Airnet® Particle Sensors
301, 501, 501A, 510, 510XR, and Airnet OPC Models

Operations Manual

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Quality Statement

The Quality Policy of Particle Measuring Systems is to strive to meet or exceed the needs and expectations of our customers and to align the activities of all employees with the common focus of customer satisfaction through continuous improvement in the quality of our products and services.

Environmental Information

This equipment must be properly disposed of at end-of-life by means of an authorized waste management system. Information regarding dismantling of the equipment and location of any hazardous materials can be located on our web site at: http://www.pmeasuring.com/support/papers/disassemblyinstructions.

Class I Laser Product

The Airnet particle sensors are Class 1 laser products. This label is located under the detector board.

WARNING

This instrument is a Class I laser product.[a] Use of controls, adjustments, or performance of procedures other than those specified here may result in hazardous radiation exposure.

a. National Center for Device and Radiological Health (formerly BRH).

Airnet 510XR and 510XR OPC

The variant optical components of the Airnet 510XR and 510XR OPC particle sensors are coated with a special Teflon® lining that allows them to withstand environments that standard particle sensors cannot.

These environments are non-condensing and potentially corrosive or oxidizing to other standard model Airnet particle sensors. Tests performed at the Boulder factory allow Particle Measuring Systems to define environments where you can use the Airnet 510XR and 510XR OPC particle sensors.

CAUTION

When using the Airnet 510XR and 510XR OPC particle sensors, it is important to verify with Particle Measuring Systems that the unit can be used safely under specific site conditions. Failure to verify this shall automatically void the warranty.

Physical Description

Top

The following two LEDs are located on the top of each Airnet particle sensor chassis:

- Status LED – Indicates the operational status of the instrument.

  When connected to Facility Net software, the LED is controlled by Facility Net's alarm settings. When disconnected from Facility Net, you can set the unit to run the status LED two distinct ways.

  ➢ Set the status LED to flash green when disconnected.

➢ Set the status LED to represent the internal state of the flow and laser status indication. The LED will normally remain green, except for a low flow or laser status error. The failure state depends upon how the particle sensor is configured in Facility Net. You can set the LED to appear green, flashing, or dimmed.

When used with OPC, the status LED is always controlled internally by the Airnet hardware. The LED normally remains green, except for a low flow or laser status where the LED turns red.

- Activity LED – The Activity LED flashes when a particle is detected.

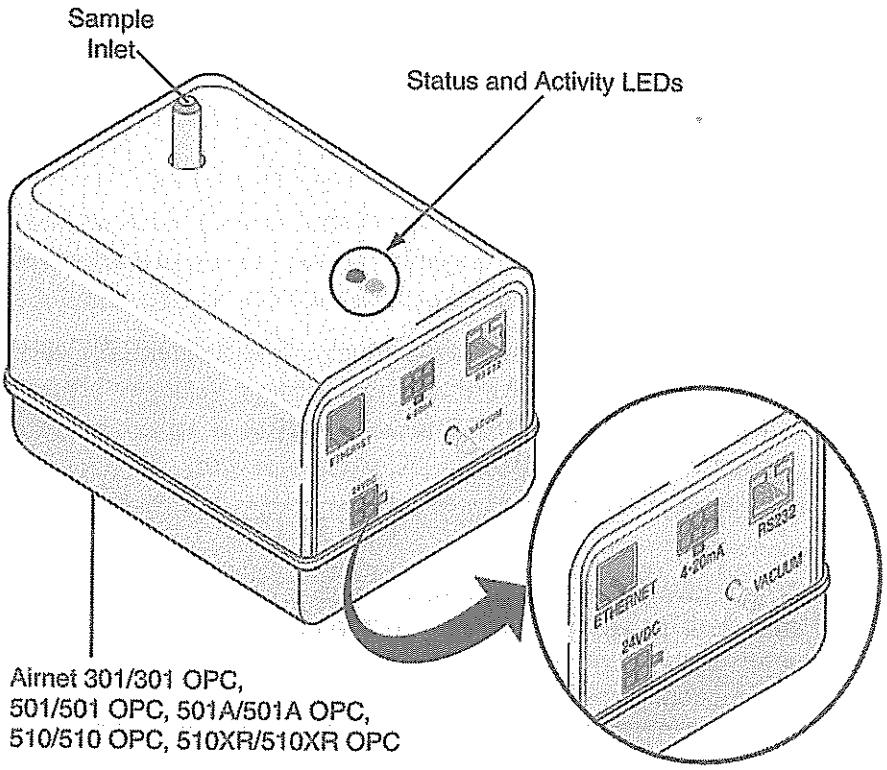

Figure 1-3: Connectors

Back

All connectors are found on the back of the unit's chassis, including:

- Electrical Power – All power is provided through the 24 VDC power connector.
- Power – Power is provided through the 24 VDC power connector. See Figure 2-5, "24 VDC Power Connector," on page 2-7.

NOTE: If any modifications are made to the factory connector, make sure to verify the 24 VDC and GND lines before connection to the Airnet unit.

- 4-20 mA Signal – The six-pin Molex® connector outputs a scaled 4-20 mA signal that transmits the following:
  - ➢ Channel 1 and 2 particle counts
  - ➢ Instrument status messages
- Ethernet – The UTP Ethernet connector allows the unit to communicate with Facility Net by connecting an Ethernet cable from the particle sensor to the Ethernet hub. The Airnet particle sensor OPC models can also communicate to OPC systems via an Ethernet connection.

NOTE: For best results, use a CAT 5 UTP cable.

- RS-232 – The RS-232 RJ-11 jack is used for configuring the unit and performing limited diagnostics.
- Vacuum Source – The barbed fitting allows a source of house vacuum (> 11 in. Hg) to be supplied to the unit.

Table 1-1: Vacuum Tubing Diameter

Airnet 301, 501, 501A, 301 OPC, 501 OPC, and 501A OPC	1/8-inch
Airnet 510, 510XR, 510 OPC, 510XR OPC	1/4-inch

Bottom

The bottom of the Airnet unit contains four tapped-thread fittings that match the countersunk screw holes on three of the four mounting rails. These rails are used to mount the Airnet to vertical or horizontal surfaces.

Specifications

	301/ 301 OPC	501/ 501 OPC	501A/ 501A OPC	510 &510 OPC/ 510 XR & 510 XR OPC
Channel thresholds (µm)	0.3 and 0.5	0.5 and 5.0	0.5 and 1.0	0.5 and 5.0
Sample flow rate[a]	0.1 CFM (2.8 LPM)	0.1 CFM (2.8 LPM)	0.1 CFM (2.8 LPM)	1.0 CFM (28 LPM)
Counting efficiency[b]	50% ± 10% at 0.30 µm	50% ± 10% at 0.50 µm	50% ± 10% at 0.50 µm	50% ± 10% at 0.50 µm
Zero count level	ISO Class 4	ISO Class 5	ISO Class 5	ISO Class 4
Maximum particle concentration	1,000,000/ft.^{3}			500,000/ft.^{3}
Flow system	External vacuum			
Vacuum source	> 11 inches of Hg			
Material (chassis)	Kydex®			
Dimensions (L × W × H)	5.3 × 2.8 × 3.5 inches (13.5 × 9.7 × 9 cm)			
Weight	1.6 lbs (.73 kg)			
Power	24 VDC			
Communications	• Ethernet connector requiring cable type CAT 5 UTP • 4-20 mA (three channels: two for particle data, one for instrument status) • RS-232 (configuration and diagnostic tool only, no data)			
	Facility Net Interface: • Programmable status: two-color LED • Activity: one-color LED			
	OPC: • Laser and flow status: two-color LED • Activity: one-color LED			
Status indicators	4-20 mA Interface: • Laser and flow status: two-color LED • Activity: one-color LED			
Calibration	Calibration materials are traceable to the USA national Institute for Standards and Technology and to one or more of the following procedures: ASTM F-328 ASTM F-649.			
Environment	Temperature: 4–35° C Humidity: Non-condensing			

a. Allow ± 5% for variations in sample flow.
b. Greater than 95% accuracy (less than 5% coincidence loss) at maximum recommended ambient concentration.

Chapter 3
Configuring for Ethernet or OPC

Configuration Defined

You can configure the Airnet particle sensor to communicate with Facility Net, send 4-20 mA signals to a SCADA system, or both. Before it can do either, you must configure the sensor.

In this chapter, configuration is the process of making the software and communications settings that will enable the Airnet particle sensor to communicate with Facility Net by means of an Ethernet network. To configure the sensor for 4-20 mA signals see Chapter 4, "4-20 mA Signal Configuration and Operation".

Airnet particle sensor systems purchased with the OPC configuration must be configured for proper operation. For additional information, see Chapter 5, "OPC Configuration and Operation."

NOTE: The following information assumes that the user has a working knowledge of terminal emulation software such as HyperTerminal®.

When to Configure the Sensor

If it will be difficult or impossible to take a computer to the Airnet particle sensor after installation, it should be configured before installation.

If access to the sensor after installation will be easy, you can configure the sensor either before or after installation.

Required Hardware and Software

- RS-232 cable
- Computer loaded with terminal emulation software

NOTE: Microsoft Windows® includes a terminal emulator called HyperTerminal. Other terminal emulator programs, are widely available. Your IT administrator or microcomputer support person may be able to provide assistance.

RS-232 Cable

A suitable cable (PMS-CD1995) is provided in your shipment. The wiring for this cable is as follows:

Table 3-1: RS-232 Pin Outs (RJ-11 jack)

Pin 1	DSR
Pin 2	**Transmit** →
Pin 3	**Receive** ←
Pin 4	RTS
Pin 5	CTS
Pin 6	GND

NOTE: Pins 1, 4, and Pin 5 are shorted together.

Setting Configuration Addresses for Ethernet

Follow these steps to configure the Airnet particle sensor to communicate with Facility Net by means of an Ethernet network.

CAUTION

As with any network-capable software, do not attempt to connect the Airnet particle sensor to a network without your network administrator's cognizance and explicit permission. The administrator will need to approve, and in most cases will issue, addresses.

To configure the Sensor

1 Connect the Airnet particle sensor to a computer that has terminal emulation software.

2 Start the terminal emulation software and proceed to the COM 1 parameters dialog box.

3 Set the following communication parameters:

Table 3-2: Terminal Emulator Communications Parameters

Baud Rate	9600
Data Bits	8
Parity	N
Stop Bits	1
Flow Control	Off
Parity Check	Off
Carrier Detect	Off
Connector	Appropriate to hardware (COM1, for example)

When communications are established with the unit, a prompt appears. Enter the Configuration commands (see "Configuration Commands" below) to set the following addresses:

4 Set the IP address.

5 Set the multicast address.

6 Set the mask address.

7 Set the gateway address.

8 Enter the "write" command.

Configuration Commands

?: Displays a command summary for the selected operational mode (a summary of the information in this table).

Sta(tus): Displays the following information:

- Current firmware version number
- MAC address
- IP address
- Multicast address
- Net mask
- Gateway

- Queue size (if used with Facility Net)
- Connection status (if used with Facility Net)
- Operational mode (if OPC option has been purchased)

Set ip aaa.bbb.ccc.ddd: The gateway address is used when communicating across different networks. This command sets the gateway address in the form of aaa.bbb.ccc.ddd. Each three-digit series is a value of 0–255, separated by a period (.) character. Use gateway 000.000.000.000 if no gateway device is available on the network. An example of a valid gateway address is **010.255.000.060**.

Set mask aaa.bbb.ccc.ddd: Sets the network mask address using a decimal notation form of aaa.bbb.ccc.ddd. Each three-digit series is a value of 0-255 separated by a period (.) character. The mask separates the network address from the host address. This address is common to all devices on the logical network. Usually the mask will be similar to, 255.255.255.000. Your network administrator will tell you if you need to enter this field.

Set multicast aaa.bbb.ccc.ddd: The multicast address must be set when using Facility Net. This command sets the multicast address in a decimal notation form of aaa.bbb.ccc.ddd. Each three-digit series is a value of 0-255 separated by a period (.) character. This address is unique to the hardware it serves. An example of a valid multicast address is: "224.100.100.001".

Set gateway aaa.bbb.ccc.ddd: The gateway address is used when communicating across different networks. This command sets the gateway address in a form of aaa.bbb.ccc.ddd. Each three-digit series is a value of 0-255 separated by a period (.) character. Use gateway 000.000.000.000 if no gateway device is available on the network. An example of a valid gateway address is: "010.255.000.060".

Set que(ue) x: When used with Facility Net, you can enter a data queue size in order to buffer data while the unit is not connected. There is no data queue when running under OPC.

The value of x can be set anywhere between 1 and 480. The queue size to enter depends on the specific application. In general, the value should be made large enough to minimize data loss when disconnected, but not so large as to create significant delays in the reception of real-time data when reconnected.

When a data queue size is set greater than one, the Airnet particle sensor will:

- Continue sampling if it was initially started, and then disconnected
- Queue up to the number of samples defined by the queue size
- Unload the queued data in chronological order when reconnected
- Periodically delete elements of the queue for which Facility Net has received the data

When the queue size is set to one (1), the Airnet particle sensor reverts to a mode where it is fully compatible with version 5.07 of the firmware. In this mode, there is no data queue, the unit reboots when disconnected, previously defined control functions are enabled, and parameters specific to batch processing are enabled.

Set opc x: If the unit was purchased with the OPC option, the unit will run under one of two possible operational modes, PMS Operational Mode or OPC Operational Mode. Without the OPC option, the unit is fixed in the PMS Operational Mode. When the value of x is set to zero (0), the unit will reboot into the PMS Operational Mode and when the value of x is set to one (1), the unit will reboot into the OPC Operational Mode.

Select the PMS Operational Mode for use with Facility Net calibration, allowing for the use of a data queue.

Select the OPC Operational Mode to interface to any third party OPC client. For additional information, refer to Chapter 5, "OPC Configuration and Operation."

Set sam (ple) x y: This command sets the minimum sample interval to x seconds and the maximum sample interval (used when zero particles are detected) to y seconds. PMS strongly recommends that both sample intervals be set to the same value when connected via OPC in order to disable the zero count sample interval processing. It is not required to set the sample interval when running the Airnet particle sensor with Facility Net.

Write: Saves the most recent changes. You must send this command after setting up the instrument, or your parameters will be lost when the sensor is de-energized.

NOTE: When the programming is complete, record these settings for future reference.

Unit Serial Number:

TCP/IP Settings for the Airnet Particle Sensor :

Date			
Software Version			
Set By			
MAC Address			
IP Address			
Multicast Address			
Net Mask Address			
Gateway Address			

Viewing Configuration Settings

Type sta(tus) and press the Enter key to display the Airnet particle sensor's configuration settings, software version, and connection status.

If this command does not produce any kind of activity on the display screen, the terminal emulator may be set up incorrectly, or the cable may be improperly connected or faulty.

Connecting the Ethernet Cable

The Airnet particle sensor communicates with Facility Net or OPC client software by means of a CAT 5 UTP Ethernet cable. The sensor is designed to work best with a CAT 5 UTP cable. Other types of Ethernet cable may produce excess noise. Your Information Systems manager, Network Administrator, or other appropriate computer support personnel may be able to assist in procuring a cable or fabricating a custom-length cable.

When connecting the Airnet particle sensor to a network, Facility Net or the OPC client software will find the sensor on the network. Based on your configuration, refer to the *Facility Net Operations Manual* or Chapter 5, "OPC Configuration and Operation" for information about monitoring and collecting data.

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Chapter 4
4-20 mA Signal Configuration / Operation

Overview

The Airnet particle sensor transmits three 4-20 mA signals. One signal communicates instrument status and the other two signals transmit particle count data from two channels. This data is typically collected and processed by a SCADA system.

NOTE: The Airnet particle sensor can output data to Facility Net software while it also outputs 4-20 mA signals to a SCADA system.

When to Configure the Sensor

If it will be difficult or impossible to take a computer to the Airnet particle sensor after installation, it should be configured before installation.

If access to the sensor after installation will be easy, you can configure the sensor either before or after installation.

4-20 mA Outputs

The instrument status signal is not controllable by the user. The two particle count signals are channels 1 and 2.

Table 4-3: Summary of 4-20 mA Signals and Channels

First signal output	Channel 1 particle counts
Second signal output	Channel 2 particle counts
Third signal output	Instrument status

Each channel is capable of driving a grounded load of 400 ohms or less. All grounds are common and are common to the internal analog ground of the sensor.

Table 4-4: 4-20 mA Channel Thresholds

Channel	301/ 301 OPC	501/ 501 OPC	501A/ 501A OPC	510/ 510 OPC	510XR/ 510XR OPC
1	0.3 µm	0.5 µm	0.5 µm	0.5 µm	0.5 µm
2	0.5 µm	5.0 µm	1.0 µm	5.0 µm	5.0 µm

Table 4-5: 4-20 mA Factory Preset Status Levels

Current	Flow Status	Laser Status
8 mA	OK	OK
12 mA	OK	Bad
16 mA	Bad	OK
20 mA	Bad	Bad

The signals are output through a 6-pin Mini-Fit, Jr. connector plug located on the sensor's rear panel.

Configuring 4-20 mA Outputs

Configuring the 4-20 mA outputs is the process of setting parameters to define the collection of the channel data, and to enable the data collection system to correctly interpret this data.

First, establish communications with the Airnet particle sensor, and then use software commands to configure the sensor.

NOTE: The following information assumes that the operator has a working knowledge of terminal emulation software such as HyperTerminal.

Required Hardware and Software

- Computer loaded with HyperTerminal, or other terminal emulation software
- RS-232 configuration cable (provided in your shipment). Wiring for this cable is as follows:

Table 4-6: RS-232 Pinouts
(RJ-11 Connectors on the Airnet Particle Sensor)

Pin 1	DSR
Pin 2	**Transmit →**
Pin 3	**Receive ←**
Pin 4	RTS
Pin 5	CTS
Pin 6	GND

NOTE: Windows 95 includes a terminal emulator called HyperTerminal. Other terminal emulator programs are widely available. Your IT administrator or microcomputer support person may be able to provide assistance.

Establishing HyperTerminal Communications

To set HyperTerminal for communications with the sensor

1 Connect the Airnet particle sensor to a computer with the provided RS-232 cable.
2 If the computer is not running, start it and open your terminal emulation program.
3 Proceed to the COM1 parameters dialog box.

4 Set the following communications parameters, and press Enter. A prompt (>) will appears on the computer display.

Table 4-7: Terminal Emulator Communications Parameters

Baud Rate	9600
Data Bits	8
Parity	N
Stop Bits	1
Flow Control	Off
Parity Check	Off
Carrier Detect	Off
Connector	Appropriate to hardware (COM1, for example)

5 At the prompt (>), enter the appropriate commands to set the parameters for your 4-20 mA application. Record your parameters for future reference. (A list of available commands are described in the following section.)

Unit Serial Number:

TCP/IP Settings for the Airnet Particle Sensor :

Date			
Software Version			
Set By			
MAC Address			
IP Address			
Multicast Address			
Net Mask Address			
Gateway Address			

Configuration Commands

The following commands are available to use when setting 4-20 mA signal parameters.

`?` Displays a command summary (a summary of the information in this table).

`sta(tus)` If in PMS Operational mode, displays the current firmware version number, MAC address, IP address, Multicast address, Net mask, gateway, and connection status. It will also display current 4-20 mA parameters.

`set samp x y` This function sets the minimum sample interval to *x* seconds and the maximum sample interval (used when zero particles are detected) to *y* seconds.

This value is stored in permanent memory and is used by the instrument when it starts. This value can be changed by means of the Ethernet interface (Facility Net). However, when the Airnet particle sensor is de-energized, the value set by the Ethernet interface is replaced by the value in permanent memory.

`set cumul n` This function selects between cumulative and differential data for the two 4-20 mA outputs.

If *n* equals 1, the data is cumulative and represents the number of particles detected that are larger than the size specified for the channels.

If *n* equals 0, the data is differential and represents the number of particles detected that are between the size specified for the first output channel and the size specified for the second output channel.

`set eos n` If *n* is set to 1 then the data in each channel is updated only at the end of each sample interval and is held constant for the duration of the subsequent sample interval. If *n* is equal to 0, the 4-20 mA channels are updated approximately every 20 milliseconds.

`set raw n` If *n* is 1, the data in each channel is simply the number of particles detected. If *n* is 0, the data is normalized by dividing the counts by the volume sampled. The output units are counts per cubic foot.

`set sca(le) n,n` This value defines the scaling of two 4-20 mA channels. This value corresponds to 20 mA at the output. The lower end of the range is always defined so that 4 mA corresponds to zero particles. The units of this value are defined by the settings entered by the `cumul` and the `raw` commands. The first *n* applies to channel 1. The second *n* applies to channel 2.

`write` Saves the most recent changes. You must send this command after completing the instrument setup, or your parameters will be lost when the sensor is de-energized.

Viewing Configuration Settings

Typing `sta(tus)` and then pressing the **Enter** key results in a display of the Airnet particle sensor's configuration settings, software version, and connection status.

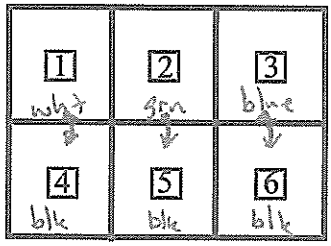
If typing `status` or `?`, and then pressing the **Enter** key, does not produce any activity on the display screen, the terminal emulator may be set up incorrectly or the cable may be improperly connected or faulty.

Connecting to a SCADA Data Collection System

To connect to a SCADA data collection system, build a cable that will allow connection of the Airnet particle sensor to the SCADA system's 4-20 mA input. The cable must be compatible with the 6-pin Molex Mini-Fit Jr.™ connector plug located on the rear of the sensor. The following pins are used on the connector.

Table 4-8: Airnet Particle Sensor 4-20 mA Connector Pins

Pin	Function
1 wht	Current output for channel 1
2 grn	Current output for channel 2
3 blue	Current output for Status
4 blk	Ground (Channel 1 return)
5 blk	Ground (Channel 2 return)
6 blk	Ground (Status return)



1. Connect the cable from the Airnet particle sensor's 4-20 mA output to the data collection system's input.
2. Set up the data collection system to correctly interpret the sensor's 4-20 mA output.