

83201 AQ PROFILER

OPERATION MANUAL
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Met One Instruments, Inc
1600 NW Washington Blvd.
Grants Pass, Oregon 97526
Telephone 541-471-7111
Facsimile 541-471-7116

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83201 Operation Manual

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Technical Support

Should you require support, please consult your printed documentation to resolve your problem. If you are still experiencing difficulty, you may contact a Technical Service representative during normal business hours—7:30 a.m. to 4:00 p.m. Pacific Time, Monday through Friday.

Voice: (541) 471-7111

Fax: (541) 471-7116

E-Mail: service@metone.com

Mail: Technical Services Department
Met One Instruments, Inc.
1600 Washington Boulevard
Grants Pass, OR 97526

Safety Notice

The contents of this manual have been checked against the hardware and software described herein. Since deviations cannot be prevented entirely, we cannot guarantee full agreement. However, the data in this manual is reviewed regularly and any necessary corrections are included in subsequent editions.

Faultless and safe operation of the product presupposes proper transportation, storage, and installation as well as careful operation and maintenance. The seller of this equipment cannot foresee all possible modes of operation in which the user may attempt to utilize this instrumentation.

The user assumes all liability associated with the use of this instrumentation. The seller further disclaims any responsibility for consequential damages.

NOTICE

CAUTION—Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

WARNING—This product, when properly installed and operated, is considered a Class I laser product. Class I products are not considered to be hazardous.

This product incorporates a laser diode-based sensor that is a CLASS 1 product as defined in 21 CFR, Subchapter J, of the Health and Safety Act of 1968. This applies when the instrument is used under normal operating conditions and with proper maintenance.

Service procedures performed on the sensor can result in exposure to invisible laser radiation. Only a factory-authorized person must perform service on this instrument.

The laser diode-based sensor inside this instrument has a warning label on it as shown below.



Table of Contents

1. INSTALLATION	5
1.1. Mounting	5
1.2. Connections / Wiring	5
1.3. Default Settings	6
2. DESCRIPTION.....	6
2.1. AQ Particle Counter	6
2.2. Sheath Air	6
2.3. Detection.....	7
2.4. Sizing and Counting	7
2.5. Calibration.....	7
3. SERIAL COMMUNICATION.....	7
3.1. User Communication	9
3.2. Computer Communication.....	9
3.2.1. Computer Command Format	9
3.2.2. Checksum Computation.....	9
3.3. Legacy Communication	10
4. MAINTENANCE.....	10
4.1. Service Schedule.....	10
5. OPERATION.....	11
5.1. Powering the AQ Profiler	11
5.2. Communication.....	11
5.3. Sample Air Flow	11
5.3.1. Flow System specifications	12
5.3.2. Pump specifications	12
5.3.3. RH and Inlet Heater	12
5.3.4. AQ Flow (MOI #83170)	13
6. SPECIFICATIONS	14
7. Warranty / Service	15

1. INSTALLATION

1.1. Mounting

The AQ profiler module can be mounted using the eight slotted openings along the edge of the unit.



Figure 1.1: AQ Profiler Module

1.2. Connections / Wiring

Three terminal blocks for electrical connectors are located on one side of the AQ profiler. The pin out detail for the electrical connections are clearly labeled at each wire input. Figure 1.2 shows all the connections for the AQ profiler assembly.

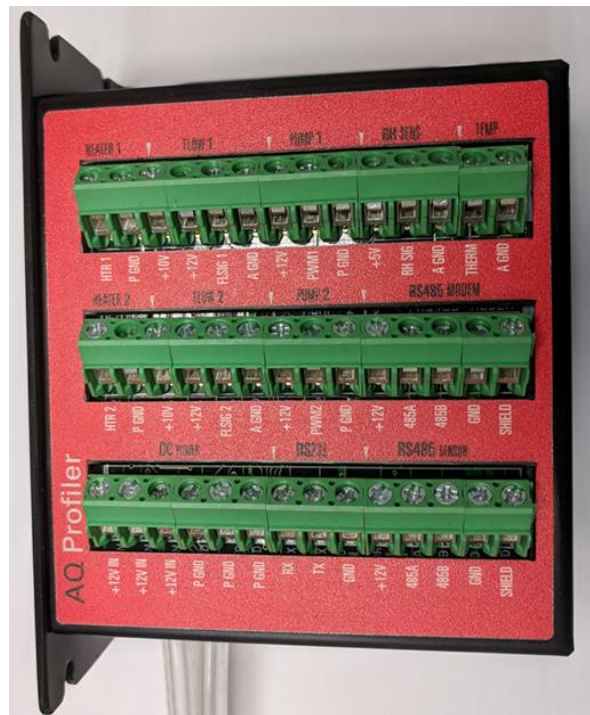


Figure 1.2: Electrical Connection Terminal Blocks

Table 1.2 Terminal Block Connection Descriptions

TB1 (Top Row)			TB2 (Middle Row)			TB3 (Bottom Row)		
1	HTR 1	Heater1	1	HTR 2	Heater2	1	+12V IN	DC Power
2	P GND	Heater1	2	P GND	Heater2	2	+12V IN	DC Power
3	+10V	Flow1	3	+10V	Flow2 ref	3	+12V IN	DC Power
4	+12V	Flow1	4	+12V	Flow2	4	P GND	DC Power
5	FLSIG 1	Flow1	5	FLSIG 2	Flow2	5	P GND	DC Power
6	A GND	Flow1	6	A GND	Flow2	6	P GND	DC Power
7	+12V	Pump1	7	+12V	Pump2	7	RX	RS232
8	PWM1	Pump1	8	PWM2	Pump2	8	TX	RS232
9	P GND	Pump1	9	P GND	Pump2	9	Gnd	RS232
10	+5V	RH Sensor	10	+12V	RS485 Modem	10	+12V	RS485 Sensor
11	RH SIG	RH Sensor	11	485A	RS485 Modem	11	485A	RS485 Sensor
12	A GND	RH Sensor	12	485B	RS485 Modem	12	485B	RS485 Sensor
13	THERM	AT Sensor	13	GND	RS485 Modem	13	GND	RS485 Sensor
14	A GND	AT Sensor	14	SHIELD	RS485 Modem	14	SHIELD	RS485 Sensor

1.3. Default Settings

The AQ Profiler is shipped with the following default settings.

Communication:

9600 Baud Rate, 8 Data Bits, No Parity, 1 Stop Bit, No flow control.

Sample Time: 60 seconds

Sample Mode: Continuous

Unit ID: 1

Modbus Slave Address: 1

2. DESCRIPTION

2.1. AQ Particle Counter

The AQ particle counter has the ability to size and count airborne particles in up to eight size ranges. Particles are sized and then counted in one of the eight counters. Depending on the settings, data is transferred automatically at the end of a sample period or continuously to an external recording device. The AQ profiler has terminal communications protocols.

2.2. Sheath Air

When a particle counter is to be used to sample aerosols containing high concentrations of particles, the sensor should incorporate sheath air to prevent particles from

contaminating the internal optics of the sensor. The particle laden sample air is enclosed in a sheath of clean filtered air that prevents particles from escaping. The AQ particle counter is equipped for and requires sheath air for operation.

2.3. Detection

The particle counter uses scattered light to measure and count particles. Sample air is drawn into the detector chamber and subjected to an intense laser beam located at right angles to the flow. The laser beam has been shaped to produce a flat very thin beam producing a small sample area. Light travels through the sample stream and terminates in the light trap. Particles pass through the laser beam and scatter light. The amount of light scattered is proportional to the size of the particle. A portion of this light scatters toward the elliptical mirror. This light is then directed to the detector. The output of the detector is then analyzed to determine the number of particles and the size of the particles. Met One Instruments uses the elliptical mirror to maximize collected light without the need for complex focusing optics.

2.4. Sizing and Counting

The amount of scattered light is converted to a voltage pulse, and based on the amplitude of the pulse signal it will pass through one or more of the size discriminators and into the associated counter(s).

2.5. Calibration

Calibration is performed using ideal (PSL) spheres, which provide a powerful tool for assessing the sensitivity, accuracy, resolution and false count level. The particle detector is compared to a reference mono-dispersed (single size) suspension of polystyrene latex (PSL) spheres in clean filtered air for both calibration and certification of performance specifications. This calibration technique serves two purposes:

1. Provides a standard traceable reference.
2. Provides a measure of how well the unit maintains its calibration (reproducibility).

3. SERIAL COMMUNICATION

There are three modes of communication:

1. User communication – This is a user interactive mode using simple letter commands for ease of use.
2. Computer communication – This mode is used for computer-to-device communication. It has a level of data integrity.
3. Legacy communications – This mode is for backward compatibility with the original 9722 and 212 instruments. This mode is deprecated and should only be used for compatibility with existing installations. All new installations should use the newer serial conventions.

Table 3.1 Command List

Command	Description															
#	Get MetRecord revision.															
1	Report settings.															
E	End (Stop) sample cycle.															
H, ?	Help menu.															
S	Start a sample cycle.															
Q	Exit User mode and enter Computer mode.															
CM	Count Mode. 0=Cumulative, 1=Differential															
CU	Get/Set Count Units. 0=CF, 1=/L, 2=TC, 3=M3															
DT	Get/Set date and time. yyyyMMddHHmmss															
ID	Get/Set location ID or address. The range is 1 to 999.															
MA	Modbus Address. The range is 1 to 247.															
OI	Interval Output On/Off. 1=Enabled, 0=Disabled.															
PT	Protocol Type 0=7500, 1=Legacy.															
QH	Query Header															
RO	Report Options. Uses bit flags for the different readings. Add up all the bit flags for combinations needed <table><tr><td>Reading</td><td>Bit</td><td>Add</td></tr><tr><td>Flow</td><td>0</td><td>1</td></tr><tr><td>Temperature</td><td>1</td><td>2</td></tr><tr><td>Pressure</td><td>2</td><td>4</td></tr><tr><td>RH</td><td>3</td><td>8</td></tr></table> e.g. RO 11 = Flow, Temperature, RH	Reading	Bit	Add	Flow	0	1	Temperature	1	2	Pressure	2	4	RH	3	8
Reading	Bit	Add														
Flow	0	1														
Temperature	1	2														
Pressure	2	4														
RH	3	8														
RQ	Request last reading.															
RV	Get product information.															
RZ	Get available Channel Size information.															
SB	Get/Set serial baud rate. 3=2400, 4=4800, 5=9600, 6=19200, 7=38400,8=57600,9=115200.															
SPR	RH Setpoint to turn inlet heater on.															
ST	Get/Set Sample Time in Seconds.															

3.1. User Communication

In the user communication mode (terminal mode), press the Enter key, <cr>, three times to enter the mode. In this mode simple character commands can be issued with no <Esc> character required.

An asterisk character appears during wake-up, and also after a command has completed. The asterisk indicates that the instrument is ready for a new command.

Commands are echoed back from the instrument in this mode. Commands are terminated by the Enter key <cr>.

A help menu can be viewed by sending H, h, or ?; giving all the commands available to the user.

Pressing <Esc>, X<cr> or Q<cr> will exit user mode.

3.2. Computer Communication

In the computer communication mode, the command format has an optional level of data integrity – checksum. This mode is entered whenever an <Esc> character is sent to the instrument. Character echo is suppressed in this mode.

3.2.1. Computer Command Format

The computer command has the following format:

<Esc>Cmd p1 p2*cs<cr>

Computer commands are prefaced with an <Esc> (0x1B) character followed directly by a command, Cmd, which is variable in length depending on the command. After the command characters there can be zero or more parameter fields, p1 p2. Each parameter field is delimited by one or more Space characters (0x20). The end of the message is signaled by the Checksum Delimiter character * (0x2A) followed by the checksum, cs, and finally terminated with a carriage return <cr> (0x0D) character. Note: the *cs is optional and should be used if data integrity enforcement is required for the application.

A computer command example follows:

<Esc>RV*00234<cr>

All command responses are terminated with a checksum

RV 092, 99999-1, R9.9.9*00234<cr><lf>

3.2.2. Checksum Computation

Checksum is calculated as the 16 bit unsigned integer sum of all of the characters after the <Esc> character up to but not including the Checksum Delimiter Character * (0x2A). It is printed out as an ASCII decimal number.

The result is always 5 characters in length with leading zeros.

The checksum may be bypassed in the following manner: *//<cr>.

3.3. Legacy Communication

In the Legacy communication mode the system emulates the serial protocol of the 9722 and 212 instruments. The PT (protocol type) command is used to set this mode when needed. Press the Enter key three times to enter Terminal Mode, much the same as User Mode above. The Legacy Mode prompt is the Greater Than symbol ">". Commands are single character and act immediately upon pressing the key. Those that require additional input will be terminated by the Enter key.

A Help Menu is available pressing the H or ? keys.

Table 3.3 Legacy Command List

Command	Description
H or ?	Help menu
C	Set to single sample
Y	Set to repeat sample
Q	Stop command
S	Start command
O	Set flow offset
T	Set sample time
R	Set RH setpoint
X	Exit terminal mode

This mode is deprecated and should not be used for new installations.

When Legacy Mode is enabled, the Terminal mode only supports the limited set of Legacy commands. The full set of commands is still available in Computer Mode only when Legacy Mode is turned on.

4. MAINTENANCE

4.1. Service Schedule

WARNING: The AQ Profiler can only be serviced or calibrated by factory-authorized personnel. Unauthorized maintenance on the AQ Profiler may result in exposure to laser radiation that can cause blindness and void warranty.

Calibrating particle sensors like the one in the Model AQ Profiler requires specialized equipment and a skilled technician. Met One Instruments maintains a calibration facility

for calibrating particle counters according to industry-accepted methods using NIST traceable standards. The AQ profiler should be calibrated on a yearly basis.

Table 4.1: Service

Item to Service	Frequency	Done By
Calibrate Sensor	Yearly	Factory service only

5. OPERATION

5.1. Powering the AQ Profiler

The AQ Profiler can operate from a voltage input of 10.5 to 15.5 volts. See 1.2 for power connector pin out.

5.2. Communication

You can use a terminal program such as Hyper-Terminal to communicate with the profiler.

RS-232 and RS-485 Operation

Communication wires can be directly connected to the left-most terminal block of the profiler. See 1.2 for connector pin out.

5.3. Sample Air Flow

You will be required to supply a vacuum to the outlet nozzle of the AQ Profiler in order for it to sample. You will also need to supply filtered air for the air sheath. For air filter we recommend a 0.1 micron in-line filter (MOI#580294). We recommend this filter if a mass flow sensor is used as well. The filter should be installed upstream from the mass flow sensor to protect its delicate sensor from contamination generated by the pump. The flow rate is critical to the proper operation of the unit. The vacuum should be smooth, without pulsation. Since most pumps create a pulsation by their very nature a surge chamber and restriction should be employed to reduce the airflow to a steady stream. The calibration of the profiler was done at a 1.0 L/min inlet flow rate and an increase in flow rate will make particles appear smaller. Changes in pump voltage can cause a shift in flow rate as well. Selecting the type of vacuum pump will be of some importance. A diaphragm pump generally has a long life between maintenance but generates large pulsations and requires larger surge chambers to suppress them. Rotary vane pumps generate a higher frequency pulsation and can be filtered with a smaller chamber or a plenum. A coarse filter should be placed before the pump to keep contaminants from damaging the pump. This is especially critical with rotary vane pumps.

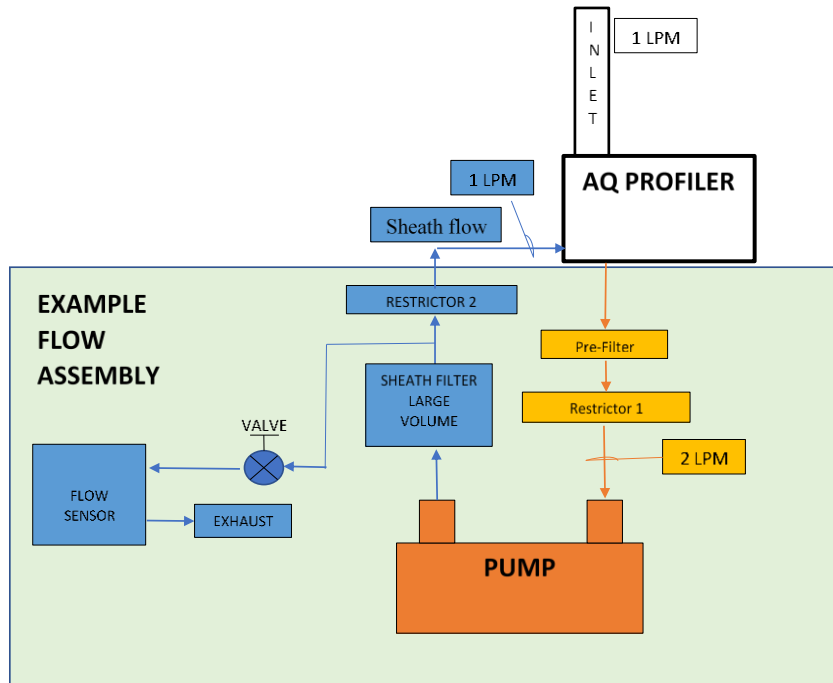


Figure 5.3: Flow Assembly

5.3.1. Flow System specifications

A 10V reference voltage connection is available for the use of a flow sensor that requires this reference. The +10V can only supply 10 mA of current. The flow signal input voltage is 0 to 5V max. Met One also offers a differential pressure flow sensor, part number 82258, which requires power from the +12V flow input due to the higher current demand of the DP sensor. Currently, only this Met One DP sensor is supported.

5.3.2. Pump specifications

DC current limit for an external pump is 0.5A. An open collector pulse width modulated signal is used to control pump speed. It can be used to drive two or three wire DC pumps. Units are configured for 3 wire pumps. Three wire pumps will run full on, when the control wire is open. When the control wire is grounded the pump shuts down. The pump speed is controlled with a 1 kHz PWM signal. A two wire pump (typically a brush motor) can also be controlled by connecting to the +12V and the PWM1 line, if the logic is reversed. Reversing the logic is done with a hardware jumper (JP2). The jumper JP2 is located on the underside of the terminal board.

5.3.3. RH and Inlet Heater

The RH (Relative Humidity) can affect the size of airborne particles when RH is greater than 50%. The particles swell in size due to moisture absorption and “seeding”. The use of an inlet heater can ‘dry’ out the particles and eliminate this source of error. The AQ Profiler has the ability to read an RH sensor and control a solid-state relay which switches the high current required for the heated inlet tube (MOI#9431). The set point for turning on the inlet tube heater is user configurable. Generally, a set point of 40% is recommended. The RH sensor can be placed between the outlet nozzle and the

vacuum pump. It is recommended to use an inlet heater with the RH sensor below the heater. Only HTR1 output is currently supported. If the unit will be used in low humidity conditions only then the inlet heater is not necessary and can be omitted.

5.3.4. AQ Flow (MOI #83170)

NOTE: The flow system listed below is an option, and is only provided if the customer specifically ordered it.

The AQ Flow system includes a flow sensor, temperature sensor and vacuum pump for connection to the AQ Profiler. Connections from the flow system to the profiler are shown below.

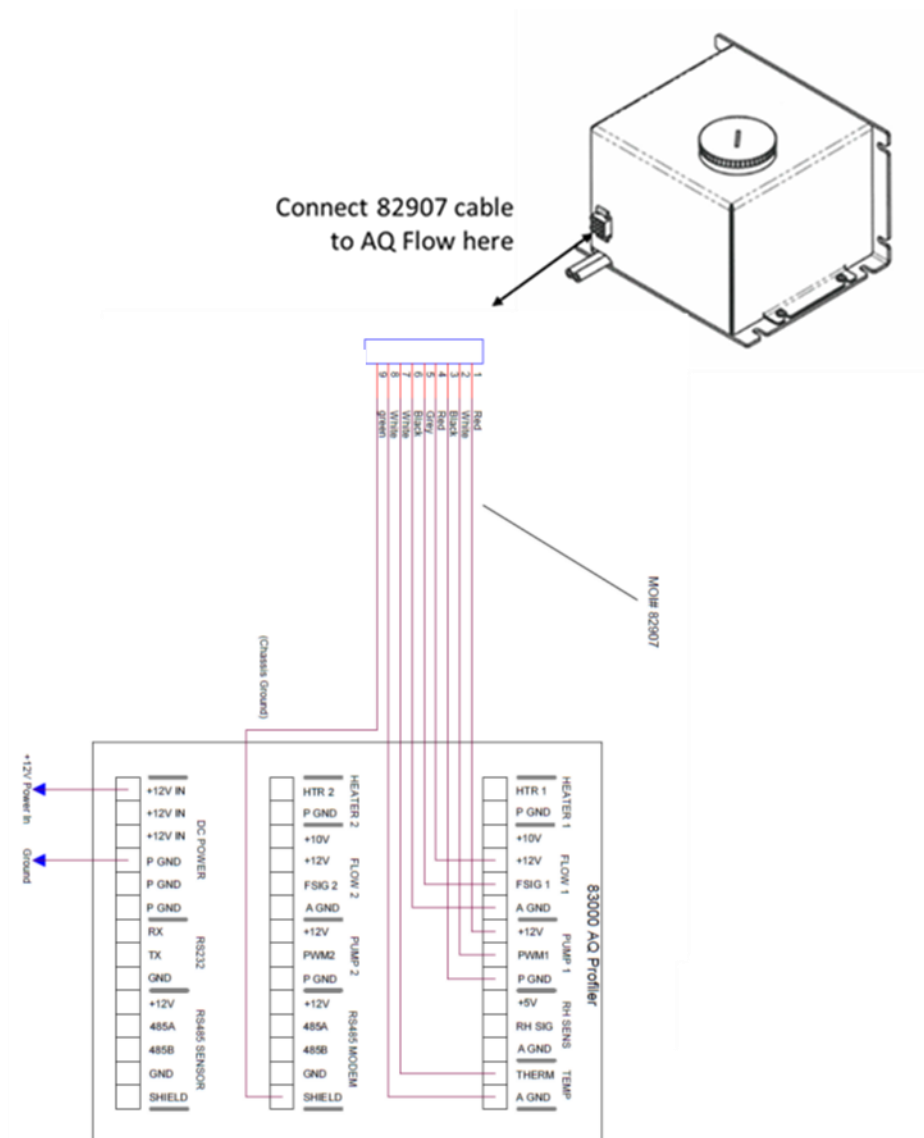


Figure 5.3.4 AQ Flow to AQ Profiler connections.

6. SPECIFICATIONS

Model Number	83201
Operation	Right angle light scatter detection, using a laser diode as light source.
Threshold	0.3 μm
Number of channels	8 channels that can be user-defined. Each channel will measure the selected size and greater. Range: 0.3 μm to 10 μm
Concentration Range	0-9,000,000 particles per cubic foot
Accuracy	$\pm 10\%$ to calibration aerosol
Sample Air Flow Rate	1.0 LPM
Sheath Air Flow Rate	1.0 LPM
Flow Control	PWM Pump driver
Communications	RS-485, half duplex RS-232
Connections	Terminal block connections on side of enclosure: DC power, RS-232, RS-485 sensor, RS-485 modem, Heater 1, Heater 2, Flow 1, Flow 2, Pump 1, Pump 2, RH sensor, AT sensor.
Operating Temperature	0° to +50° C
Storage Temperature	-20° to +60° C
Power	10.5-15.5 VDC. Average operating current 70mA, 600mA with AQ Flow, 1.3A with AQ Flow and heated inlet.
Size	Height: 3.63in, Width: 4.75in, Length: 2.34in
Weight	1 lb 10 oz
Serial Settings	Baud = 9600, 8 data bits, no parity, and 1 stop bit. (factory Default) 115200, 57600, 38400, 19200, 9600, 4800, 2400 (selectable).
Communications Protocol	Terminal Command Set