55°C.
Pressure range	800 to 1200 hPA.
Operating humidity range	15-95%.

4.3 Key Features

- **Quick Deployment**
  Ready to roll right out of the box! This robust system is primed for setup in under 15 minutes. Whether you're monitoring the air inside your living space or tracking pollutants in an industrial setting, the CS-AQMS1 is your go-to for both indoor and outdoor scenarios.

- **Advanced Monitoring**
  Dive deep into air quality insights! Effortlessly measure particulates of sizes 1, 2.5, 4, and 10 microns alongside a customizable range of air pollutant gases, including CO, CO_2, O_3, CH_4, SO_2, NO_2, NO_x, VOC, and TVOC. But that's not all. Keep tabs on the air temperature, relative humidity, and barometric pressure for an all-encompassing environmental overview.

- **Reliable Performance**
  Designed for resilience, the CS-AQMS1 guarantees unwavering functionality in temperatures ranging from a chilly -20 to a scorching 50°C.

- **Seamless Connectivity**
  Stay connected, always! The system boasts 4G LTE and WiFi options—just slot in a SIM card for uninterrupted cellular connectivity. Access your air quality data anytime, anywhere, with cloud availability (subscription-based) and a removable microSD card.

- **Precision and Ease**
  Trust in the factory calibration that ensures you're starting with pinpoint accuracy. The intuitive CredoSense cloud dashboard simplifies data visualization, while the built-in self-diagnostics ensure your readings are consistently top-notch.

4.4 Data Logging and Networking Connectivity

a) Maximum logging rate: Every minute (can change depending on gas sensor's response time)

b) Storage options: Comes with 32GB microSD card and cloud storage.

c) Backup feature: Internal data backup during cloud connectivity interruptions.

d) Internet Access:

   - Cellular: 4G LTE SIM supported. (User needs to provide the SIM card).
   - WiFi: 2.4 GHz.

e) Always logging: CS-AQMS1 saves data to the SD card, even offline. No internet? No problem!

f) CredoSense cloud: Use for data access, system updates, and firmware tweaks.

g) Alert system: Warnings displayed in cloud data for SD or cloud upload issues.

⚠ The CS-AQMS1 doesn't support public Wi-Fi with browser logins.

5 Installation

5.1 Mounting the Device

To ensure optimal performance of the CS-AQMS1 device, it is recommended to install the device in a well-ventilated area, free from any obstructions. When utilizing the device indoors, position it at breathing level. If installed outdoors, mount it under a suitable shade to shield it from direct sunlight and protect it from the impact of heavy rainfall. For precise positioning guidance, please refer to Figures 3 and 4.

Figure 3: Avoid horizontal positioning of CS-AQMS1 while mounting.

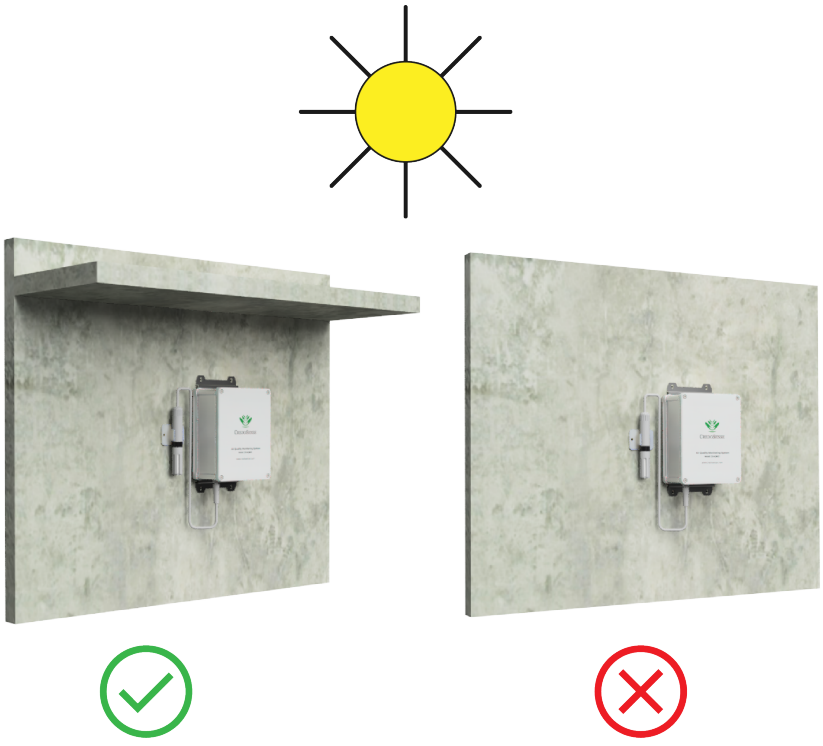

Figure 4: Place CS-AQMS1 under a proper shade to protect it from direct sunlight and rainfall.

After choosing the desired location for mounting the CS-AQMS1, proceed with the installation process by following the step-by-step guide outlined below:

1. Install your CS-AQMS1 securely on a wall or pole (Figures 6 and 7) using either screws or zip ties.
2. Mount the sensor probe by employing the sensor mounting plate and securing it with two screws onto a wall or pole. Position the sensor probe vertically, ensuring it is not in close proximity to the CS-AQMS1. Placing it too close may result in the heat generated within the CS-AQMS1 affecting the accuracy of the probe readings. Subsequently, connect the sensor probe's cable to the CS-AQMS1, following the visual reference provided in Figure 5.

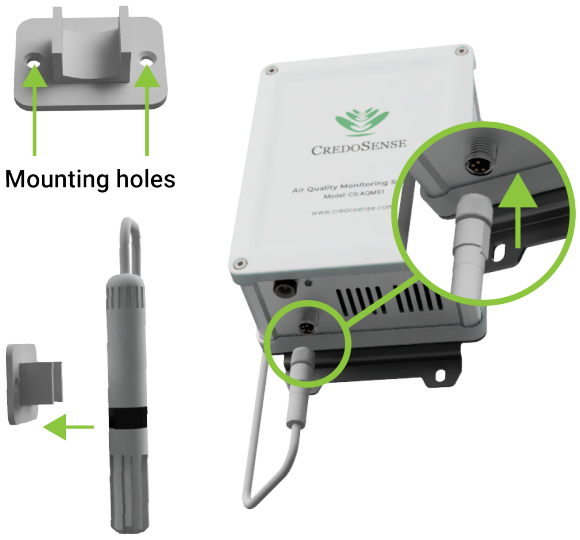

Figure 5: Connecting sensor probe to CS-AQMS1.

Figures 6 and 7 depict the CS-AQMS1 securely mounted on both a wall and a pole, showcasing the recommended installation configurations.

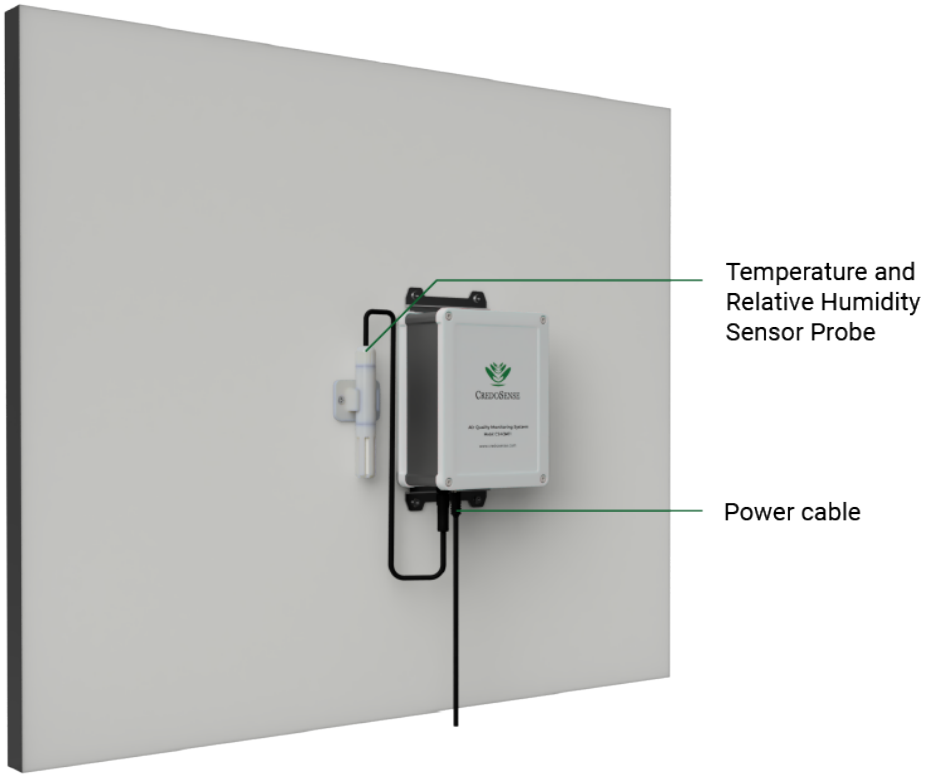

Figure 6: The CS-AQMS1 mounted on a wall.

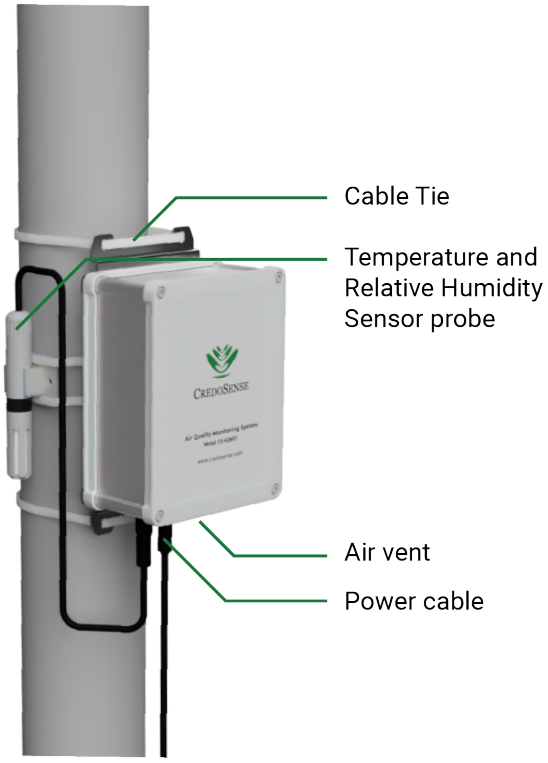

Figure 7: The CS-AQMS1 mounted on a pole.

5.2 Setting up cloud account

Access the CredoSense Cloud platform via data.credosense.cloud, triggering the appearance of a sign-in window (Figure 19). Click on “Create an account”, and a new window (Figure 9) will appear. Register using a valid email address, and upon clicking “Register”, you will be redirected to the following page, as depicted in Figure 10.

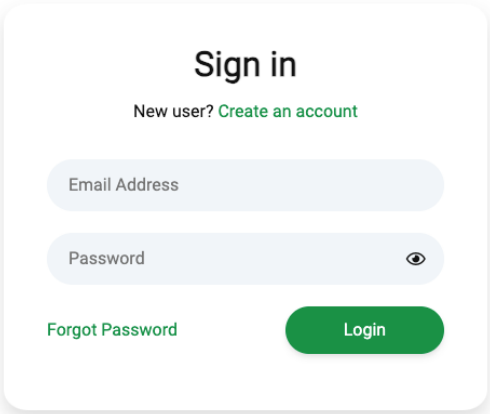

Figure 8: Signing in window.

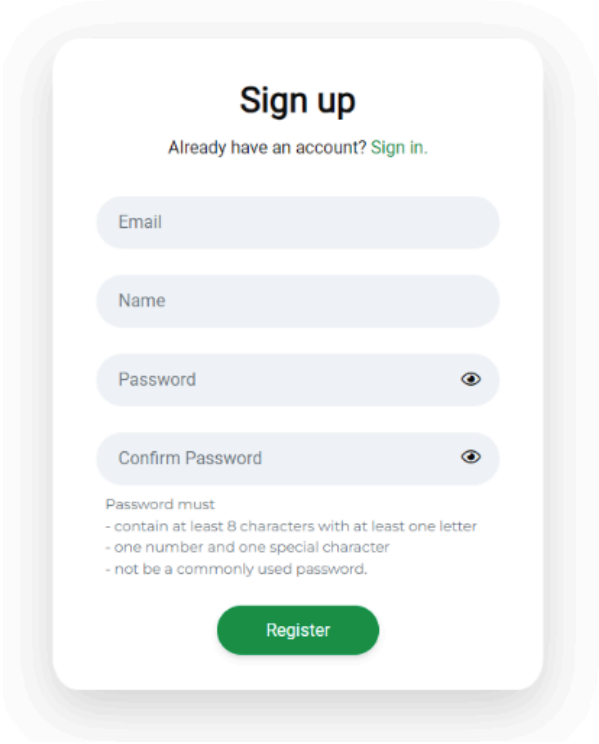

Figure 9: Signing up into cloud.

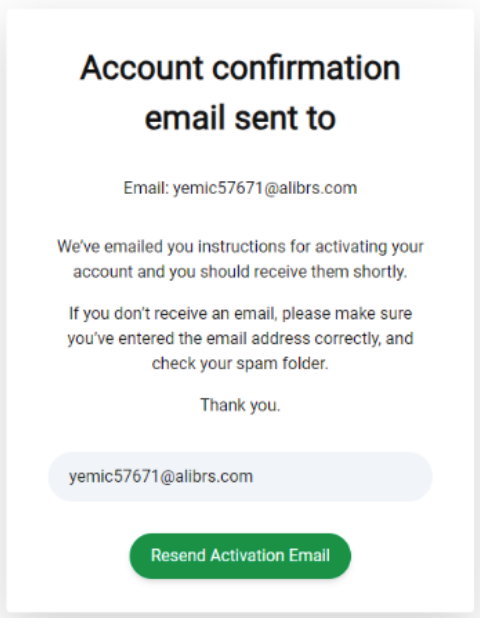

Figure 10: Account activation.

Access your email inbox and complete the email verification process by clicking on the "VERIFY YOUR EMAIL", button. This action will direct you to the Credosense Cloud platform, where you have the option to customize your profile to align with your preferences. Please be aware that the provided email address will serve as the designated identifier for the configuration of your CS-AQMS1 device.

5.3 Setting up CS-AQMS1

5.3.1 Connect computer or phone to the CS-AQMS1

Activate the device by powering it up. Once the LED begins flashing (Table 2), establish a connection with a computer or phone. Access the WiFi settings on your computer or phone and locate the device (CS-AQMS1 [My Device] as displayed in Figure 11). Connect your computer or phone to the device using the password[1] as indicated in Figure 3.

Upon successful connection, the CS-AQMS1 configuration panel will automatically launch in a browser window (Figure 12). If the window does not appear automatically, follow these steps:

- Open a browser.
- Enter 192.168.4.1 in the address bar and
- Press "Go".

[1]The password for all CS-AQMS1 is 'credosense'.

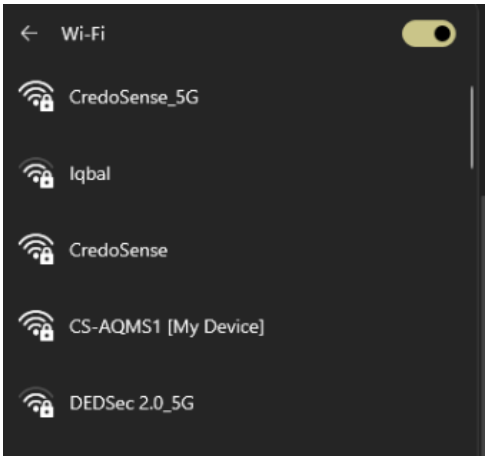

Figure 11: Connect computer or phone to the CS-AQMS1.

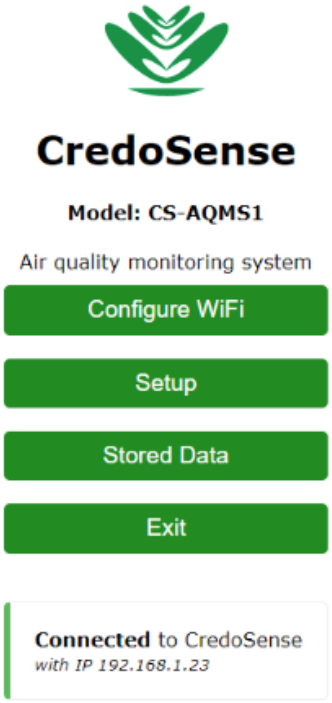

Figure 12: The CS-AQMS1 configuration panel.

Click on the “Configure WiFi”, button. Subsequently, a list of available WiFi networks (Figure 13) will be displayed on the following page. Choose the WiFi network that you intend to use for the CS-AQMS1 internet connection. Ensure that the selected WiFi network has active internet connectivity.

⚠ The WiFi network will only operate on a 2.4GHz frequency.

Figure 13: Choosing a WiFi network for the CS-AQMS1.

Click on “Save”, to establish a connection with the selected network. The following window (Figure 14) will then appear:

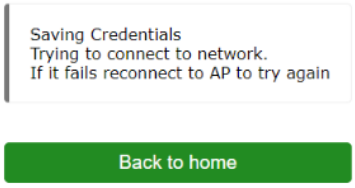

Figure 14: Saving credentials.

Click on “Back to home”, and the user will notice the device is connected to the WiFi network (Figure 15).

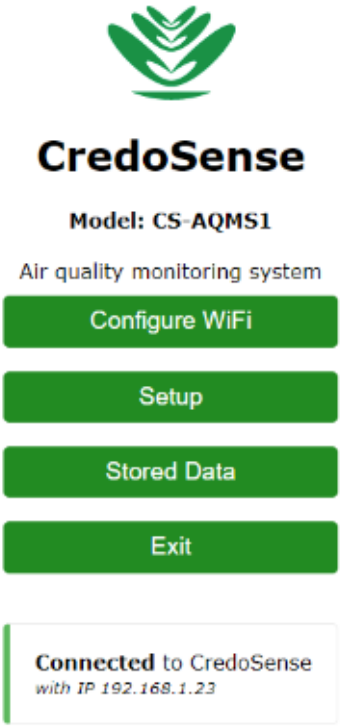

Figure 15: WiFi connected.

5.3.2 CS-AQMS1 Configuration

You can configure various settings for the device, such as the device name, user ID or email, timezone, logging interval, and running average for PM data (Figure 16), by clicking on Setup. Each of these configurations is briefly explained below:

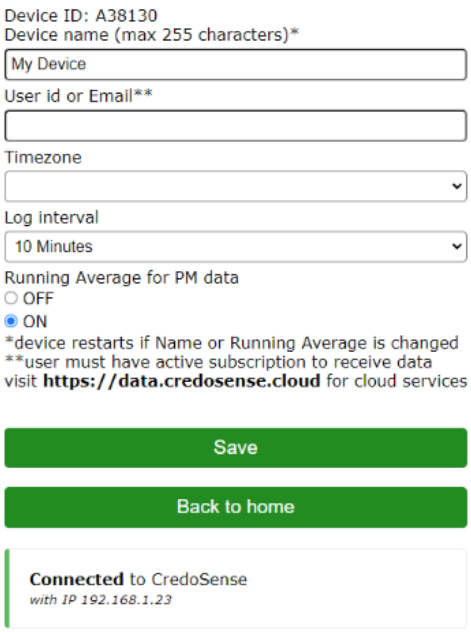

Figure 16: Configure the CS-AQMS1.

1. **Device name**: The designated name serves a dual purpose: it is employed in the cloud

and also appears as the WiFi name when connecting a phone or desktop to CS-AQMS1 for configuration. For instance, if set as "Adam's AQMS", the WiFi name will be displayed (Figure 17) as CS-AQMS1 [Adam's AQMS]. Please be aware that altering the name will prompt a device restart. Following this change, reconnect to the new WiFi to proceed with the setup process.

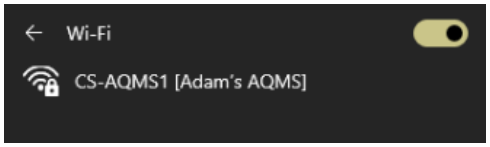

Figure 17: Showing device name.

2. **Timezone**: Select the suitable time zone. This setting is used to record time data within the microSD card.
3. **Log Interval**: This feature allows users to choose their preferred logging interval, ranging from 15 seconds to 1 hour. Figure 18 shows a list of available logging intervals.

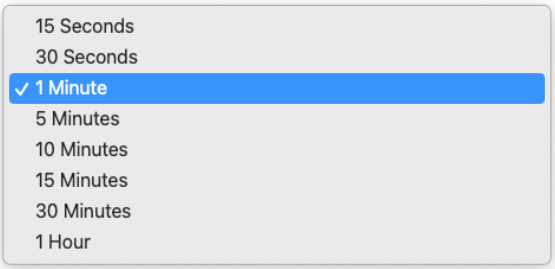

Figure 18: List of options for setting time intervals.

4. **Running Average for PM Data**: This configuration determines whether the device should use a running average.

   ON: The CS-AQMS1 collects PM data every second. Upon logging the data, it computes the average for the complete interval. For instance, if the user sets a logging interval of 1 minute, the CS-AQMS1 will take sixty readings, calculate the average by dividing the sum by 60, and log the average data.

   OFF: In this scenario, the CS-AQMS1 refrains from averaging the data throughout the entire interval. Instead, it calculates the average of the data from the last 5 seconds of the logging interval and records that specific value.

Click on "Save" to complete the setup. Press "Go to Home" and then "Exit" to exit configuration mode.

⚠ Configuration mode is available for a duration of 10 minutes after powering up. The WiFi network named CS-AQMS1 [—] will no longer be visible after this time period. To initiate re-configuration, power off the device and then turn it back on. This action will reinstate the CS-AQMS1 [—] WiFi network, enabling the device to be re-configured by connecting to this network.

6 Using the System

6.1 Sign-in to Cloud

Navigate to CredoSense Cloud Platform via data.credosense.cloud. The landing page will prompt you for sign-in credentials, as shown in Figure 19. Please enter the email and password used during the creation of your cloud account.

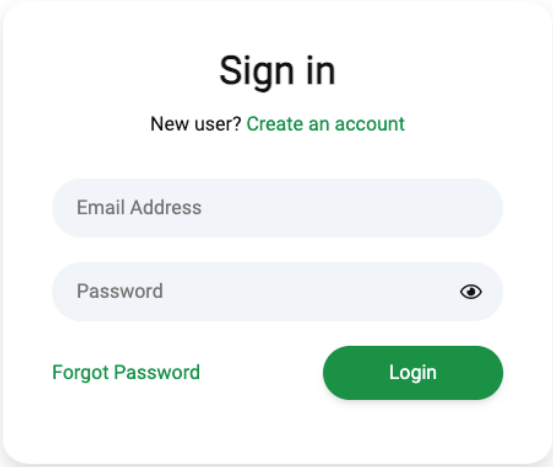

Figure 19: Signing in into cloud.

6.2 Dashboard Overview

After successfully signing in, you will be directed to the dashboard of the CredoSense Cloud Platform, as illustrated in Figure 20. The dashboard homepage displays a list of connected CS-AQMS1 devices. In Figure 20, a single connected device is visible, showcasing details such as device name, model number, device ID, and subscription information. Additionally, there is an option to extend or purchase a subscription by clicking on the “Buy Subscription” button. Detailed information about purchasing or extending a subscription is available in Section 6.2.5.

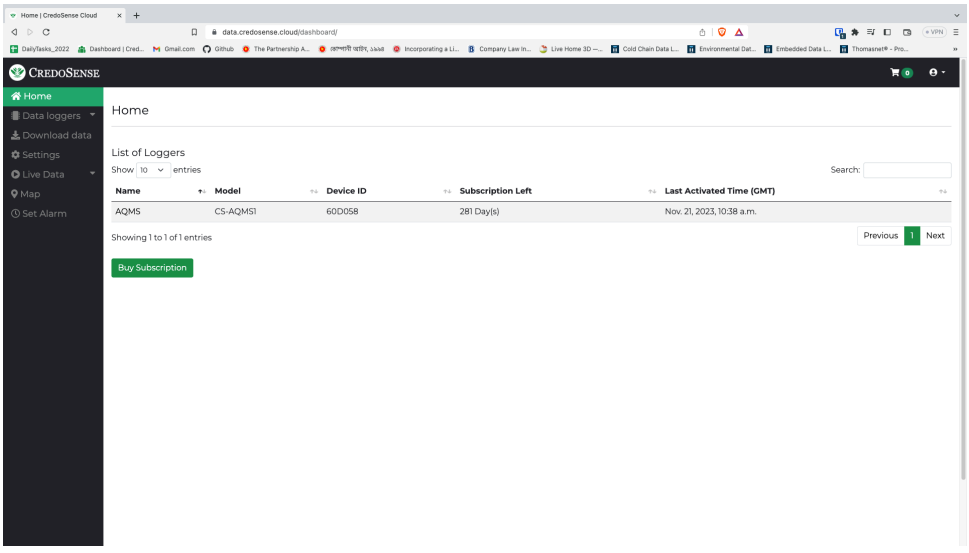

Figure 20: Cloud dashboard of AQMS1.

6.2.1 Data Summary

If you possess a list of connected CS-AQMS1 devices on the cloud platform and wish to view the summary of data for a specific CS-AQMS1, navigate to the “Data Logger” tab in the top left corner. Upon clicking, you will be presented with a list to choose from. Once you select your desired CS-AQMS1, a summary of data will be displayed on the screen, as depicted in Figure 21. The summary will show the minimum, maximum, and average values of the data stored in the cloud so far.

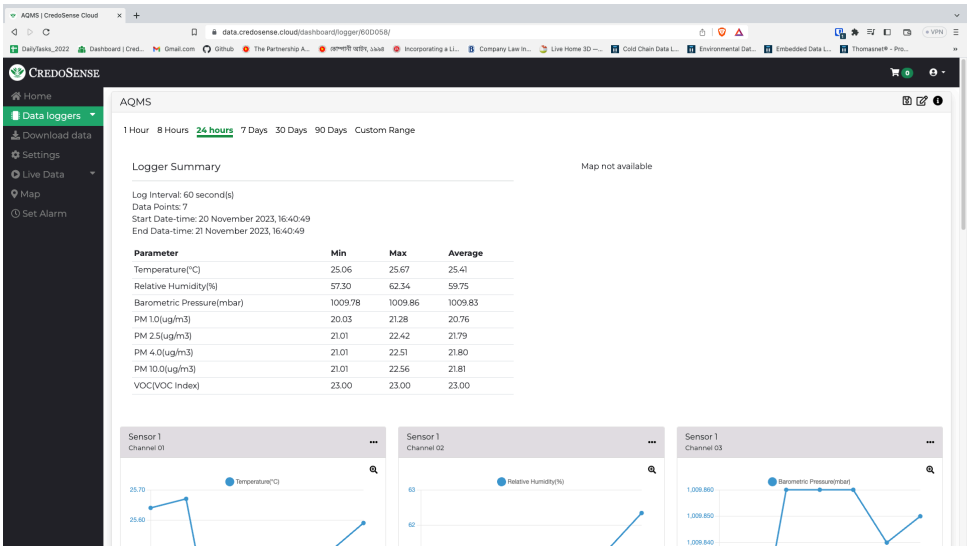

Figure 21: Summary of data.

Continue scrolling to find a graphical representation of your data, showcased in Figure 22.

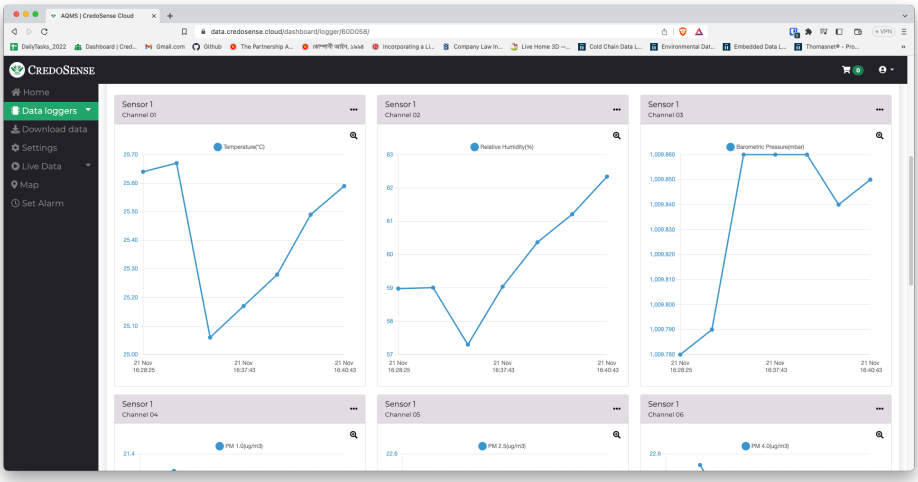

Figure 22: Graphical representation of data.

6.2.2 Live Monitoring

Live data monitoring is also accessible directly from the dashboard. Click on the “Live Data” tab, and from there, select your CS-AQMS1. You will then be able to observe live data, as depicted in Figure 23.

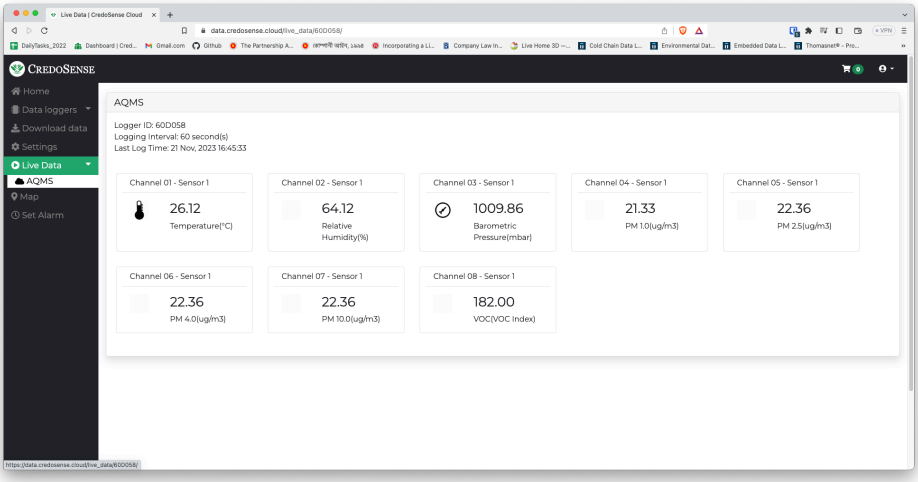

Figure 23: Live monitoring of the CS-AQMS1.

6.2.3 Editing Device and Finding Information

In Figure 24, three icons are presented, with the icon on the right featuring an "i" symbol designated for device information. Clicking on it will open a small window displaying device information, as illustrated in Figure 25. You will also receive the current firmware version you are using from here. The icon in the middle, featuring a pen and paper sign, is designated for editing the device. From here, you can modify your logger name, set logging intervals, delete the logger, and erase data.

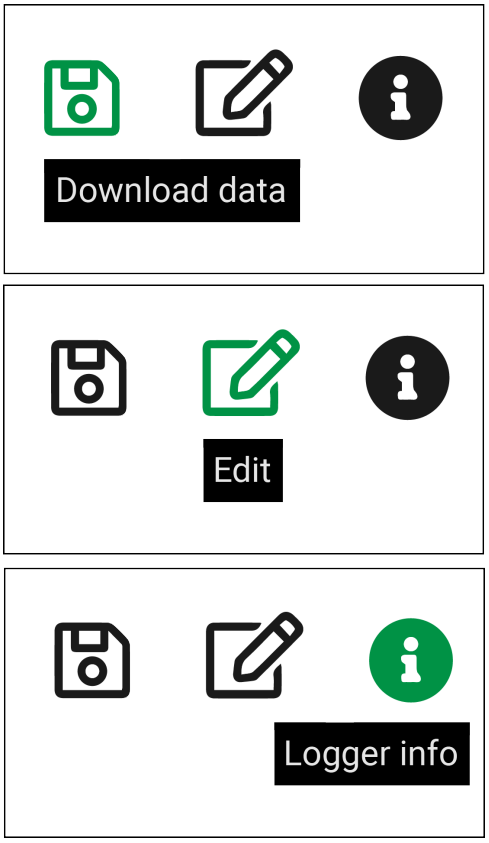

Figure 24: Menu for device information, edit device, and download data.

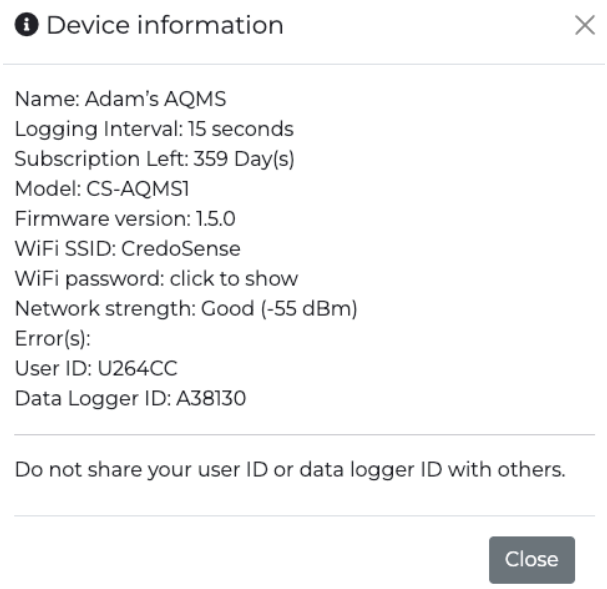

Figure 25: Device information.

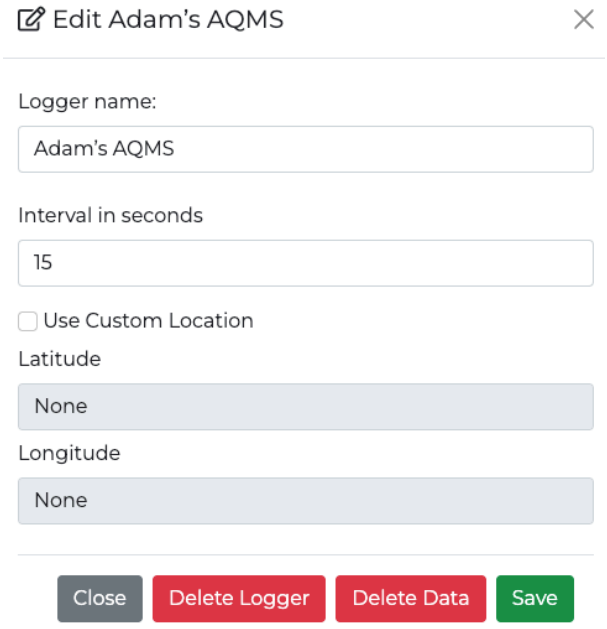

Figure 26: Edit your CS-AQMS1 device.

6.2.4 Download Data

A user can download data in four ways, as follows:

1. Click on the download icon shown in Figure 24. A new window will appear. Select the date and time, then proceed to download your data. Alternatively, choose to download data by selecting from a preset time duration listed at the bottom of Figure 27.

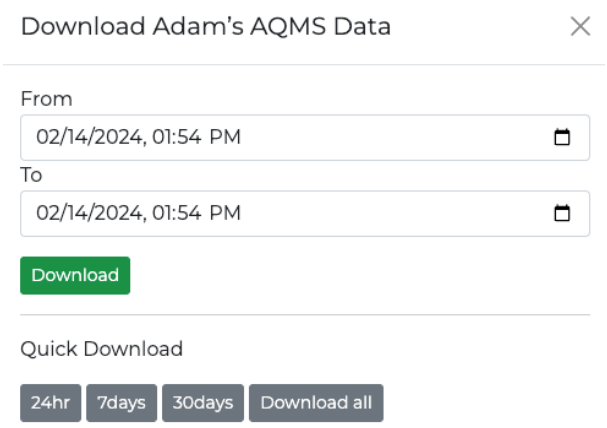

Figure 27: Download data from the top-right menu.

2. Click on the "Download Data" tab in the main menu located at the top-left corner of the dashboard. A new window will appear (Figure 28).

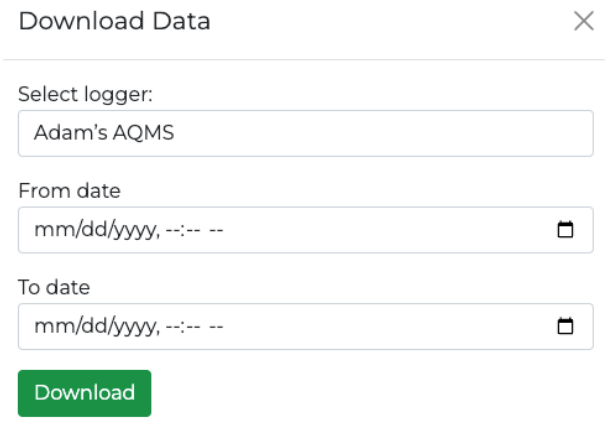

Figure 28: Download data from the menu (top-left).

3. Download data directly from the microSD card. At first, remove the microSD card from the device by gently pushing it. Figures 29 and 30 demonstrates how to remove your microSD card from the CS-AQMS1. After the removal from device, connect the microSD card to the computer, and within the "data" folder, locate your data in CSV file format. Each month's data is stored in a separate file.

Figure 29: Unscrew the device.

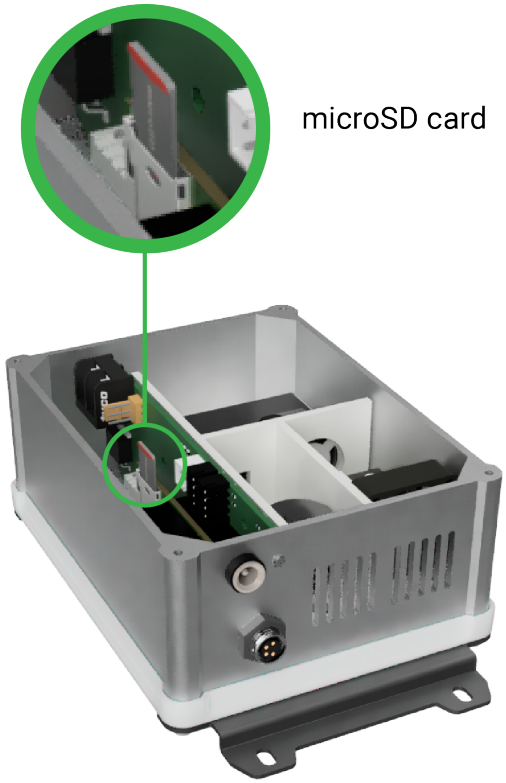

Figure 30: Remove microSD card.

4. You can download data from a microSD card without removing it from the device. To do this, please follow the following steps:

    a) Power off the device if it is currently powered on.
    b) Turn the power back on.
    c) From a computer or phone, search for available WiFi networks.
    d) Look for a network name that starts with CS-AQMS1 and connect to that network.

e) If prompted, enter “credosense” as the password.

f) The configuration page should automatically open (Figure 31). If not, open a browser and type 192.168.4.1 in the address bar.

g) Click on the ”Stored Data” button.

h) If a microSD card is present, the files on the microSD card will be displayed on the screen.

i) Download the files onto your computer or phone using the browser.

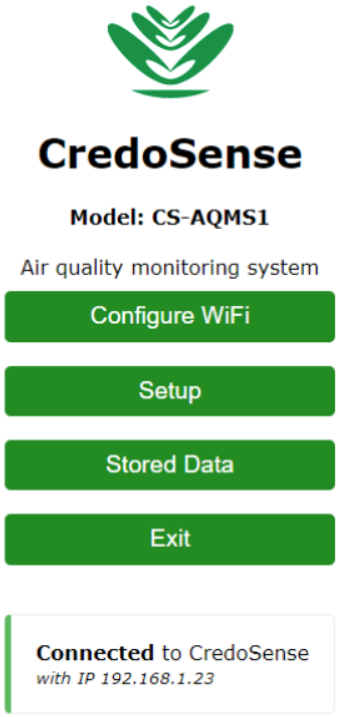

Figure 31: Download data from the configuration panel.

6.2.5 Buy/Extend Subscription

When a new device is purchased and connected to the cloud for the first time, the 7-day subscription is automatically enabled. To extend the subscription period or purchase a new subscription package, click on the “Buy Subscription” button, as shown in Figure 32. The process of purchasing or extending a subscription is outlined in Figures 33, 34, 35, and 36, providing step-by-step guidance for your convenience.

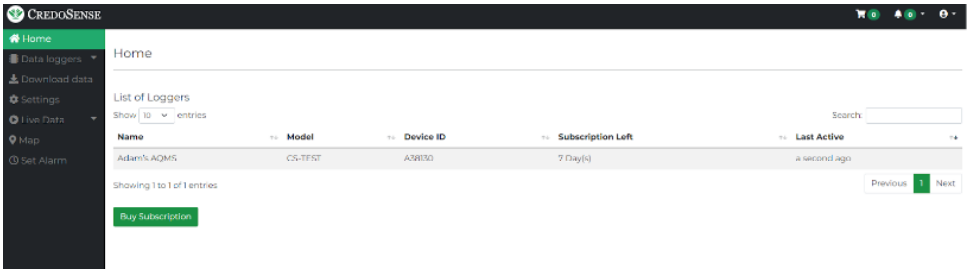

Figure 32: Purchase or extend cloud subscription.

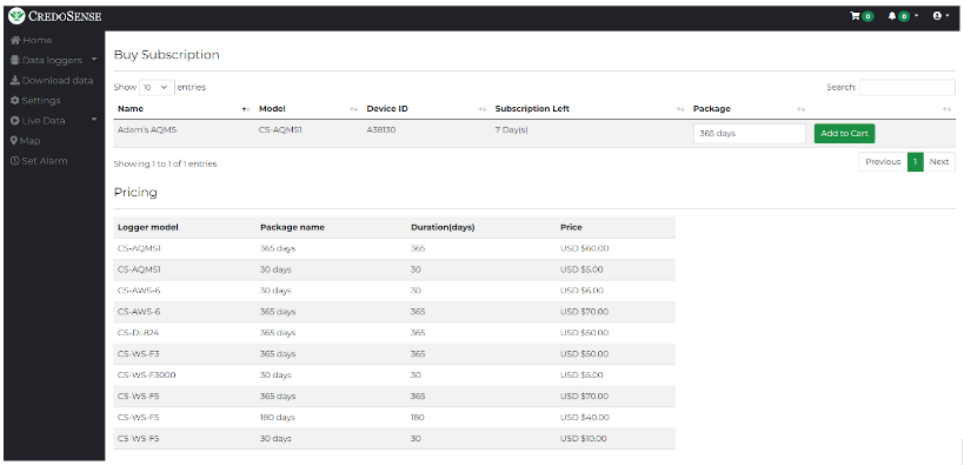

Figure 33: Add package to cart.

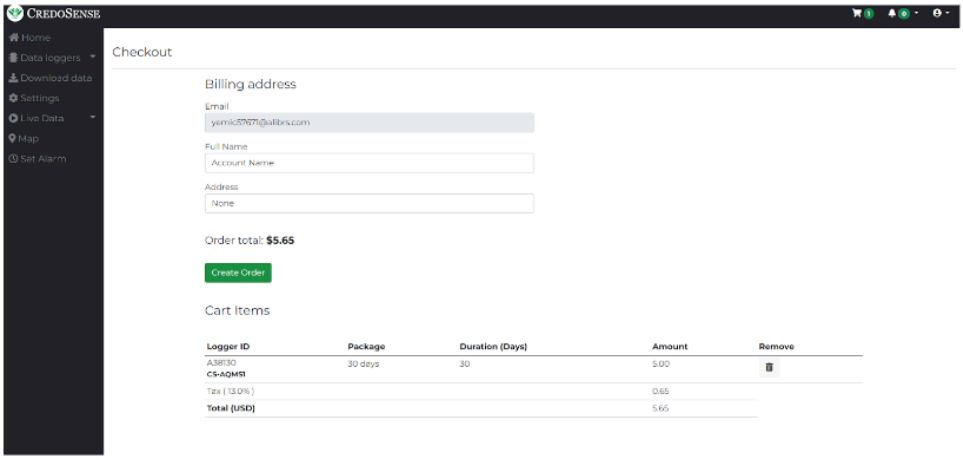

Figure 34: Provide billing information

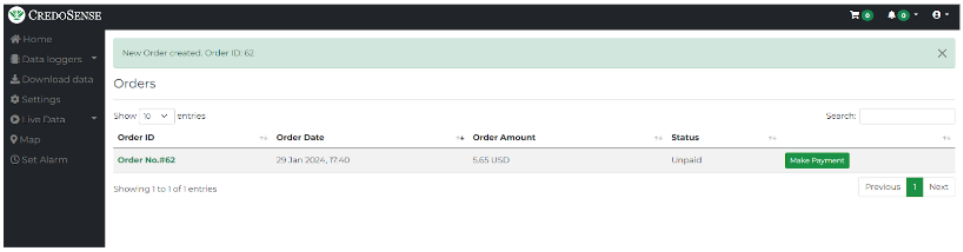

Figure 35: Create an order number.

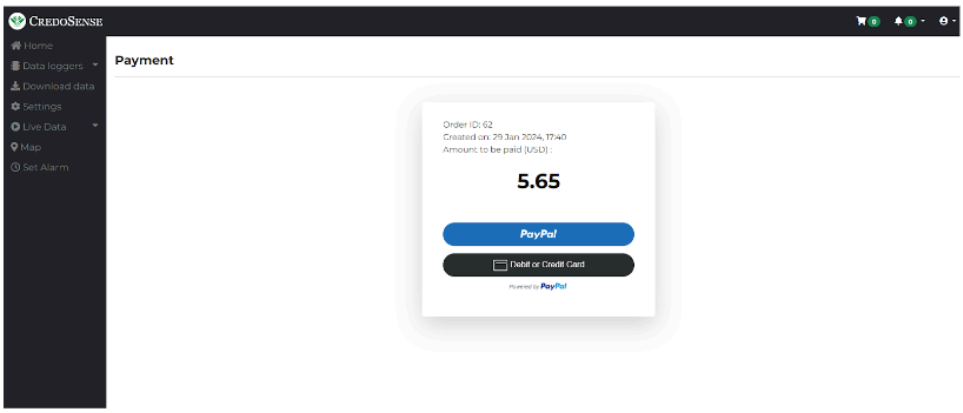

Figure 36: Choose payment method.

7 Safety Information

7.1 Precautions

1. Operating Environment
   Place the monitoring unit in a well-ventilated and dry environment. Avoid extreme temperatures, direct sunlight, and exposure to water.

2. Handling and Maintenance
   Handle the system with care to prevent damage to sensors and components.

3. Power Supply
   Use only the provided power adapter to avoid damage to the monitoring unit. Ensure the power outlet meets the specified voltage and current requirements.

4. Avoid Contaminants
   Do not touch the sensors directly. Keep the sensor ports clean from dust and other contaminants.

5. Optimal Placement
   Position the monitoring unit at a height representative of the air quality in the monitored space. Avoid placing the unit near obstacles that could obstruct airflow.

8 Frequently Asked Questions (FAQ)

This chapter compiles questions submitted by customers through email, direct communication, or our social media platform. We have made every effort to address all these questions, ensuring that customers can benefit from the information provided. It is important to note that we have listed these questions with slight modifications to enhance overall clarity and understanding for everyone.

Q1: We know that, currently, CredoSense supports sensors for CO, CO_2, O_3, CH_4, SO_2, NO_2, NO_x, H_2S, CH_2O, VOC, and TVOC gasses. In the CS-AQMS1 system, a user can integrate up to three customized gas sensors. If we wanted to measure all these gases at the same time, is there a way? We understand that we can put at least three different gases at the same time. Could you please confirm that?

Answer to Q1: Currently, our CS-AQMS1 is available in four versions, as outlined in Table 3. Each model comes equipped with four fundamental sensors: Particulate Matter (PM), Temperature, Relative Humidity (RH), and Barometric Pressure (BMP). Furthermore, you have the flexibility to choose any three gas sensors from the options provided in our product description.

Table 3: CS-AQMS1 available version.

#SL	Model	Connectivity	Sensors
1	CS-AQMS1-W	WiFi	PM; Temp., RH, & BMP
2	CS-AQMS1-WL	WiFi, 4G LTE	PM; Temp., RH, & BMP
3	CS-AQMS1-WG	WiFi	PM; Temp., RH, & BMP; Gas sensors
4	CS-AQMS1-WLG	WiFi, 4G LTE	PM; Temp., RH, & BMP; Gas sensors

Points to consider:

- The price will vary based on the chosen gas sensors
- Each system is designed to accommodate only three specific gas sensors, and this configuration is fixed (users can't swap gas sensors)
- To monitor all gases, one would need to acquire three separate CS-AQMS1 systems. Please let me know if further clarity is needed.

Q2: How is data from the different measurements expressed in the output? Is it point data (for example one value in ppm) or is there a possibility of having a variation in the data and obtaining a graph?

Answer to Q2: Each sensor provides measurements in its specific standard units; for instance, PM sensors report values in ug/m^3. Every recorded measurement comes with a timestamp based on the logging interval chosen by the user. Users can graph these measurements after downloading them. Alternatively, a graphing dashboard and a real-time data view dashboard are available if they utilize our cloud service. Thus, users have the freedom to decide how they would like to display their data. Some examples below (Figure 37 and Figure 38):

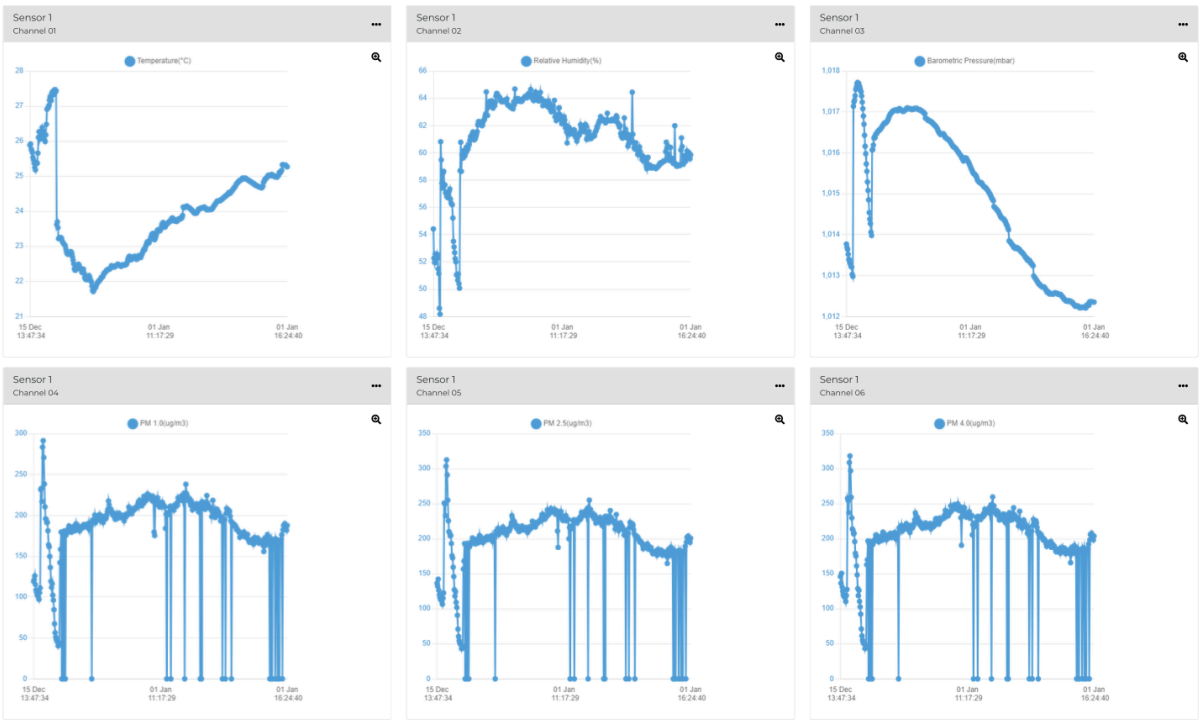

Figure 37: Graph View of the CS-AQMS1 Data

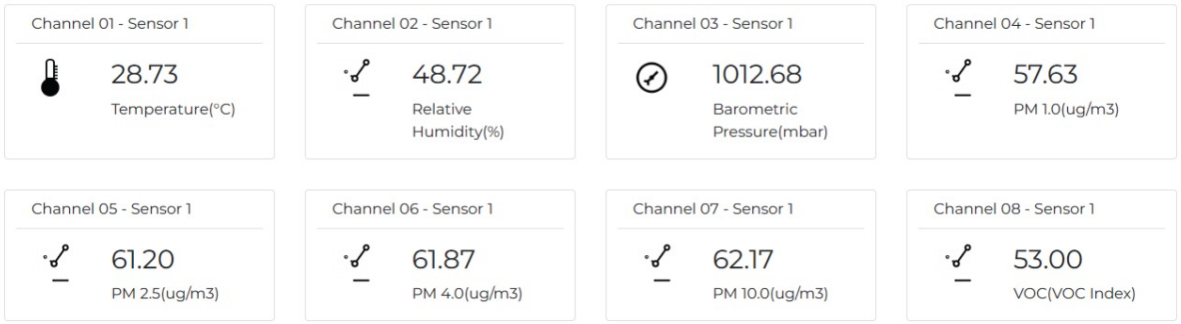

Figure 38: Point View of the AQMS1 Data

Q3: How does calibration work? And how often should we do it? Do we need to do it ourselves or do we need to return it to Bangladesh? Which material/instruments is required for the calibration process?

Answer to Q3: Our sensors come with factory calibration, ensuring high accuracy with minimal drift, typically very slight each year. Although they are designed for precision, it's prudent for users to monitor the readings to determine if recalibration is necessary periodically. We recommend undergoing this recalibration process **every two years** for optimal performance. Conveniently, you won't need to send your sensors abroad for re-calibration. As a Canadian company, we manage all calibrations right here in Toronto. It's worth noting that while our primary calibration and customer support is based in Canada, a significant portion of our research and development activities take place in Bangladesh.

Q3: [**Sensors in the winter**] What are the consequences on the device if the temperature

drops below -30 or -40°C (FYI Our freezers at the university generally can go to only -18°C. We could have access to freezers that go to -80°C for testing, but we don't want to destroy the sensors at the test stage). Does the device only shut down or something else happen? Is there a possibility of losing data? We receive a considerable amount of snow as well. Snow can insulate but it can also melt and create frozen pockets. We might expect more issues (snow melt/freeze/ice expansion) issues in the environments that we will be monitoring. What is your experience with this? In order for the sensors to take reliable measurements, should they be housed in some kind of shield system like the radiation sensors for example?

Answer to Q4: Our sensors can operate in extreme temperatures, like -20°C, and in very high relative humidity levels up to 99%. However, please be aware that the readings may not be entirely reliable in these conditions because the sensors aren't calibrated for such extremes. Rest assured, the system will retain data even in these situations.

Snow poses a unique challenge. If it blocks the air inlet pathways, it can affect the system's performance. We have equipped our CS-AQMS1 with a specially designed heater to combat this. Nevertheless, it's crucial to position the sensor in a location where snow accumulation isn't an issue. We advise placing the sensor within a protective housing for sites anticipating severe winter conditions. An example would be a 5mm thick white opaque plexiglass housing, as the attached image demonstrates (Figure 39). This cost-effective solution will ensure the sensor's optimal performance and longevity throughout winter.

Figure 39: A low-cost housing for winter protection