

Standard Operating Procedure for QuantAQ MODULAIR™ and QuantAQ MODULAIR™-PM Air Quality Sensors



**State of Alaska
Department of Environmental Conservation
Division of Air Quality
Air Monitoring & Quality Assurance Program**

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Table of Contents

List of Figures 3

List of Tables 3

Abbreviations, Terms, and Definitions 4

1. Introduction and Scope..... 6

2. Methods 6

2.1. Particulate Matter Sensors..... 6

2.2. Gaseous Sensors..... 6

2.3. Meteorological Parameters..... 7

3. Interferences 8

3.1. Optical Particle Counter 8

4. Data Technical Specifications..... 8

4.1. Measurement Procedure 8

4.2. Limit of Detection and Limit of Concentration..... 8

5. Nullification Codes for Erroneous Data 9

6. Data Transmission and Access 10

6.1. QuantAQ Web Interface 11

6.2. AirVision DAS..... 11

7. Set-Up and Installation 11

7.1. Device Registration 11

7.2. Collocation Prior to Installation 12

7.3. Siting Criteria for Installation 12

7.4. Installing MODULAIR™ (Pre-2025) Using AC Power..... 13

7.5. Installing MODULAIR™-X Using AC Power 15

7.6. Warm-Up Period and Stabilization 18

8. Maintenance..... 18

9. Documentation 18

10. Troubleshooting..... 19

10.1. AC Power 19

10.2. Individual Sensor Errors and Internal μ SD Card Faults 19



10.3. Connectivity Issues 20

11. References 21

Appendix A – Audits..... 22

Appendix B – Pole Mounting Kit Instructions 25

List of Figures

Figure 1: MODULAIR™ and MODULAIR™-PM Particulate Matter Sensor Function Flowchart. 7

Figure 2: The Internal Front-Panel of the MODULAIR™ Sensor 17

Figure 3: The Core Board and Micro USB Port Location on MODULAIR™-X Sensors..... 18

Figure 4. Example Audit Pod Siting 23

Figure 5. Example Audit Timeseries Graph 24

Figure 6. Example Audit Linear Regression Plot 24

Figure 7. Pole Mount Kit Installation for QuantAQ Mount Kit..... 26

Figure 8. Pole Mount Kit Installation for External Mount Kit 26

List of Tables

Table 1: Technical Specifications for MODULAIR™ and MODULAIR™-PM Parameters..... 8

Table 2: Measurement Error for MODULAIR™ 8

Table 3: Measurement Error for MODULAIR™-PM Particulate Matter 9

Table 4: MODULAIR™ and MODULAIR™-PM Data Code Descriptions 10

Table 5: MODULAIR™ LED Indicator Status and Meaning 20



Abbreviations, Terms, and Definitions

ADVP	Automatic data validation processors
AMQA	Air Monitoring and Quality Assurance Program of DEC. Responsible for coordinating all aspects (quality assurance, data collection, and data processing) with respect to ambient air quality and meteorological monitoring of the DEC Division of Air Quality.
API	Application programming interface
AQI	Air Quality Index. The AQI is an index for reporting daily air quality and what associated health concerns the public should be aware of. The AQI focuses on health effects that might happen within a few hours or days of breathing polluted air. The AQI rates the air quality in 6 steps from good to hazardous.
°C	Degrees Celsius
CO	Carbon monoxide
DAS	Data acquisition system
DEC	Alaska Department of Environmental Conservation. The department of state government with primary responsibility for management and oversight of provisions of the Clean Air Act, including EPA's National Ambient Air Quality Standards.
EPA	U.S. Environmental Protection Agency
GPS	Global positioning system
LED	Light-emitting diode
LOC	Limit of concentration
LOD	Limit of detection
mmHG	Millimeters of mercury
μSD	Micro SD card
μg/m³	Microgram per cubic meter
MODULAIR™	Ambient air quality sensor by QuantAQ that monitors particulate matter and gaseous pollutants, meteorology is optional
MODULAIR™-PM	Ambient air quality sensor by QuantAQ that monitors particulate matter, meteorology is optional
MODULAIR™-X	2025 generation of MODULAIR™ sensors, equipped with Wi-Fi connection capabilities
nm	nanometer
NO	Nitric oxide



NO₂	Nitrogen dioxide
OPC	Optical particle counter
O₃	Ozone
%	Percentage
+/-	Plus or minus
PM₁₀	Particulate matter less than or equal to 10 microns in size
PM_{2.5}	Particulate matter less than or equal to 2.5 microns in size
PM₁	Particulate matter less than or equal to 1 micron in size
ppb	parts per billion
QA	Quality Assurance
QAPP	Quality Assurance Project Plan. A plan which identifies data quality goals and identifies pollutant-specific data quality assessment criteria.
QC	Quality control
QuantAQ	Manufacturer of MODULAIR™ ambient air quality sensor
R²	Coefficient of determination (R-squared)
RH	Relative humidity
SO₂	Sulfur dioxide
SOP	Standard operating procedure



1. Introduction and Scope

This document shall establish standard operating procedures (SOP) for the QuantAQ MODULAIR™ and QuantAQ MODULAIR™-PM air quality sensor pods used in particulate matter and gaseous pollutant monitoring. Both of the MODULAIR™ sensor pod models are powered using AC connection; alternatively, a solar power system is available for purchase from the manufacturer. Data is collected and saved to an onboard μ SD card every five seconds. Each minute, these values are averaged and sent remotely to the QuantAQ web interface via cellular or Wi-Fi* transmission. The Alaska Department of Environmental Conservation (DEC) Air Monitoring and Quality Assurance (AMQA) Program is using MODULAIR™ sensor pods to collect baseline air quality data and assess pollutant trends throughout Alaska.

*All MODULAIR™-X models manufactured after January 2025 come equipped with cellular and Wi-Fi connection capabilities. MODULAIR™ pre-2025 models do not have Wi-Fi capabilities. All Wi-Fi-equipped models contain an "X" in their device ID (i.e., MOD-X-00000 versus MOD-00000). This document outlines operating and installation guidelines for both generations of devices.

For this document, pods will be referred to as MODULAIR™ or MODULAIR™-PM, without the "X" for Wi-Fi capability distinction. Please refer to the ID on each individual sensor to determine its connection capabilities.

2. Methods

2.1. Particulate Matter Sensors

The MODULAIR™ and MODULAIR™-PM sensors measure particulate matter (PM) concentrations in a range of sizes (PM_{1} , $PM_{2.5}$, and PM_{10}) using both a nephelometer and an optical particle counter (OPC). The OPC is used to count and size particles above 350 nm and the nephelometer is used to estimate the mass of particles below the detection threshold of the OPC (Hagan & Cross, 2024) (See Figure 1). The OPC counts and sizes particles individually as they pass through the instrument's laser beam; particulates are then assigned to a size bin depending on their particle diameter measurements. Assumptions about the physical and optical properties of each aerosol are made to convert from number concentration to mass. The nephelometer measures the concentration of suspended particles in the air; the scattered light signal is then converted to mass. The nephelometer is used to estimate the mass below the detection threshold of the OPC.

2.2. Gaseous Sensors

MODULAIR™ sensor pods are equipped with Alphasense sensors to measure four gas-phase pollutants: carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2), and ozone (O_3). Before shipment, each MODULAIR™ unit undergoes a laboratory-based calibration where sensors are placed in an environmental chamber and undergo a multi-point calibration using known concentrations of target gases (McClosky & Hagan, 2024).



2.3. Meteorological Parameters

All MODULAIR™ and MODULAIR™-PM sensor pods are configured to measure temperature (degrees Celsius) and relative humidity (% RH); these measurements are taken inside the flow cell and should not be interpreted as true ambient measurements. QuantAQ offers an additional meteorological sensor that can measure wind speed and wind direction.

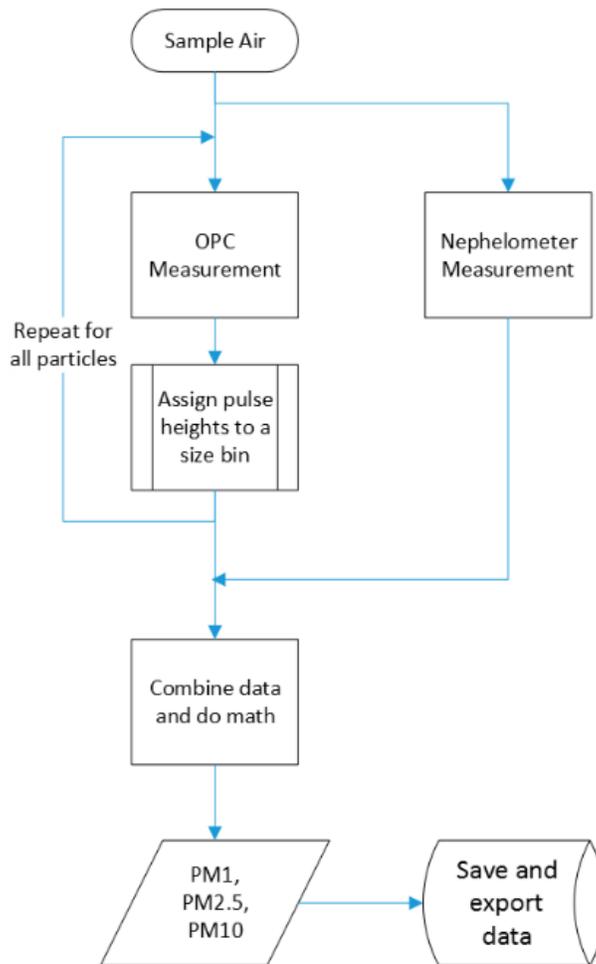


Figure 1: MODULAIR™ and MODULAIR™-PM Particulate Matter Sensor Function Flowchart.

Description of Figure 1: The PM sensors receive sample air through the air intake area. Air samples progress through OPC and nephelometer measurement. Within the OPC, each pulse height is assigned to a size bin. Data are combined from the OPC and nephelometer measurement results. Math calculations are applied, producing concentration outputs for PM₁, PM_{2.5}, and PM₁₀. Finally, concentration data are saved and exported.

Figure Source: Hagan & Cross, 2024



3. Interferences

3.1. Optical Particle Counter

Humidity can affect particulate matter measurements by increasing the size of an individual particle with water adhered to the surface. The MODULAIR™ and MODULAIR™-PM models do not utilize a heated inlet, and hygroscopic effects can interfere with the PM₁₀ sensor to cause inaccurate elevated readings. AMQA staff monitor this interference closely and set automatic flags on aberrant data in the post-collection AirVision data acquisition system (DAS) (see Table 3).

4. Data Technical Specifications

4.1. Measurement Procedure

The MODULAIR™ sensor models collect and report data every minute and data are compiled into 1-hour averages for review and analysis.

4.2. Limit of Detection and Limit of Concentration

Each sensor has its own range of precision, accuracy, and detectable concentrations (see Table).

Table 1: Technical Specifications for MODULAIR™ and MODULAIR™-PM Parameters

Parameter	MODULAIR™ Range	MODULAIR™ Accuracy	MODULAIR™-PM Range	MODULAIR™-PM Accuracy
Temperature	-40°C to 125°C	+/-2°C	-40°C to 85°C	+/-2°C
Relative Humidity	0 – 100%	+/-2% RH	0 – 100%	+/-2% RH
NO	0-5,000 ppb	5 ppb or 20%	N/A	N/A
NO ₂	0-5,000 ppb	6 ppb or 35%	N/A	N/A
CO	0-13,000 ppb	40 ppb or 20%	N/A	N/A
O ₃	0-500 ppb	5 ppb or 20%	N/A	N/A
PM ₁	0-2,000 µg/m ³	See Table 2	0-2,000 µg/m ³	See Table 3
PM _{2.5}	0-2,000 µg/m ³	See Table 2	0-2,000 µg/m ³	See Table 3
PM ₁₀	0-2,000 µg/m ³	See Table 2	0-2,000 µg/m ³	See Table 3

Source: MODULAIR™ Product Specification Sheet

Table 2: Measurement Error for MODULAIR™

Time Interval	MODULAIR™ - PM ₁	MODULAIR™ - PM _{2.5}	MODULAIR™ - PM ₁₀
5min	R ² =0.886 MAE = 2.0 µgm ⁻³	R ² =0.921 MAE _E = 1.7 µgm ⁻³	R ² =0.793 CV _{MAE} = 0.14



Time Interval	MODULAIR™ - PM ₁	MODULAIR™ - PM _{2.5}	MODULAIR™ - PM ₁₀
	RMSE=2.8µgm ⁻³	RMSE = 2.5µgm ⁻³	MAE = 1.3µgm ⁻³
1hr	R ² =0.898 MAE = 1.9 µgm ⁻³ RMSE=2.7µgm ⁻³	R ² =0.932 MAE = 1.6 µgm ⁻³ RMSE = 2.3µgm ⁻³	R ² =0.810 CV _{MAE} = 0.32 MAE = 7.6µgm ⁻³
24hr	R ² =0.947 MAE = 1.5 µgm ⁻³ RMSE=1.8µgm ⁻³	R ² =0.960 MAE = 2.3 µgm ⁻³ RMSE = 1.6µgm ⁻³	R ² =0.874 CV _{MAE} = 0.31 MAE = 7.6µgm ⁻³

Source: MODULAIR™ Product Specification Sheet

Table 3: Measurement Error for MODULAIR™-PM Particulate Matter

Time Interval	MODULAIR™-PM - PM ₁	MODULAIR™-PM - PM _{2.5}	MODULAIR™-PM - PM ₁₀
5min	R ² =0.875 CV _{MAE} = 0.30 MAE = 2.9µgm ⁻³	N/A	N/A
1hr	R ² =0.899 CV _{MAE} = 0.29 MAE = 2.8µgm ⁻³	R ² = 0.9.3 CV _{MAE} = 0.14 MAE = 1.3 µgm ⁻³	R ² = 0.810 CV _{MAE} = 0.32 MAE = 7.6 µgm ⁻³
24hr	R ² =0.919 CV _{MAE} = 0.26 MAE = 2.4µgm ⁻³	R ² = 0.967 CV _{MAE} = 0.12 MAE = 1.2 µgm ⁻³	R ² = 0.874 CV _{MAE} = 0.31 MAE = 7.6 µgm ⁻³

Source: MODULAIR™ Product Specification Sheet

5. Nullification Codes for Erroneous Data

To remove obvious outlying or erroneous data, the AirVision DAS automatically flags data points based on certain criteria conditions. The DAS interprets these codes as erroneous data points and either nullifies or flags data with a code label. AMQA staff also flag or invalidate data in various scenarios. Table 4 below lists the numerical codes, labels, and descriptions for various criteria that AMQA uses in the AirVision DAS.



Table 4: MODULAIR™ and MODULAIR™-PM Data Code Descriptions

Code/Flag	Label	Description	Notes
*	Potential fog, ice fog, smoke, dust	ADVP* rule that nullifies PM _{2.5} and PM ₁₀ hourly values greater than 1000 µg/m ³ .	Annotation manually added to data if cause of high values is known.
<	Logger invalid	Automatic DAS flag if <75% data capture.	-
>	Some Data Missing	Automatic DAS flag if >75% but <100% valid readings captured in a hour.	-
a	Audit	Flag for audit period. Flag is manually applied.	Annotation added to data for audit period dates and associated sensor serial numbers.
^	Collocation period	Collocation period. Flag is manually applied to data.	Annotation added to data for collocation period dates and associated sensor serial numbers.
AV	Power Failure	Invalid data for power outage. Null code is manually applied to data.	Annotation added to data.
AL	Voided by Operator	Invalid data if sensor is running indoors, during warmup period for testing, or for other various outages. Null code is manually applied to data.	Annotation added to data point to explain reason for voiding data.

*ADVP- Automatic data validation process (ADVP) is a process internal to the AirVision DAS.

6. Data Transmission and Access

Data can be accessed in three ways: downloaded from the internal µSD card, downloaded from the QuantAQ web interface, or through the QuantAQ application programming interface (API). Data is transmitted from the MODULAIR™ and MODULAIR™-PM sensor pods



to the QuantAQ web interface via cellular network or Wi-Fi network. MODULAIR™ and MODULAIR™-PM sensors are equipped with a global SIM card that is compatible with AT&T, T-Mobile, and Verizon networks. As of the date of this document, MODULAIR™ and MODULAIR™-PM sensors do not work with GCI or other local Alaska networks. MODULAIR™ and MODULAIR™-PM sensors manufactured after January 2025 are also equipped with Wi-Fi capabilities for data transmission.

6.1. QuantAQ Web Interface

Data can be accessed through the QuantAQ online interface: <https://www.quant-aq.com/>. The web interface gives the user near real-time access to data with the ability to view data graphically over a customizable timeframe. The user can export historical data for further analysis. The QuantAQ web interface also provides information on device health, firmware version, and maintenance items performed by the manufacturer.

6.2. AirVision DAS

Once sensor data is available on the QuantAQ web interface, AMQA uses an API to call minute data from the QuantAQ web interface and import into the AirVision DAS on an hourly basis. Once the minute data is polled in the DAS, the data is automatically rolled up into hourly averages and run through automatic data validation processors (ADVP) which perform preliminary data validation.

7. Set-Up and Installation

7.1. Device Registration

This must be completed upon receiving new sensors. The process can be completed without powering on the device.

Locate the **Registration Card** containing a QR code and a short confirmation code.

Scan the QR code

- Using an internet-connected phone, tablet, or computer, scan the QR code on your Registration Card. You will be directed to the registration page on the QuantAQ web interface. It is best to first log in to the QuantAQ web interface on the same device. If this is your first time logging in, you will need to create an account.

Fill out the device registration form

- Fill out the form presented on your screen.

Enter the claim code

- Enter the 6-digit code on the registration card.



- Once completed, press "Register". The device should now be visible in your QuantAQ web interface account. Make sure to name and organize the device appropriately within the web interface.

7.2. Collocation Prior to Installation

MODULAIR™ and MODULAIR™-PM sensors need to be collocated upon receipt from the manufacturer and prior to deployment. Please refer to DEC's Quality Assurance Project Plan (ADEC, 2024) for further information.

7.3. Siting Criteria for Installation

Proper installation of MODULAIR™ and MODULAIR™-PM sensors is critical for reliable data capture. The guidance below is based on standard air quality siting requirements.

- Away from point sources: The pod location should be representative of ambient air conditions and away from pollution sources or obstacles that could bias data higher or lower than actual ambient conditions. Examples of pollution sources include:
 - Exhaust fan openings
 - Heating vents
 - Smoking areas
 - Building boiler exhausts
 - Chimneys
 - Car idling zones
- At least 180° of unobstructed air flow: it can be on a flat wall but not mounted in a concave corner that would prevent airflow.
- Out of prolonged direct sunlight, avoid south-facing locations since direct sunlight and reflected/radiated heat can cause erroneous temperature data.
- If possible, the pod should be placed under an eave or overhanging roof to prevent water and snow from building up or going inside the pod.
- Sensor pod should be installed 10 – 40 ft above the ground.
- Sensor pod should be within 50 ft of a power outlet to minimize the need for extension cords.
- Location and height should minimize equipment vulnerability to tampering and vandalism.
- Sensor pod should be within range of a) a cellular network (data is transmitted via AT&T, Verizon, and T-Mobile 4G, 5G or LTE), or b) a reliable Wi-Fi connection for MODULAIR™ -X models.
- Reduce risk of damage from high winds as much as possible.



7.4. Installing MODULAIR™ (Pre-2025) Using AC Power

Unpack Box and Check Inventory List

- MODULAIR™ Air Quality Sensor
- Power supply and USB-C charging cable
- Mounting hardware (flanges with 4, 10-32 screws)
- 16 GB μSD card (pre-installed)
- Device registration card
- 6" black antenna with screw-on adapter

Accessories List

- Extension cord (if needed)
- Zip ties for cable management
- Phillips head screwdriver, snips, level
- Additional mounting equipment, if necessary (pole mount kit, tripod, etc.) and associated tools

Scout Location for Installing Pod

- See Section 7.3 for siting criteria.
- Double check length of extension cable and cord on MODULAIR™ pod.
- If using hose clamps to secure pod, do a test of the hose clamps at the install location by securing one of the clamps around the pole. Ensure there is enough room to accommodate the pod.

Initiate Pod

Note: do this work in an area where you can lay the pod down easily and work with small screws, i.e. inside an office building, or on a clean outdoor workstation.

- Remove pod from box.
- Plug in MODULAIR™ power cord to MODULAIR™ port on bottom of pod. Plug power cord into power block. Connect to an extension cord if necessary.
- Plug in the extension cable, if necessary. The pod now has power but is not yet turned on.
- Lay pod 'face down' with front on table.
- Connect flanges and/or pole mounting kit.
- Secure the antenna to side of the MODULAIR™ pod by screwing the antenna onto the mounting point. The antenna is very fragile; be mindful to hold firmly onto the



rotating cuff at the base of the antenna during installation and rotate the antennae gently by hand.

- Open the front panel and turn on the pod by moving the on/off switch to ON position (Figure 2).
- As you do this, watch the LED light sequence and refer to Table 5.
- The LED light will blink green during start-up as it attempts to connect to a cellular network.
- Observe the LED sequence to determine that a connection to the server has been achieved.
- LED sequence you should see:
 1. Blinking green, power-up, connecting to network.
 2. Breathing green, connected to network, but not connected to the cloud.
 3. Blinking cyan, connecting to the cloud.
 4. Breathing cyan, successfully connected to the internet and cloud, all is good. (See Table 5 for a complete list of device status lights).
- Upon successful connection (breathing cyan), you can move forward.
- Close the front panel and ensure it is properly latched.

Install Pod

- Mounting sensor on a flat wall, use flanges:
 1. Ensure flanges are securely attached to pod
 2. Hold pod up to wall and mark points of attachment
 3. Ensure pod is level.
 4. Fix flanges to wall. Test that the pod is secure by gently pulling on pod. There should be no 'wiggle room' between wall, flanges, and pod.
 5. Ensure cords are properly managed (use Zip Ties and/or wall staples to secure loose cordage). Utilize electrical drip loops as needed.
- Mounting sensor to small pole, use U-bolts.
- Mounting sensor to big pole, use pole mounting kit:
 1. Follow the instructions included in the pole mounting kit (Figure 8, Appendix B).
 2. Check which size of hose clamps best fit your pole. Ensure the hose clamps are big enough to fit through the pole mounting bracket and around the pole.



7.5. Installing MODULAIR™-X Using AC Power

Unpack Box and Check Inventory List

- MODULAIR™ Air Quality Sensor
- 12V, 2A USB-C Power Brick
- USB-C to M12 Power Cable
- Device Registration Card
- MODULAIR™ Pole Mount Kit

Accessories List

- Extension cord (if needed)
- USB-A to Micro USB cable (if connecting sensor to Wi-Fi)
- Portable laptop with USB-A port and connection to internet (if connecting sensor to Wi-Fi)
- Zip ties for cable management
- Phillips head screwdriver, snips, level
- Additional mounting equipment, if necessary (pole mount kit, tripod, etc.) and associated tools.

Scout Location for Installing Pod

- See Section 7.3 for siting criteria
- Double-check length of extension cable and cord
- If using hose clamps to secure pod, do a test of the hose clamps at the install location by securing one of the clamps around the pole. Ensure there is enough room to accommodate the pod.

Initiate Pod

Complete the following steps prior to mounting sensors on wall or pole to ensure adequate cellular/Wi-Fi connection.

If using **CELLULAR CONNECTION**:

- Plug in the M12 to USB-C power cable.
- Open the front panel and turn on the pod by moving the on/off switch to ON position (Figure 2).
- As you do this, watch the LED light sequence and refer to Table 5.
- The LED light will blink green during start-up as it attempts to connect to a cellular network.



- Observe the LED sequence to determine that a connection to the server has been achieved.
- LED sequence you should see:
 1. Blinking green, power-up, connecting to network.
 2. Breathing green, connected to network, but not connected to the cloud.
 3. Blinking cyan, connecting to the cloud.
 4. Breathing cyan, successfully connected to the internet and cloud, all is good. (See Table 5 for a complete list of device status lights).
- Upon successful connection (breathing cyan), you can move forward.
- Close the front panel and ensure it is properly latched.

If using **Wi-Fi CONNECTION:**

*Please note that configuring Wi-Fi is **not** required for operation. All MODULAIR™ devices have cellular modems, and Wi-Fi is a fallback in the event you are operating in an area that does not have a reliable cellular connection (post-2025 models only).*

- Verify the device supports Wi-Fi: Check the device serial number. If it begins with "MOD-X" (e.g., MOD-X-00001 or MOD-X-PM-00001), you are good to go.
- Open the Wi-Fi configuration tool: <https://app.quant-aq.com/wifi-setup> *This tool can only be used in Chrome, Edge, or Opera browsers on Windows, Linux, Mac, or Chromebook. **It cannot be used on phones or tablets and cannot be used with Safari or Firefox.***
- Connect the sensor to a computer using a USB-A to Micro USB cable. To access the Micro USB port, you must access the Core Board located behind the front panel. Unscrew the front panel screw located above the µSD card port and swing the door open (Figure 2). Locate the port and plug the cable in (Figure 3).
- Power up the sensor and wait for the status LED to begin blinking.
- On the Wi-Fi configuration tool, click the "Select Device" button and grant your browser USB permissions if needed. Select your device from the popup window - it should look something like "M-SoM - Paired".
- Once the page has loaded available Wi-Fi networks, select the network you would like to configure, enter its password if present, and click "Configure".
- Once you receive a success message, your device will store the credentials and connect to the network. You may have to scroll down the page to see the success message.
- The device will store up to 10 network credentials before overwriting them.



- Once connected to the Wi-Fi network, remove the USB cable from the Micro USB port and close the front panel. Be mindful that the front panel door does not hit and accidentally eject the μ SD card.

Install Pod

- Mounting sensor on a flat wall, use flanges:
 1. Ensure flanges are securely attached to pod
 2. Hold pod up to wall and mark points to secure.
 3. Ensure pod is level.
 4. Fix flanges to wall. Test that the pod is secure by gently pulling on pod. There should be no 'wobble room' between wall, flanges, and pod.
 5. Ensure cords are properly managed (use Zip Ties and/or wall staples to secure loose cordage). Utilize electrical drip loops as needed.
- Mounting sensor to small pole, use U-bolts.
- Mounting sensor to big pole, use pole mounting kit:
 1. Follow the instructions included in the pole mounting kit (Figure 7, Appendix B).
 2. Check which size of hose clamps best fit your pole. Ensure the hose clamps are big enough to fit through the pole mounting bracket and around the pole.

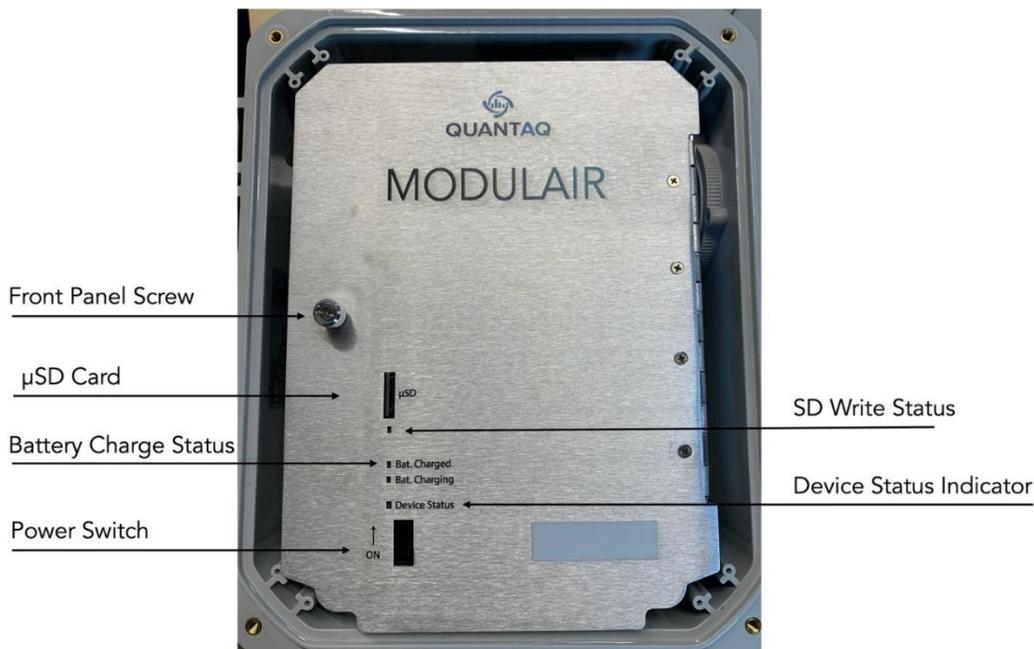


Figure 2: The Internal Front-Panel of the MODULAIR™ Sensor

Source: QuantAQ Modulair™ Hardware.



Figure 3: The Core Board and Micro USB Port Location on MODULAIR™-X Sensors

7.6. Warm-Up Period and Stabilization

MODULAIR™ and MODULAIR™-PM sensors can take up to an hour to warm-up after being powered on. Gaseous parameters may not operate immediately. Keep an eye on the data stream and make sure to nullify and annotate data until all parameters are sampling (see Table 3).

8. Maintenance

If an internal sensor fails, the QuantAQ web interface will display an alert for the failure. Upon failure, the sensor should be power cycled in place. If the power cycle does not resolve the failure, the pod should undergo further troubleshooting by AMQA staff. Community partners may also assist in troubleshooting, removing, or replacing failing sensor pods at the discretion of AMQA staff. AMQA staff may reach out to QuantAQ through the QuantAQ web interface for additional troubleshooting assistance. In certain instances, the sensor may need to be shipped back to the manufacturer for repairs.

The manufacturer recommends against using canned air to clean out the pm sensors. Instead, use a damp cloth to clean the sampling inlet and screen on the base of the sensor. A vacuum can be used to vacuum out the inlet but not blow into the inlet as this could damage the optics.

9. Documentation

All communications and actions should be thoroughly documented in AMQA's Salesforce software. Actions to document include:

- Device power failures,



- Power and/or network outages,
- Sensor/parameter failures,
- SD card/port issues,
- SD card replacements,
- Phone calls and emails with community contacts,
- Correspondences with QuantAQ support staff,
- Actions taken on sensor (power cycles, accessory replacement, etc.),
- Sensor updates (i.e. gaseous model updates, etc.)
- Sensor replacements, and
- Sensor relocations.

10. Troubleshooting

10.1. AC Power

When using an AC power supply, if the MODULAIR™ and MODULAIR™-PM pod does not seem to be working, ensure all power sources are functional and all connections to the AC power supply are secure and operational (ie: not rusted or damaged). Ensure the power switch is in the ON position. After checking all connections, conduct a power cycle of the pod and observe the device status light under the front panel. Refer to Table 5 for LED light codes used for diagnosing device issues.

10.2. Individual Sensor Errors and Internal μ SD Card Faults

Devices should be monitored and checked daily on the QuantAQ web interface fleet health panel, as well as on each individual device's data viewing page. Daily checks in the Device Health window are important for identifying internal μ SD and individual sensor issues.

- Particulate and gaseous sensor errors: One or more individual sensors may be malfunctioning. First, try power cycling the unit. If there is no change in sensor status, the entire unit may need to be sent to QuantAQ for service; consult with manufacturer.
- Internal μ SD card errors: This means that data may not be getting stored locally on the device's μ SD card but data is still getting transmitted to the QuantAQ web interface and DEC's DAS. Troubleshooting this issue includes checking that the μ SD card is properly seated in its slot (sometimes can get bumped out by the front door panel). If the μ SD card is properly seated and has been removed and replaced with no status change, try replacing the μ SD card altogether. If there is still no change, there may be an issue with the μ SD port, in which case the entire unit will need sent to QuantAQ for servicing.



10.3. Connectivity Issues

If the MODULAIR™ has power but is not transmitting data, open the front panel and observe the LED device status light. Refer to Table 5 for LED light codes used for diagnosing device issues.

Table 5: MODULAIR™ LED Indicator Status and Meaning

LED Color	Pattern	Mode	Description
Green	Blinking	Looking for internet	If your device is blinking green, it is trying to connect to the cellular network. There is no need to take any action.
Green	Breathing	Cloud not connected	If your device is breathing green, it has a cellular connection but has not been able to connect to the cloud.
Cyan	Blinking	Connecting to the cloud	Blinking cyan indicates the device has a cellular connection and is attempting to connect to the cloud. There is no need to take any action. This will happen each time on device startup.
Cyan	Breathing	Connected	When your device is breathing cyan, everything is good and you are connected to the internet and the QuantAQ Cloud.
Magenta	Blinking	Firmware Update	When your device is blinking magenta, it is undergoing an over-the-air firmware update. DO NOT power off when this is happening.
White	Breathing	Internet Off	If the LED is breathing white, the cellular connection has been turned off. If you did not explicitly turn off the cellular connection via the on-board switch, please notify QuantAQ.
Red	Blinking	System Failure	A system failure has occurred. This is likely caused by faulty on-board



LED Color	Pattern	Mode	Description
			firmware or corrupted memory. Please contact QuantAQ for next steps.

Source: QuantAQ Modulair™ Hardware

11. References

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Appendix A – Audits

Sensor Audits

To ensure the accuracy of the sensor network, DEC staff will conduct sensor audits as time and resources allow, with the goal of every pod being audited at least once in its lifetime. Audit pods should be collocated with FRM/FEM monitors prior to being deployed for an audit to ensure instrument agreement. Audit pods should also be compared to the permanent pod(s) at its home regulatory site for inter-pod comparison. The following criteria should be followed when conducting a sensor audit:

- Audit period should be a minimum of 7 days,
- The audit pod should be installed as close as possible while still allowing adequate airflow to the local pod (see example images for example proper placements),
- The installation is temporary and therefore should be minimally invasive and not create new holes/damage, etc. in the host building. Various installation methods include hose clamps, struts, and a temporary tripod (tripods must be secured at base to avoid tipping).

Data Analysis

When processing data, the first 24 hours after audit pod installation shall be excluded to give the audit pod time to stabilize in its new environment.

After the audit period is complete, data from both the audit and local pods will be compared using timeseries plots and linear regression. Descriptive statistics as outlined in the DQOs (ADEC, 2024) will inform pod agreement.



Figure 4. Example Audit Pod Siting

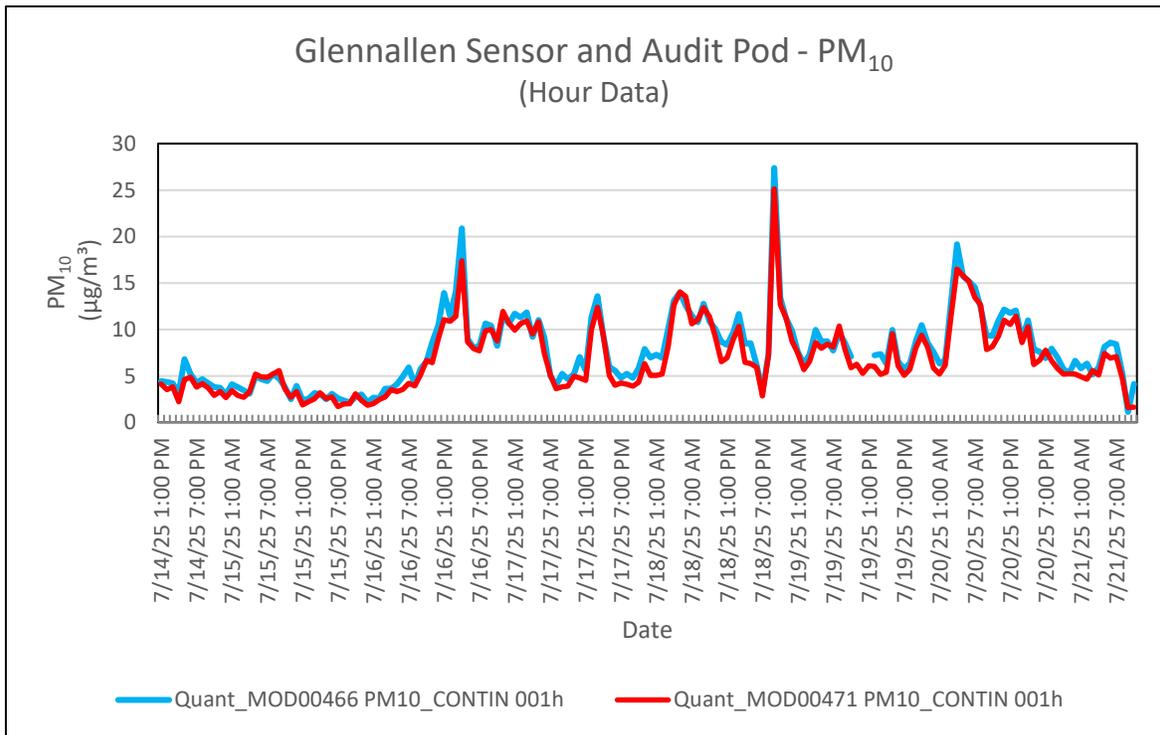




Figure 5. Example Audit Timeseries Graph

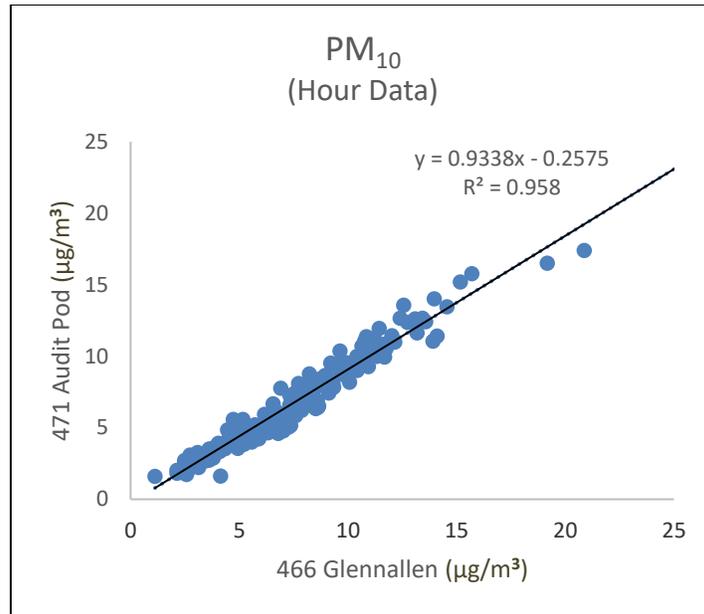


Figure 6. Example Audit Linear Regression Plot



Appendix B – Pole Mounting Kit Instructions

- For MODULAIR™-X sensors with the included Pole Mount Kit (Figure 7):
 - *The Pole Mount Kit comes with everything needed to install the Modulair™ to a pole or post with diameters between 1.25" and 2". It is designed to support poles or posts with diameters as large as 6" using hose clamps or straps (not included in kit).*
- 1. Attach the bracket to a pole (diameter between 1.25 and 2 inches) using the four 2.5" 1/4"-20 carriage bolts, four clamps, and four 1/4"-20 locknuts.
- 2. Attach the Modulair™ sensor to the bracket by partially setting the four 10-32 mounting screws into the back of the sensor, sliding the screws through the keyhole opening, and then securing the screws. Make sure all screws and clamps are secure with minimal room for movement.
- For MODULAIR™-(X) sensors with the External Pole Mount Kit (Figure 8):
 - *The External Pole Mount Kit comes with hardware needed to install the Modulair™ to a pole or post. Ensure that you have hose clamps with diameters at least 2" longer than diameter of the pole you intend to mount the sensor on.*
- 3. Attach the metal brackets to the back of the sensor. Use washers large enough to span the cap in the bracket. Tighten metal squares against metal brackets, with grooves aligned with tracks on the brackets.
- 4. Thread the hose clamps behind the metal squares and mount the sensor against the pole. Tighten and lock hose clamps. Make sure all screws and clamps are secure with minimal room for movement.

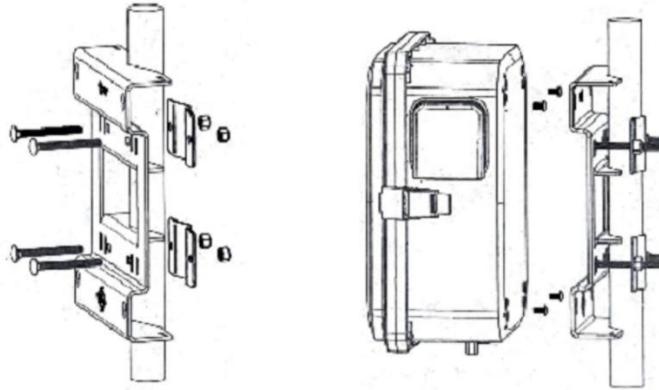


Figure 7. Pole Mount Kit Installation for QuantAQ Mount Kit.

Source: QuantAQ Modulair™ Hardware

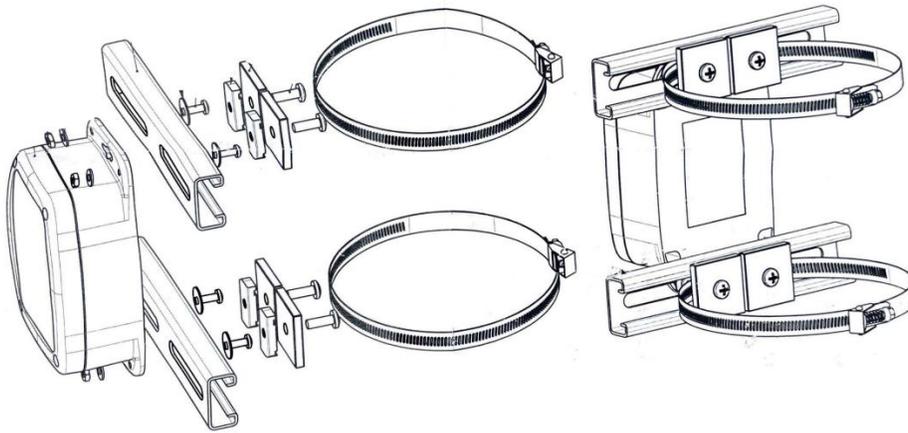


Figure 8. Pole Mount Kit Installation for External Mount Kit

Source: QuantAQ Modulair™ Hardware

12.