Catalog Number 701248

MET ONE 7000 Series Particle Counter

USER MANUAL

January 2009, Edition 2

rg/dk

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Section 1 Specifications

Specifications are subject to change without notice.

Instrument	
Light source	Long Life Laser™ diode
Weight	3.96 kg (8.7 lb) AC version, 3.91 kg (8.6 lb) DC version
Dimensions (W x D x H)	22.90 cm x 12.50 cm x 16.0 cm (9.02 in. x 4.92 in. x 6.30 in.) (Figure 1 on page 4)
Enclosure	316L stainless steel
Status indicator	Multi-colored LED for normal status, count alarm, count alert, sensor failure, flow failure or communication failure
Power requirements	24 VDC ± 10% or 100 to 230 VAC 50/60 Hz (source: Class 2 limited energy, < 150 VA)
Power consumption, maximum	Serial unit: 7.6 W AC, 5.9 W DC; Ethernet unit: 6.9 W DC, 8.9 W AC maximum; Analog Unit: 6.1 W DC, 7.9 W AC maximum; wireless unit 9.7 W DC, 12.5 W AC maximum
Operating temperature	10 to 32 °C (50 to 90 °F)
Storage temperature	–40 to 70 °C (–40 to 158 °F)
Operating humidity	5 to 95% relative humidity, non-condensing
Storage humidity	5 to 98% relative humidity, non-condensing
Port sizes	Model 7005: barb fitting for 0.32 cm (1/8-inch) ID inlet tubing, 0.64 cm (¼-inch) ID outlet tubing
	Model 7005: barb fitting for 0.64 cm (¼-inch) ID inlet tubing, 0.64 cm (¼-inch) ID outlet tubing
Signal output options	Analog 4–20 mA
	Serial RS485 with Modbus RTU or FXB communication protocol
	Ethernet with ModbusTCP protocol
Data storage	1000 samples/records
Sampling	
Number of size channels	Standard: 2; optional: 4
Flow rate	Model 7005: 0.1 cfm (2.83 Lpm)
	Model 7015: 1.0 cfm (28.3 Lpm)
Sensitivity	Model 7005: 0.5 µm at 0.1 cfm (2.83 Lpm)
	Model 7015: 0.5 µm at 1.0 cfm (28.3 Lpm)
Range	Model 7005: 0.3 µm to 10.0 µm at 0.1 cfm (2.83 Lpm)
	Model 7015: 0.5 µm to 10.0 µm at 1.0 cfm (28.3 Lpm)
Flow control	Through critical orifice
Inlet pressure	Ambient to 2.5 mm (0.1 in) Hg vacuum
Vacuum requirements	At least 406 mm (16 in.) Hg
Counting efficiency	Model 7005: 50% at 0.5 µm (per JIS and ISO)
	Model 7015: 50% at 0.5 µm (per JIS and ISO)
Coincidence loss	Model 7005: 5% at 70,600,000 particles/m^3 (2,000,000 particles/ft^3) Model 7015: 5% at 14,000,000 particles/m^3 (400,000 particles/ft^3)
False count rate	One or less in five minutes

WI-FI specification	
Category	**Description**
Network standards	IEEE 802.11b; IEEE 802.11g
Frequency range	2.412 - 2.484 GHz
Antenna connector	1, no diversity supported. Impedance 50 ohms
Data rates	1,2,5.5,11Mbps(802.11b) 6,9,12,18,24,36,48,54Mbps(802.11g)
Number of selectable sub-channels	Up to 14 channels. Profiles available will include USA, France, Japan, Spain, Canada and "Other" (multiple countries)
Security	WEP 64/128, WPA, WPA2, PSK, TKIP
Range	Up to 300 feet (91m) indoors[1]
Transmit output power	14 dBm or 25 milliwatts
Protocols supported	ARP, UDP, TCP, DHCP, Auto IP

[1] Maximum range may be reduced depending on several factors. Refer to section 3.6.6 on page 20 of this manual.

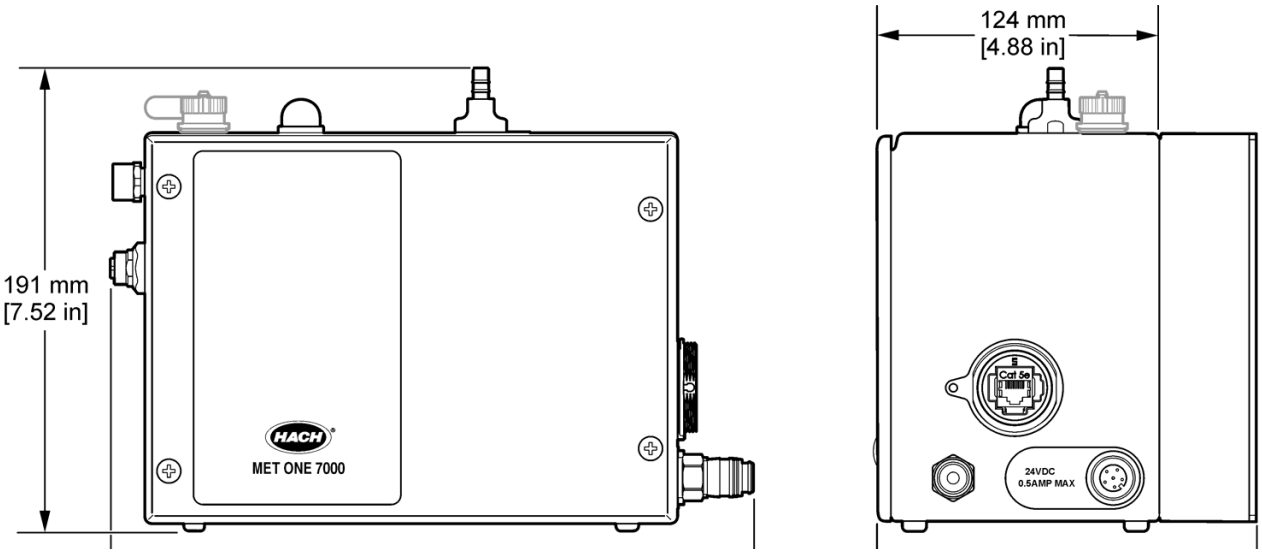


Figure 1 MET ONE 7000 dimensions

Section 2 General information

The contents of this manual are thought to be accurate. The manufacturer is not liable for direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, the manufacturer reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation.

Revised editions are found on the manufacturer's web site.

2.1 Safety information

Read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

Important Note: *Information that requires special emphasis.*

2.1.2 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user. ***Note:*** *To return for recycling, contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.*
	This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. If on the instrument, refer to the instruction manual for operation or safety information.
	This symbol indicates that a risk of electrical shock and/or electrocution exists.
	This symbol indicates the need for protective eye wear.
	This symbol indicates that a laser device is used in the equipment.
	This symbol indicates the presence of devices sensitive to Electro-static Discharge (ESD) and indicates that care must be taken to prevent damage to the equipment.
	This symbol identifies the location of a fuse or current limiting device.

2.1.3 Class 1 LASER

LASER CLASS 1	This symbol indicates that the instrument contains a Class 1 LASER device.

A Class 1 LASER is installed in this instrument. Class 1 LASERS are products where the radiant power of the LASER beam accessible (the accessible emission) is always below the Maximum Permissible Exposure value. Therefore, for Class 1 LASERS the output power is below the level at which it is believed eye damage will occur. Exposure to the beam of a Class 1 LASER will not result in eye injury. Class 1 LASERS may therefore be considered safe. However, Class 1 LASER products may contain LASER systems of a higher Class but there are adequate engineering control measures to ensure that access to the beam is not reasonably likely. This Class 1 Laser product complies with 21 CFR Chapter 1, subchapter J. It is evaluated and tested in accordance with EN 61010-1, Safety Requirements for Electrical Equipment for Measurement and Control and Laboratory Use and IEC/EN 60825-1, Safety of Laser Products.

2.2 General product information

Figure 3 shows a diagram of the MET ONE 7000 particle counter. The remote airborne particle counters use a laser diode light source and collection optics for particle detection. The air quality of a clean room can be monitored by placing multiple particle counters at specific locations in the room.

The MET ONE 7000 particle counter has three main components—the sensor, counting electronics and communication electronics. Room air is pulled through the particle counter by a vacuum source. The sensor detects the particles that enter the counter. The counting electronics store the count data. The data is transferred to the central monitoring software through the communication electronics and relevant communication protocols.

The MET ONE 7000 is available in different configurations (Figure 2).

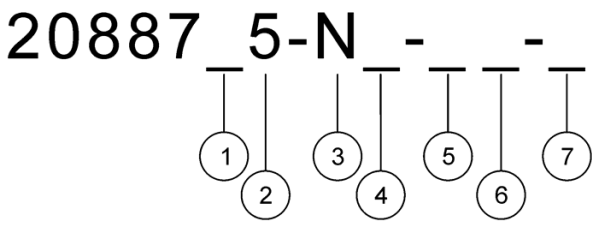


Figure 2 MET ONE 7000 configuration

1	0 = 0.1 cfm 1 = 1.0 cfm	**5**	E = Ethernet S = Serial RS-485 A = Analog W = Wireless
2	5 = 0.5 µm minimum sensitivity	**6**	D = 24 VDC input power A = 100 to 230 VAC 50/60 Hz input power
3	N = No built-in pump	**7**	0 = DC power cord B = Type B power cord D = Type D power cord E = Type E power cord G = Type G power cord J = Type J power cord
4	F = with flow measurement N = without flow measurement		

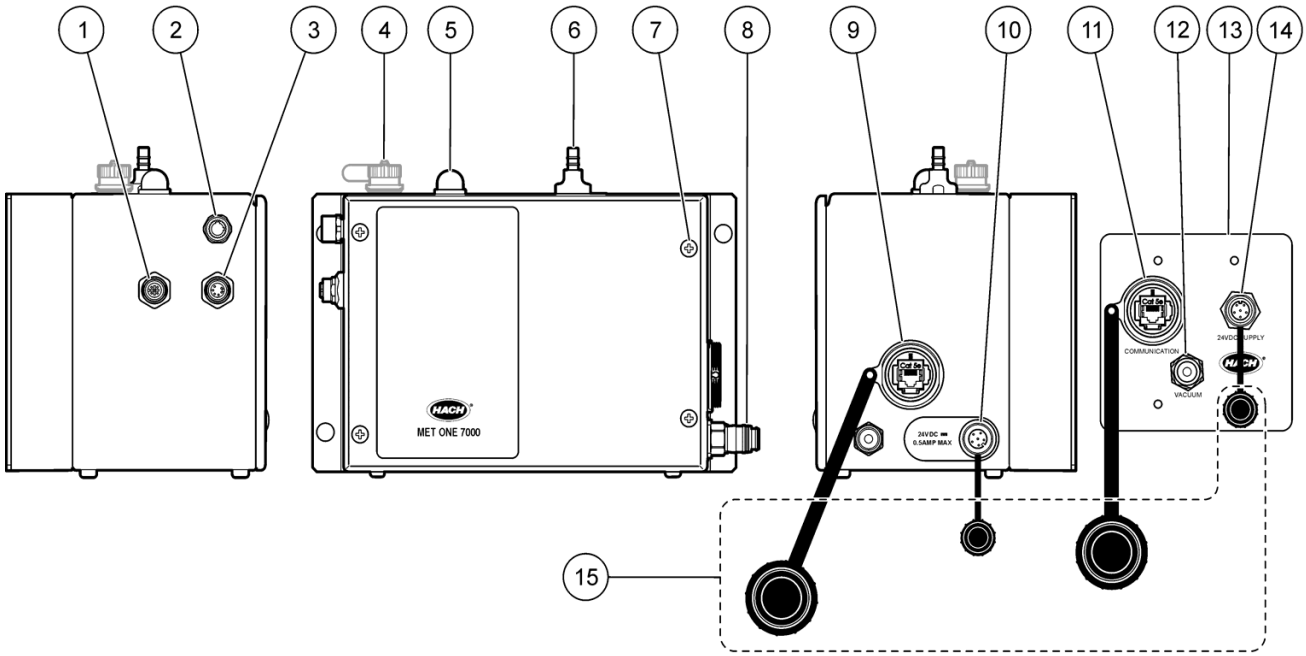


Figure 3 Overview of Met One 7000 particle counter

1	RH/Temp probe connector	**9**	Communication connector
2	External LED indicator connector	**10**	3 or 6 pin power connector
3	Display/Service port connector	**11**	Wall plate communication connector
4	Connector for WI-FI antenna	**12**	Wall plate quick-connect vacuum fitting
5	Status LED indicator	**13**	Wall plate
6	Inlet tube fitting, ¼-in. or 1/8-in.	**14**	Wall plate VDC power connector
7	Cover screw	**15**	Waterproof cap
8	Quick-connect vacuum fitting		

2.3 Status LED indicator description

The particle counter has a multi-color LED indicator (Figure 3) that indicates the status of the system. The colors indicate normal, alarm, alert or failure (refer to Table 1). The limits that activate the indicator can be changed using the central monitoring software or the setup utility (section 4.1.2 on page 28).

Table 1 LED indicator description

LED color	Indication	System status
Green	Blinking (3 second)	Normal operation sampling
	Steady	Normal operation not sampling
Red	Solid or blinking	Count alarm
Blue	Steady	Sensor failure
Blue	Flashing	Communication failure
Blue	One short flash, one long flash	Flow failure

Important Note: *A yellow LED can be activated from the central monitoring software to flash for count alert. If not activated by the software, the yellow LED will only turn on during startup initialization.*

For a description of the Ethernet LED indicators, refer to section 4.2.2.2 on page 34. For a description of the Wireless LED indicators, refer to section 4.3.1.5 on page 39.

2.4 Theory of operation

The sensor in the MET ONE 7000 air particle counter contains a laser diode light source that illuminates an area called the view volume with intense light. Particles in the sample pass through the view volume and scatter the laser light, which is then collected through the collection optics and focused onto a photodiode. The intensity of scattered light varies depending on the size of the particle. The photodiode detects and converts the light signal to electrical pulses, the magnitude of which is proportional to the particle size. The information processed by the on-board controller electronics are then communicated to the central monitoring system through the communication electronics.

The pulses are counted and measured by electronics on a circuit board containing counting operations circuitry. Comparators are used to measure pulse height and sort the signals into channels according to size. Counting circuits count the pulses in each channel. The results indicate the particle counts for each size channel.

Calculations, if required by the operator, are performed and the data is available to the I/O circuits for the facility monitoring system software through suitable communication protocol or for peripheral devices. The firmware that controls counter operations is stored in flash memory. The counting operations circuitry can also process external analog signals from environmental probes when used.

Additional circuitry provides device controls for the sample flow and external accessories. Power regulation and distribution circuits control the proper levels and internal application of DC voltages.

Isokinetic sampling probes

The isokinetic sampling probe is designed for accurate sampling in laminar flow environments. The velocity of air in the probe is close to that of a typical vertical or horizontal laminar flow environment such as a clean room or clean hood. The probe will match the vertical (or horizontal) flow speed of the air in order to collect representative samples of the cleanroom laminar flow for the particle counter. Refer to Figure 4 for a comparison of sampling with and without the isokinetic probe.

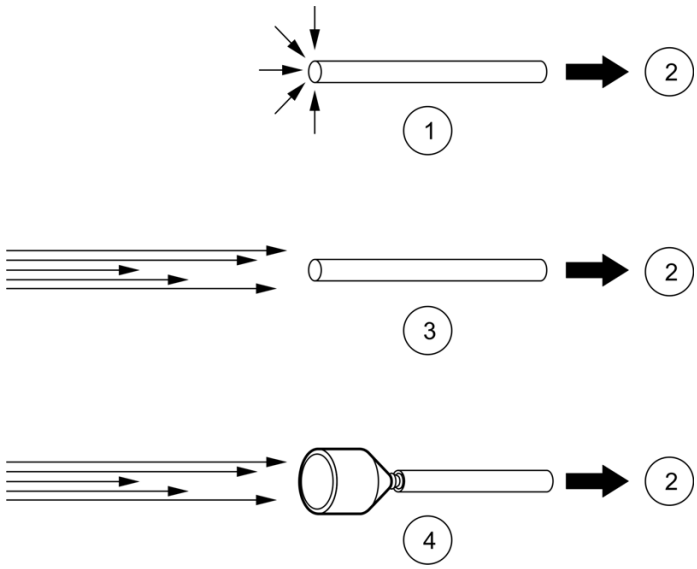


Figure 4 Isokinetic probe function

1	No probe in non-laminar air flow	**3**	No probe in laminar air flow—particles are missed
2	To particle counter	**4**	Isokinetic probe in laminar air flow—most accurate

Section 3 Installation

Important Note: *Approved personnel only must install or commission the equipment.*

3.1 Component list

Compare each item to the items in the shipment (Figure 5). Keep the packaging materials to use when the counter is sent to the factory for calibration. If an item is missing or damaged, contact the manufacturer (Section 8 on page 49).

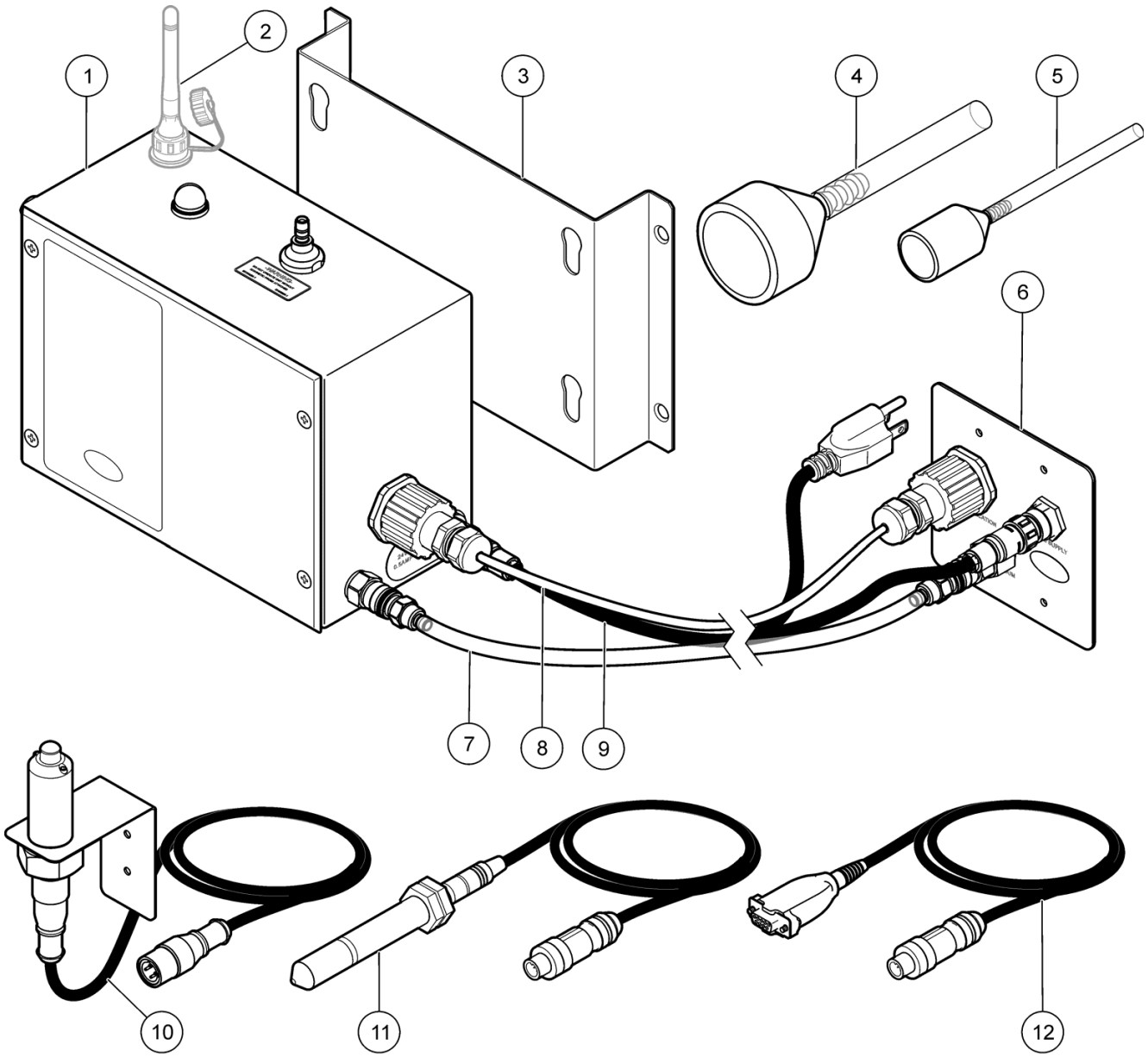


Figure 5 Instrument components[1]

1	MET ONE 7000 particle counter	**7**	Communication cable
2	Antenna (Wireless unit only)	**8**	Power cable (AC or DC)
3	Wall mount plate	**9**	Vacuum tubing
4	Isokinetic Probe for 1.0 cfm flow option	**10**	External LED indicator (optional)
5	Isokinetic Probe for 0.1 cfm flow option	**11**	RH/Temp probe (optional)
6	Wall plate	**12**	Service port cable (4-pin DIN to 9-pin serial)

[1] Not shown: user manual

3.2 Installation overview

The tasks that follow are necessary to install the particle counter (Figure 6):

1. Mount the counter on a wall (section 3.4.1 on page 13).
2. Install and ground the wall plate.
3. Terminate the electrical and communications cables at the wall plate (section 3.6 on page 17).
4. Terminate the house vacuum at the wall plate.
5. Install the sample probe and tubing (section 3.4.2 on page 14).
6. Install the cables for power and communications (section 3.6 on page 17).

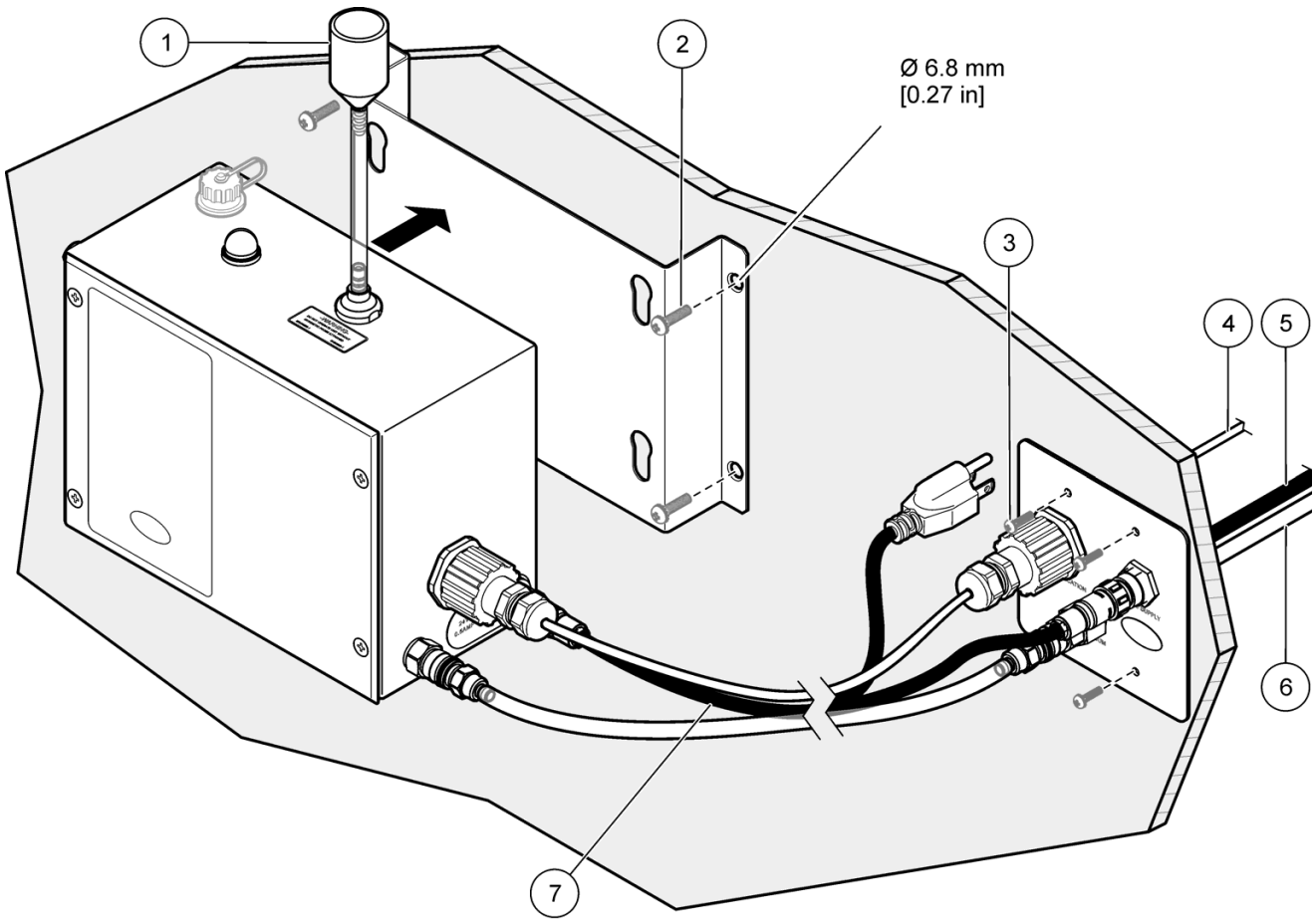


Figure 6 Installation overview

1	Isokinetic probe—direct mount	**5**	Power cable termination into wall plate (DC only)
2	Mount plate screws (user supplied)	**6**	House vacuum termination into wall plate
3	Wall plate screws (user supplied)	**7**	Instrument power cord connection (AC or DC)
4	Communications cord termination into wall plate		

3.3 Installation guidelines

Important Note: *Stop the vacuum pump and make sure all waterproof caps are in place before a cleaning or disinfecting cycle is started.*

Refer to the following general guidelines during installation.

- The MET ONE 7000 is designed to be installed in areas where frequent washdown occurs. The wall plate and connectors provide sealed connections at both the wall and the instrument. When possible, mount the instrument directly below the sample point. Otherwise, keep the airflow in a constant downward direction.
- Put the vacuum pump in a central location. There must be sufficient vacuum for all particle counters in the network.
- Make sure that the temperature in the installation area is not more than the specified temperature for the particle counter (Specifications on page 3). A high temperature decreases the life of the electronic components and laser.
- Keep the distance between the particle counter and the sampling point to a minimum. Make sure that the distance is not more than 3 m (10 ft).
- Make sure that the tubing does not bend and restrict the air flow (section 3.4.2 on page 14).
- Follow the sampling guidelines to prevent sampling errors (3.4.3.2 on page 16).

Vacuum system guidelines
Important Note: *When using house vacuum, put the vacuum in a central location or provide a large distribution manifold to minimize vacuum loss.*

- Capacity—a minimum vacuum capacity of 16 inches Hg is necessary at each particle counter. The vacuum is necessary to control the flow rate at each particle counter.
- Distribution manifold—use a distribution manifold that will keep the vacuum loss to a minimum. Typical materials used for vacuum distribution include brazed copper pipe, schedule 80 PVC pipe or tubing such as Cobolite®.
- Distribution valves—use short tubing lengths to supply the vacuum from the distribution manifold to the individual particle counters. Use a valve and a barb fitting of the correct dimension at each location.
- Minimize piping loss—all junctions, elbows and the tubing length increase the vacuum loss in a system. The loss increases as the distance from the vacuum source to the counters and the number of junctions and elbows increase.

3.4 Mechanical installation

Install the particle counter on a wall with the following supplied parts:

- Mounting plate and screws
- Wall plate. The wall plate fits a standard 2-gang installation box (US) allowing for easy termination of wiring (RS-485 daisy chain, DC Power, Ethernet connection) and vacuum with an auto shut off quick disconnect.

3.4.1 Mount the particle counter and wall plate

1. Attach the mounting plate to the back of the particle counter with the flat head screws supplied.
2. Use customer supplied screws to install the mounting plate on the wall.
3. Hang the particle counter assembly on the slotted holes on the mounting plate. (Figure 6 on page 12).

4. Install the wall plate next to the particle counter using the four screw holes on the plate.

Note: *Installation of the wall plate into a standard 2-gang box is recommended (section 3.4 on page 13).*

5. Properly ground the wall plate.
6. Terminate the electrical and communication networking wiring (section 3.6 on page 17).
7. Following the tubing connection guidelines, terminate the house vacuum at the back of the wall plate (Figure 7 on page 15).
8. Connect the instrument power (24 VDC only), communications cable, and vacuum to the wall plate according to type (3.6.4 on page 18, 3.6.5 on page 19 or 3.6.7 on page 21).

3.4.2 Tubing installation

Use hooks or cable ties to hold the tubing and prevent a bend in the tubing. A bend in the tubing can restrict the air flow and cause the following problems:

- A restriction on the sampling side can cause particles to collect on the inside of the tubing. The particles will not be counted. The collected particles can release at random, which will cause spikes in the count level.
- A restriction on the vacuum side will cause the vacuum to fall below specified levels. The low vacuum can cause a flow alarm and low particle count.

Prerequisites:

- Sample tubing—Hytrel® Bevaline, Tygon® or equivalent
- Vacuum tubing—Hytrel Bevaline, Tygon or equivalent
- Tubing hooks or cable ties

Installation procedure:

Important Note: *Do not connect the vacuum tube to the vacuum source until the room is ready for sampling.*

Complete the following steps to install the intake or vacuum tubing.

1. Cut the intake (sample) tubing to connect the counter to the sample probe. Keep the tube length to a minimum. Make sure that the length is not more than 3 m (10 ft).

   Note: *A tube length that is longer than 3 meters can cause a loss of particles > 1 µm. If a longer length is necessary, compare the results between a portable particle counter and the remote particle counter. A lower result in the remote counter indicates a tube length that is too long.*

2. Cut the vacuum tubing to connect the counter to the vacuum source. Keep the tube length to a minimum.
3. Put a cover on the tube ends to make sure that unwanted material does not go in the tubes during installation.
4. Support the tubing with hooks or cable ties at intervals that are not more than 4 feet apart. Make sure that the tubing has a minimum bend radius of 4-inches (Figure 7).
5. Connect the intake tubing to the fitting on the top of the particle counter. Connect the other end of the tubing to the isokinetic probe.
6. Connect the vacuum tubing to the fitting on the side of the counter. Do not connect the other end to the vacuum until the room is ready for sampling.

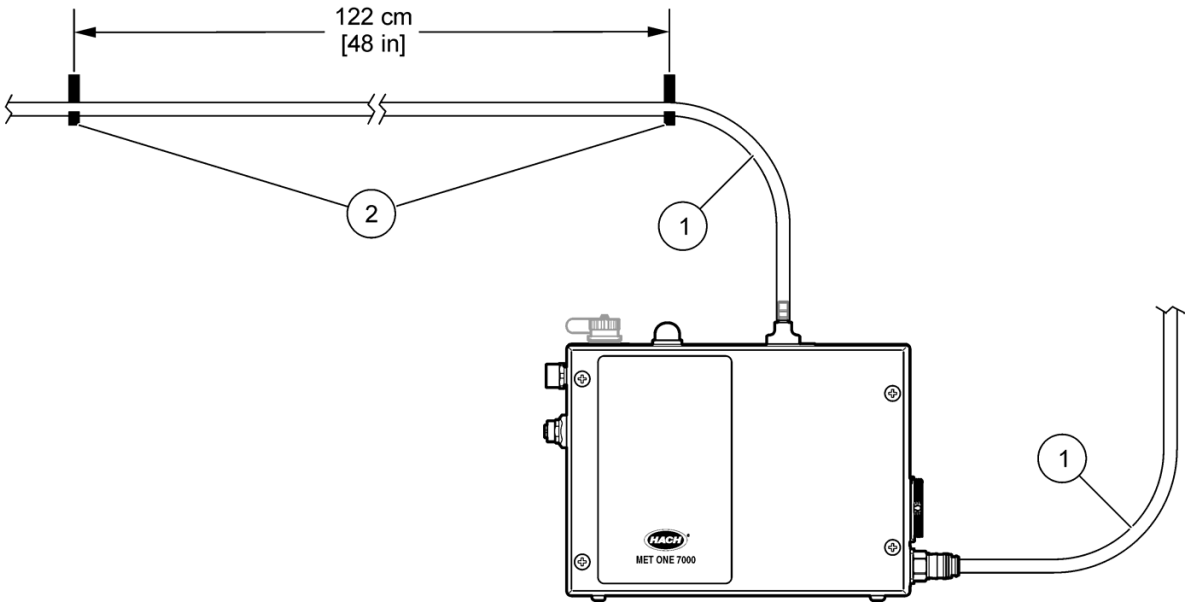


Figure 7 Tubing installation guidelines

1	Bend radius—minimum of 102 mm (4 in.)	**2**	Tubing supports—4 feet maximum between supports

3.4.3 Sample probe installation

The sample probe must be installed correctly to prevent contamination of the counter and to get a representative sample of the area.

3.4.3.1 Sample probe kits

The following optional kits are available for installing the sampling probe. Refer to Figure 8 and Replacement parts and accessories on page 47 for order information.

- Direct mount—the probe is installed on a short piece of tubing directly on top of the counter (Figure 6). Use this probe when the particle counter can be located where the sample is collected. Use the direct mount probe to keep particle loss to a minimum.
- T-type wall bracket—the probe is installed in a wall bracket. The tubing is cut to connect the probe to the counter.
- Vertical wall mount—the probe is connected to a stainless steel tube and bracket. Use this probe for installation on equipment with stainless steel tubing. The probe can be located where the sample is collected.
- Through-wall mount—the probe is connected to a stainless steel tube and wall bracket. Use this probe to collect samples on the other side of a wall from the counter.
- Ceiling mount—the probe is connected to a stainless steel tube (J-hook or 90 degree) and ceiling bracket. Use this probe to collect samples in the middle of a room or when the particle counter is installed above the room.

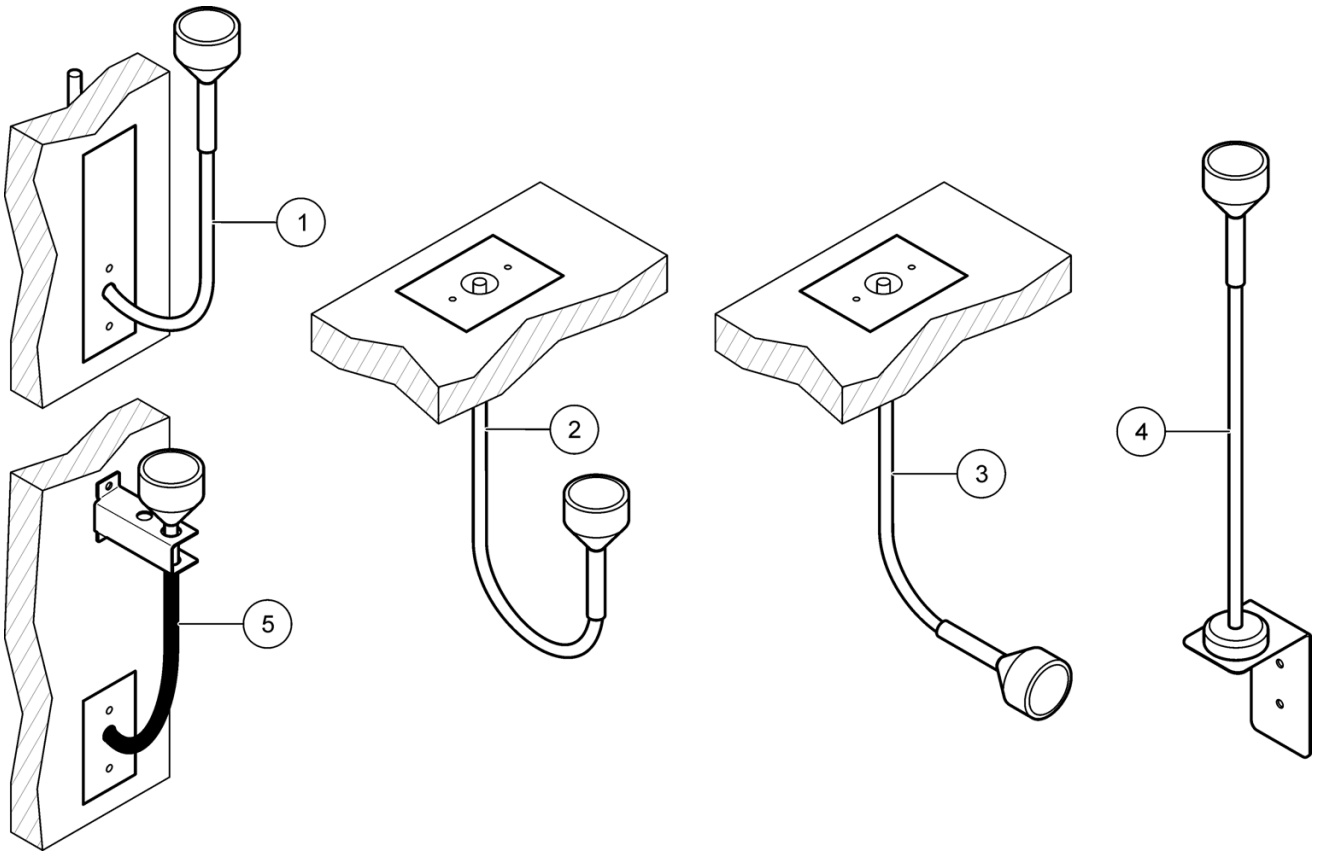


Figure 8 Probe mount options

1	Through-wall mount	**4**	Vertical wall mount
2	Ceiling mount—J hook	**5**	T-type wall bracket
3	Ceiling mount—90 degree		

3.4.3.2 Sample probe guidelines

The position of an isokinetic probe is very important for count accuracy. Refer to the sampling guidelines and Figure 4 on page 10 before installation.

Sampling guidelines

- Keep the sample probe a minimum of 12 inches from loose materials, dust, liquids and sprays.
- Keep the sample probe a minimum of 12 inches from potential contamination sources such as an instrument exhaust fan.
- Laminar flow—install at least 1 sample probe per 25 sq. ft. of surface area.
- Turbulent flow—install at least 2 sample probes per clean room.
- Position the sampling probe to face the direction of flow (refer to Figure 4 on page 10).
- Powders will contaminate the sensor and cause incorrect results or a counter failure.
- Liquids will contaminate the internal optics of the sensor and change the calibration of the counter. Liquids can be suspended in air in the form of oil droplets.
- The vapors from drying adhesives or other chemicals can permanently coat the sensor optics or other internal parts.

- All types of smoke will contaminate the sensor.
- Vapors that contain corrosives will quickly cause permanent damage to the optics or electronics of the counter.

3.5 Wiring safety information

When making any wiring connection to the instrument, obey the warnings and notes that follow. Obey all warnings and notes in the installation sections. For more safety information refer to section 2.1 on page 5.

Important Note: *Always remove power to the instrument before an electrical connection is made.*

Electrostatic discharge (ESD) considerations
To keep hazards and ESD risks to a minimum, remove power to the instrument when a maintenance procedure does not require power.

Internal electronic components can be damaged by static electricity. This damage can cause degraded instrument performance or instrument failure.

To prevent ESD damage to the instrument, complete the following steps:

- Before touching an electronic component, discharge static electricity from the body. Touch an earth-grounded metal surface such as the chassis of an instrument or a metal conduit or pipe.
- To keep static build-up to a minimum, avoid excessive movement. Transport static-sensitive components in anti-static containers or packaging.
- To discharge static electricity from the body and keep it discharged, wear a wrist strap connected by a wire to earth ground.
- Handle all static-sensitive components in a static-safe area. If possible, use anti-static floor pads and work bench pads.

3.6 Electrical installation

Refer to the following sections for the communication option that is used:

- RS485 (section 3.6.4 on page 18)
- Ethernet (section 3.6.5 on page 19)
- Analog (section 3.6.7 on page 21)
- Wireless (section 3.6.6 on page 20)

3.6.1 Wire preparation

Properly prepare each wire by removing the insulation on the wires by ¼ inch.

3.6.2 DC power requirements

DANGER
Electrocution hazard. Do not connect this product directly to an AC power source.

DANGER
Electrocution hazard. The output voltage of the power supply unit for this product must not exceed 28 VDC.

The DC configuration requires an external power source that can supply 24 VDC to supply power to the instrument.

3.6.3 AC power requirements

DANGER
Electrocution hazard. Do not connect this product directly to an DC power source.

DANGER
Electrocution hazard. The output voltage of the power supply unit for this product must not exceed 100 to 230 VAC.

The AC configuration requires use of the AC power cord supplied with the instrument.

3.6.4 RS485 wiring

Refer to Figure 9 and Table 2 to install a particle counter with RS485 communication.

Network wiring
RS485 (EIA-485) supports up to 32 instruments (12 K load each). Use a high grade wire for serial communications such as Belden 9841. The manufacturer recommends that the length of the network does not exceed 1200 meters.

A typical network wiring diagram for the particle counter is shown in Figure 10. Up to 32 remote counters can be in the network using RS485 Modbus or FXB communication.

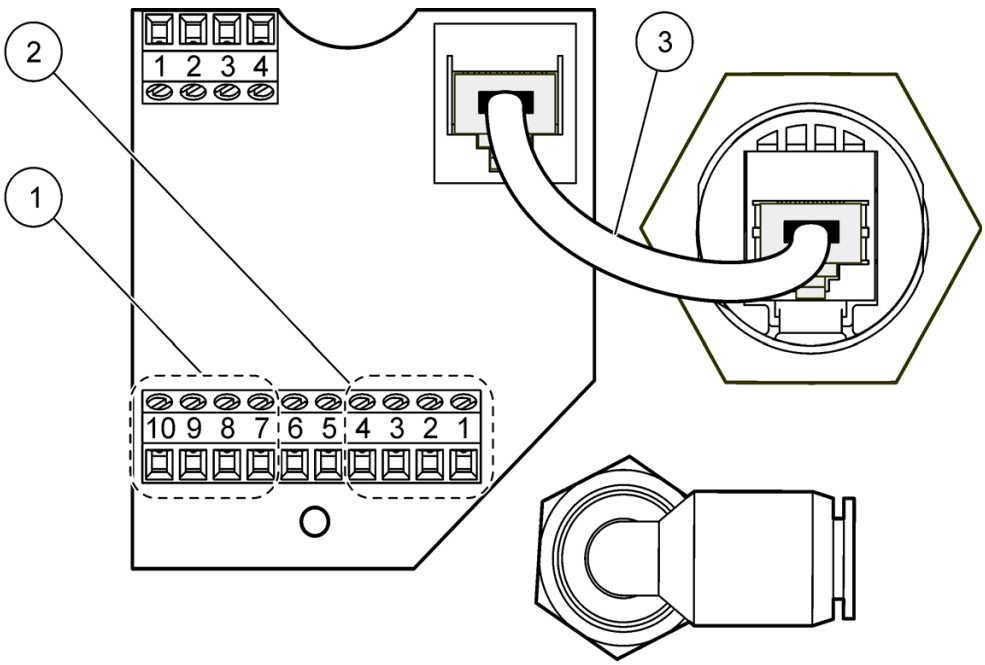


Figure 9 Terminal assignments at wall plate—RS485 communication

1	Power connection terminals (DC power only)	**3**	Jumper cable
2	Communication connection terminals		

Table 2 Terminal assignments at wall plate—RS485 output

Terminal	Assignment
1	RS485 B
2	RS485 A
3	RS485 B (alternate daisy chain connection)
4	RS485 A (alternate daisy chain connection)

Table 2 Terminal assignments at wall plate—RS485 output (continued)

Terminal	Assignment
5	(not used—future option)
6	Shield ground
7	+24 VDC
8	Common
9	+24 VDC
10	Common

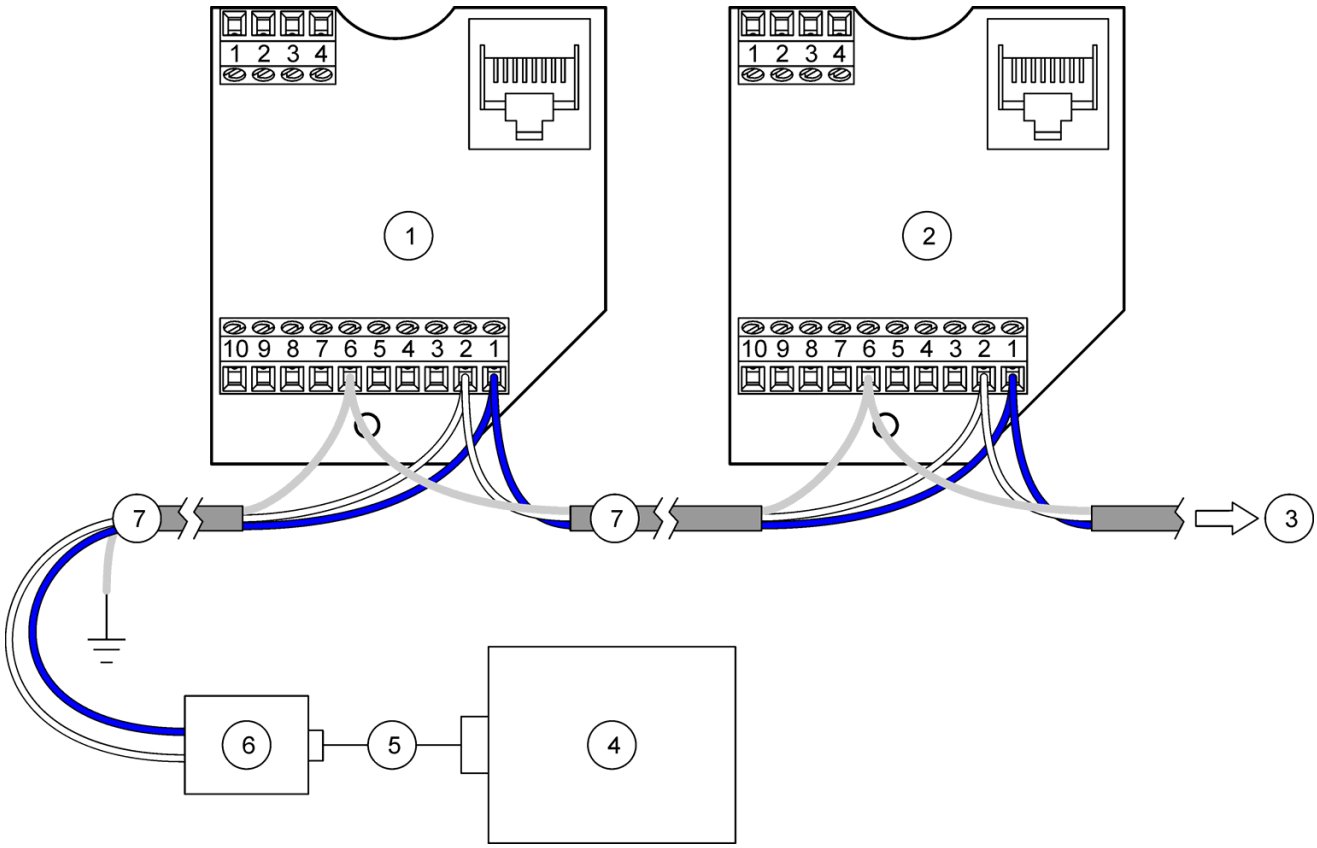


Figure 10 Network wiring at wall plate—10-pin connector

1	Wall plate 1	**5**	Cable
2	Wall plate 2	**6**	RS232 to RS485 converter
3	To additional wall plates	**7**	Network cable
4	PC		

3.6.5 Ethernet wiring

Important Note: *The supplied Ethernet cable caps must be used to maintain a waterproof connection.*

Ethernet standard 10Base-T or 100Base-T can be used. However, the facility wiring must be appropriate for the speed of the network to prevent intermittent problems from occurring. For particle counter installations, Ethernet standard 10Base-T is sufficient to transmit data and is more forgiving of installation errors.

- Length—100 meters maximum single wire length (repeaters can be used to increase the distance)
- Repeaters—4 maximum
- Connector type—RJ-45 (standard Ethernet wiring convention T-568B)

Refer to Figure 11 and Table 3 to install a particle counter with Ethernet communication.

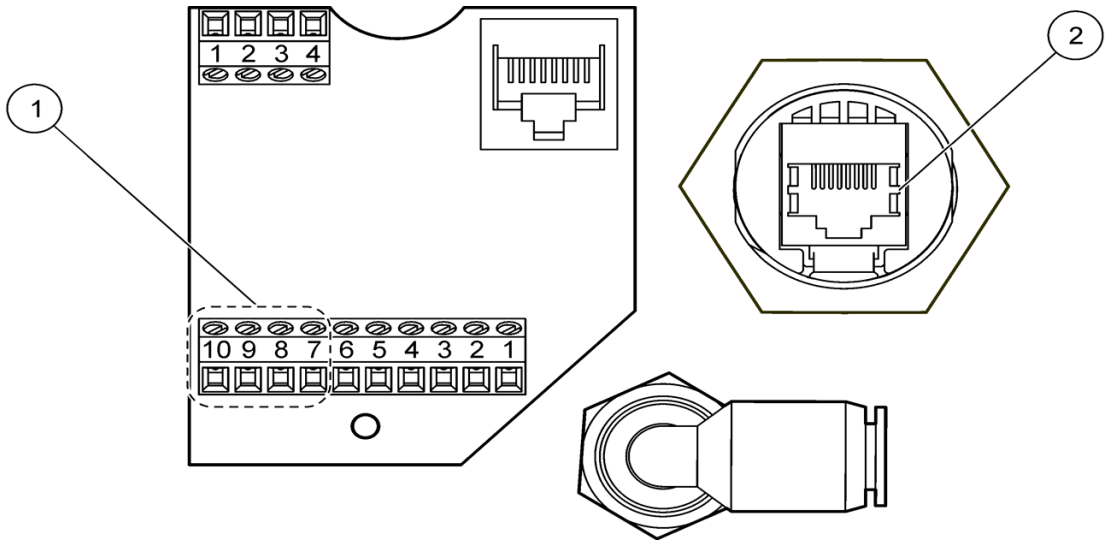


Figure 11 Terminal assignments at wall plate—Ethernet communication

1	Power connection terminals (DC power only)	**2**	To Ethernet hub

Table 3 Terminal assignments at wall plate—Ethernet communication

Terminal	Assignment
1	(not used—future option)
2	(not used—future option)
3	(not used—future option)
4	(not used—future option)
5	(not used—future option)
6	Shield ground
7	+24 VDC
8	Common
9	+24 VDC
10	Common

3.6.6 Wireless installation

Disclaimer

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or

television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: *Changes or modifications to this device not explicitly approved by Hach Ultra Analytics will void the user's authority to operate this device.*

No extra wiring is required for Wireless installation beyond the instrument power connection. The instrument should be located to minimize obstacles such as metal objects and walls between the instrument and the Wireless network access point. Avoid devices that can cause RF interference to the instrument such as microwave ovens, arc welders, motors, and other industrial machinery. Use lower data rates when necessary to increase the operating range. For good margin, the instrument should be able to communicate at twice the required distance.

Notes:

- The antenna gain must not exceed 5 db.
- The antenna must be installed such that 20cm is maintained between the antenna and users.
- The instrument module may not be co-located with any other transmitter or antenna.

The data rates available are not necessarily the data throughput rate. When using security encryption or increased distance between the instrument and the network access point the data throughput also lowers.

An RF site survey should be conducted to identify potential problems before installation. The only way to determine the actual range and data rate is to test the unit in the environment.

3.6.7 Analog wiring

Counters with the analog output option send a 4-20 mA signal that is proportional to the number of counts in a given sampling time. A data acquisition system receives the signal. The maximum number of counts that correspond to the 20 mA signal is set using the setup utility program. An analog instrument can have 2 or 4 channel sizes. If the power is set to off, then all channels send an output that is < 2 mA. The channel output is < 2 mA if there is a sensor-calibration failure or flow failure and the instrument has a flow monitor installed.

Analog instruments cannot be used in network configuration. Refer to Figure 12, Table 4 and Table 5 to install a particle counter with the analog output.

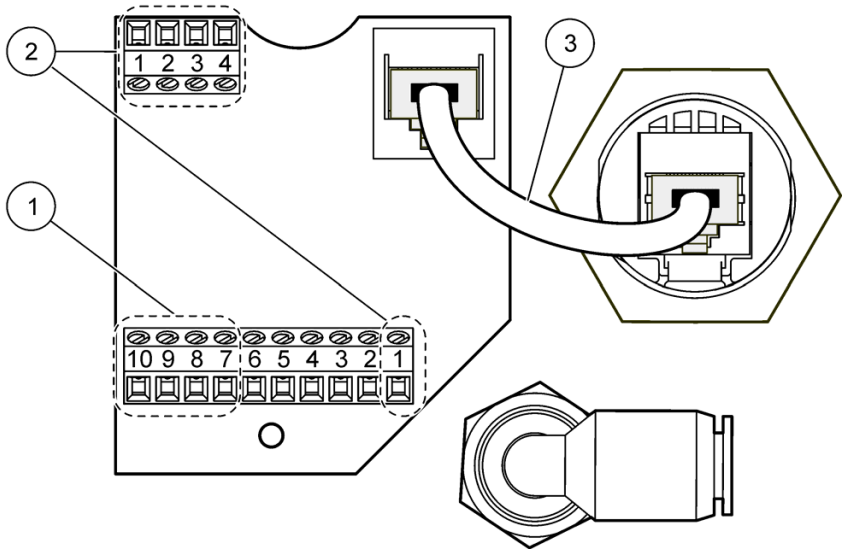


Figure 12 Terminal assignments at wall plate—analog output

1	Power connection terminals (DC power only)	**3**	Jumper cable
2	Channel output terminals (Table 5)		

Table 4 Terminal assignments at wall plate—analog output

Terminal	Assignment
1	CL +24 VDC
2	(Not used—future option)
3	(Not used—future option)
4	(Not used—future option)
5	(Not used—future option)
6	Shield ground
7	+24 VDC
8	Common
9	+24 VDC
10	Common

Table 5 Channel output terminal assignments

Terminal	Assignment
1	Channel 1
2	Channel 2
3	Channel 3
4	Channel 4

When using a +24 Volt power supply as the voltage supply to the counter as shown in Figure 13, the power supply can also be used as the 4-20 mA loop power source if loop resistance is met, as shown in Figure 14. The maximum limit of total loop resistance (load and wiring combined) allowed is shown in Figure 15.

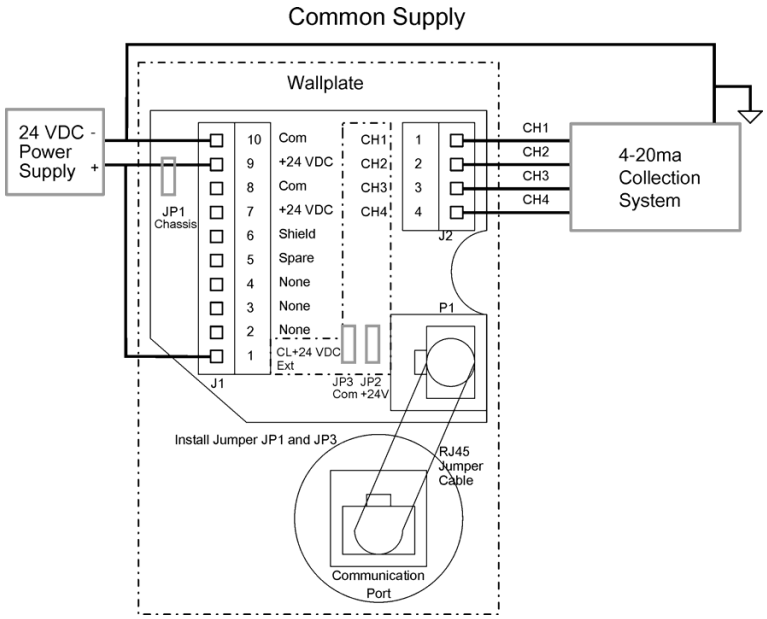


Figure 13 Wallplate connection for common power and loop supply

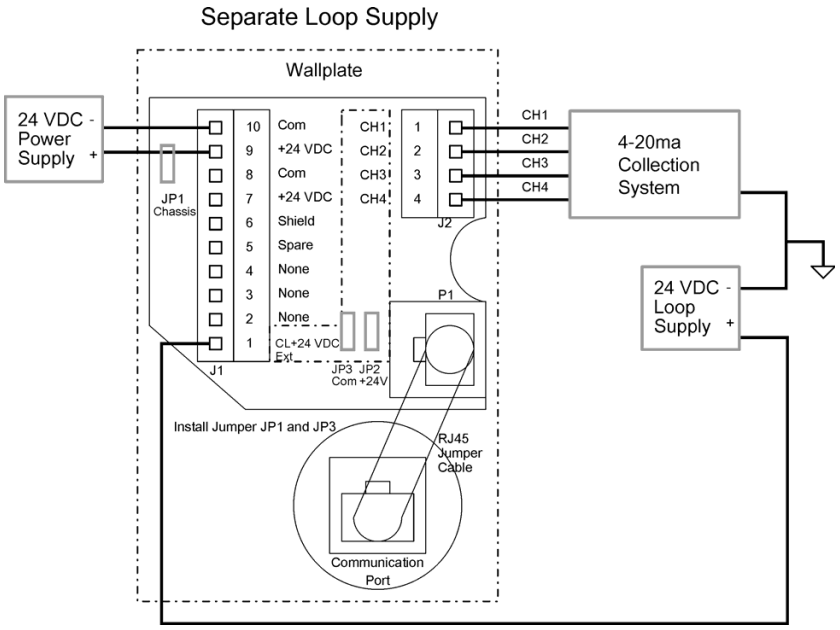


Figure 14 Wallplate connection for separate power and loop supply

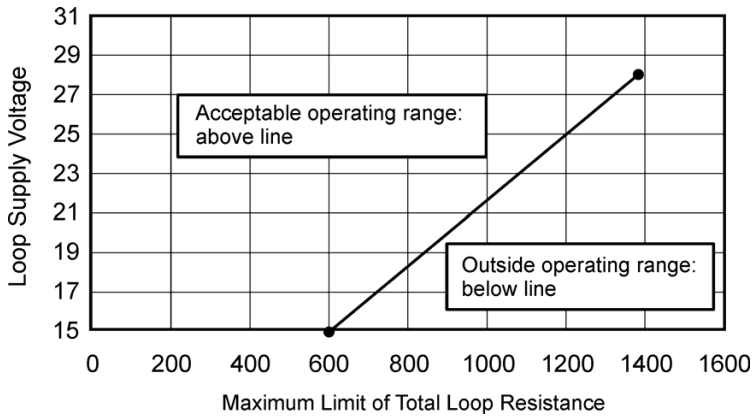


Figure 15 Maximum limit for current loop operation

3.6.8 Testing analog output

Use a set of load resistors with 0.1 % accuracy and at least ¼ watt capability. Typically values of 100, 250 or 600 ohms are used.

For 100 ohms:

- **a.** 4 ma output will create a 0.4 volt output +/- 0.01 volts
- **b.** 20 ma output will create a 2.0 volt output +/- 0.01 volts
- **c.** A fault condition for FLOW or SENSOR/CAL will cause a value close to 0 volts

Each particle counter must be configured before operation for parameters such as sample time and count alarm thresholds.

4.1 Configure the particle counter

A setup utility program is used to configure parameters that are stored in the particle counter. When power is applied, the counter will look for a new configuration. If a new configuration is not found, the previously saved configuration will be used.

4.1.1 Configuration setup

Each particle counter must be connected to a PC for configuration.

Prerequisites

- Service port cable, 4-pin DIN to 9-pin serial connector (section 7.1 on page 47)
- MET ONE 7000 setup utility program—requires PC with Windows® 2000 Professional or Windows® XP Professional

Setup

1. Make sure that Microsoft .Net Framework is installed on the PC. If not installed, open the dotnetfx.exe file on the utility program CD to install the application.

   Note: *The user must be logged on to the PC as an Administrator.*

2. Copy and paste the SetupUtility.exe file from the utility program CD to the PC.
3. Connect the particle counter to the PC as shown in Figure 16.
4. Start the utility program to configure the instrument (section 4.1.2 on page 28).

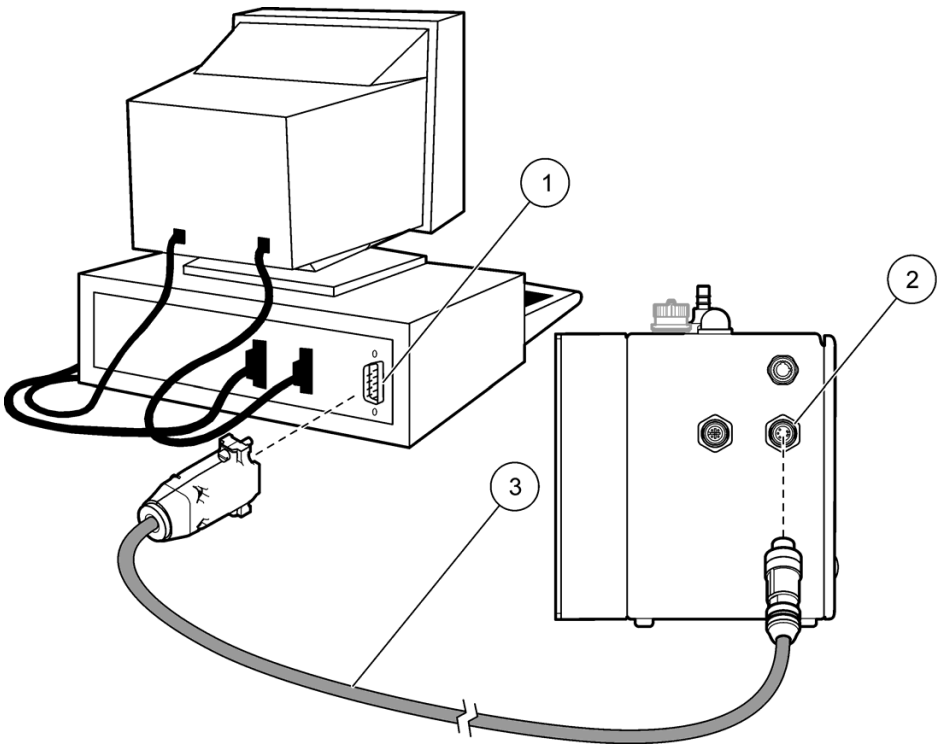


Figure 16 Particle counter connection to PC

1	RS232 COM port on PC	**3**	Cable, service port (4-pin DIN to 9-pin serial)
2	Service port on the particle counter		

4.1.2 Utility program operation

Complete the following steps to configure the particle counter.

1. Open the SetupUtility.exe file. The utility program will open (refer to Figure 17 for non-wireless, or to Figure 18 for wireless).
2. Find the **Comport** field. If necessary, change the COM port to match the port on the PC that the particle counter is connected to. Click **READ INSTRUMENT**. The utility will read the data that is stored in the instrument.
3. Make sure that the data in the **Instrument Information** section is accurate. This section shows the instrument model number, communication option, firmware version and communication address (if applicable).
4. Change the parameters in the **General** section as is necessary. Refer to the parameter descriptions that follow:
   - **Count Mode** (for Modbus or FXB only)—set to differential or cumulative. The default count mode is set as cumulative.
   - **System Date/Time**—enter the current date (YYYY/MM/DD) and time (HH:MM:SS, 24-hour format).
   - **Sample Timing: Sample**—the length of time that data is collected for each sample. The default sample time is one minute (00:01:00).
   - **Sample Timing: Hold**—the length of time that data collection is stopped between samples. Use the Hold time to stop data collection during maintenance procedures. The default Hold time is 0 (00:00:00).
   - **Count Alarms**—set the number of counts for each size channel that will trigger a count alarm.
   - **Sample Mode**—set to Auto.
   - **Flow Units—**set to CFM (cubic feet per minute) or LPM (liters per minute).
5. The **Diagnostics** section can be used to make sure that the wiring to an external light stack is correct. Set the **Indicator LED** to flash or not flash for one of the colors. Look for the LED on the light stack to illuminate or flash to make sure that the wiring is correct.

   Note: *It is not possible to save the diagnostic settings and they have no effect on the instrument operation. For a description of the LED indicators, refer to section 2.3 on page 9.*

6. Change the settings for the communication protocol that is used:
   - **Serial**—select the RS485 serial communication protocol (FXB or Modbus). If Modbus is selected, enter the slave address. When the address is 31 or less, use the dip switches on the bottom of the instrument to set the address (refer to Table 6 on page 31).

     Note: *If DIP switches are used the address can be set between 0 and 31. If an address of 32 or higher is entered, the dip switch setting will be ignored and the entered value will be used. The total number of physical counters that can be connected to a RS485 network is 32 maximum, irrespective of FXB or Modbus protocol selected.*

   - **Analog**—set the count value for each channel that corresponds to the 20 mA output signal (default = 1000).
   - **Ethernet**—refer to section 4.2.2 on page 32.
   - **Wireless**—refer to section 4.3.1 on page 35.
7. Click **SAVE SETTINGS** to save the settings in the instrument.

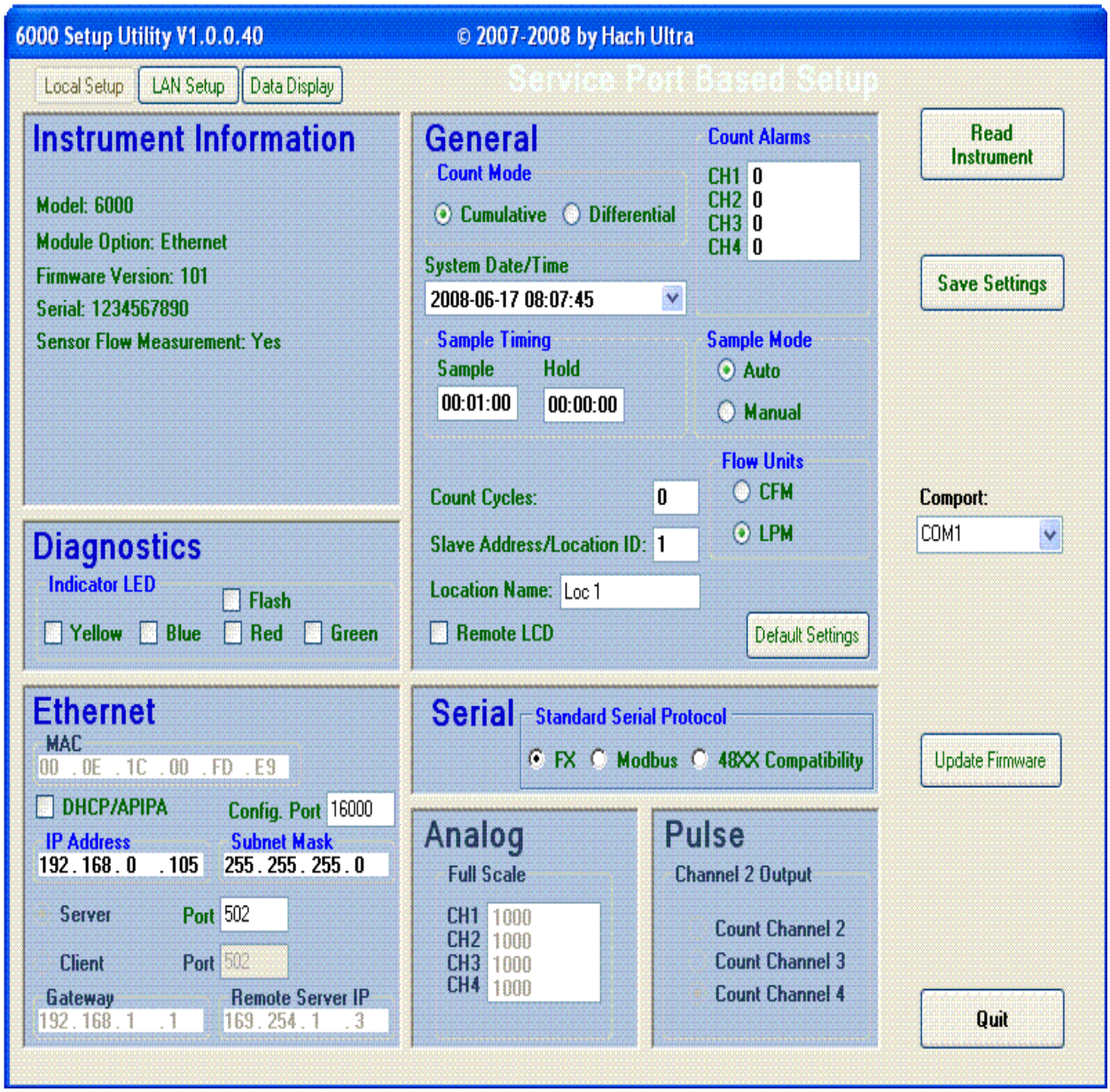


Figure 17 Setup utility program (non-wireless)

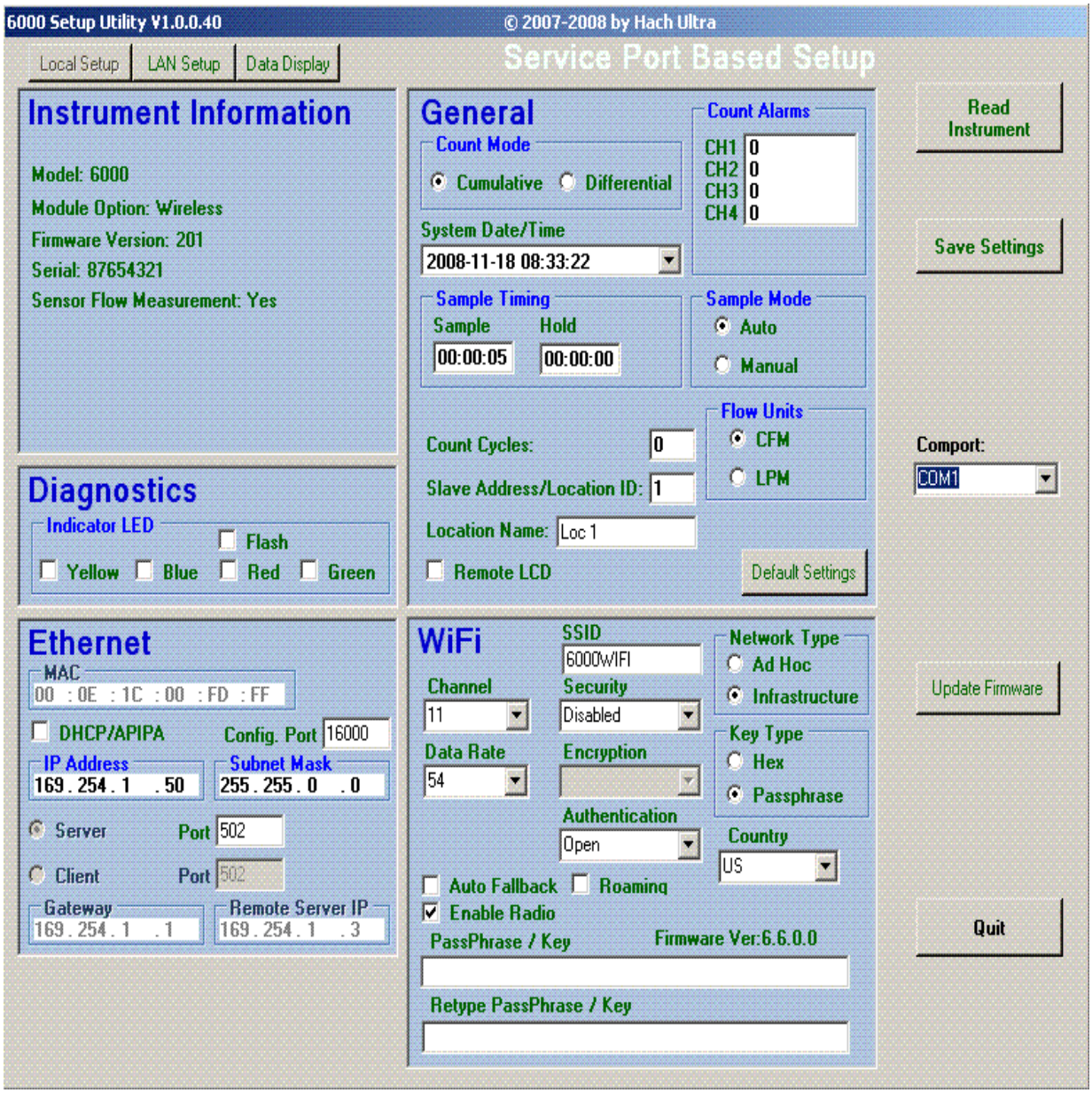


Figure 18 Setup utility program (wireless)

4.2 Particle counter communication

Each MET ONE 7000 particle counter is assembled with one of the following communications formats:

- RS485 communications—Modus RTU (section 4.2.1 on page 31) or FXB protocol (Appendix B on page 63)
- Ethernet with ModbusTCP protocol (section 4.2.2 on page 32)
- Analog output (section 4.2.3 on page 34)
- Wireless communications (section 4.3 on page 35)

4.2.1 RS485 serial output with Modbus RTU protocol

The RS485 serial network circuit provides communications for a maximum of 32 remote counters and a control computer. Only one counter can transmit data at a time.

Each counter must have a unique instrument address. Refer to Set the instrument address—RS485 on page 31 for instructions on setting the instrument address.

MET ONE 7000 counters with the RS485 Modbus communication option use industry-standard Modbus RTU protocol. In this communication mode, a series of registers hold data about measurement results and operation parameters. The parameters are preset by the user through a utility setup program or through the central monitoring software. A list of tables in Appendix A on page 53 shows the register addresses, types and use. A user must write drivers to communicate with the particle counter through these registers with the Modbus RTU protocol.

Set the instrument address—RS485

For a network of counters with RS485 Modbus or FXB protocol, use the dip switch on the bottom of the counter to set the address (refer to Table 6). Open the door of the particle counter to access the dip switch (Figure 19).

Important note: *Address 0 can only be used with FXB protocol. Address 0 is reserved for use as a broadcast address for Modbus RTU.*

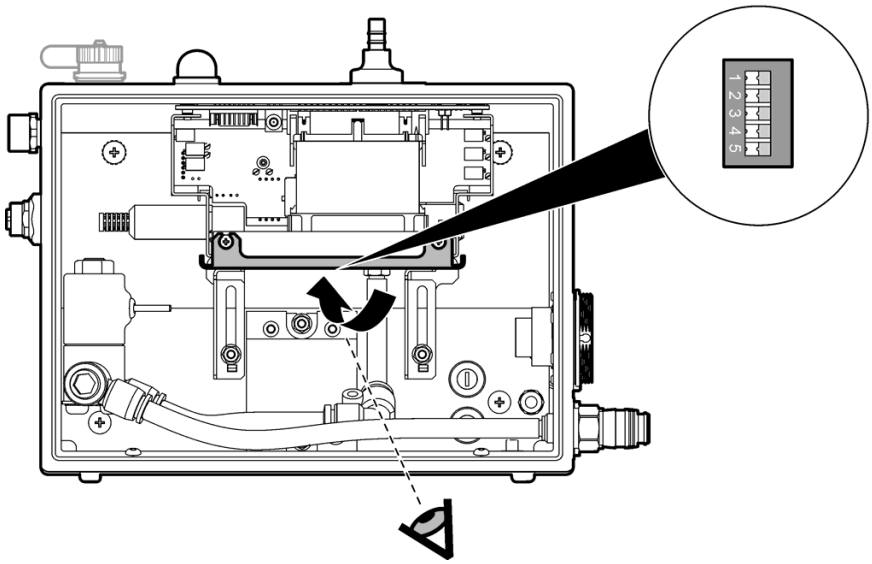


Figure 19 Dip switches in the off position

Table 6 Dip switch settings for network address

Network address	Dip switch 1	Dip switch 2	Dip switch 3	Dip switch 4	Dip switch 5
0[1]	Off	Off	Off	Off	Off
1	On	Off	Off	Off	Off
2	Off	On	Off	Off	Off
3	On	On	Off	Off	Off
4	Off	Off	On	Off	Off
5	On	Off	On	Off	Off
6	Off	On	On	Off	Off
7	On	On	On	Off	Off

Table 6 Dip switch settings for network address (continued)

Network address	Dip switch 1	Dip switch 2	Dip switch 3	Dip switch 4	Dip switch 5
0[1]	Off	Off	Off	Off	Off
8	Off	Off	Off	On	Off
9	On	Off	Off	On	Off
10	Off	On	Off	On	Off
11	On	On	Off	On	Off
12	Off	Off	On	On	Off
13	On	Off	On	On	Off
14	Off	On	On	On	Off
15	On	On	On	On	Off
16	Off	Off	Off	Off	On
17	On	Off	Off	Off	On
18	Off	On	Off	Off	On
19	On	On	Off	Off	On
20	Off	Off	On	Off	On
21	On	Off	On	Off	On
22	Off	On	On	Off	On
23	On	On	On	Off	On
24	Off	Off	Off	On	On
25	On	Off	Off	On	On
26	Off	On	Off	On	On
27	On	On	Off	On	On
28	Off	Off	On	On	On
29	On	Off	On	On	On
30	Off	On	On	On	On
31	On	On	On	On	On

[1] Address 0 can only be used with FX B protocol. If address 0 is set with Modbus protocol, the instrument will use address 1.

4.2.2 Ethernet with ModbusTCP protocol

Important Note: *The network should be set up by a network professional. After the network is set up, the counter can be configured through the network (operational) settings.*

Refer to Figure 20 and Table 7 for a description of the fields for Ethernet configuration.

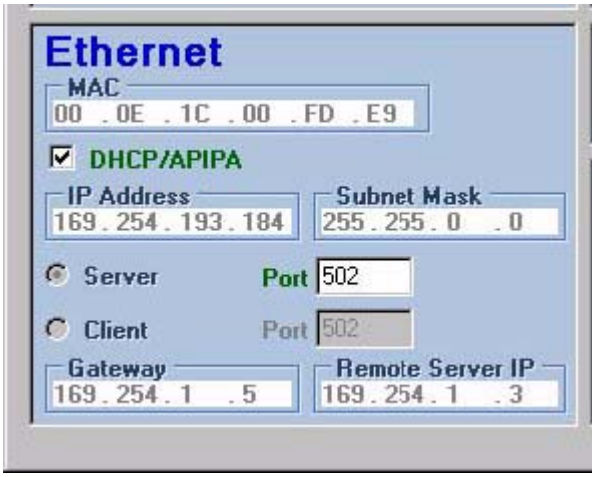


Figure 20 Ethernet section of utility program

Table 7 Ethernet field description

Field	Description	Default
MAC	Media access control: unique permanent hardware address (read-only)	Read-only
DHCP/APIPA	Enables or disables static or dynamic IP addressing by connection to a DHCP server. When enabled, the counter will get an IP address and subnet mask automatically on power up. If a DHCP server is not available, the counter will use APIPA for an IP address and subnet mask. APIPA IP address range: 169.254.0.0 to 169.254.255.255; subnet mask: 255.255.0.0 (Class B network).	Disabled
IP Address	For static IP addresses, each LAN-based instrument must have a unique IP address. Range: 169.254.0.0 to 169.254.255.255 (e.g. 169.254.180.43).	169.254.1.2
Subnet Mask	Instruments of the same type that communicate with a single software package such as FMS use the same subnet mask. Range: 0 to 255, integer only.	255.255.0.0
Server Port	ModbusTCP server listen port. Range: 0 to 65535, integer only.	502
Client Port	Not available	Disabled
Gateway	Not available	Disabled
Remote Server IP	Not available	Disabled

4.2.2.1 LAN setup

For configuration through a network, only the LAN settings can be changed. All other settings must be changed through local setup by direct connection to the service port on the counter or through a ModbusTCP connection.

1. In the utility program, select **LAN SETUP**. The LAN Based Setup window will be shown (Figure 21). The software will search for LAN instruments.
2. If LAN instruments are found, the instruments will be listed as shown in Figure 21. Select an instrument to show the LAN Instrument Settings.
3. Change the instrument settings if necessary. Refer to Figure 20 and Table 7 for a description of the settings. When configured as necessary, click **SAVE SETTINGS**.

   A ModbusTCP connection can be made where all the Modbus registers are available. The user can then access all configuration options in the Modbus register map (refer to Appendix A on page 53).

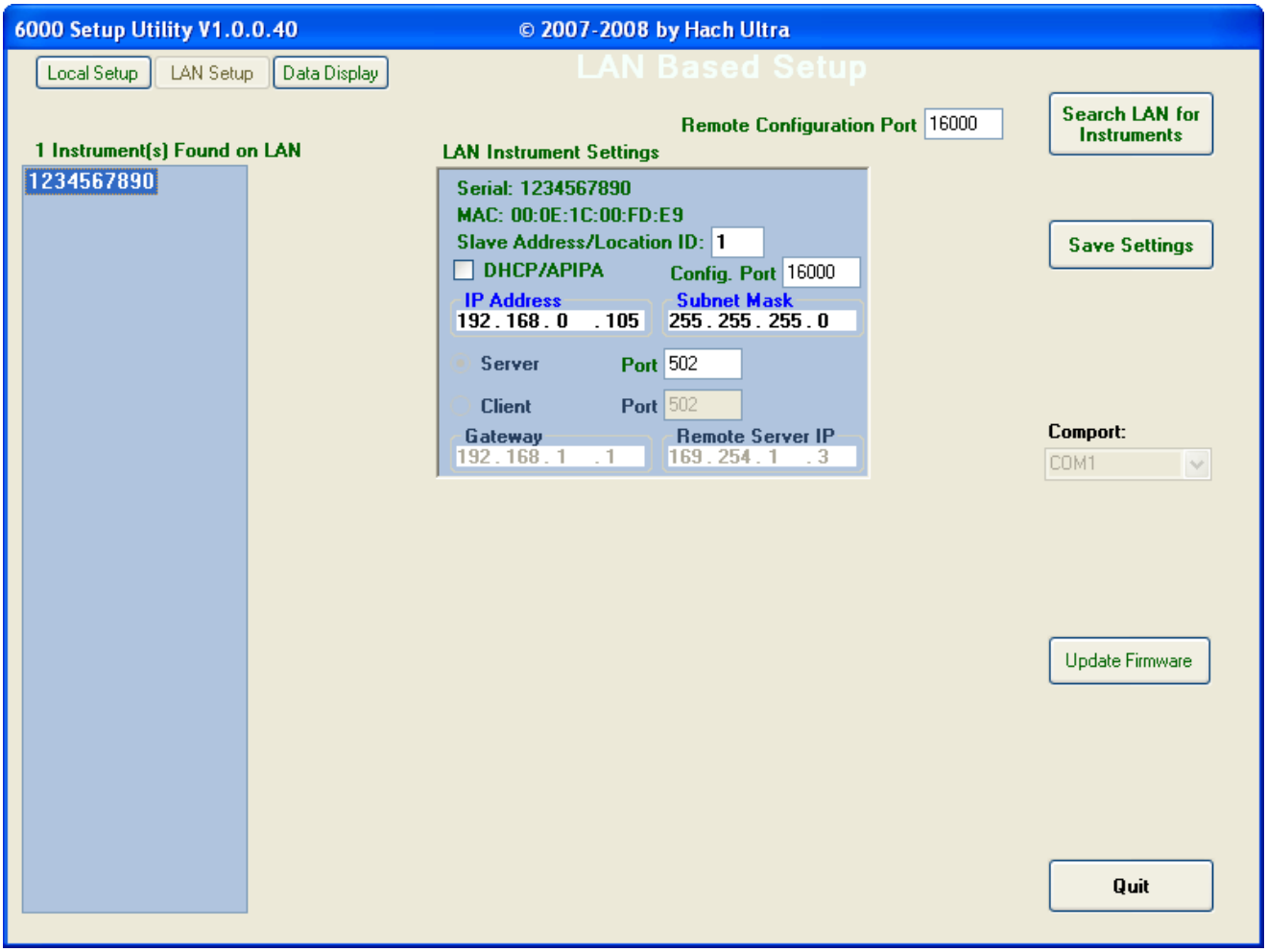


Figure 21 LAN setup for Ethernet units

Error messages
If an error message such as “Invalid IP setting” is shown, refer to Table 7 to find the values that can be used. Enter a value in the range for the setting.

4.2.2.2 Ethernet LED indicators

Refer to Table 8 for a description of the Ethernet connection LED indicators.

Table 8 LED indicators for Ethernet

LED color	On/Off	Indicator
Yellow	On	Connected
Green	Off	10Base-T
Green	On	100Base-T

4.2.3 Analog output

The analog unit sends a 4–20 mA signal that is proportional to the number of particles that are counted in a given sampling time. A data acquisition system installed by the user and connected to an output channel of the analog unit receives the signal. The 4–20 mA output current is scaled for a range between zero and a maximum count set by the user. Analog units cannot be networked.

4.3 Wireless

4.3.1 Wireless with Modbus TCP protocol

Important note: *A good working knowledge of Wireless Network installation, security, and operation is required. The network should be set up by a network professional. After the network is set up, the counter can be configured through the network (operational) settings.*

Note: *Hach Ultra Analytics and its vendors disclaim any responsibility of providing network and access point security with the purchase, installation and operation of its wireless air particle counters. Network and access point security is the sole responsibility of the customer using the wireless particle counters. Hach Ultra Analytics and its vendors will not be liable for any indirect, special, incidental or consequential damages caused by the breach in network security even if Hach Ultra Analytics or its vendors has been given advanced notice of the possibility of such damages.*

4.3.1.1 Wireless configuration

Configuration of the instrument for use with a Wireless LAN is accomplished by setting the parameters in the Ethernet and Wireless sections of the utility program.

4.3.1.2 Ethernet setup

Refer to Figure 22 and Table 9 for a description of the Ethernet fields.

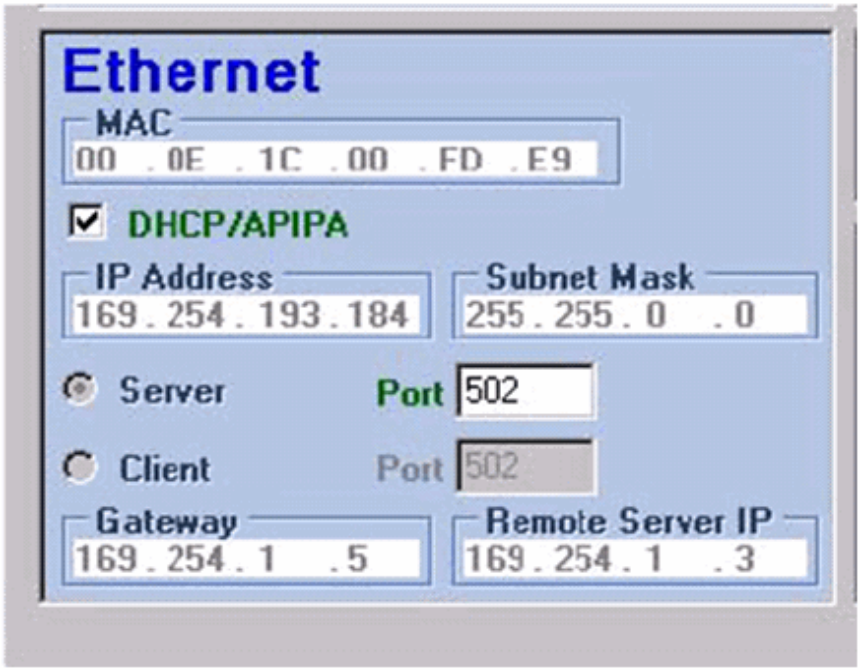


Figure 22 Ethernet section of utility program

Table 9 Ethernet field description

Field	Description	Default
MAC	MAC Media access control: unique permanent hardware address (read-only)	Read only

Table 9 Ethernet field description

Field	Description	Default
DHC/APIPA	Enables or disables static or dynamic IP addressing by connection to a DHCP server. When enabled, the counter will get an IP address and subnet mask automatically on power up. If a DHCP server is not available, the counter will use APIPA for an IP address and subnet mask. APIPA IP address range: 169.254.0.0 to 169.254.255.255; subnet mask: 255.255.0.0 (Class B network).	Disabled
IP Address	For static IP addresses, each LAN-based instrument must have a unique IP address. Range: 169.254.0.0 to 169.254.255.255 (e.g. 169.254.180.43).	169.254.1.2
Subnet mask	Instruments of the same type that communicate with a single software package such as FMS use the same subnet mask. Range: 0 to 255, integer only.	255.255.0.0
Server port	ModbusTCP server listen port. Range: 0 to 65535, integer only.	502
Client port	Not available	Disabled
Gateway	Not available	Disabled
Remote server IP	Not available	Disabled

4.3.1.3 Wireless setup

Refer to Figure 23 and Table 10 for description of the fields for Ethernet configuration.

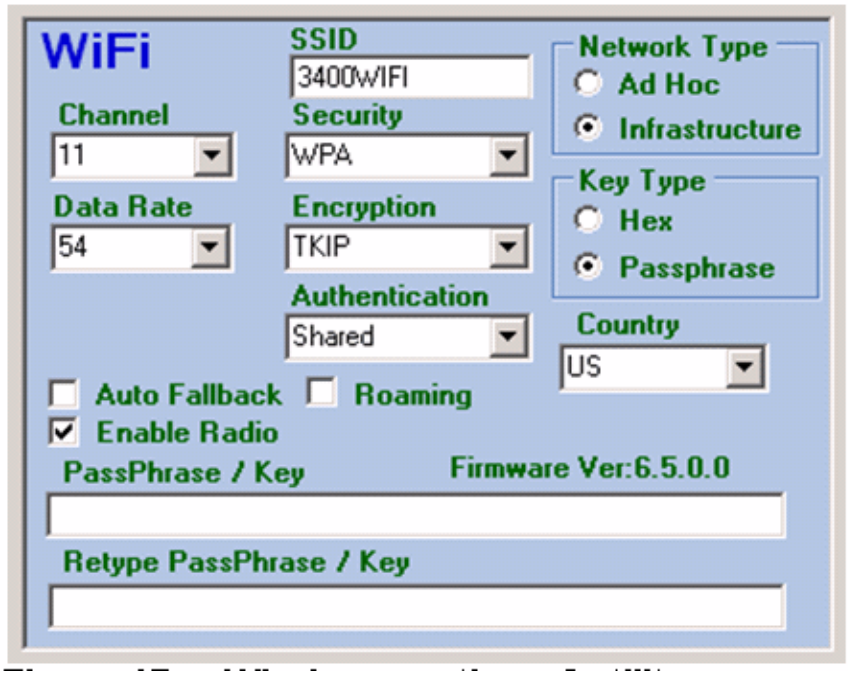


Figure 23 Wireless section of utility program

Table 10 Wireless field description

Field	Description	Default
Channel	Channel when using Ad Hoc mode (peer to peer). When used with a Wireless LAN the channel to be used is determined by the Access Point, and the instrument Wireless radio will set the channel automatically.	11

Table 10 Wireless field description

Field	Description	Default
Data rate	Data Rate for communications. Use lower Data Rate numbers if increased distance is needed between the instrument and the Access Point. Selections are 1Mbps, 2Mbs, 5.5Mbps 11Mbps, 18Mbps, 24Mbps, 36Mbps, and 54Mbps. See the Auto Fallback field description.	54Mbps
SSID	Service Set Identifier name used to identify the Wireless LAN to be used. The SSID should use standard alpha numeric characters and avoid punctuation, spaces, or other special characters. The SSID should be a minimum of 8 characters in length.	6000WIFI
Security	Security authentication for the Wireless LAN. Selections available are Disabled, WEP, WPA, and WPA2	DIsabled
Encryption	Sets the Encryption based on the Security settings of the Wireless LAN. Pairwise and Group encryption is available. Disabled Security uses Open Authentication. WEP security selection allows 64 or 128 bit. WPA security selection allows TKIP or TKIP/WEP. WPA2 security selection allows CCMP, CCMP/TKIP, CCMP/WEP, TKIP, and TKIP/WEP.	Disabled
Authentication	Authentication can be selected as Open or Shared (PSK or Pre-Shared Key). When using a PassPhrase or Hex Key the Authentication should be set to Shared.	Open
Network type	Sets the Wireless communication Network Type as Ad Hoc or Infrastructure. Use infrastructure when connecting to a Wireless LAN.	Infrastructure
Key type	Selects the Key type as Hex or PassPhrase.	PassPhrase
Country	Country where the instrument is installed. Selections are US, France, Japan, Others, Spain, and Canada. Consult the factory for other country settings.	US
Auto fallback	Enables automatic Data rate. See the Data Rate Field.	DIsabled
Roaming	If enabled, Roaming manages the dynamic list of APs belonging to the same network as the AP to which the instrument is currently associated and stores relevant selection criteria for this list.	Disabled
Enable radio	When checked the radio will operate normally. When unchecked the radio will not communicate.	Enabled
PassPhrase/Key	This field contains the actual network encryption key or PassPhrase. A PassPhrase can be up to 63 alpha numeric or 64 Hex characters in length and should be at least 20-character minimum. When using hexadecimal for WEP, the key can only be 5 (WEP64) or 13 (WEP128), i.e., 1C-FD-BA-CF-2E for WEP64. The instrument only uses the first of four WEP keys. Hex values are represented by ASCII characters (not binary). The characters entered into this field are hidden. By default the key / passphrase is blank.	Blank
PassPhrase/Key retype	PassPhrase/Key is retyped in this field to verify the entry is correct. The characters entered in this field are hidden.	Blank
Firmware ver	Displays the firmware version of the Wireless Radio for diagnostic purposes.	6.5.0.0 or newer

4.3.1.4 Network configuration

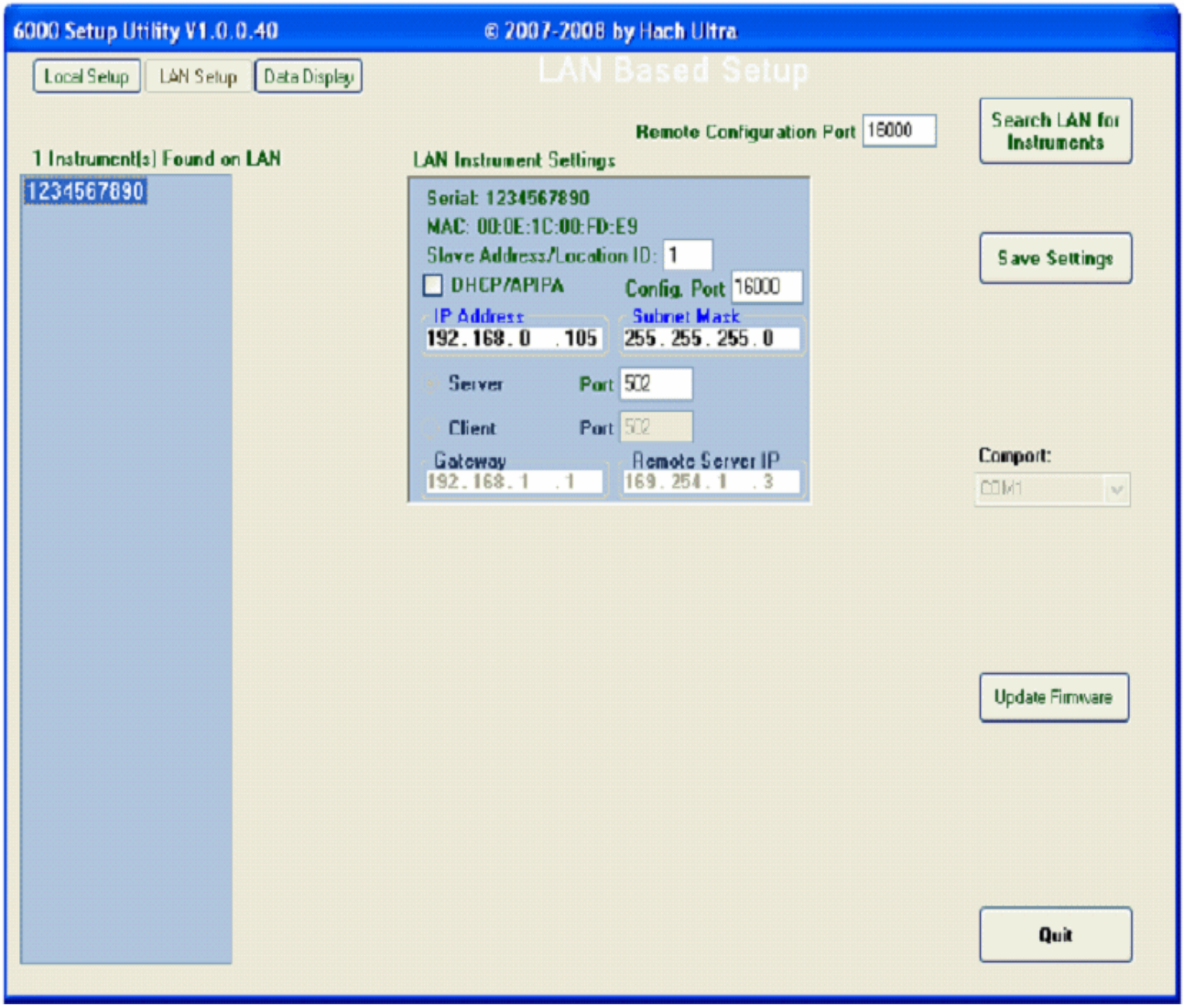


Figure 24 LAN setup for Ethernet units

Error messages
If an error message such as "Invalid IP setting" is shown, refer to Table 9 to find the values that can be used. Enter a value in the range for the setting.

4.3.1.5 Wireless LED indicators

Refer to Table Table 11 for a description of the Ethernet connection LED indicators.

Table 11 LED indicators for wireless

LED indicator	On/Off	Indicator
Green	On	Internal instrument Ethernet Link is established
Yellow	On	Wireless communication is enabled. Occasional blinking indicates data transfer. High rates of blinking may occur if a Wireless LAN cannot be found, or the Wireless settings are incorrect.

4.4 Firmware update

Use the utility program to update the instrument with a new version of firmware.

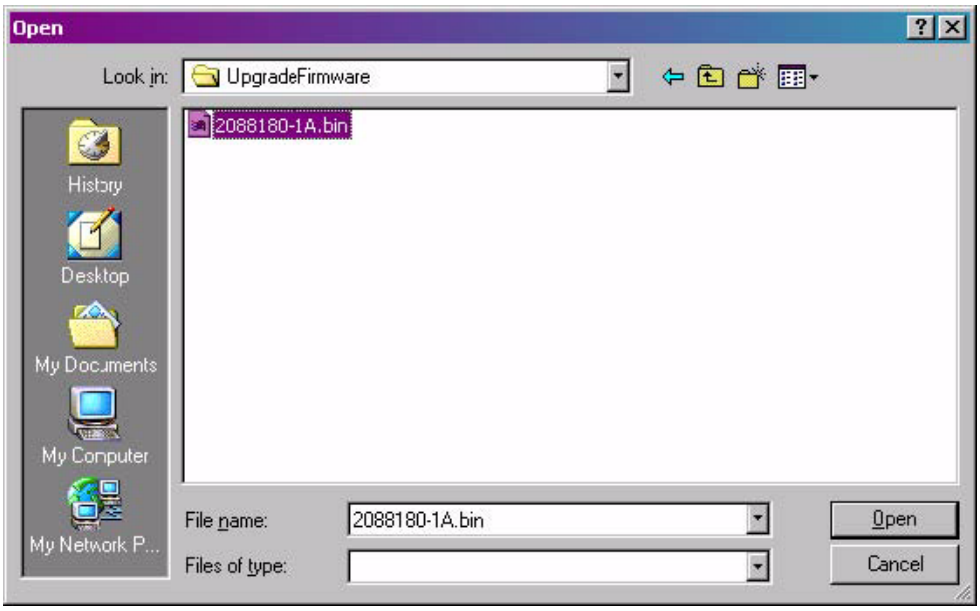
Important note: *Power loss during a firmware update can cause serious problems with the instrument. Refer to* *Firmware update error on page 40**.*

To install the firmware on the particle counter, complete the steps that follow.

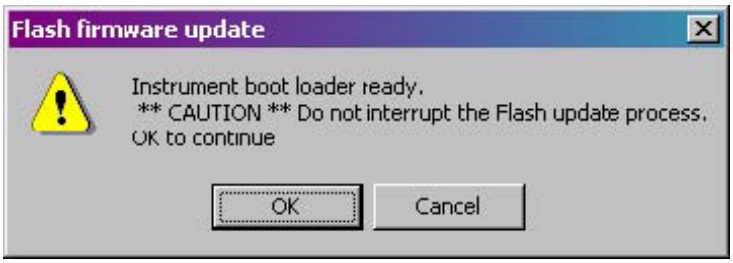
1. Open the 7000 Setup Utility program.

Note: *Verify the Firmware Version shown in the Instrument Information section of the Setup Utility is Version 1.05 or newer. Also verify that the Setup Utility is version 1.0.0.49 or newer. Consult the factory for other versions.*

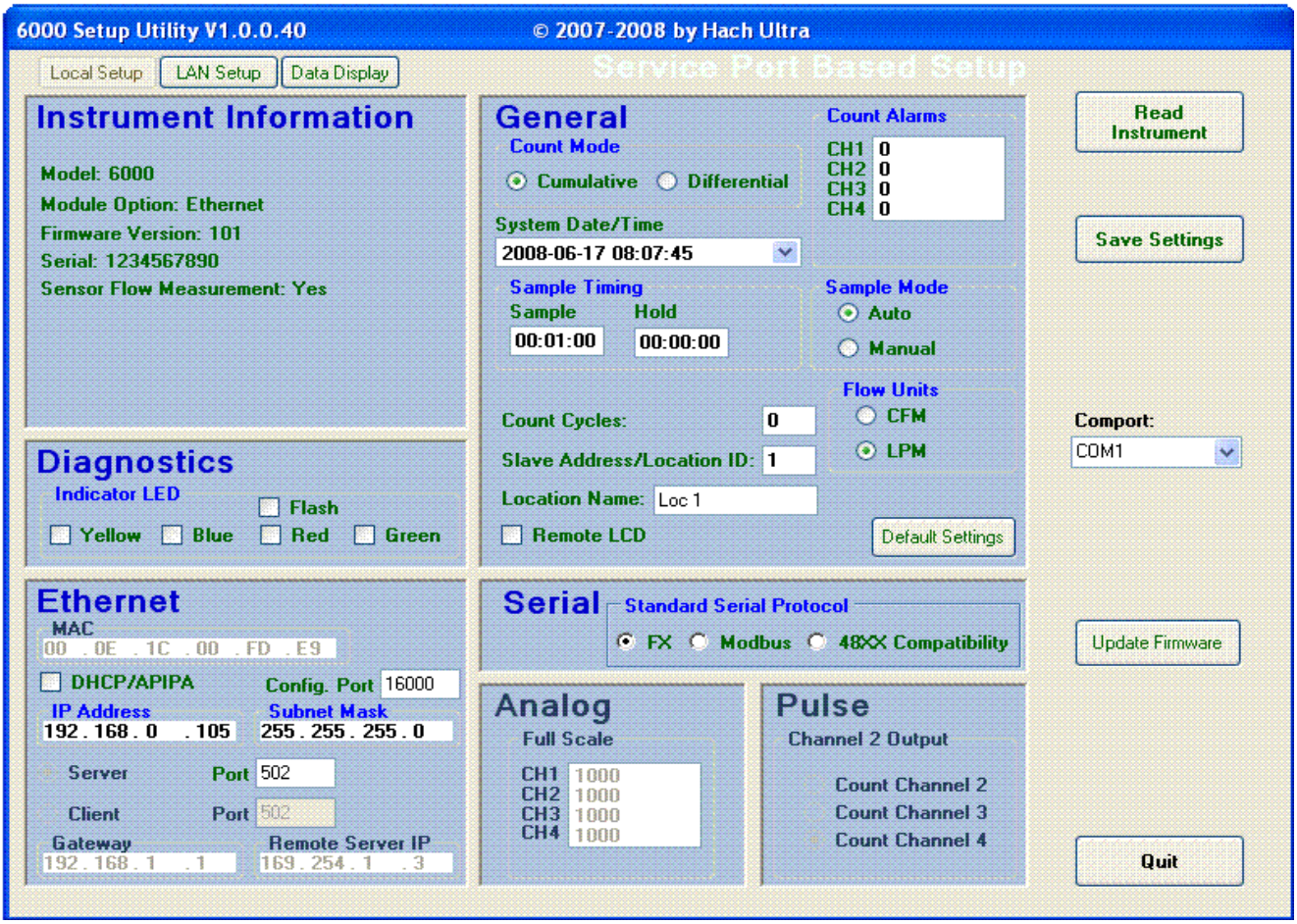
2. Click **UPDATE FIRMWARE**. A window will open for file selection.



3. Select the file that contains the firmware update information and click **OPEN**. A window will open to indicate that the instrument is ready to receive the update.



4. Click **OK**. The instrument update will start. The update status will show below the **UPDATE FIRMWARE** button. The green LED on the counter will flash to indicate update activity. A confirmation message will be shown when the update is complete.



Firmware update error

If an error message is shown during the update, make sure that the instrument has power and that the instrument is connected to the correct port on the PC.

Power failure during update
If a power failure occurred during the update, complete the following procedure.

1. Complete steps 1 to 3 in section 4.4.
2. When the message “Waiting for instrument reply” is shown, remove and connect the terminal connector on the counter. The instrument power must be applied within 30 seconds of opening the firmware file.

   If the update fails again, the instrument must be sent to the factory for repair.

Section 5 Maintenance

DANGER
Personal injury hazard. Only qualified personnel should conduct the tasks described in this section of the manual.

Important Note: *Do not disassemble the particle counter for maintenance. If the internal components require cleaning, contact the manufacturer.*

5.1 Maintenance schedule

Complete the maintenance tasks according to the schedule in Table 12 to keep the particle counter operating efficiently. The maintenance tasks are described in the following sections.

Table 12 Maintenance schedule

Maintenance task	As needed	6 months	Annually
Calibrate			X
Clean instrument	X		
Inspect sample tubing		X	
Purge	X		
Wipe down	X		

5.2 Cleaning the instrument

Important Note: *If the particle counter is installed in a clean room where wash downs occur, avoid hitting the particle counter with a direct high pressure liquid jet stream. System vacuum supply should be disabled and the sampling inlet probe to the MET ONE 7000 counter should be covered. Liquid solutions entering the counter flow path will damage the sensor.*

5.2.1 Wipe down

Wipe the external surface with a soft cloth lightly moistened with isopropyl alcohol (IPA). The isokinetic probes can be autoclaved for cleaning.

5.2.2 Zero counting

Zero counting is a process for removing contaminants such as particles, lint, or dust from the inside of the counter. Zero counting uses a near-absolute filter to block any external particles from entering the counter. Over time, particles are removed from the inlet tube and other internal areas and counted. When the count reaches zero, the counter is considered clean.

Prerequisites:

- Standard purge filter assembly (refer to Replacement parts and accessories on page 47).

Procedure:
Perform zero counting as follows:

1. Attach a standard purge filter assembly to the sensor inlet tube.
2. Start the count cycle and run for at least 30 minutes.
3. Start sampling data in 5-minute intervals and continue until the count reaches zero.

4. When the count is zero and no alarms are on, the counter is functioning correctly. If the count does not reach zero after nine or ten 5-minute sampling periods, purge the sensor overnight.

5.2.3 Purging

Purging is an extension of zero counting (section 5.2.2), running as long as is necessary to achieve zero count results, often for 24 hours. Purging is usually done before a test to make sure there is a proper baseline reference for the counter.

1. Cut off approximately one inch of the inlet tubing so that any stretched or scored section is removed for a good seal.
2. Attach a standard purge filter assembly to the sensor inlet tube.
3. Allow the counter to operate for 24 hours. If a zero count is not reached after 24 hours, inspect the sample tubing for contamination and change if necessary.
4. Allow the instrument to run for 15 minutes with the purge filter assembly attached. Take a 5 minute sample and record the results. A passing condition is 0-1 count in the 5 minute sample. Repeat for 3 cycles as needed. If the instrument does not pass this purge process, please contact the Technical support team for assistance.

   For further help, contact an authorized service center.

5.3 Tubing replacement

Replace the inlet tubing (from the counter to the isokinetic probe) regularly to avoid organic growth or inorganic particle contamination on the tube walls. Such contamination may result in false high particle counts. Tubing of typical FMS installations in life science and pharmaceutical manufacturing cleanrooms are recommended for replacement once every year.

5.4 Calibration

The MET ONE 7000 particle counter must be returned to the service center for calibration (section 8.1 on page 49). The manufacturer also offers service contracts for routine calibration needs. Please contact your sales representative for available service contract options.

To remove the instrument from the clean room for calibration/repair services:

1. Twist and remove the connectors to disconnect the wiring.
2. Press the quick disconnect to release the tubing from instrument/wallplate.
3. Slide the unit up and off the keyhole wallplate to remove.

Section 6 Troubleshooting

6.1 Troubleshooting table

Use Table 13 for help with problems that may occur with the system.

Table 13 Troubleshooting table

Problem	Possible causes	Solution
Communication failure	Incorrect wiring	Examine the system for loose or incorrect connections
	Unit not configured	Configure the counter using the setup utility program
	Intermittent connection problem	Use the CRTS (communication reliable test software) to find the problem if using the FXB communication protocol
Flow failure	Cap placed on inlet probe during wash down not removed.	Remove cap from probe
	Kink in tubing	Examine both sample and vacuum tubing for bends that may restrict the air flow
	Leak in vacuum line	Examine the vacuum line and fittings for leaks in the system
	Vacuum pump failure	Repair the vacuum pump
High count alarm	High counts in room	Troubleshoot the process to determine the source of the counts
	Probe placed near source of contamination	Reposition probe
	Potential sensor contamination	**1** Use a portable counter to confirm the counts from the remote counter. **2** If the count is similar, the problem is with the process and not the counter. If the count is lower, use a zero count filter to clean the internal components. **3** If the count is still high, contact the nearest service center for repair.
Sensor failure	Contamination	Purge the counter using the zero count filter (section 5.2.3 on page 44)

7.1 Parts and accessories

Description	Catalog Number
AC power cordset	2088665-B 2088665-D 2088665-E 2088665-G 2088665-J
Bracket, to mount RH/temperature probe	2088517
Bracket, to mount external LED light stack with isokinetic probe	2088480
Bracket, wall, for external LED light stack	2088482
Bracket, wall, type T, for isokinetic probe	2082644-3
Cable, for external stainless steel LED light stack, 4 m with connector	460-400-7004
Cable, service port (4-pin to 9-pin serial)	2088676-01
Filter, zero counting, 1 cfm ¼ in. tube	203813-3
Filter, zero counting, 0.1 cfm 1/8 in. tube	2088667
Light stack, stainless steel, external LED	2088396-01
Mounting plate, narrow	2088634
Mounting plate, raised	2088680
Kit, umbilical cords or wall plate connection, DC, 3 ft cord length	2088767-03-DC
Kit, umbilical cords or wall plate connection, DC, 6 ft cord length	2088767-06-DC
Kit, umbilical cords or wall plate connection, DC, 9 ft cord length	2088767-09-DC
Kit, umbilical cords or wall plate connection, DC, 12 ft cord length	2088767-12-DC
Kit, umbilical cords or wall plate connection, AC, 3 ft cord length	2088767-03-AC[1]
Kit, umbilical cords or wall plate connection, AC, 6 ft cord length	2088767-06-AC[1]
Kit, umbilical cords or wall plate connection, AC, 9 ft cord length	2088767-09-AC[1]
Kit, umbilical cords or wall plate connection, AC, 12 ft cord length	2088767-12-AC[1]
Kit, wall plate assembly	2088624-01
Option, 4-channel setting	2088601-03 2088601-15
Power supply unit, 24 VDC, 5.0 A, universal input for FMS	230-300-0001
Probe, isokinetic 0.1 cfm	2080416-1
Probe, isokinetic 1.0 cfm	2082646-2
Probe mount—wall, J hook (1.0 cfm only)	2082369-1
Probe, extended—vertical wall mount, 0.1 cfm	2080999-1 2080999-2 2080999-5 2080999-6
Probe, extended—vertical wall mount, 1.0 cfm	2080999-3 2080999-4
Probe, extended—vertical wall mount with bracket for indicator light stack, 0.1 cfm	2080999-7 2080999-8 2080999-11 2080999-12
Probe, extended—vertical wall mount with bracket for indicator light stack, 1.0 cfm	2080999-9 2080999-10
Probe mount—ceiling, J hook (1.0 cfm only)	2082363-1
Probe mount—ceiling, 90 degree (1.0 cfm only)	2082366-1

7.1 Parts and accessories

Description	Catalog Number
RH (relative humidity)/temperature probe with cable	2088674-01
Setup kit, configuration (includes service port cable)	2088757-01
Ship kit, standard (includes mount plate, wall plate, connectors, umbilical cords, isokinetic probe)	2088747-01 2088747-02 2088747-03 2088747-04
Tubing, ¼-inch ID	960200
Tubing, 1/8-inch ID	960024
Antenna for Wi-Fi counter	490-200-0002

[1] AC power cords are not included in the Kit for umbilical cords. AC power cords have a fixed length of 6 feet and must be chosen from P/N 2088665-B/D/E/G or J.

Section 8 Contact information

8.1 Return procedures

The MET ONE 7000 series Particle Counter has a one-year calibration cycle. Each of the MET ONE 7000 models must be returned to an authorized service center for calibration after one year of the date of calibration, listed on the decal on the back of the models.

To return the MET ONE 7000 series Particle Counters for repair or calibration, first obtain a returned material authorization number (RA#). The RA# number is necessary for any instrument that requires repair or calibration by an authorized service center. Include the RA# number on the shipping label when the instrument is returned.

For the most up-to-date RA# process information, including copies of all required forms, call Hach Ultra Analytics at 800.866.7889 or +1 541.472.6500.

If you have a service contract, contact your Hach Ultra service representative. To return an instrument for credit, please contact the local sales representative.

8.2 Technical support

Technical Support Engineers are available to provide advice and recommendations for applications, product operation, measurement specifications, hardware and software, factory and customer site training.

Please provide name, company, phone number, fax number, model number, serial number and comment or question.

Call +1 541.472.6500
Toll Free 800.866.7889 (US/CA)
Fax +1 (541) 472-6180
6:00 AM to 4:30 PM Pacific Time
Monday through Friday
Email: TechSupportGP@hachultra.com

Section 9 Limited warranty

Hach Ultra warrants this instrument to be free of defects in materials and workmanship for a period of two (2) years from the shipping date. If any instrument covered under this warranty proves defective during this period, Hach Ultra will, at its option, either repair the defective product without charge for parts and labor, or provide an equivalent replacement in exchange for the defective product.

Hach Ultra warrants the Long Life Laser™ diode to be free of defects in materials and workmanship for a period of three (3) years from the shipping date. If any diode covered under this warranty proves defective during this period, Hach Ultra will, at its option, either repair the defective diode without charge for parts and labor, or provide an equivalent replacement in exchange for the defective product.

To obtain service under this warranty, the customer must notify the nearest Hach Ultra service support center on or before the expiration of the warranty period and follow their instructions for return of the defective instrument. The customer is responsible for all costs associated with packaging and transporting the defective unit to the service support center, and must prepay all shipping charges. Hach Ultra will pay for return shipping if the shipment is to a location within the same country as the service support center.

This warranty shall not apply to any defect, failure, or damage caused by improper use or maintenance or by inadequate maintenance or care. This warranty shall not apply to damage resulting from attempts by personnel other than Hach Ultra representatives, or factory authorized and trained personnel, to install, repair or service the instrument; to damage resulting from improper use or connection to incompatible equipment; or to instruments that have been modified or integrated with other products when the effect of such modification or integration materially increases the time or difficulty of servicing the instrument.

THIS WARRANTY IS GIVEN BY HACH ULTRA ANALYTICS WITH RESPECT TO THIS INSTRUMENT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. HACH ULTRA ANALYTICS AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR NON-CONTRACTUAL PURPOSE. HACH ULTRA ANALYTICS' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. HACH ULTRA ANALYTICS AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES EVEN IF HACH ULTRA ANALYTICS OR ITS VENDORS HAS BEEN GIVEN ADVANCED NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Appendix A Modbus register maps

Important Note: *The Modbus register tables in this section may become updated. Contact Hach Ultra Analytics for updated tables.*

This section describes the Modbus registers that are used to communicate with Met One 6000 series particle counters. These registers are applicable to units that have RS485 serial output with Modbus RTU protocol or Ethernet output with ModbusTCP protocol. Detailed descriptions of the Modbus registers are available from the manufacturer.

- Each register is 16-bits wide (2 bytes). Some values use more than one sequential register (e.g., model number = 20 bytes, which is 10 registers long).
- Access codes **R/W/P** = read/write/protected.

A.1 Identity information

The identity block contains basic information about the instrument (refer to Table 14). These registers can only be configured at the factory and by qualified service personnel.

Table 14 Modbus register for identity information

Address	Register description	Access	Size (bytes)	Data format
0–14	Manufacturer ID[1]	R/P	30	Printable ASCII (0x20–0x7E)
15–24	Model number[1]	R/P	20	Printable ASCII (0x20–0x7E)
25–29	Serial number[1]	R/P	10	Printable ASCII (0x20–0x7E)
30–33	Sensor ID[1]	R/P	8	Printable ASCII (0x20–0x7E)
34	Last calibration date—year	R/P	2	YY (0–9999)
35	Last calibration date—month, day	R/P	2	MD (1–12, 1–31)
36	Calibration due date—year	R/P	2	YY (0–9999)
37	Calibration due date—month/day	R/P	2	MD (1–12, 1–31)
38	Firmware version (counter)[2, 3]	R	2	100 = V1.00
39	Hardware version[2]	R	2	100 = V1.00
40	Reserved		2	
41–99	Expansion			

[1] Each 16-bit register contains two 8-bit characters. For example, 0x3838, 0x3031 and 0x0000 for model number = "8801" (upper byte of first address = 0x38, which is ASCII '8', and lower byte = 0x38, which is ASCII '8'). A register byte value of 0x00 or word value of 0x0000 indicates the end of the value.

[2] The version is for the particle counter and not the Ethernet.

[3] If the value is 1–26, then the value represents legacy firmware revision A–Z (e.g. a value of 3 represents revision C). A decimal value of 101 indicates firmware version 1.01.

A.2 Counter configuration

The configuration data block (Table 15) has parameters that directly affect the sampling characteristics of the instrument. If a sample is active, any modifications to these registers will restart the current sample.

Table 15 Configuration information

Address	Register description	Access	Size (bytes)	Data format
100	Modbus slave address	R/W	2	1–247 (0 = broadcast)
101–102	Reserved			
103	Sample mode	R/W	2	1 = auto, 2 = manual
104	Sample control	R/W	2	1 = run, 2 = stop
105	Sample cycles	R/W	2	1–100, 0 = infinite
106	Sample period—hours	R/W	2	H (0–23)
107	Sample period—minutes and seconds	R/W	2	MS (0–59:0–59)
108	Hold period—hours	R/W	2	H (0–23)
109	Hold period—minutes and seconds	R/W	2	MS (0–59:0–59)
110	Delay period—hours	R/W	2	H (0–23)
111	Delay period—minutes and seconds	R/W	2	MS (0–59:0–59)
112	UTC—year	R/W	2	YYYY (2000–2105)
113	UTC—month and day	R/W	2	MD (1–12, 1–31)
114	UTC—hour	R/W	2	H (0–23)
115	UTC—minute and second	R/W	2	MS (0–59, 0–59)
116–119	Reserved			
120	Active mode	R/W	2	1 = active, 2 = inactive
121–126	Reserved			
127	Location name	R/W	32	Double byte characters (16)
143	Concentration mode	R/W	2	0 = counts, 1 = counts/ft^3, 2 = counts/L, 3 = counts/m^3
144	Count mode	R/W	2	0 = cumulative, 1 = differential
145	Flow units	R/W	2	0 = Lpm, 1 = cfm
146	Communication timeout—seconds	R/W	2	12 hour maximum 1–43200 seconds
147	Protocol selection	R/W	2	0 = FX, 1 = Modbus RTU, 2 = 48XX compatibility mode
148	Channel 2 pulse out selection	R/W	2	Count channel 2, 3 and 4
149	Light/LED indicator flash	R/W	2	0 = steady, 1 = flashing
150	Red light/LED indicator	R/W	2	0 = off, 1 = on
151	Green light/LED indicator	R/W	2	0 = off, 1 = on
152	Yellow light/LED indicator	R/W	2	0 = off, 1 = on
153	Blue light/LED indicator	R/W	2	0 = off, 1 = on
154	Analog channel 1 full scale	R/W	4	0–4,294,967,295
156	Analog channel 2 full scale	R/W	4	0–4,294,967,295
158	Analog channel 3 full scale	R/W	4	0–4,294,967,295
160	Analog channel 4 full scale	R/W	4	0–4,294,967,295
162	Remote LCD	R/W	2	0 = disable, 1 = enable
163–199	Expansion			

A.3 Data label

Table 16 provides a register for sample and analog data labels.

Table 16 Count bin data labels

Address	Register description	Access	Size (bytes)	Data format
200	Size 1 label	R/P	4	0.001–999 microns
202	Size 2 label	R/P	4	0.001–999 microns
204	Size 3 label	R/P	4	0.001–999 microns
206	Size 4 label	R/P	4	0.001–999 microns
208–231	Reserved			
232	Analog input 1 label	R	4	CAL
234	Analog input 2 label	R	4	TMP
236	Analog input 3 label	R	4	RH
238	Analog input 4 label	R	4	FLO
240–251	Reserved			
252–299	Expansion			

A.4 Sample data

Sample data records (Table 17) are updated at each polled interval regardless of the sample and hold times in the configuration registers. If real-time data is not required, use the buffered records (address 500+).

Table 17 Sample data

Address	Register description	Access	Size (bytes)	Notes
300	Sample UTC timestamp—year	R	2	YYYY (2000–9999)
301	Sample UTC timestamp—month/day	R	2	MD (1–12, 1–31)
302	Sample UTC timestamp—hour	R	2	H (0–23)
303	Sample UTC timestamp—minute/second	R	2	MS (0–59, 0–59)
304	Sample period—hours	R	2	H (0-23)
305	Sample period—minutes/seconds	R	2	MS (0–59, 0–59)
306	Modbus address	R	2	Integer (1–247)
307-308	Sample volume	R	4	
309	Sample status. Refer to Table 18.	R	2	Bit wise mapped
310	Reserved			
311	Size 1 counts	R	4	0–4,294,967,295
313	Size 2 counts	R	4	0–4,294,967,295
315	Size 3 counts	R	4	0–4,294,967,295
317	Size 4 counts	R	4	0–4,294,967,295
319–342	Reserved			
343	Analog channel 1 (CAL)	R	2	mV
344	Analog channel 2 (temperature)	R	2	0.1 ºC external probe only
345	Analog channel 5 (relative humidity)	R	2	0.1% RH external probe only
346	Analog channel 6 (flow)	R	2	100 = 0.100 cfm; 1000 = 1.000 cfm
347–352	Reserved			
353	Location name	R	32	Double byte characters (16)
385–399	Expansion			

Sample alarm status

Registers 309 and 509, sample status and buffered sample status, contain the sample alarm status (refer to Table 18 for an example). These alarms are bit-wise mapped.

Table 18 Register 309 sample alarm status

Address	Status
0	Calibration
1	Flow
2	Temperature
3	Relative humidity
4	Air velocity
5	System alarm
6	Count alarm
7	Reserved
8	Channel 1 count alarm
9	Channel 2 count alarm
10	Channel 3 count alarm
11	Channel 4 count alarm
12–15	Reserved

A.5 Buffered sample data

Table 19 shows the offline buffered sample record access control.

Table 19 Buffered sample record control

Address	Register description	Access	Size (bytes)	Data format
400	Number of buffered sample records	R	2	0–1000
401	Retrieve buffered record Table 20	W	2	1
402	Buffered record ready	R	2	1 = record available
403	Erase buffer	W	2	1 = start
404–498	Expansion			
499	Auto download	R/W	2	0 = Disable, 1 = Enable

A.6 Buffered record block

The buffered record block (Table 20) gives a remote application the ability to access data that is stored in the instrument. The block is continuously updated with new sample data.

Table 20 Buffered record

Address	Register description	Access	Size (bytes)	Data format
500	Buffered UTC timestamp—year	R	2	YYYY (2000–9999)
501	Buffered UTC timestamp—month/day	R	2	MD (1–12, 1–31)
502	Buffered UTC timestamp—hour	R	2	H (0–23)
503	Buffered UTC timestamp—minute/second	R	2	MS (0–59, 0–59)
504	Buffered sample period—hours	R	2	H (0–23)
505	Buffered sample period—minutes/seconds	R	2	MS (0–59, 0–59)
506	Buffered Modbus address	R	2	Integer (1–247)
507–508	Buffered sample volume	R	4	
509	Buffered sample status[1]	R	4	Bitmap
511	Buffered size 1 counts	R	4	0–4,294,967,29
513	Buffered size 2 counts	R	4	0–4,294,967,295
515	Buffered size 3 counts	R	4	0–4,294,967,295
517	Buffered size 4 counts	R	4	0–4,294,967,295
519–542	Reserved			
543	Buffered analog channel 1(CAL)	R	2	mV
544	Buffered analog channel 4 (external temp)	R	2	0.1ºC external probe only
545	Buffered analog channel 5 (RH)	R	2	0.1% RH external probe only
546	Buffered analog channel 6 (flow)	R	2	100 = 0.100 cfm, 1000 = 1.000 cfm
547–552	Reserved			
553	Location name	R	32	Double byte characters (16)
585–599	Expansion			

[1] Contains sample alarm status. Refer to Table 18 on page 56.

A.7 Sample mode parameters

The sample mode parameters register (Table 21) defines basic counting characteristics of a sample. Any updates to these registers will restart any active sample sequences.

Table 21 Sample mode parameters

Address	Register description	Access	Size (bytes)	Data format
600	Number of count bins	R	2	1–4
601–616	Reserved			
617	Count bin 1 limit	R/W	4	0–4,294,967,295
619	Count bin 2 limit	R/W	4	0–4,294,967,295
621	Count bin 3 limit	R/W	4	0–4,294,967,295
623	Count bin 4 limit	R/W	4	0–4,294,967,295
625–653	Reserved			
654	ADC multiplier	R/P	2	Factory calibration only
655	DAC multiplier 1	R/P	2	Factory calibration only
656	DAC multiplier 2	R/P	2	Factory calibration only
657	DAC offset 1	R/P	2	Factory calibration only
658	DAC offset 2	R/P	2	Factory calibration only
659	DAC offset 3	R/P	2	Factory calibration only
660	DAC offset 4	R/P	2	Factory calibration only
661	Flow offset	R/P	2	Factory calibration only
662	ADC offset	R/P	2	Factory calibration only
663–699	Expansion			

A.8 Diagnostic data

Table 22 shows the Diagnostics data register that is updated at a 30 second (default) rate or at the conclusion of any Test mode diagnostics.

Table 22 Diagnostics data record

Address	Register description	Access	Size (bytes)	Data format
700–705	Reserved			
706	+5 VDC	R	2	mV
707	+3.3 VDC	R	2	mV
708	+5 VA	R	2	mV
709–714	Reserved			
715	Laser calibration	R	2	mV
716	Laser current	R	2	mA
717–723	Reserved			
724	Error condition[1]	R	2	System specific (e.g. sensor error)
725–749	Expansion			

[1] Set bits indicate a failure.

A.9 Sensor calibration information

The sensor calibration information register is used for instruments that can electronically adjust the calibration circuitry or algorithm. The sensor information can be read from a plug and play sensor or can be loaded at the factory or by qualified field personnel.

Table 23 Sensor calibration information

Address	Register description	Access	Size (bytes)	Data format
900–903	Reserved			
904–943	Sensor calibration curve sizes	R/P	80	Size (20 points maximum) format: XXX.XXX
944–983	Sensor calibration curve voltages	R/P	80	mV (20 points maximum) format: XXXX.XX
984–985	Reserved			
986	Nominal flow	R/P	2	Range: 1–10000, 1 = 0.01cfm
987–996	Reserved			
997	Sensor type	R/P	2	1 = liquid, 2 = air
998–1089	Reserved			
1090	Sensor flow measurement present	R/P	2	0 = not present, 1 = present
1091–1099	Expansion			

A.10 Miscellaneous functions

Table 24 shows the register blocks to perform a specialized action, such as resetting the instrument (hardware reset) and saving all instrument configuration parameters to non-volatile EEPROM memory.

Table 24 Miscellaneous functions

Address	Register description	Access	Size (bytes)	Data format
1100	Set Write access password	W	2	
1101	Module reset	W	2	1 = reset
1102	Reserved			
1103	Save all settings	W	2	1 = save
1104	Default settings	W	2	1 = default
1105–1199	Expansion			

A.11 Application-specific information

Table 25 shows application specific register blocks.

Table 25 Application specific

Address	Register description	Access	Size (bytes)	Data format
1200	Run status	R	2	0=Delay, 1=Start, 2= Stop, 3=Count, 4=Hold
1201–1259	Reserved			
1260–1299	Expansion			

A.12 Ethernet configuration

Table 26 shows the register blocks for counters that have an Ethernet module. These settings will take affect when the settings have been saved and when the counter has been reset (refer to registers 1101 and 1103 in section A.10)

Table 26 Ethernet configuration

Address	Register Description	Access	Size (bytes)	Notes
1300	Ethernet MAC address	R	6 bytes	00-0E-1C-XX-XX-XX = default
1303	DCHP enabled	R/W	2 bytes	0 = disabled, 1 = enabled
1304	IP address	R/W	4 bytes	169.254.1.2 = default
1306	Subnet mask	R/W	4 bytes	255.255.0.0 (class B)
1308	Gateway	R/W	4 bytes	169.254.1.5 = default
1310	Modbus server port	R/W	2 bytes	502 = default
1311	Server	R/W	2 bytes	Not active—server: 1 (default), client: 0
1312	Remote Modbus server port (client port)	R/W	2 bytes	Not active—reserved for client apps.
1313	Remote Modbus server IP address	R/W	4 bytes	Not active—reserved for client apps.
1315–1399	Expansion			

A.13 Wireless configuration

Table 2x shows the register blocks for counters that have a Wireless module. These settings will take affect when the settings have been saved and when the counter has been reset (refer to registers 1101 and 1103 in section A.10).

Table 27 Wireless configuration

Address	Register description	Access	Size	Notes
1400	Security	R/W	2 bytes	None, WEP, WPA, WPA2
1401	Authentication	R/W	2 bytes	Open, Shared
1402	WEP encryption	R/W	2 bytes	64, 128 bit
1403	WPA encryption	R/W	2 bytes	TKIP, TKIP/WEP
1404	WPA2 encryption	R/W	2 bytes	CCMP, CCMP/TKIP, CCMP/WEP, TKIP, TKIP/WEP
1405	Key type	R/W	2 bytes	Hex, Pass phrase
1406	Network type	R/W	2 bytes	Infrastructure, Ad-Hoc
1407	Reserved	R/W	2 bytes	
1408	Auto data rate	R/W	2 bytes	Fixed, Auto
1409	Data rate	R/W	2 bytes	1, 2, 5,5, 11, 18, 24, 36, 54
1410	Channel	R/W	2 bytes	1-14
1411-1426	Network SSID	R/W	32 bytes	ASCII string
1427-1458	Key/Pass phrase	W	64 bytes	ASCII string
1459	Reserved	R/W	2 bytes	
1460	Country	R/W	2 bytes	0-5
1461	Enable	R/W	2 bytes	Disabled, Enabled
1462	TX key index	R/W	2 bytes	0-3
1463	Key/Passphrase length	R/W	2 bytes	0-48 WPA/WPA2 or 0-63 WEP
1464	Roaming	R/W	2 bytes	Disabled, Enabled
1465-1472	Radio firmware version	R	16 bytes	ASCII String
1473-1499	Expansion	R		

A.14 Last sample data

Table 28 shows the register block mirrors of the real-time and buffered data register blocks with different data. This block is updated with the most recent data at the end of each sample. Data remains available until the next sample. The update interval is based on the sample and hold time programmed into the configuration registers (Table 15 Configuration information on page 54).

Table 28 Last sample data

Address	Register Description	Access	Size (bytes)	Notes
1500	Sample UTC timestamp—year	R	2	YYYY (2000–9999)
1501	Sample UTC timestamp—month/day	R	2	MD (1–12, 1–31)
1502	Sample UTC timestamp—hour	R	2	H (0–23)
1503	Sample UTC timestamp—minute/second	R	2	MS (0–59, 0–59)
1504	Sample period—hours	R	2	H (0–23)
1505	Sample period—minutes/seconds	R	2	MS (0–59, 0–59)
1506	Modbus address	R	2	Integer (1–247)
1507–1508	Sample volume	R	4	
1509	Sample status	R	2	Bitmap
1510	Reserved			
1511	Size 1 counts	R	4	0–4,294,967,295
1513	Size 2 counts	R	4	0–4,294,967,295
1515	Size 3 counts	R	4	0–4,294,967,295
1517	Size 4 counts	R	4	0–4,294,967,295
1519–1542	Reserved			
1543	Analog channel 1 (Flow)	R	2	mV
1544	Analog channel 2 (Temperature)	R	2	0.1 ºC external probe only
1545	Analog channel 3 (Relative humidity)	R	2	0.1% RH external probe only
1546	Analog channel 4	R	2	
1547	Analog channel 5 (CAL)	R	2	mV
1548–1552	Reserved			
1553	Location name	R	32	Double byte characters (16)
1585-1599	Expansion			

Appendix B FXB communication

RS485 serial output with FXB protocol

To communicate with any remote counter, it must first be made active by sending the correct location code. The location code is a single character in the range 128 (80H), equal to location “00” and so on to 191 (BFh) equal to location “63”.

Note: *The valid range for most Hach Ultra Analytics software is from location “00” to “31.”*

Note: *When using FX protocol, the serial record always reports counts in raw cumulative particles and flow in cfm. The selectable formats for concentration mode, flow units and count mode are only available for Modbus.*

B.1 Command and data syntax

Data and commands are in the ASCII range while select numbers are not. Valid select numbers are in the range 128 (80H) to 191 (BFH) and are sent as a single character.

Note: *When the remote counter is used with PVO software, the valid range of location numbers is 00 through 31.*

The remote counter responds to ASCII commands and sends a data record that varies in length based on the content. The command and data syntax is defined below.

The ASCII commands listed in Table 29, Table 30 on page 64 and Table 31 on page 64 are supported by the remote counter and are case-sensitive.

Table 29 Request for data commands

Command	Description
"A" Send Buffered Record	The next data record in the rotating buffer will be sent. When the rotating buffer is empty, a “#" will be sent. Each record is erased from the buffer as it is sent. A record of the most recent count cycle will always be sent first. If no count cycles have been completed since the counter was turned on, then a "#" will be sent. The record cannot be sent until the current count cycle is complete.
"B" Send Current Record	The data record of the most recent sample period will be sent. Thereafter, if no new sample period has been completed, a "#" character will be sent. The rotating buffer is unaffected.
"C" Clear Buffer	Content of the rotating buffer will be erased.
"D" Number of Records	The counter will send the number of records in the rotating buffer terminated by a carriage return and line feed. The number of records returned is of varying length, no leading zeros, and has no limit. If no data records are available, a "0" will be returned (D0<cr><lf>).
"E" EPROM Revision	The counter will send the EPROM number and latest revision. The format field length can vary, and is terminated by a carriage return and line feed.
"H" Hold Time	When an upper case "H" followed by a carriage return and line feed are sent, the counter will display the current Hold Time terminated by a "carriage return" plus "line feed" (<cr><lf>). Hold time will be in a format of HHMMSS (hours, minute, second). To program the hold time, enter upper case "H" followed by the relevant time information only. Use the form of HHMMSS (hours, minute, second) terminated by (<cr><lf>). Do not enter leading zeros.
"L" Sample Period	When an upper case "L" followed by a carriage return and line feed are sent, the counter will display the current Sample Period terminated by a carriage return line feed (<cr><lf>). Sample period will be in a format of HHMMSS (hours, minute, second). To program the sample period, enter upper case "L" followed by the relevant time information only. Use the form of HHMMSS (hours, only) terminated by (<cr><lf>). Do not enter leading zeros.
"M" Mode Request	The counter will send its present mode. If counting, a "C" will be sent. If holding, an "H" will be sent. If stopped, an "S" will be sent.
"R" Retransmit Record	The last record sent will be retransmitted. The buffer will not be cleared. If there is no record to retransmit, a “#” following the echoed command will be sent.

Table 29 Request for data commands (continued)

Command	Description
"T" Identify Model	The counter will send an alphanumeric data string name label terminated by a carriage return and line feed. The "Name Label" field can vary in length.
"U" Universal Device Select	The counter will be placed in the "remote" mode, and will respond to all commands after receiving this command, regardless of which select code is programmed into the counter.
"V" Protocol Version	The counter will send an alpha data string terminated by a carriage return and line feed. The "Protocol Version" field will contain FX (enhanced Standard FIX Protocol).

Table 30 Action commands

Command	Description
"128–191" Device Select	The counter will respond to all subsequent commands when the select code of the counter is sent. The counter is deselected (made unresponsive to computer commands) by selecting another counter, that is, sending a number between 128 (corresponding to Loc = 0) and 191 (corresponding to Loc = 63) that matches the select code of a different counter. To send a number, press and hold the <Alt> key, then enter the number.
"a" Auto	When the "d" command is used, the counter will count in the auto mode.
"b" Manual	When the "d" command is used, the counter will count in the manual mode.
"c" Start Counting (computer controlled)	The counter will begin counting without waiting for an even second boundary (immediate start). Counting will continue until stopped by the computer. The count cycle should be controlled by the computer.
"d" Start Counting (counter controlled)	The counter will begin counting on an even second boundary (using internal clock; not in the middle of a second) and control the count cycle based on the front-panel setting for the period (sample time).
"e" Stop Counting	The counter will immediately stop counting without waiting for an even second boundary.
"g" Active Mode	This device will enter a mode that prepares it for counting. For example, the air pump will turn on to purge the air path, and the sensor's laser will turn on.
"h" Standby Mode	The device will enter a mode that will turn off air pumps and shut down laser sensors to conserve power or reduce equipment wear, if applicable. Only this command can turn off the pump and laser.

Table 31 Universal action commands

Command	Description
"ua" Universal Auto Sample Mode	Puts the counter(s) in the "Auto" count mode. When the "ud" command is used, the device(s) will count in the auto mode. Auto mode causes the device(s) to continuously cycle through their own Sample and Hold Period settings. This command is not echoed.
"ub" Universal Manual Sample Mode	Places the counter(s) in the "Manual" count mode. When the "ud" command is used, the device(s) will count in the manual mode. Manual mode causes the device(s) to cycle through their own Sample Period once. This command is not echoed.
"uC" Universal Clear Buffer	The contents of the buffer will be erased. This command is not echoed.
"uc" Universal Auto Sample Mode	The counter(s) will start counting in either pre-selected counting mode (Auto, Manual). This command is not echoed. The device will start counting without waiting for an even second boundary (quick start). Counting will continue until stopped by the computer. The count cycle of the computer will control time.

Table 31 Universal action commands (continued)

Command	Description
"ud" Universal Start Count	The counter(s) will start counting in either of the two preselected counting modes (Auto or Manual). This command is not echoed.
"ue" Universal Stop Count	The counter(s) will stop counting and will build a data record. This command is not echoed.
"ug" Universal Active Mode	The counter(s) will enter a mode that prepares it for counting. For example, the air pump will turn on to purge the air path, and sensor's laser will turn on. This command is not echoed.
"uh" Universal Standby Mode	The counter(s) will enter a mode that will turn off air pumps and shut down laser sensors to conserve power or reduce equipment wear, if applicable. Only this command can turn off the pump and laser. This command is not echoed.

B.2 Command responses

The remote counter will respond to all commands and select codes by sending the command character back to the computer. If the counter does not recognize a command, it will send a "?" character. If the computer is asking for a record from an empty buffer, the counter will send a "#" character. If the computer is asking for a record that has already been sent, the counter will send a "#" character unless the computer uses the Resend Record command.

The remote counter will not echo any command characters if a parity or framing error occurs.

B.3 Data record format

Each remote counter can send a record of its data. The data record is a string of ASCII characters where the position in the string identifies the meaning. Figure 25 on page 66 shows the serial communications format of a 2 and 4 channel remote counter with enviro probe and flow measurement. Table 32 on page 67 defines the data elements. CRLF is the carriage return and line feed command.

Refer to B.3.1 on page 68 for additional data record format examples.

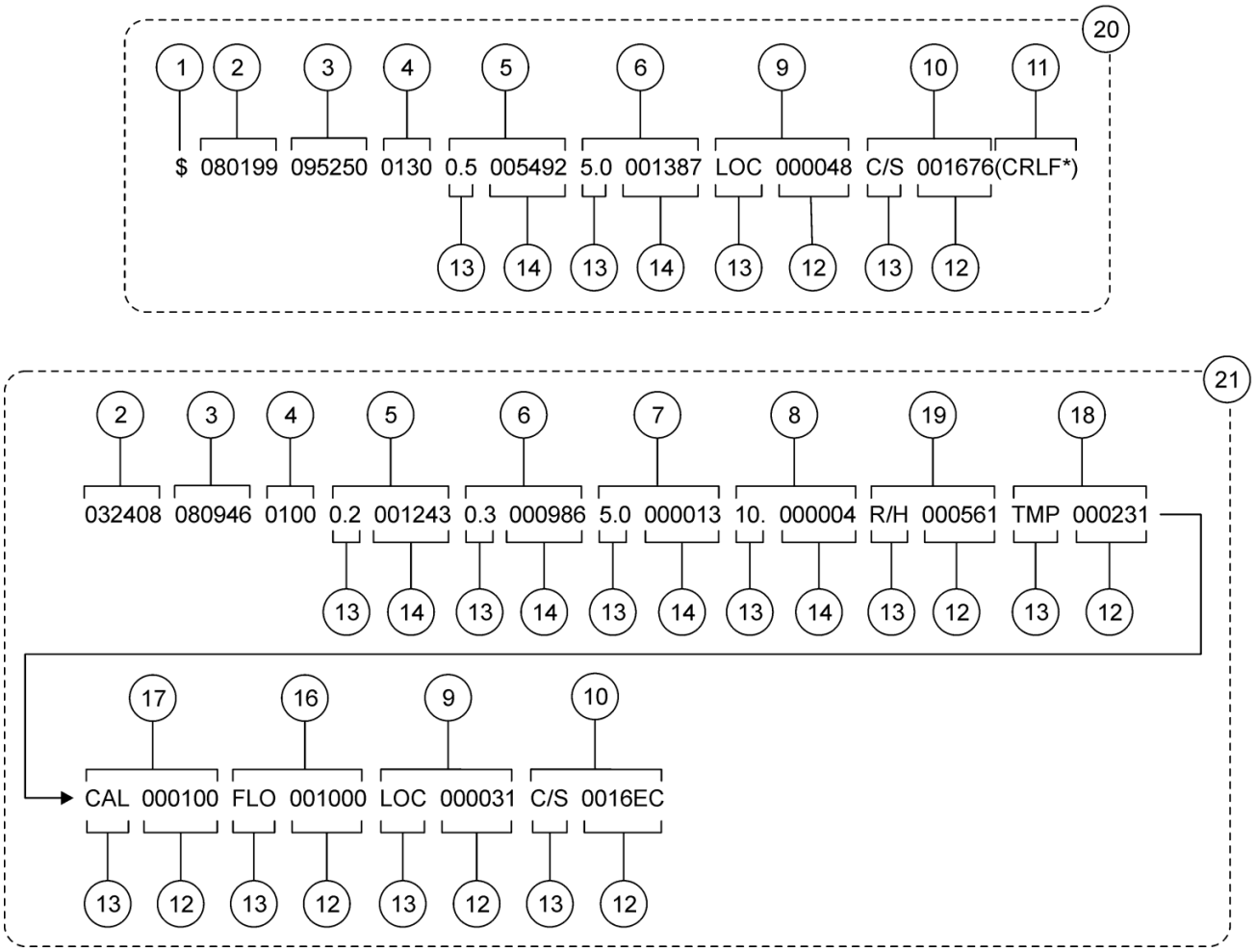


Figure 25 Data record format examples of a 2 channel counter without flow sensor and a 4 channel sensor with flow and RH/Temp sensor

1	Status ($ = count alarm)	**12**	Value
2	Date	**13**	Tag
3	Time	**14**	Count
4	Period	**15**	Size
5	Channel 1	**16**	Flow rate
6	Channel 2	**17**	Calibration value
7	Channel 3	**18**	Air temperature reading
8	Channel 4	**19**	Relative humidity
9	Location	**20**	2-channel basic 48XX data record format
10	Checksum	**21**	4-channel with enviro probe and flow measurement data record format
11	End message		

Table 32 Data record element descriptions

<table>
<tr><th>Information</th><th>Description</th></tr>
<tr><td>Status</td><td>When translated to a binary byte, the status character indicates the status of the counter. As shown below, ASCII character "$" has a decimal value of 36, which when converted to a binary byte, sets the third and sixth (always 1) bits. Bit 0 is considered to be the first bit.
<table>
<tr><th>ASCII character</th><th>Meaning</th><th>Decimal equivalent</th><th>Binary equivalent (bit 76543210)</th></tr>
<tr><td>(blank space)</td><td>No alarms</td><td>32</td><td>00100000</td></tr>
<tr><td>!</td><td>Check sensor</td><td>33</td><td>00100001</td></tr>
<tr><td>$</td><td>Alarm/count alarm</td><td>36</td><td>00100100</td></tr>
<tr><td>%</td><td>Check sensor and alarm</td><td>37</td><td>00100101</td></tr>
<tr><td>`</td><td>Air flow alarm</td><td>96</td><td>01100000</td></tr>
</table></td></tr>
<tr><td>Date</td><td>Date information is carried in the third through eighth characters of the record. The second character is always a space, to separate the status character from the date characters. The date is arranged as MMDDYY (Month Day Year). In the serial communications example on the previous page, the date is August 1, 1999 (the day the counter collected the data).</td></tr>
<tr><td>Time</td><td>Time information is carried in the tenth through the fifteenth characters of the record. The ninth character is always a space, to separate the date from the time. The time is arranged as HHMMSS (Hours Minutes Seconds) military time. In the example on the previous page the time is 9:52 A.M. and 50 seconds.</td></tr>
<tr><td>Period</td><td>The period is the sample time or the length of counting time. The period information is carried in the seventeenth through twentieth characters. The sixteenth character is always a space, to separate the time and period. The period is presented in minutes and seconds. In the example on the previous page the period was 0130 or one minute, 30 seconds. When the period is controlled by the computer (c command), the period characters will be zeros. When the period is controlled by the counter (d command), the characters will represent the sample time.</td></tr>
<tr><td>Tags</td><td>The tags contain three characters that identify the type of data that will follow. If the data is particle count, the tag will indicate the particle size. If the data is location number, the tag is called LOC. The data following the LOC tag will be the number programmed during setup as the remote counter's location number (any identifying number from zero to 31 can be assigned) will be indicated. Other tag examples:
FLO - Flow rate value in CFM. A value of 000100 equals .100 CFM. A value of 001000 equals 1.000 CFM.
CAL - Calibration value of the sensor. A value of 000100 equals a calibration voltage of 1.00 VDC. Valid ranges are 0.80 to 1.20 VDC. A reported value outside this range will cause a calibration alarm to be reported in the status byte.
TMP - Air temperature reading from the externally attached environmental probe. A value of 000231 equals 23.1 °C.
R/H - Relative Humidity reading from the externally attached environmental probe. A value of 000561 equals 56.1% RH.</td></tr>
<tr><td>Chan 1, Chan 2</td><td>These characters contain count data from the measurements the counter has made. The size and count are each preceded by a space character for separation.</td></tr>
<tr><td>Size</td><td>The size is three characters, preceded by a space, and indicates the particle size range.</td></tr>
<tr><td>Count</td><td>The count is six characters, preceded by a space, and indicates the number of particles counted for the particle size range preceding the number. In the data string example in Figure 25 on page 66, the count in the channel 1 size range was 5492 particles.</td></tr>
<tr><td>Location</td><td>A unique number assigned to each unit in multiple counter installations. The assigned number applies to the "device" select code number and eliminates simultaneous talking on the bus during serial networking of multiple counters.</td></tr>
<tr><td>Checksum</td><td>The checksum is a six-character hexadecimal number (with two leading zeros), preceded by a three-character tag and a space. The numerical value of the checksum is equal to the sum of the decimal equivalent of each ASCII character in the record, including spaces. Used for testing accuracy of data transmission.</td></tr>
</table>

Table 32 Data record element descriptions (continued)

Information	Description
Flow rate	Flow rate value shown in CFM. A value of 000100 equals .100 CFM. A value of 001000 equals 1.000 CFM.
Calibration value	Calibration value of the sensor. A value of 000100 equals a calibration voltage of 1.00 VDC. Valid ranges are 0.80 to 1.20 VDC. A reported value outside this range will cause a calibration alarm to be reported in the status byte.
Air temperature	Air temperature reading from the externally attached environmental probe. A value of 000231 equals 23.1°C.
Relative humidity	Relative humidity reading from the externally attached environmental probe. A value of 000561 equals 56.1% RH.

B.3.1 Data record format examples

Refer to Figure 25 on page 66 and Table 32 on page 67 for element descriptions.

2-channel with flow measurement example:

032408 080715 0100 0.5 000278 5.0 000013 CAL 000100 FLO 000100 LOC 000001 C/S 001512

2-channel with no flow measurement example:

032408 080717 0100 0.5 000278 5.0 000013 CAL 000100 LOC 000003 C/S 00155A

2-channel enviro probe and flow measurement example:

032408 080712 0100 0.5 000278 5.0 000013 R/H 000561 TMP 000231 CAL 000100 FLO 000100 LOC 000002 C/S 0016B1

DECLARATION of CONFORMITY

We,

Hach Ultra Analytics
481 California Avenue
Grants Pass, OR 97526

declare under sole responsibility that the

MODEL(s): 7000 Series
PART NUMBER(s): 2088703-XX-XX-X, 2088705-XX-XX-X, 2088715-XX-XX-X

conforms to Directive 2004/108/EC for Electromagnetic Compatibility and Directive 2006/95/EC for Low Voltage. Compliance is accordance to the following specifications as listed in the official Journal of the European Communities:

EN 61326:06, Class A, Group 1, Emissions:

EN 55011 Class A Radiated
EN 55011 Class A Conducted

EN 61326:06, Immunity:

EN 61000-3-2 Harmonic Current Emissions Limits
EN 61000-3-3 Voltage Fluctuation and Flicker Limits
EN 61000-4-2 Electrostatic Discharge
EN 61000-4-3 Radiated Immunity, Amplitude Modulated
EN 61000-4-4 Electrical Fast Transient
EN 61000-4-5 Surge Transient
EN 61000-4-6 Conducted Immunity
EN 61000-4-11 Voltage Dips and Interrupts

For the DC versions, power supplies used are the PULS CS5.241-C1 (5 amp) and the SOLA HEVI_DUTY Model SDN 10-24-100P (10 amp)

EN 61010-1:2001 Amendments 1 & 2, Safety Requirement for Electrical Equipment for Measurement, Control and Laboratory Use.

EN60825-1:2001 Safety of Laser Products, Equipment Classification, Requirements and User's guide.

Hach Ultra Analytics hereby declares that the optional WiFi - RF subsystem in the model 7000 is in full compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC for (class-2 equipment) as stated in English, the language of the manufacturer.

Hach Ultra Analytics

Grants Pass, OR 27OCT08
(Place and date of issue)

Jerry Szpak, Director of Research & Development

(Name/signature of authorized person)

TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the

Federal Communications Commission

By:

TCB

Timco Engineering, Inc.
849 NW State Road 45
P.O. Box 370,
Newberry, FL 32669

Date of Grant: 06/21/2006

Application Dated: 06/21/2006

lantronix
15353 Barranca Parkway
Irvine, CO 92618

Attention: Trish Selbo

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: R68WIPORTG
Name of Grantee: lantronix
Equipment Class: Digital Transmission System
Notes: WIRELESS DEVICE SERVER

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	2412.0 - 2462.0	0.1282		

Modular Approval. Power listed is conducted. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. OEM integrators must be provided with antenna installation instructions. OEM integrators and end-Users must be provided with transmitter operation conditions for satisfying RF exposure compliance. This grant is valid only when the device is sold to OEM integrators and the OEM integrators are instructed to ensure that the end user has no manual instructions to remove or install the device. Separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

This class 2 permissive change adds a specific host configuration with a new antenna.

Warning
Hach Ultra Analytics and its vendors disclaim any responsibility of providing network and access point security with the purchase, installation and operation of its wireless air particle counters. Network and access point security is the sole responsibility of the customer using the wireless particle counters. Hach Ultra Analytics and its vendors will not be liable for any indirect, special, incidental or consequential damages caused by the breach in network security even if Hach Ultra Analytics or its vendors has been given advanced notice of the possibility of such damages.

Country specific approval for Wi-Fi device

Products with the wireless option contain a Wi-Fi device operating in the 2.4Ghz range. The Antenna used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operated in conjunction with any other antenna or transmitters.

Products with the wireless option contain a Modular RF Device within

FCC ID: R68WIPORT

IC ID : 3867A-WIPORT

Harmonized countries approved for operation - ISO Country codes

Country	ISO31662 letter code	Country	ISO31662 letter code
Austria	AT	Poland	PL
Belgium	BA	Portugal	PT
Denmark	DK	Spain	ES
Finland	FI	Sweden	SE
France	FR	United Kingdom	GB
Germany	DE	Iceland	IS
Greece	GR	Norway	NO
Hungary	HU	Switzerland	CH
Ireland	IE	Turkey	TR
Italy	IT	Netherlands	NL
Mexico	MX	—	—

Regulatory RF Device Approvals:

FCC: Approved as a Modular Device under a TCB Grant of Authorization.
FCC ID: R68WIPORT

IC: Approved as a Modular Device under Certificat D'Acceptabilite' Technique
C-REL ID : 3867A-WIPORT

COFETEL: Approved as a modular device by certificate of Homologation
CFT: RCPLAW108-1337

Notified Body Opinion: Compliant under the R&TTE Directive 1999/5/EC to the essentials requirements of Article 3.2 according to the assessment procedures in Article 10(5) and Annex IV for (class-2 equipment) and marked as CE1177