Operators Manual

UM-II and Controller

32 Port Universal Manifold and Controller

LIGHTHOUSE® WORLDWIDE SOLUTIONS

Lighthouse Worldwide Solutions®

UM-II and Controller

Operators Manual

Manufactured By:

Lighthouse Worldwide Solutions

300 West Antelope Road

White City, OR 97503

248083442-1 R2

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About this Manual

This manual describes the installation and operation of the UM-II, Manifold Controller and associated peripherals.

Text Conventions

The following typefaces have the following meanings:

italics	Represents information not to be typed or interpreted literally. For example, *file* represents a file name. Manual titles are also displayed in italics.
boldface	Introduces or emphasizes a term.
`Courier font`	Indicates command syntax or text displayed by the diagnostic terminal.
`Bold Courier`	Indicates commands and information that you type. You can use uppercase or lowercase letters; in this manual, commands are shown in uppercase.
Helvetica Italics	Indicates a comment on a command or text output.

Note: *Notes are used to stress an importance or assist the reader in a particular topic.*

WARNING: ***A warning appears in a paragraph like this and warns that doing something incorrectly could result in personal injury, damage to the instrument or loss and/or improper storage of data.***

Hexadecimal numbers are shown with the word "hex" or with a lower case "h" following the digits. For example:

```
hex 0D
0Dh
```

Additional Help

For more information about the Lighthouse Manifold System, contact Lighthouse Worldwide Solutions®:

www.golighthouse.com
techsupport@golighthouse.com

Service & Support 1-800-945-5905 Toll free USA
1-541-770-5905 Outside of USA

1 Introduction

System Overview

This operators manual describes how to set up, connect, operate and troubleshoot the UM-II Manifold and Controller system and associated peripherals. The Solair particle counter is covered in greater detail in its operating manual. If difficulties arise, the first steps to take when diagnosing any failures are to verify that the equipment has been installed and set up properly and that adequate AC power is available for the equipment to work reliably. The scope of this document is to provide an installation, operation and end-user troubleshooting guide.

Note: ***Information in this manual may be repeated from one chapter to another. This is done to prevent a need to flip from one section of the manual to another repeatedly.***

This chapter provides general information about the UM-II 32 Port Universal Manifold, Manifold Controller and optional vacuum pump (blower).

The Manifold supplied by Lighthouse is an "air shield manifold" that uses a high-volume vacuum pump, or blower, to pull sample air through all of the sample tubes simultaneously. What this means is that the system maintains air movement through each sample tube and reduces or eliminates particulate "dropouts". It also provides a "shield" effect to prevent cross-contamination between sample tubes by maintaining a vacuum higher than that provided by the counter. This negates the effects of leaks around the manifold's sample tube, preventing particles from entering the sample port. The required minimum flow rate of 1.5 CFM at ALL sample ports must be maintained in order for this condition to be true.

The particle counter (typically a Solair) analyzes the selected air stream for particles and reports this information to the Universal Manifold Controller (UMC). The UMC stores up to 8 particle count channels per record and up to 250 records. It can supply this data to a PC running a database or analysis software, such as LMS Express in real time or on a cyclical basis. Up to 32 locations can be monitored via the Manifold using sequential or non-sequential selection of the ports from which the samples will be taken. The system is designed to acquire accurate particle counts from all locations.

The UMC allows the user to:

- Set sampling Sequence, Purge, Sample and Hold times;

- Configure the number of samples taken from any location;
- Save the data for historical data review;
- Store up to 250 records in the UMC onboard memory;
- Upload available data to an external system.

Failure Analysis Overview

Because of the UMC's design, trouble shooting a failure is easily performed in a lab environment, but due to the complexity of an installed system, troubleshooting requires an on-site approach. Any reported error(s) are critical to accurate diagnosis of the failure.

See "System Balancing" on page B-2 for guidelines for system design.

System Components Specification

Table 1-1 System Specifications

Sample Ports	Up to 32 locations
Optional Manifold Blower	
Safety Provision:	Automatic pump shut-off
Power:	208 VAC @7.2A, 415 VAC @3.3A 3-phase
Dimensions:	16.7"(l) x 15" (w) x 20"(h) [47 x 38 x 51cm]
Weight:	75 lbs (34 kg)
Flow Rate:	154 CFM
UM-II Manifold	
Flow Rate:	> 1.5 CFM (42.5 LPM), minimum per port
Cross-Port Contamination:	< 0.01%
Particle Sample Tubing:	Particle transport tubing 1/2" OD, 3/8" ID (1.25 cm OD, 0.94 cm ID)
Fittings Provided:	32 barb fittings for 3/8" (0.94cm) ID sample tubing connection; 2 each push-in couplers for 1/2" OD particle counter sample tubing
Power:	Manifold - 24 VDC@3A Power Supply - 100-240 VAC, 50-60Hz 1.5A
Dimensions:	13.5"(l) x 13.5"(w) x 15.25"(h) [24 x 39 x 34 cm]
Weight:	13.5 lbs (6.1 kg)

Manifold Controller	
Compatible Control Software:	Lighthouse Monitoring System, LMS Express, RT and RT+, and most other manufacturers' Building Automation and Factory Automation Systems
Communication Protocol:	RS-485/MODBUS ASCII
Touch Screen Display:	Color, 5.7" (14.47 cm), VGA
Key Software features:	Password protection, custom sequence, historical data review
Data Storage:	Up to 250 records
Enclosure:	Stainless steel
Power:	100-240 VAC, 50-60Hz 2A
Dimensions:	6.0"(l) x 8.0"(w) x 8.75" (h) [16.76 x 20.32 x 22.23 cm]
Weight:	5.9 lbs (2.7 kg)
Operating Temp/RH:	50° F to 104° F (10° C to 40° C) / 20% to 95% non-condensing
Storage Temp/RH:	14° F to 122° F (-10° C to 50° C) / Up to 98% non-condensing
Sample Tubing Runs	
Minimum Run Length	10 feet (3 meters)
Maximum Run Length	125 Feet (38 meters)
Maximum Total Length	4,000 feet (1216 meters)
Sample Tube Flow Limits	1.5 to 4 CFM (42.5 to 113.3 lpm)

Typical Installations

Figure 1-1 and Figure 1-2 illustrate installation racks that can provide a centralized mounting point for the manifold system's components.

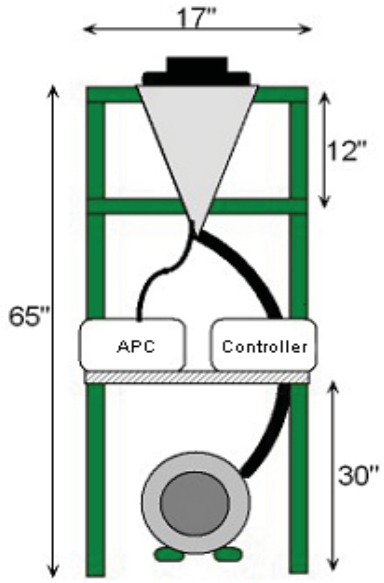


Figure 1-1 Compact Rack System

The Compact Rack (Figure 1-1) installation provides a stable mounting point for the Manifold, Manifold Controller and Sensor and allows for placement of the pump under the rack system. This solution saves space and provides security for the components where space is limited. Remote communication with the controller is still possible.

The Full Rack System incorporates shelf space for the Manifold, Manifold Controller, Sensor (APC), computer system and Lighthouse's Sensor Interface Unit (SIU). There is room for an Uninterruptable Power Supply (UPS), as shown in Figure 1-2. With this option, all system components can be located together and still take up a relatively small space. This installation is especially suited in smaller facilities where remote data retrieval or control are neither practical nor required.

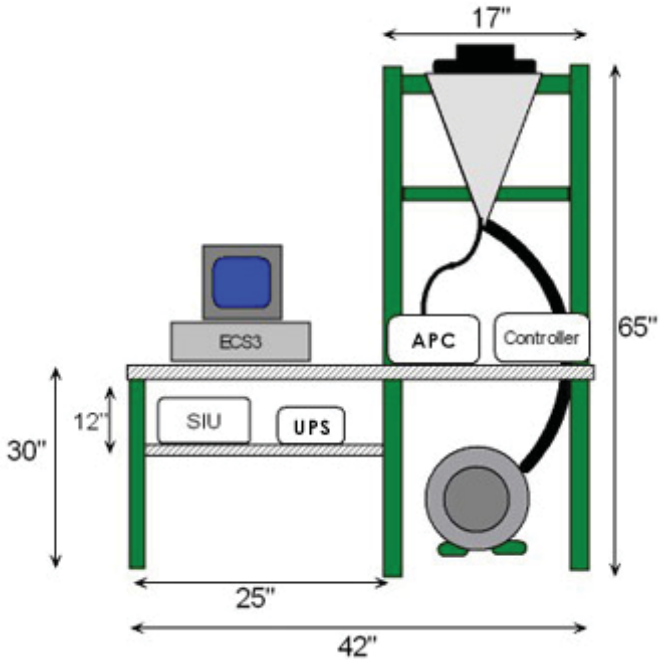


Figure 1-2 Full Rack System

2 *Manifold Install*

The UM-II Manifold collects samples from up to 32 locations via multiplexed monitoring. It interfaces with the Lighthouse Manifold Controller and Lighthouse Particle Counters as well as existing building automation and factory management systems. This chapter provides specific information for the installation of the manifold and tubing.

Figure 2-1 UM-II Manifold

UM-II Manifold Specifications

Sample Ports	Up to 32 locations
Optional Manifold Blower (Vacuum Pump)	
Safety Provision:	Automatic pump shut-off
Power:	208, 418 VAC - Three Phase
Dimensions:	15" (w) x 20"(h) x 16.7"(d) [47x38x51cm^3]
Weight:	75 lbs (34 kg)
Flow Rate:	154 CFM
UM-II Manifold	
Flow Rate:	>1.5 CFM per port minimum
Particle Sample Tubing:	Particle transport tubing 1/2" OD, 3/8" ID (1.25 cm OD, 0.94 cm ID)
Fittings Provided:	32 barb fittings for 3/8" (0.94cm) ID sample tubing connection; 2 each push-in couplers for 1/2" OD particle counter sample tubing
Power:	24 VDC
Dimensions:	13.5"(w)x15.25"(h)x13.5"(d) [24x39x34 cm^3]
Weight:	13.5 lbs (6.1 kg)

Figure 2-2 Manifold Specifications

Installation and Set Up

Install the Manifold

The UM-II Manifold can be installed horizontally or vertically and should be located centrally to all tubing runs. This maintains a balance between sample ports that is beneficial to stable particle counts.

WARNING: ***Do not install the manifold near any wet processes. If a tubing run terminates near a wet bench or hazardous chemical vapor source, you must plumb the vacuum pump's exhaust to a scrubber. In addition, exposure of the sampling equipment to liquids or corrosive or reactive gasses may cause them to fail and void their warranties.***

It is recommended that the Manifold's blower (vacuum pump) be installed less than 20 feet from the manifold. When installing the blower, secure it to the flooring so that it does not move on its own while it is running. If the blower is near any vibration sensitive equipment, either move the blower to another location or mount it on a vibration damper. See "Vacuum Pump Install" on page 4-1.

Manifold Tubing

The tubing specified for the Manifold is Bevaline® hytrel-lined tubing.

The maximum recommended length for any run is 125 ft. (38.1 m), the shortest length is 10 ft. (3 m) and the total for all runs is 4,000 feet (1216 m). To prevent large particle "dropout", it is critical to keep bend radii greater than 3 feet and avoid 90-degree, or tighter, tubing turns.

Do not "randomize" the port connections by mixing short tubing runs next to long runs randomly. Whenever possible, assign lengths from short to long back to short. Adjacent ports with radically different lengths attached require extended purge and hold cycles.

Suspended tubing MUST be supported over its entire length to prevent stretching, sagging or kinking and causing particulate dropouts. Keep tubing runs away from heat sources and high traffic areas and do not splice the tubes.

Note: *The word "Sensor" refers to the Particle Counter*

Manifold tubing and the Manifold itself are not recommended for wet processes nor should they be installed near wet processes. Do not allow fluid or chemicals to get inside the tubing, Manifold or Sensor.

Connect Sampling Tubes to Manifold

When preparing tubing for the Manifold, make sure the ends are cut perpendicular to the tubing. Perpendicluar cuts will help to prevent leaks or particulate accumulation in the fittings.

WARNING: ***Unused Manifold ports must be kept plugged at all times.***

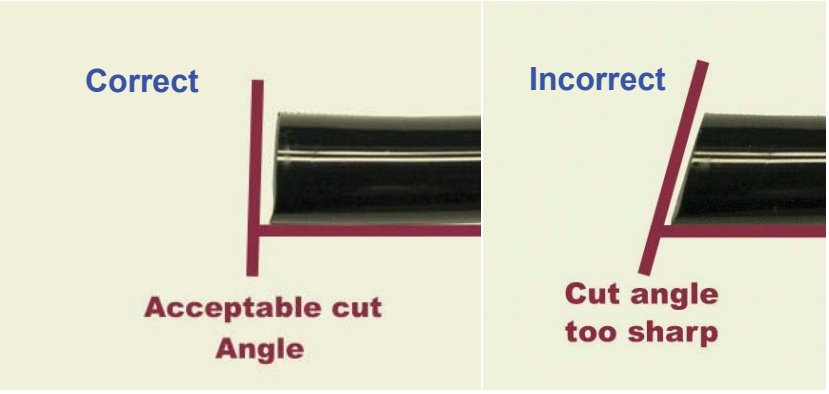


Figure 2-3 Good and Bad Tubing Cuts

Figure 2-4 Sample Tube Install Detail

Install the tubing by pushing inward while using a back-and-forth motion on the tubing. Push the tubing fully onto the barb.

Note: *It is recommended that all tubing runs have a foot or two of service loop (extra length) at each end. This allows for any need to remove tubing to fix leaks or particulate debris that may accumulate over time. Make sure service loops do not sag.*

When all sample tubes have been installed, make sure remaining ports are plugged. Store unused plugs in dust-free containers.

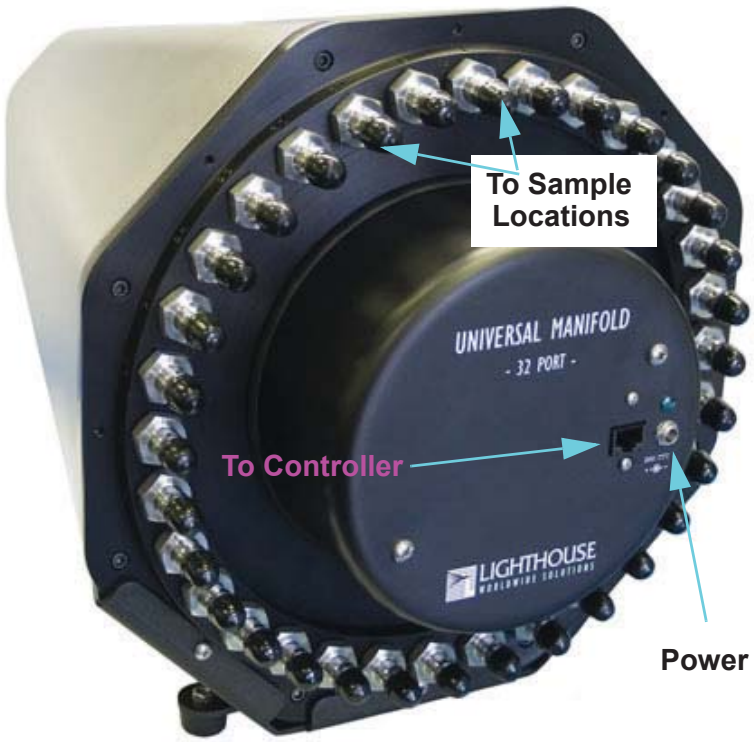


Figure 2-5 Front of Manifold Showing Connections

Connect Manifold to Vacuum Pump and Sensor

Connect the Manifold to the vacuum pump's IN port (see Figure 4-3 in "Vacuum Pump Install") by attaching tubing from the pump to the back of the Manifold as shown in Figure 2-7. It is strongly recommended that stainless steel clamps be used to keep the hose in place.

Refer to Figure 2-6 and Figure 2-7. To connect the Manifold sampling circuit to the Sensor (Particle Counter), remove the sensor's Inlet nozzle cap and the Manifold's port plug. Install Bevaline® tubing from the back of the Manifold (Figure 2-7) to the Sensor inlet nozzle. Next, remove the Manifold's Sensor Exhaust port plug and install another length of tubing to the Sensor's exhaust port. This connection will maintain a balance between the Manifold and Sensor and assist the Sensor's internal pump.

Connecting an older Sensor exhaust port uses a push-in style nozzle and newer Sensors use a barb-style.

Figure 2-6 Sensor Inlet Nozzle and Exhaust Port

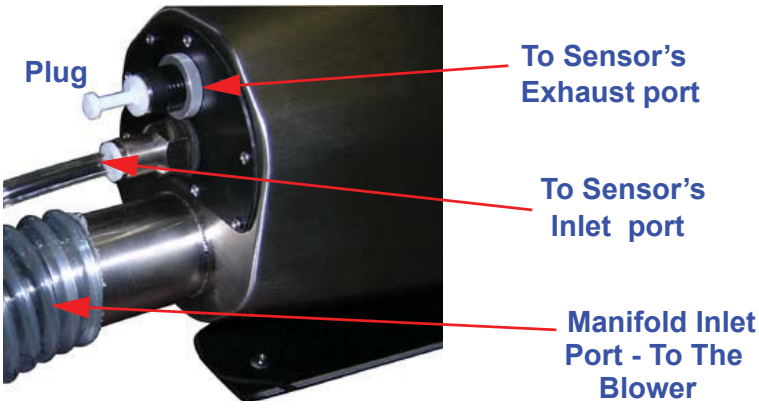


Figure 2-7 Rear of Manifold Tubing Connections

Connect Manifold to Manifold Controller

Attach one end of a standard Cat5e cable to the port on the front of the Manifold and the other to the port on the back of the Controller labeled "Manifold". Refer to Figure 2-8.

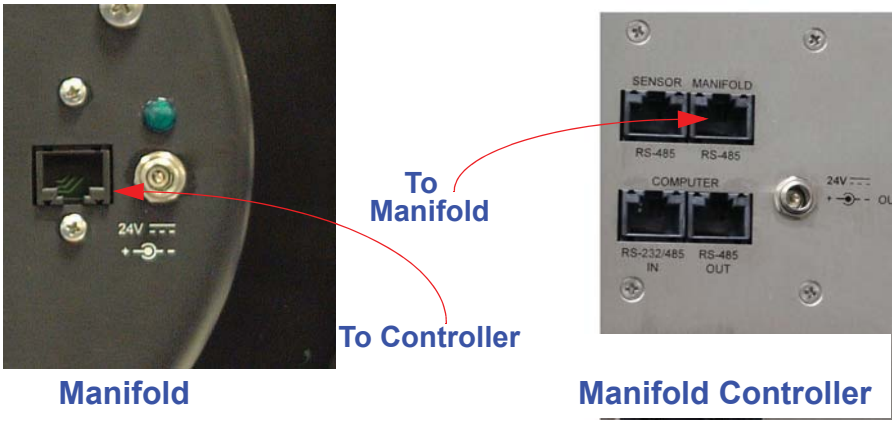


Figure 2-8 Manifold to Controller Connections

3 Particle Counter Install

Installation Overview

This chapter provides specific information on how to physically connect a Particle Counter to the Manifold Controller; set up the Controller and Particle Counter COMM addresses on the Controller and program the channel sizes and the COMM address for the Particle Counter.

The Manifold Controller can control and retrieve data from the following Lighthouse instruments:

- Solair 1100/1100+
- Solair 3100/3100+
- Solair 5100/5100+

Note: *The word "Sensor" refers to the Particle Counter*

WARNING: ***ALL devices MUST be removed from power before connecting instruments together.***

Connect Particle Counter to Manifold Controller

Connect one end of a standard Cat5e cable to the **RS-485 IN** port on the back of the Sensor.

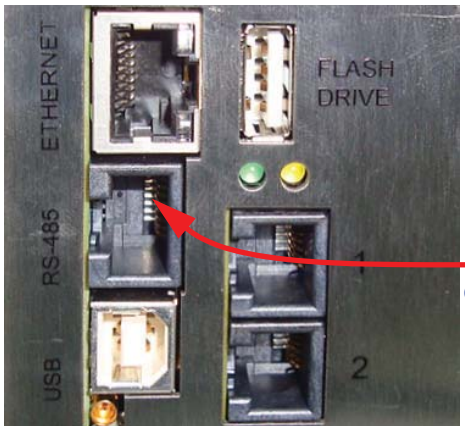


Figure 3-1 Rear of Sensor

Connect the other end of the Cat5 cable to the port labeled "**SENSOR**" on the rear of the Manifold Controller.

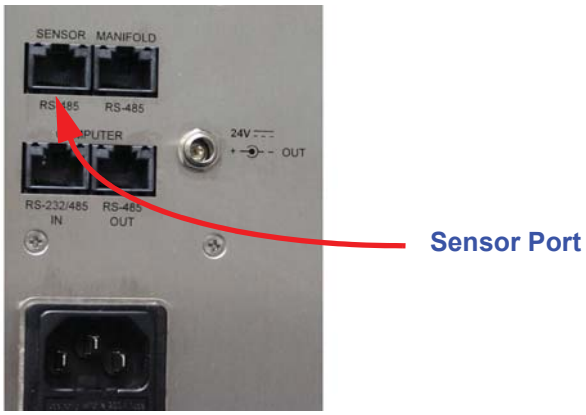


Figure 3-2 Manifold Controller Rear Connections

Enabling Sensor Channel Sizes

The Manifold Controller will collect and display data only from the channel sizes that are enabled on the Sensor. Channels of different sizes can be enabled or disabled to meet most situations. Apply power to the Sensor.

1. On the Sensor's MAIN screen, press the CONFIG button.

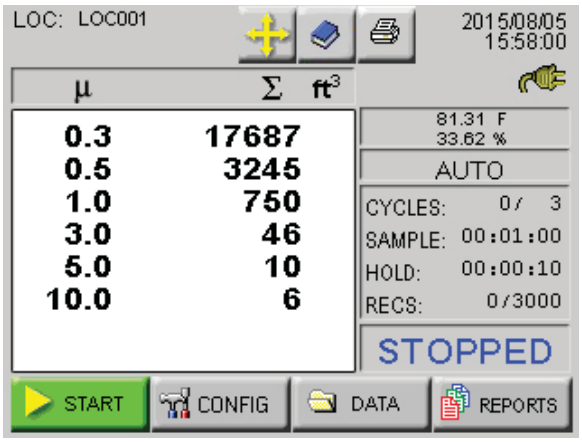


Figure 3-3 Sensor Main Screen

2. Press PARTICLE button In the DATA SETUP half of the screen.

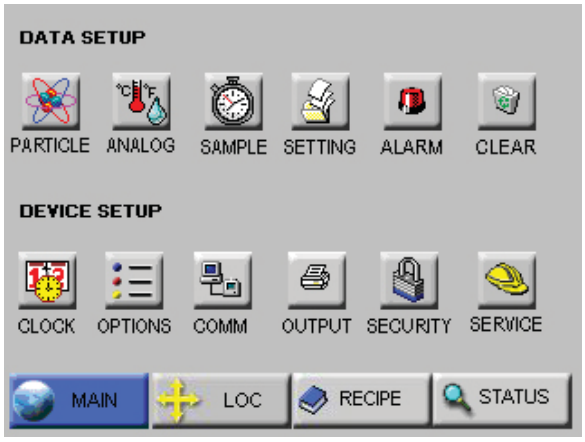


Figure 3-4 Sensor CONFIG Screen

3. Refer to Figure 3-5 and press the selection button to the right of the channel size to select or deselect sampled sizes. A ✓ indicates enabled and a ✗ indicates it is disabled.

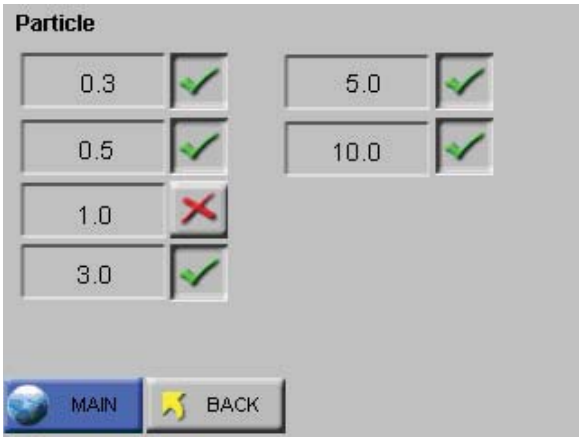


Figure 3-5 Sensor's CFG: Particle Channel Setup Screen

4. Press BACK to save return to the CONFIG screen or MAIN to save the configuration and return to the MAIN screen.

WARNING: ***Changing the available channels causes the sensor to clear data from ALL channels. This guarantees that the data stored in the buffers directly correlates to the channels that are enabled and that the data stored for a channel that is no longer active will not produce inaccurate calculation results or printouts.***

Note: ***The data buffer is cleared when channels are enabled or disabled so that the data in the buffers correlates to the channels that are enabled.***

- Pressing MAIN or BACK will prompt to clear all collected data. Press CANCEL to cancel changes and return to the CONFIG screen or press OK to allow clearing of the data and return to the CONFIG screen.

When channels are disabled, they are removed from the MAIN screen display, screen reports and from the printouts. The channel size label(s) will remain in the View Data Buffer screen but the instrument will not record data for those channels.

Set Particle Counter COMM Address

To communicate with the Manifold Controller, the Sensor must have a valid COMM address selected and this address must be programmed into the Controller.

1. Press the CONFIG button on the Sensor's MAIN screen followed by the COMM button.

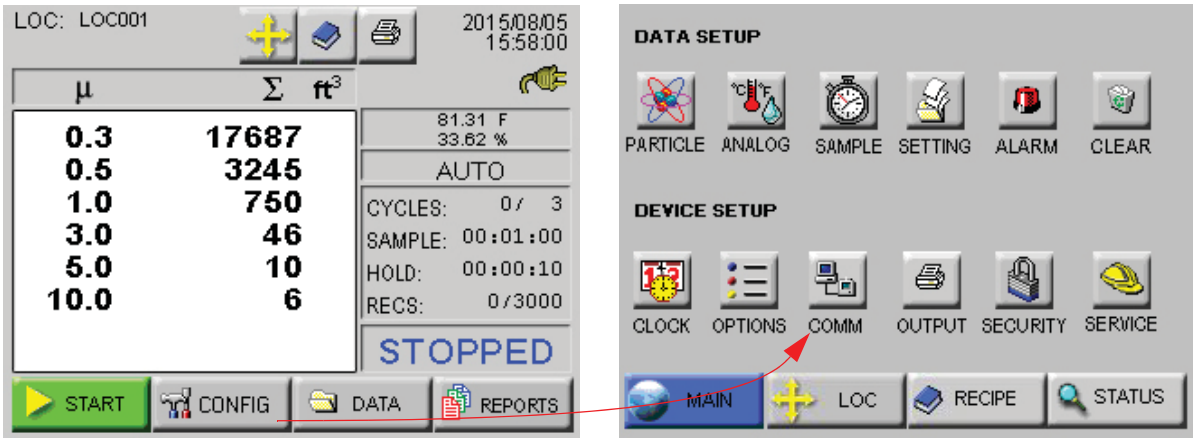


Figure 3-6 Sensor Main Screen with CONFIG Screen

2. Use the numeric keys to enter ’1’ as the desired instrument address. Press the ERASE button to erase an incorrect character the ENTER button to confirm it.

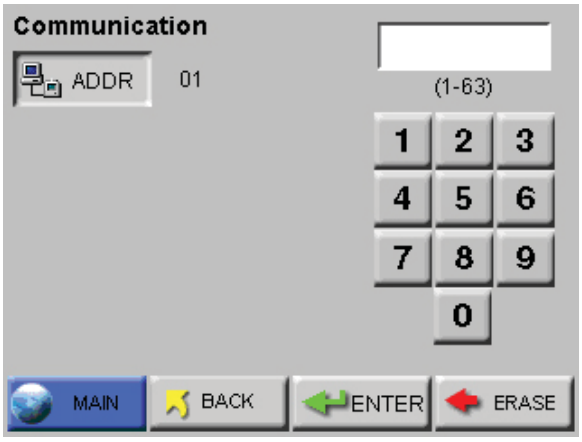


Figure 3-7 Sensor CONFIG Communication Screen

3. Press MAIN to return to the MAIN screen or BACK to return to the CONFIG screen.

Set Manifold Controller’s Sensor Address

Because the Manifold Controller communicates with the Sensor via RS-485, the Sensor address programmed into the Manifold Controller must match the SOLAIR’s COMM address as entered in “Set Particle Counter COMM Address” above. Apply power to the Manifold Controller.

1. Press the CONFIG button on the Manifold Controller’s MAIN screen to open the CONFIG screen (Figure 3-8).

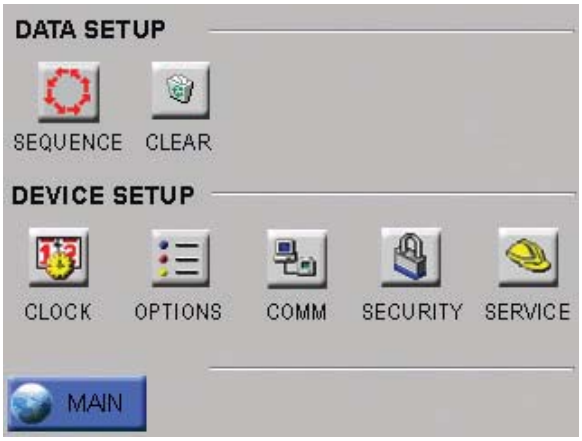


Figure 3-8 Controller CONFIG Screen

2. Press the COMM button to open the Communication screen. With the CNTRLR button active, enter the Controller address using the numeric keypad. In the example shown, the address used is ’1’, which should be the first controller address if multiple controllers will be incorporated into the system.

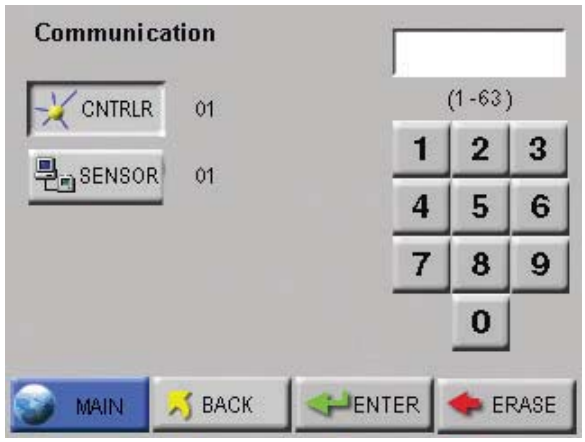


Figure 3-9 Controller CONFIG Screen

3. Press the Sensor button to change its address. An address of ’1’is the default and should be used in this case. An address greater than ’1’ may cause the controller to lose communication with the sensor.

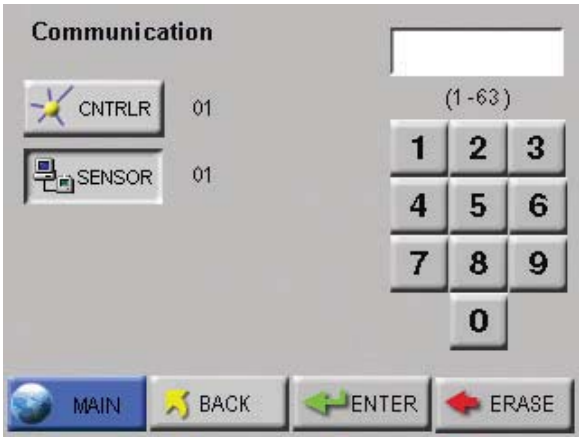


Figure 3-10 Controller Sensor CONFIG Screen

4. Press ERASE to delete an incorrect number or ENTER to accept the number.
5. Press BACK to save the setting and return to the CONFIG screen or MAIN to save and return to the Manifold Controller’s MAIN screen.

When the Manifold Controller, Sensor and Manifold are powered on, all units should be found by the Controller and displayed as active.

4 Vacuum Pump Install

Initial Inspection

The vacuum pump (blower) is thoroughly inspected and tested at the factory and is ready for use upon receipt. It is presumed for the sake of this document that the pump has not yet been unpacked. This chapter covers its installation and the installation of its associated hardware. If the pump is already in place, this chapter will serve as a guideline for verifying the pump's correct installation and operation.

Note: *The terms vacuum pump, pump and blower are used interchangeably throughout this document.*

When the blower is received, the shipping carton should be inspected for damage. If the carton is damaged, notify Lighthouse Worldwide Solutions® at 1-800-945-5905 (toll free) or 1-541-770-5905 (from outside of U.S.A.) and the carrier.

WARNING: ***Handle the pump VERY carefully - it is very heavy! Do NOT lift the pump from the carton - lift the carton from the pump.***

If the carton appears to be undamaged, carefully remove and inspect the unit for broken parts, scratches, dents, or other damage before use. If it appears to be damaged, DO NOT use it and immediately contact Lighthouse Technical Support.

Verify the contents of the shipment to the packing list:

- Fuji (or equivalent) vacuum pump;
- Operations manual;
- Relief Valve;
- 2-inch ID flexible hose (if ordered);
- 1-½-inch OD fittings (if ordered);
- Additional components as described on the packing list.

If anything is missing, please contact your sales representative at Lighthouse Worldwide Solutions immediately at the phone number provided or the one listed above.

By turning it onto either side, the pump's carton can be opened carefully at the bottom, its bottom flaps folded up and the carton then

lifted off the pump. This prevents personal injury. Keep the carton and all packing materials for reshipment if necessary.

Figure 4-1 Vacuum Pump Components

Figure 4-2 Optional Components

Optional Components

Optional components that may be ordered with the vacuum pump are shown in Figure 4-2 and include fittings and tubing. These items help during installation of the pump because they are designed to fit the Manifold and the pump.

Please contact Lighthouse Worldwide Solutions® for details.

Site Power Requirements

The power input is 208 VAC, 50-60Hz, 3-phase, 7.2A or 418 VAC, 50-60Hz, 3-phase, 3.3A. Make sure the correct AC service and

connections, including properly rated circuit breaker, are in place and ready for use before installing. Electrical installation of the pump should be performed only by a licensed contractor or the facility maintenance personnel. The pump can be mounted on a vibration damping pad or similar apparatus to reduce vibration transmission.

Set up of the vacuum pump may include adjusting the vacuum strength to get the correct flow at the end of each sampling tube.

The steps, in order, of a typical installation are:

1. Sampling tube network is planned and installed;

2. The vacuum pump is located and connected to AC supply;

3. The manifold is attached to the sample tube network and vacuum pump;

4. The particle counter and manifold controller are attached to the manifold;

5. The entire system is energized, configured, adjusted and tested.

It is important that a minimum of 1.5 CFM flow be maintained at each sample location to allow for changes in flow when the manifold selects a different port for sampling. Accuracy of counts and system operation cannot be guaranteed unless this minimum is maintained. In fact, if the system is reportedly malfunctioning, this is the first check to make - flow rate at each sample point. Correcting a low system flow rate often resolves system or random failures.

Vacuum Pump Air Connections

The vacuum pump's connection to the manifold must withstand a high vacuum without collapsing. The ribbed flex tubing provided by Lighthouse is designed for this purpose. Refer to Figure 4-3 for example of the pump's typical setup and connection.

WARNING: ***During the installation of the pump's flex tube and associated couplings, be very careful to use the pump's INPUT for the connection to the manifold. Connecting to the pump's OUTPUT will reverse the flow to the sampling network and contaminate the facility when the pump starts running.***

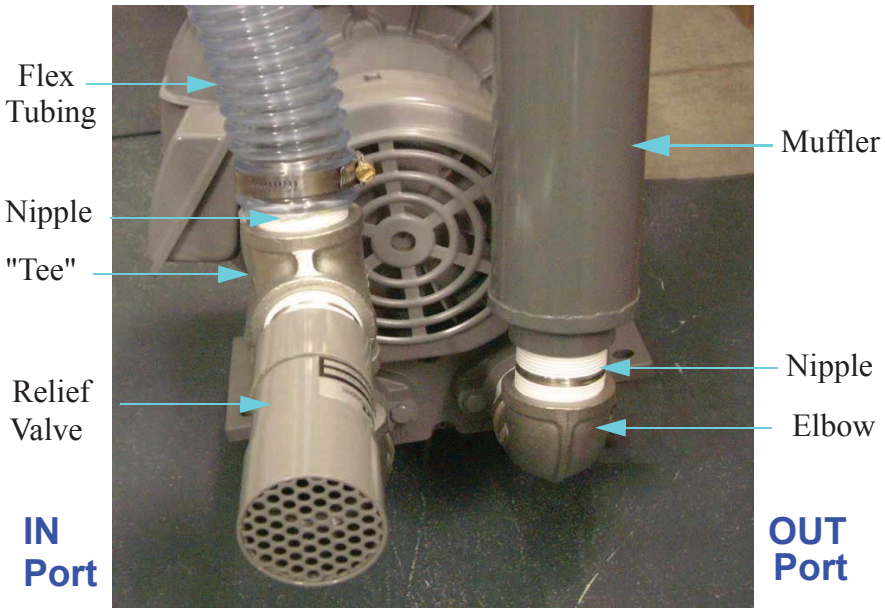


Figure 4-3 Example of a Typical Vacuum Pump Installed

Installing Coupling Components

1. The vacuum pump is attached to the manifold using 2-inch ID ribbed flex tubing connected to one end of a "Tee" fitting. Figure 4-4 through Figure 4-7 show the progression of attaching the coupling components to the pump. All photos show the fittings dressed with PTFE (Teflon) tape which helps lubricate and seals the

fittings. Because the pump is pulling air through the manifold, particulates generated by the tape will not be of concern unless the pump is installed and exhausts air within a cleanroom.

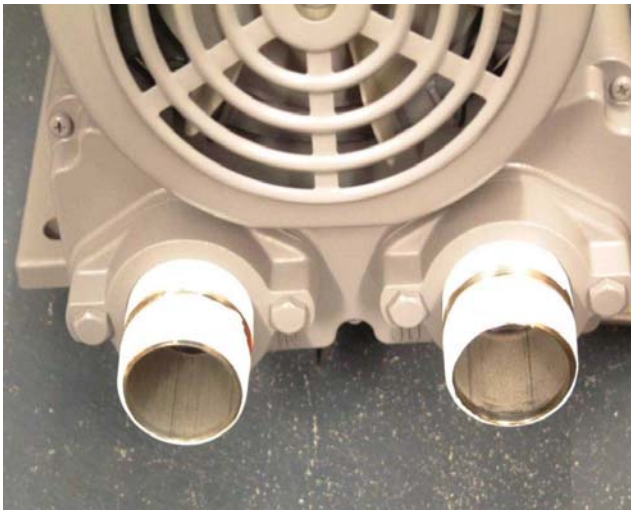


Figure 4-4 Pump IN and OUT Port Nipples Installed

Figure 4-5 Pump's IN Port Elbow Installed

2. The progress shown in Figure 4-6 illustrates the pump with the IN port's coupling hardware installed and ready for flex hose attachment. The relief valve is aimed to the left, which is an option

during the install. The view in Figure 4-7 shows the "Tee" fitting turned to face the valve outward from the pump, a second choice. Serviceability of the relief valve should dictate how to install it.

Figure 4-6 Pump IN Port Components in Place

OUT Port

Figure 4-7 Pump OUT Port Components in Place

3. The final attachment to the pump is the flex hose. Use stainless steel hose clamps to prevent corrosion and for strength.

4. Adjustment of the relief valve is performed at the factory to a pressure of 82" H_2O. Once the system is fully installed, the relief valve may have to be readjusted to drop air flow down. If tubing runs have been correctly installed, readjustment may not be needed. See “System Balancing” in “Troubleshooting” on page B-2 for details on balancing and troubleshooting flow issues.

Vacuum Pump Relief Valve Adjustment

1. Refer to Figure 4-8 for valve parts descriptions. Adjustment of the valve is relatively simple but requires some disassembly to complete. Adjustment may require pump start, check flow, stop pump, adjust, start pump, check flow, etc.

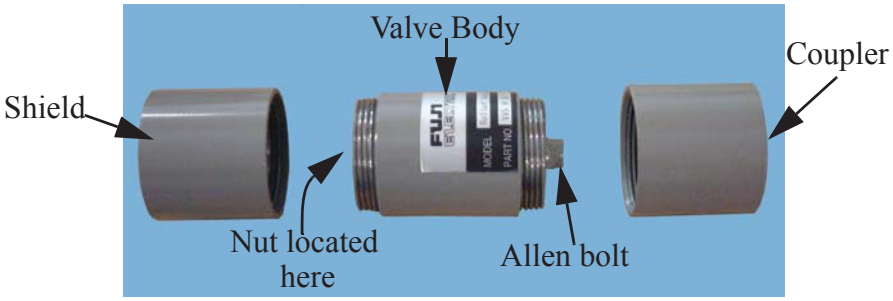
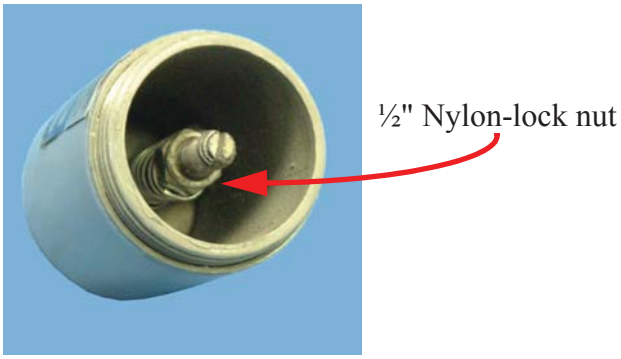


Figure 4-8 Relief Valve Components

2. Remove the relief valve from the nipple on the "Tee" fitting. The valve has three parts - coupler, valve and shield. The valve can be removed without removing the coupler. Remove the shield from the valve to perform the adjustment, noting the orientation of the valve - it must be reinstalled correctly (Allen bolt toward "Tee") to prevent a malfunction of the valve.



3. Note that one end of the valve has an Allen head, the other has a spring-loaded nylon center nut. The tools required are a ¼" Allen wrench and a ½" deep-well socket wrench.

4. To decrease the flow of the pump through the manifold, the bypass level of the valve must be relaxed or loosened which causes the valve to open with less pressure. This reduces the vacuum or flow through the manifold. With the ½" socket wrench in place to hold the nut steady, use the ¼" Allen wrench to turn the Allen bolt in a counter-clockwise manner. It is best to turn in measured amounts,

such as, ½ or 1 turn at a time. Reassemble the valve, start the pump and measure the flow. The valve is not linear in behavior so it may take a couple of attempts before achieving the desired result.

5. To increase the flow of the pump through the manifold, the bypass level of the valve must be increased. Using the socket and Allen wrenches, turn the Allen bolt in a clockwise manner. This increases the spring's pressure against the fixed point in the valve body, making it more difficult to open the valve, thereby increasing the pump's output flow and increasing the vacuum.

6. See "Troubleshooting" in "Troubleshooting" on page B-1 for additional information on blower setup and system balancing.

5 *Final System Set Up and Checks*

Overview

From a system level, a typical installation of a manifold involves a Manifold Controller, a UM-II ("Manifold"), vacuum pump ("blower" or "pump") and a particle counter ("Sensor", typically a Solair 1.0 CFM). The Manifold cannot be installed without the Manifold Controller which programs the Sensor's sampling functions and can communicate with external computers for data collection. This chapter will provide the steps to get the Manifold Controller connected to and working with the Manifold, Sensor and an external computer.

Connect Power

The power input for the Manifold Controller is 100-240VAC, 50-60Hz, 2A. An AC power cable is included in its package. The Manifold uses DC power provided by a 24 VDC, 3A power supply or "brick". The blower sold by Lighthouse requires 3-phase 208, 7.2A or 418 VAC, 3.3A. Refer to *Chapter 2, "Vacuum Pump Install"* for details on the pump installation.

Make sure that power connections are correct and that adequate circuit breaker protection has been provided. This document will not dictate how these connections will be completed. Proper operation of this equipment cannot be guaranteed without an adequate and safe AC supply being available at all times.

Installation of power protection is strongly recommended to prevent voltage spikes from reaching the sensor, manifold and controller. Install an Uninterruptible Power Supply (UPS) for the Manifold Controller and Solair to prevent damage to the instrument and, in the event of a power outage, loss of data.

Photos of the Sensor used in this document are those of the Solair 3100+. Other sensor brands may be used but accuracy of the results cannot be guaranteed. It is not within the scope of this document to describe the proper installation of sensors other than Lighthouse sensors nor to aid in the troubleshooting of systems that were not installed by Lighthouse Engineers.

Connect the System Components

The rear of the Manifold Controller provides Computer, Sensor and Manifold RJ-45 ports as shown in Figure 5-1. These ports are designed to communicate correctly with the respective units. Make sure that each instrument is connected to the correct port BEFORE applying power.

Figure 5-1 Manifold Controller Communication Ports

Note: *The word "Sensor" refers to the Particle Counter*

Port Descriptions

Computer RS-232/485 IN Port

The Computer RS-232/485 port is wired for RS-232 and RS-485 communications. Pinouts are shown in Table 5-1. The design allows for either short-distance RS-232 (for use in a single-system network or troubleshooting) or long-distance RS-485 (in a plant-wide monitoring network).

Determine how the Manifold System will be used before connecting the Manifold Controller to a computer or monitoring system.

Lighthouse supplies adapters for connecting to the Manifold System and Sensor, individually. If you are unsure about which adapter to use or how to connect it, contact Lighthouse Sales, Technical Support or Customer Service before proceeding. The adapter used will dictate how the port will respond and using the wrong adapter or using one improperly may cause a malfunction or damage the circuits at both ends of the connection.

Computer RS-485 OUT Port

This port allows daisy chaining of Manifold Controllers, uses standard Cat5e cabling and must be connected to the next Controller's RS-232/485 IN port.

WARNING: ***Do NOT connect the IN port to another IN port. An IN port must connect only to an OUT port.***

Failure to heed this warning may damage equipment and void their warranties.

RJ-45 Pin	Signal Name
1	RS-232 TX
2	RS-232 RX
3	RESERVED for future use
4	RS-485B
5	RS-485A
6	RESERVED for future use
7	RESERVED for future use
8	GND

Table 5-1 Computer Port Pinouts

Sensor and Manifold Ports

The Sensor and Manifold ports are identical and designed only for RS-485 communications. The pinouts are identical but the controller handles the data differently for each port (connector). If the wrong instrument is connected or is using the wrong port, the Controller will indicate that the device is having a problem. Pin assignments are shown in Table 5-2.

RJ-45 Pin	Signal Name
1-3	N/A
4	**RS-485B**
5	**RS-485A**
6	N/A
7	24VDC
8	Ground

Table 5-2 Sensor Port Pinouts

Connections: Manifold to Manifold Controller

WARNING: ***Before any connection setup is performed, please use electrical safety precautions to avoid personal harm or damage to the instruments.***

1. Remove AC power from ALL instruments before making new or changing existing connections.

2. Connect the Manifold Controller to the Manifold by connecting a Cat5e cable to the connector labeled "Manifold" on the back of the Manifold Controller. Connect the other end of the cable to the connector on the front of the Manifold as shown in Figure 5-2.

Figure 5-2 Connecting Manifold to Manifold Controller

Sensor to Manifold Controller

1. Remove AC power from ALL instruments before making new or changing current connections.

Note: *The word "Sensor" refers to the Particle Counter.*

2. Connect the Manifold Controller to the Sensor by connecting a Cat5e cable to the port marked "Sensor" on the back of the Manifold Controller. Connect the free end of the cable to the RS-232/485 IN port on the back of the Sensor as shown in Figure 5-3.

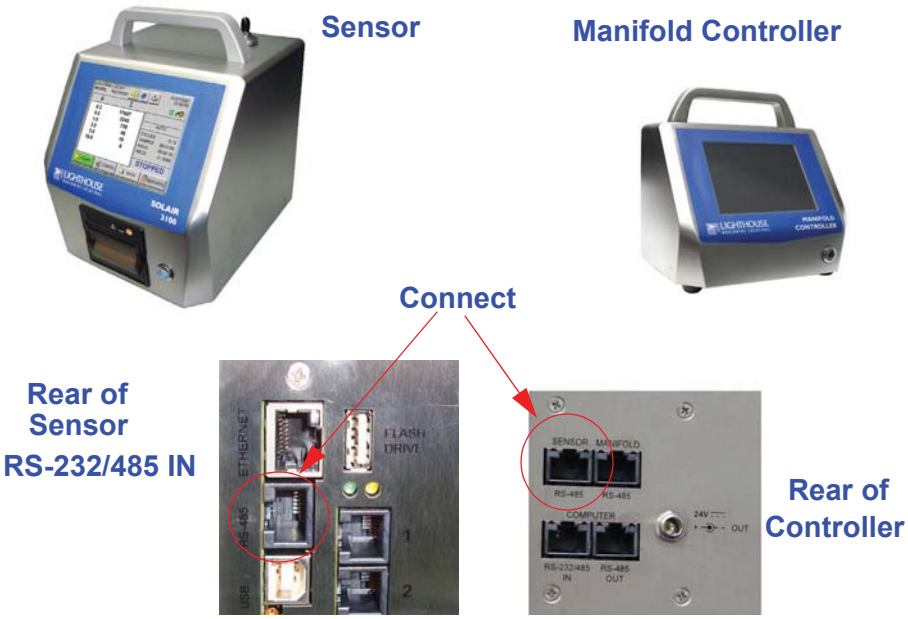


Figure 5-3 Connecting Sensor to Manifold Controller

Communication Test

After properly connecting the Manifold and Sensor to the Manifold Controller, a communication test is needed to verify the system.

Apply Power to the Instruments

1. The Manifold Controller supplies +24 VDC power to the Manifold via the round screw-on cable. When power is applied to the Manifold Controller, the Manifold's green LED should come on and sampling positioner activity should be heard. There is no power switch for the Manifold.

2. Attach the Sensor and Manifold Controller to their AC supply.

3. Turn on the pump, the Sensor then the Manifold Controller in this order. To shutdown, reverse the order to power off the Manifold Controller, the Sensor then the pump.

4. The Manifold Controller MAIN screen should appear as shown in Figure 5-4. If service indicators appear in the upper-right hand corner (see "Operating the UM-II Controller", page 6-3 for Status Symbols), check the connections. If there are no service indicators, proceed with the next step.

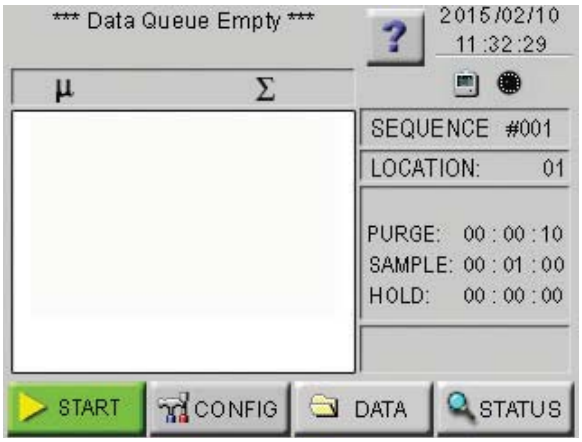


Figure 5-4 Manifold Controller MAIN Screen

Note: *If the Manifold or Sensor labels are displayed in red or as a TIMEOUT status, a communication problem exists; check the connections.*

5. Press the STATUS button. The "STATUS-MANIFOLD CNTRLR" screen appears. Under "Communication Status", make sure that the Manifold and Sensor are not displayed in red nor in TIMEOUT status.

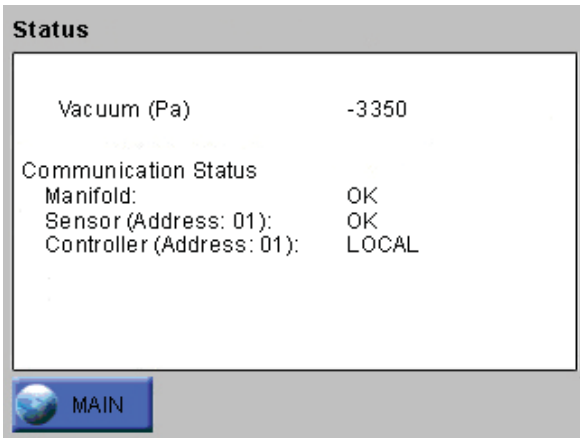


Figure 5-5 Status Screen

Note: *In order for the Manifold Controller to communicate with a Particle Counter, the Particle Counter COMM address has to match the Manifold Controller COMM address.*

6. Make sure that the Manifold Controller and Sensor COMM addresses match. Refer to *Chapter 6, "Operating the UM-II Controller"* for instructions on setting the address of each instrument.

7. If neither the Manifold, Sensor nor Manifold Controller are in red on the Status screen, the instruments are communicating properly.

8. If any instrument is displaying in red or in TIMEOUT status, check cable condition and connection. Swapping cables with known-good cables will help isolate the problem and may resolve the failure. Refer to *Chapter 6, "Operating the UM-II Controller"* for specific troubleshooting steps.

Connect to an External Computer or an FMS

The Manifold Controller has the ability to connect to a Facility Management System (FMS) such as the Lighthouse Monitoring System incorporating LMSNet, Pro or Pharma or LMS Express RT, RT+. The MODBUS protocol is used in these applications to control devices and download data.

Please refer to *Appendix A*, "MODBUS Register Map v1.49".

By uploading the data into the LMS Express products or any of the Lighthouse Monitoring System (LMS) softwares such as Net, Pro or Pharma, historical data can be stored for future review and trending.

Please refer to the appropriate LMS manual for further information about these systems.

External Computer Connection

The Manifold Controller RJ-45 connector labeled RS-232/485 IN is used to connect it to an external computer or network. This connection can use RS-232 communications or RS-485 with an RS-232/485 adapter.

An RJ-45 to DB-9 modular adapter, RS-232 to RS-485 adapter and USB to RJ45 RS232 or 485 adapter are available from Lighthouse Worldwide Solutions®.

The pinouts of the modular adapter are shown in Table 5-3.

RJ-45 Pin	Signal Name	DB-9 Pin
1	TX > RX	2
2	RX < TX	3
8	Ground	5
3	CTS < RTS	7

Table 5-3 RJ-45 to DB-9 Connections

RS-232 Communications

The Manifold Controller uses RS-232 communication for distances of less than 50 feet from a computer.

To connect the Manifold Controller to a computer using RS-232 protocol follow the instruction below (see Figure 5-6).

1. Disconnect power from the Manifold Controller.
2. Connect the RJ-45 end of an RS-232 adapter cable to the port labeled RS-232/485 IN under "Computer" on the back of the Manifold Controller.
3. Connect the USB end of the cable to any available USB port on the monitoring computer.
4. Reconnect power to the Manifold Controller.

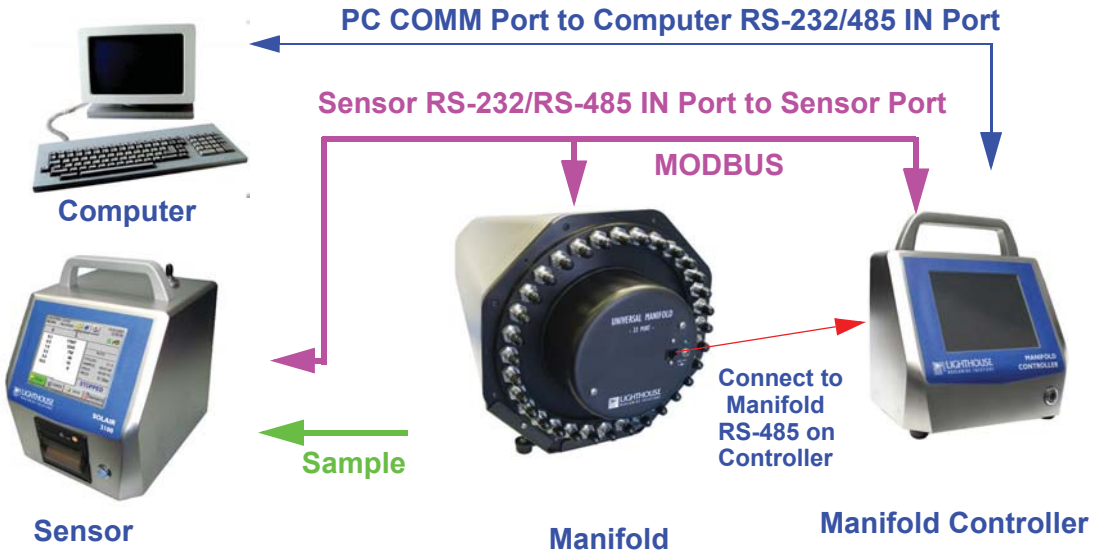


Figure 5-6 Computer Connection using RS-232/485 Protocol

RS-485 Communications

The instrument uses RS-485 communication for distances greater than 50 feet from a computer or monitoring system.

In order to use the RS-485 protocol, an RS-232/485 converter must be used in a 2-wire configuration where ChB+ goes to RJ-45 pin 4, ChA- goes to RJ-45 pin 5. Lighthouse has an RS-485 adapter kit that includes the cables and connectors to set this up.

An alternative to this is the RS485 to USB Adapter cable. Please contact a Lighthouse Worldwide Solutions® Sales Representative for this kit.

To connect the Manifold Controller to a computer using RS-485 protocol follow the instructions below (refer to Figure 5-6).

1. Disconnect power from the Manifold Controller.
2. Connect the RJ-45 end of the adapter cable to the port labeled "Computer" on the back of the Manifold Controller.
3. Connect the other end of the RJ-45 cable to the RJ-45/RS-232 converter.
4. Connect the RS-232 end of the RJ-45/RS-232 converter to the RS-485 converter: pin 4 to ChB+ and pin 5 on ChA-.
5. Connect the DB-9 end of the RS-485 converter to a COM (Serial) port on the computer.
6. An alternate is using the LWS RS485 to USB Adapter cable to connect between the computer's USB port to the Manifold's ***Computer*** port.
7. Reconnect power to the Manifold Controller and proceed to *Chapter 6, "Operating the UM-II Controller"* for details on Controller setup.

6 Operating the UM-II Controller

This chapter describes how to set up and operate the Manifold Controller.

Touch Screen Overview

All of the instrument's functionality can be accessed through its touch screen interface. The Function Map in Figure 6-1 shows the functions available from the various screens.

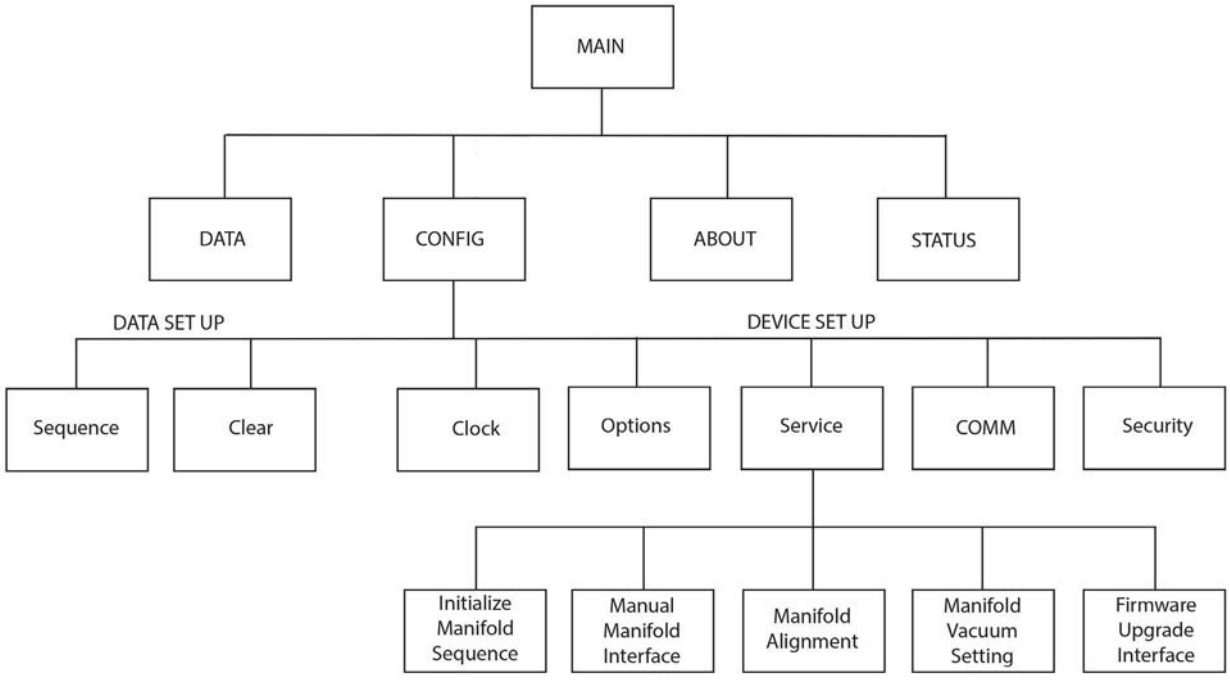


Figure 6-1 Manifold Controller Function Map

MAIN Screen

When the Manifold Controller is powered on, a splash screen displays for a few seconds, then the MAIN Screen appears (Figure 6-2).

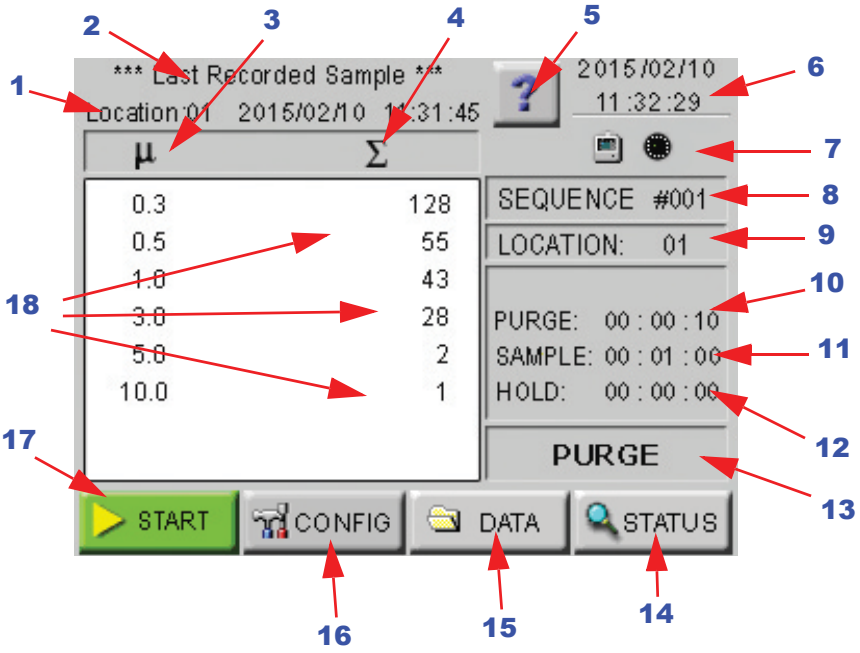


Figure 6-2 MAIN Screen

MAIN Screen Buttons, Fields and ICONs

1. **LOCATION 01:** Displays the Location displayed in the Last Recorded Sample.

2. ***** Last Recorded Sample ***:** This area of the screen displays the most-recent or Last Recorded sample.

3. **Micron Symbol** (μ)**:** Displays the particle channel sizes (in microns) as selected on the Particle Counter.

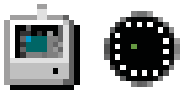
4. **Cumulative Symbol (Σ)**: Indicates that the data is displayed in cumulative counts as opposed to differential data .

5. **About Button:** Shows current firmware and other revision information about the controller.

6. **Current Date and Time:** Displays the controller current date and time.

7. **Status Symbols**: The Manifold Controller will display Status Symbols to indicate various conditions. The different Status Symbols are shown in the left margin.

The ***Remote Mode*** icon displays when the Manifold Controller is being controlled by a remote computer.



When connected correctly, the ***Particle Counter*** and ***Manifold icons*** will appear on the MAIN Screen.

When the Particle Counter or Manifold does not respond, the respective ***Timeout icons*** will appear which are the Particle Counter and Manifold icons with a red slash through them.

If there is an error on the Manifold, such as a positioning error, the ***Manifold Error*** icon appears. A red exclamation mark appears on the Manifold icon.

If an error condition occurs on the Particle Counter, such as a low flow condition or laser error, the ***Particle Counter Error*** icon appears. A red exclamation mark appears on the Particle Counter icon.

If the Manifold Controller needs to be serviced, the ***Manifold Controller Error*** icon appears

If the vacuum pump (blower) is not providing the right vacuum level to the Manifold, the ***Vacuum Error*** icon appears.

8. **SEQUENCE XXX**: Displays the current sequence number in the Manifold Controller's sequence of sampling locations. If the Manifold Controller is running in Manual mode, this box displays MANUAL instead of SEQUENCE XXX.

9. **LOCATION**: This is the Location (or Port#, 1-32) assigned to the current sequence number (1-32).

10. **PURGE:** Purge Time (hh:mm:ss) is the amount of time the Manifold Controller flushes (purges) the tubing with air between counts from different Manifold locations. "Dirty" sample locations require longer purge times for the port following the dirty sample.

11. **SAMPLE:** The Sample Time (hh:mm:ss) is the duration of one sampling period. The Sample Time counts down on the MAIN Screen when the instrument is in Sequence or Manual mode to show how much time is remaining in the sampling cycle.

12. **HOLD:** Displays the Hold Time between samples. The Hold Time (hh:mm:ss) is the time between count cycles when the instrument is not counting particles and can be set to a maximum of 23 hours, 59 minutes, 59 seconds. This field counts down to indicate how much time is left during a Hold period.

13. **Sample State:** Displays the Sensor sample state such as SAMPLING, PURGE or HOLD. Refer to Figure 6-3.

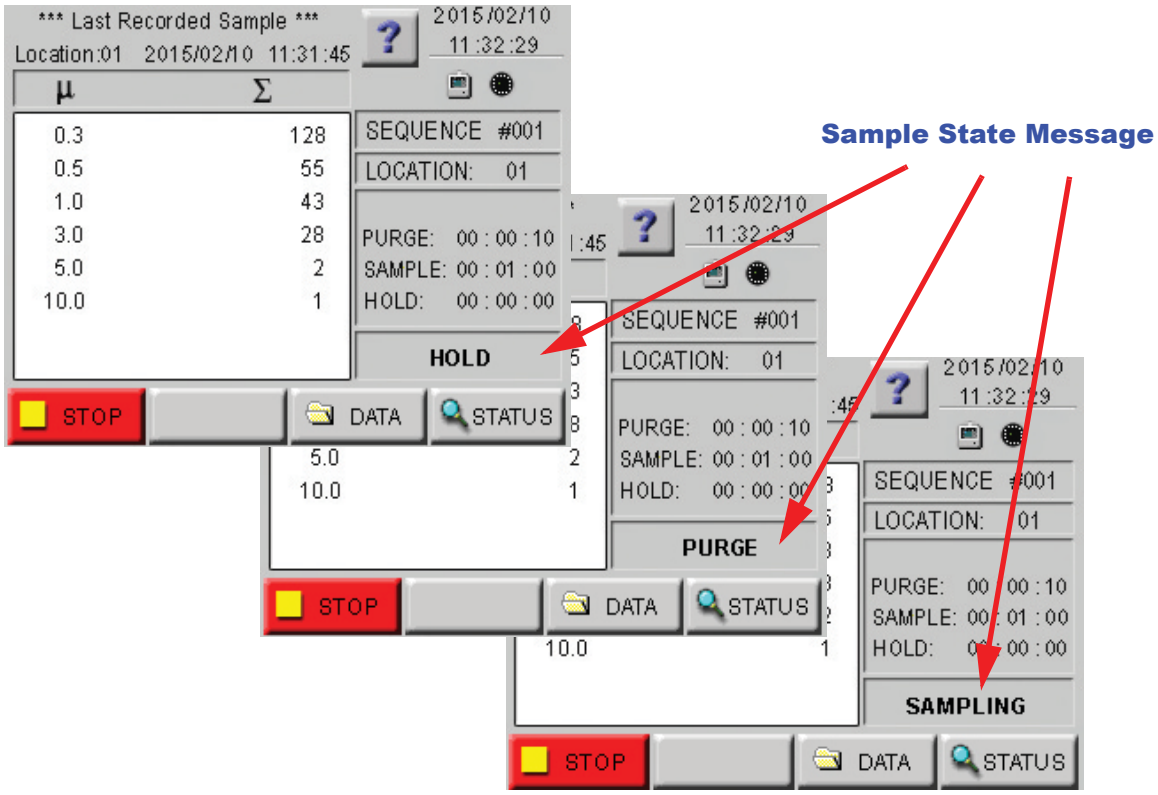


Figure 6-3 PURGE, SAMPLING and HOLD Sample States

14. **STATUS:** Displays the Manifold Controller status regarding connections to the sensor and manifold and the vacuum state.

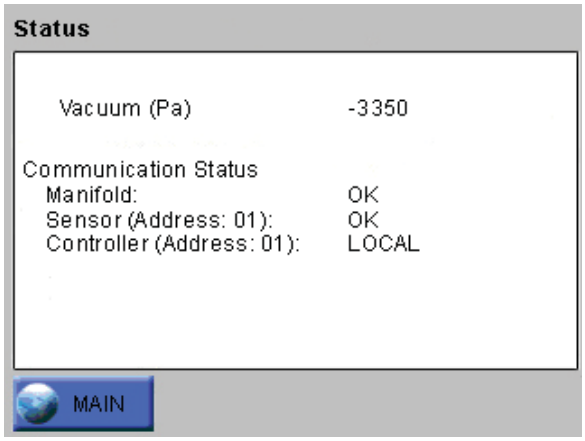


Figure 6-4 Manifold Controller Status Screen

15. **DATA:** Displays the DATA buffer memory screen.

16. **CONFIG:** Press the CONFIG button to open the Configuration screen to change the Manifold Controller DATA or DEVICE Setups. Refer to "CONFIG Screen" on page 6-6 for more information.

17. **START/STOP:** Press Start/Stop button on the screen to start a cycle. While running, the instrument displays the Sensor Sample State of PURGE, SAMPLING or HOLD in the lower right corner of the screen as illustrated in Figure 6-3. The CONFIG button is blanked out and disabled. Press Start/Stop button to stop counting and the word PURGE, SAMPLING or HOLD will disappear.

18. **DATA Display:** This is the area of the screen dedicated to showing the data the Sensor is reporting to the Manifold Controller.

CONFIG Screen

Note: *The unit is shipped from the factory as password disabled. To enable the password feature, access the SECURTY screen to set a password. (See pg. 4-15)*

Press the CONFIG button on the MAIN screen to change settings for the Manifold Controller (Figure 6-5).

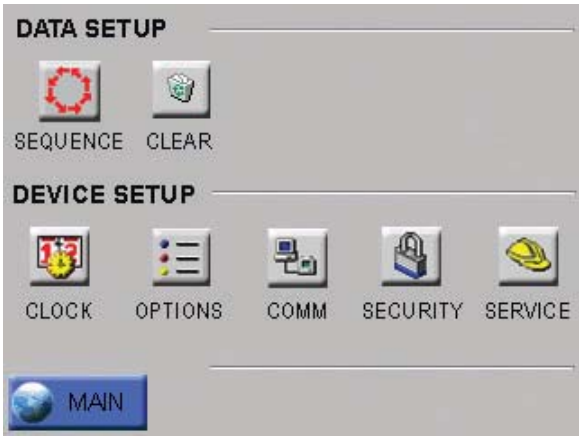


Figure 6-5 Configuration Screen

The Configuration screen has two areas - DATA SETUP and DEVICE SETUP. DATA SETUP configures the sequence of sample locations and the time settings per location. DEVICE SETUP configures the Manifold Controller and its communications with other instruments.

DATA SETUP

Press SEQUENCE to set the order the Manifold Controller cycles through specified Manifold ports (Figure 6-6). The default time values shown are set in “Service Functions” on page 6-16.

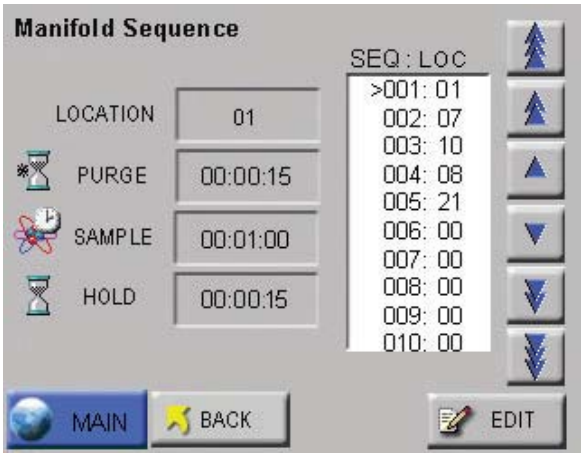


Figure 6-6 Manifold Sequence Screen

The display on the right side of the screen shows the list of sequence numbers and the locations assigned to them. Below is an example of a sequence.

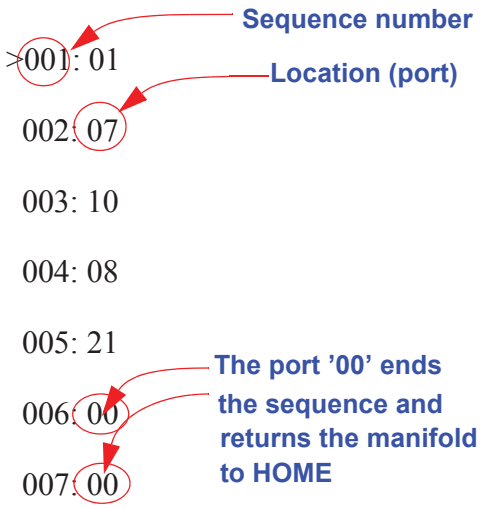


Figure 6-7 Sequence Setup Example

Note: *The double and triple arrow buttons jump up or down 10 and 100 sequence numbers at a time respectively.*

The current sequence number, 001, is marked with the cursor symbol (">"). Use the UP or DOWN arrows on the right side of the screen to move the cursor up or down in the list.

The location number 00 is used to mark the end of a sequence. In the above example 005 is the last step in the sequence because 006 has been assigned location 00. To set the Location, Purge Time, Sample Time and Hold Time for a particular sequence number, use the UP and DOWN arrows on the right side of the screen to move the cursor (">") to the desired sequence number. Press the EDIT button to edit the Sequence Timing (Figure 6-8).

Sequence Timing

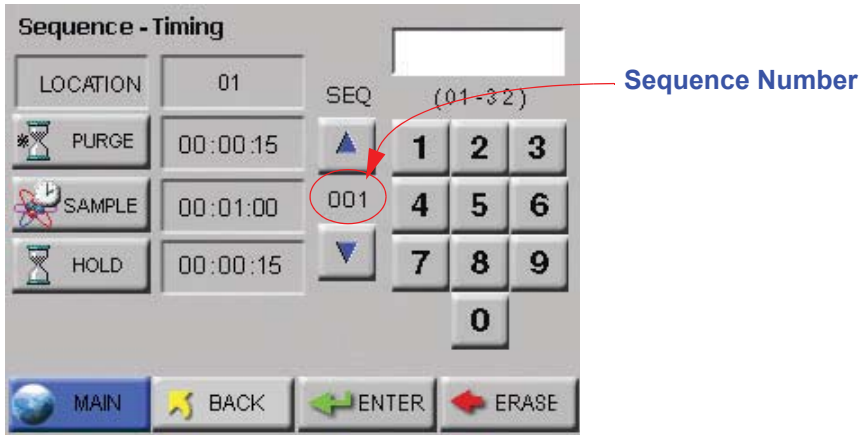


Figure 6-8 Sequence Timing Screen

The sequence number to be edited is displayed in the center of the screen between the UP and DOWN arrows.

To change the value of each parameter, press the appropriate button on the left side of the window: LOCATION, PURGE, SAMPLE or HOLD. Use the keypad on the right to enter the value desired. If an incorrect number is entered, press the ERASE button to delete it. Press the ENTER button to accept the final value.

Use the UP or DOWN arrow to move to the next sequence to be configured.

- **Location** assigns the manifold port number to use for that sequence.
- **Purge Time** (hh:mm:ss) is the time the system flushes the Inlet tubing of any remaining particles from the previous sample location before sampling the new location. The length of the sample tube connecting the Sensor to the Manifold is used to determine the value to be entered. Fifteen to thirty (15-30) seconds per foot of tubing typically ensures count accuracy of different locations. Purge time is especially important when two ports are sampled in sequence and the earlier sample is taken from a typically "dirty" area. Extend the purge time on the location following the dirty sample if the "cleaner location" appears to be counting high at the start of the sample. This setting may need some experimentation to produce successful results.

Note: *All counters count down on the MAIN screen to indicate the time left for that function.*

- **Sample Time** (hh:mm:ss) is the duration of one Sampling Period. The maximum Sample Time is 23 hours, 59 minutes and 59 seconds.
- **Hold Time** (hh:mm:ss) is the time between count cycles when the instrument is not counting particles. Configure it in the same manner as the Sample Time to a maximum of 99 hours, 59 minutes and 59 seconds. The minimum HOLD time must be 5 seconds. Setting a value less than 5 seconds will cause erratic counts.

Once the values are entered for each sequence number, press the BACK button to return to the previous CONFIG Screen, or press the MAIN button to return to the MAIN Screen.

CLEAR: This clears the data stored on the Manifold Controller. Press the CLEAR button on the CONFIG Screen to go to the Clear Data Set Screen (Figure 6-9).

Note: *Download data to LMS before clearing the buffer. This will allow Historical Reviews and prevent loss of data.*

Figure 6-9 Clear Data Set Screen

Note: *Set and enable a password on the instrument to prevent other users from being entering the CONFIG screen and possibly clearing the unit's data. (See page 6-15)*

Press OK to delete the data from the instrument.

Press CANCEL to exit this screen without deleting the data.

After pressing OK or CANCEL the CONFIG Screen appears. Press the MAIN button to return to the MAIN Screen.

DEVICE SETUP

CLOCK: Sets the Manifold Controller Date and Time. Press the CONFIG screen CLOCK button to display the Date & Time screen

shown in Figure 6-10.

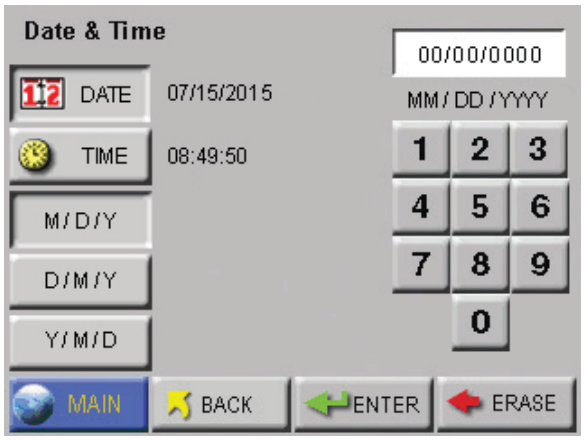


Figure 6-10 Date & Time Screen

To set the DATE, press the DATE button then choose the date format button desired (M / D / Y is shown). The screen will change to show the corresponding format. Use the number keypad to enter the date in the chosen format, starting at the left-most character. If an incorrect number is entered, press the ERASE button to delete the number. Press the ENTER button to accept the date after all digits have been entered.

Press the TIME button to choose TIME setting then use the number keypad to enter the time in HH:MM:SS format. If an incorrect number is entered, press the ERASE button to delete the number. Press the ENTER button to accept the time after all digits have been entered and to start the clock.

Note: *The Manifold Controller synchronizes time on the Sensor every time the START button is pressed or a START command is sent to the Controller.*

Press the BACK button to return to the previous CONFIG Screen, or press the MAIN button to return to the MAIN Screen.

OPTIONS: Press the OPTIONS button to display the Options screen shown in Figure 6-11.

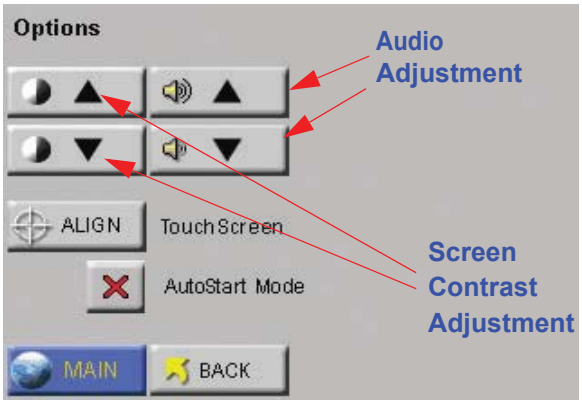


Figure 6-11 Options Screen

Contrast Adjustment: To increase or decrease the LCD screen's contrast, press the Contrast Adjustment UP or DOWN button.

Audio Adjustment: To increase or decrease the volume of the instrument's beep, press the Audio Adjustment UP or DOWN button.

AutoStart Mode: When AutoStart is enabled, the Manifold Controller will start running its sequence when it is turned on and has finished its startup routine successfully. By default, AutoStart is disabled. To enable it, press the AutoStart Mode's  . The button is changed to a  , indicating that AutoStart is enabled. Figure 6-12 shows the screen.

Figure 6-12 AutoStart Mode Splash Screen

ALIGN: Press the ALIGN button to align the touch screen so that locations touched on the screen correspond to the expected button action or function.

Use a PDA Stylus for greater accuracy with touch screen interface.

WARNING: ***Take care to touch the screen at the specified locations only. Touching the screen elsewhere during this process will align the screen incorrectly.***

1. At the ALIGN Intro screen, read then touch anywhere to start.

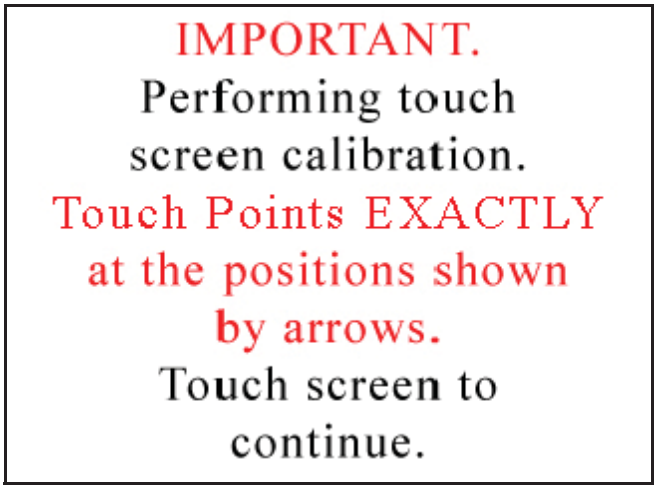


Figure 6-13 Alignment Step 1

2. Carefully touch the arrow tip in the upper right corner three times.

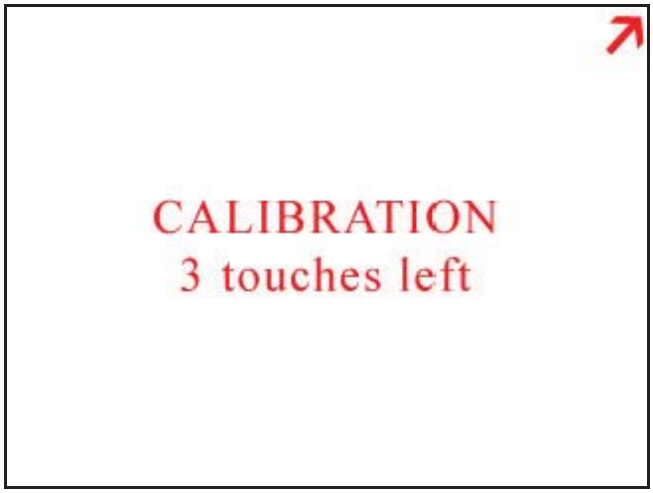


Figure 6-14 Alignment Step 2

3. Carefully touch the arrow tip as shown in Figure 6-15.

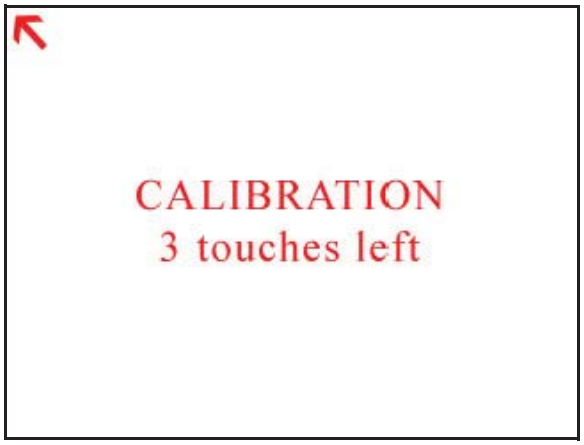


Figure 6-15 Alignment Step 3

4. Carefully touch the arrow tip as shown in Figure 6-16.

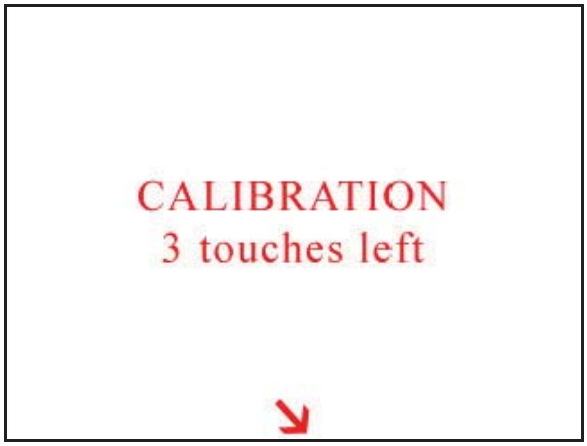


Figure 6-16 Alignment Step 4

Note: *If touching the buttons doesn't give the proper response or the buttons stop working during normal operation of the instrument, turn the unit off, wait for the blank screen, then turn it back on.*

5. If the alignment process is successful, Figure 6-17 screen appears then the Main screen returns.

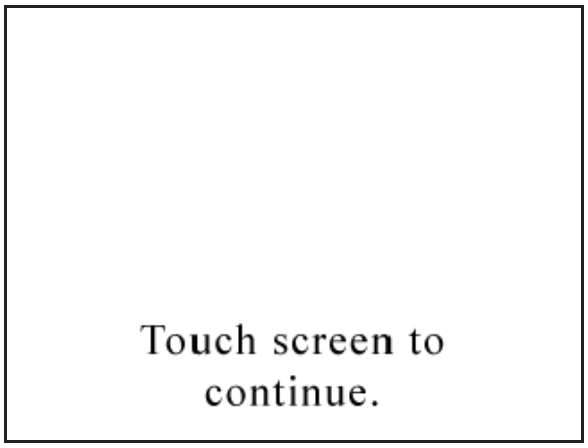


Figure 6-17 Successful Calibration Verify

6. Power cycle the unit by turning the power switch OFF then, after the screen goes dark, turn power ON.

Enter Device COMM Addresses

LMS Express will search for the Manifold Controller's COMM address and the Manifold Controller will search for a particle counter that has the same address. Both addresses can be set by the following steps.

Note: *Address range for the Controller and Particle Counter are 1 to 63.*

1. Press the COMM button to enter the COMM Address for either the Manifold Controller or the Particle Counter. The Communication screen shown in Figure 6-18 appears.

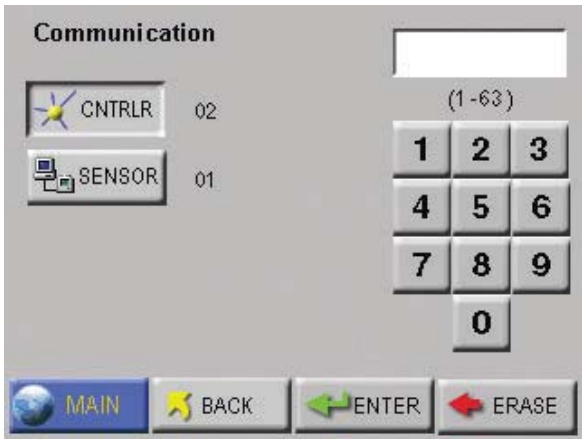


Figure 6-18 Communication Screen

2. Press the CNTRLR button then enter a value using the keypad to set the address for the Manifold Controller. Press the ERASE button to delete an incorrect number and press the ENTER button to accept the value.

3. Press the SENSOR button then enter a value using the keypad to set the address for the Particle Counter. Press the ERASE button to delete an incorrect number and press the ENTER button to accept the value.

4. Press the BACK button to return to the previous CONFIG Screen or press the MAIN button to return to the MAIN Screen.

Enable the Security Feature

1. Press the SECURITY button to open the Security screen shown in Figure 6-19.

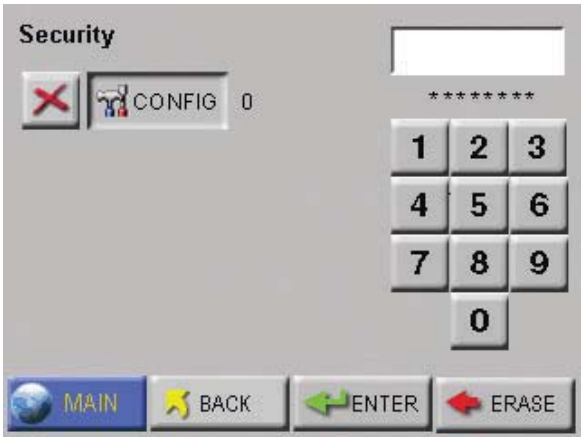


Figure 6-19 Security Screen

WARNING: ***Be sure to store the password in a safe place. If the password is lost or forgotten, please call Lighthouse Technical Support for assistance.***

2. Use the keypad to enter a password. Passwords should be 8 digits long. Press the ERASE button to delete an incorrect number and press the ENTER button to accept the password. The entered password will appear next to the CONFIG button on the Security Screen.

3. Enable the password by pressing the enable/disable button to the left of the CONFIG field. If the button's icon is a red X, the password is disabled. After pressing the button to enable the password, the button's icon is changed to a green check mark.

4. The password is disabled at the factory before the instrument is shipped. After the password is enabled or disabled, press the BACK button to return to the previous CONFIG Screen, or press the MAIN button to return to the MAIN Screen.

Service Functions

WARNING: ***Making changes to the Manifold Controller Service Options affect the Manifold Controller functions and can cause it to malfunction if not performed properly.***

Several service options are built into the firmware and are available from the Service screen. Press the SERVICE button to enter the Service screen shown in Figure 6-20.

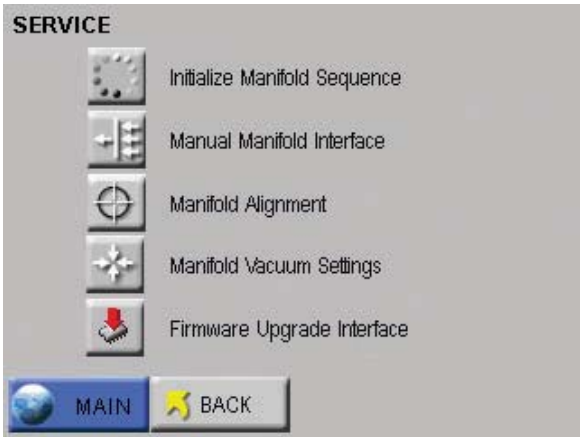


Figure 6-20 Service Screen

Press one of the Service option buttons to select the option.

Press the BACK button to return to the previous CONFIG screen and the MAIN button to return to the MAIN Screen.

Initialize Manifold Sequence

WARNING: ***All configured sequence numbers, locations, PURGE, HOLD and SAMPLE times will be lost when you use the Initialize Manifold command.***

Press the Initialize Manifold Sequence button to display the INIT SEQUENCE Screen shown in Figure 6-21. This action clears the Controller's memory of all settings and data and may be necessary should a power fault occur or settings need to be changed back to defaults for all locations.

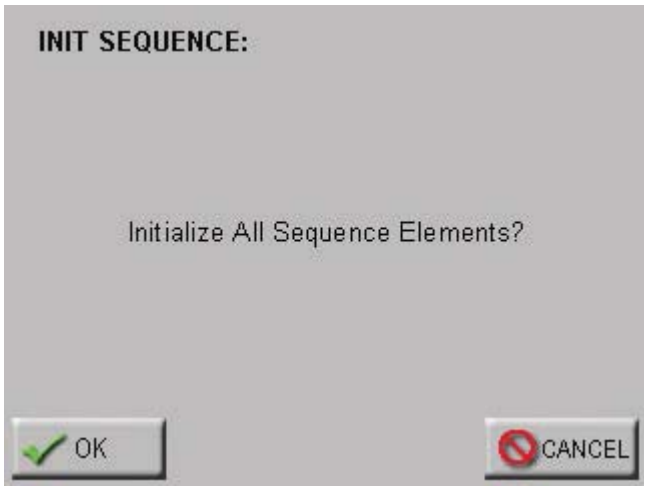


Figure 6-21 Initialize Sequence Screen

Press CANCEL to exit this screen without resetting the sequence elements.

After pressing either the LOCATION, PURGE, SAMPLE or HOLD buttons, use the keypad on the right to enter the value for the parameter.

Press OK to set the Purge, Sample and Hold Times for all locations. Every sequence with a location assigned to them will have the same Purge, Sample and Hold Times as set on this screen.

The sequence is reset when OK is pressed. Sequence 001 is initialized to sample from location 01, 002 from location 02, 003 from location 03, etc. up to sequence 032, which will sample from location 32.

Manual Manifold Interface

Press the Manual Manifold Interface button on the Service Screen to

display the Manual Sampling Setup screens as shown in Figure 6-22.

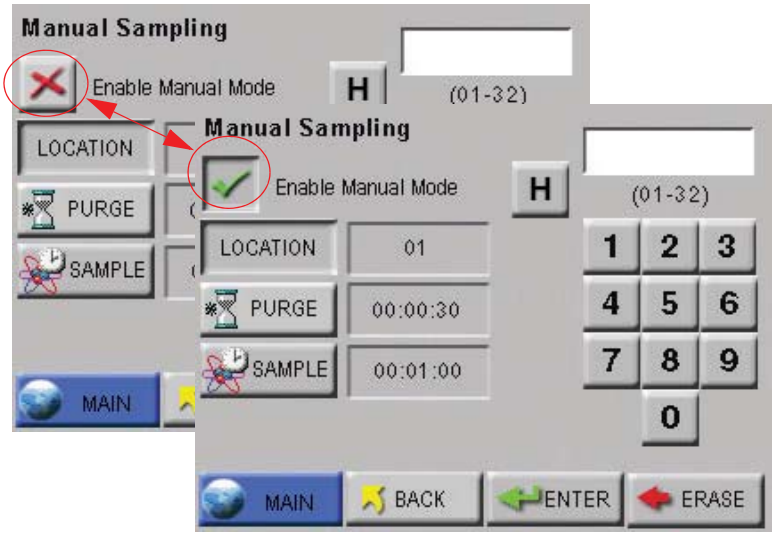


Figure 6-22 Manual Sample Setup Screen

Press the ✕ to the left of the Enable Manual Mode field to enable Manual Mode. Enabling switches the button to a ✓ as shown in Figure 6-22.

Manual Mode is used for sampling only one location at a time.

Press the corresponding button for LOCATION, PURGE or SAMPLE then use the numeric keypad to enter the desired value. Press ERASE to remove an incorrect number and press ENTER to accept the final value.

LOCATION can be 1-32 which corresponds to the position of the manifold sample tube over a corresponding port. Press ENTER to position the manifold to the port.

PURGE time is the duration of purging the sample tube before sampling.

SAMPLE time is the length of sampling time before the final particle count value is recorded.

Pressing the H (HOME) button resets the manifold to its Home position.

Press the BACK button to return to the previous screen or the MAIN button to return to the MAIN Screen.

If Manual Mode is enabled, starting the Manifold Controller will start it

in Manual Mode and use only the settings you entered on the Manual Manifold Interface screen. In Manual Mode the Controller will only sample from the specified Manifold location once; it will not run through the sequence of ports.

If Manual Mode is enabled, the MAIN Screen displays MANUAL instead of SEQUENCE as shown in Figure 6-23.

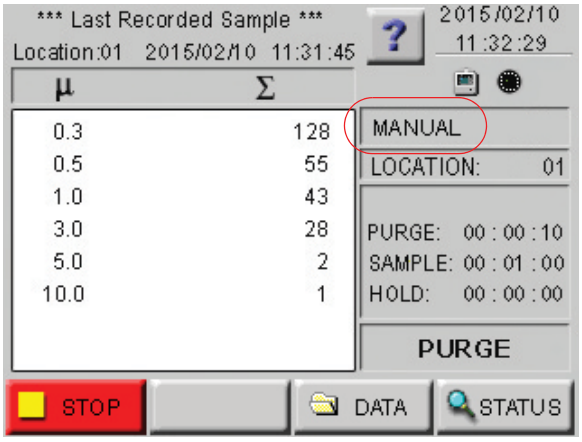


Figure 6-23 MAIN Screen, Manual Sampling Mode

Manifold Alignment

WARNING: ***Improper alignment of the manifold can cause loss of accurate data supplied by the system. Do NOT attempt to align unless factory certified for this procedure. A misaligned manifold will have to be returned to the factory to be repaired.***

Manifold Alignment aligns the Manifold sampling tube and assigns the HOME position. To set the Manifold HOME position, press the Manifold Alignment button on the Service screen and the Manifold Alignment Screen shown in Figure 6-24 appears.

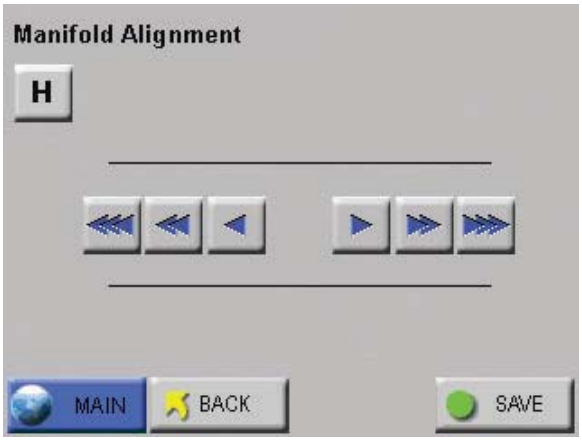


Figure 6-24 Manifold Alignment Screen

Note: *There are 100 total increments between channel positions on the manifold.*

There are three styles of alignment buttons - the single arrow moves the Manifold sampling tube one increment for fine alignment, the double arrow moves it ten increments and the triple arrow button moves the sampling tube into the next channel position.

View the position of the manifold's sample orifice by sending the manifold to the Home position and removing the sample tube from port #1. Use a flashlight or other bright light source to view the sample tube. Press the left or right single-arrow button to determine which way it needs to go if it is misaligned. If the center of the tube is in the center of the coupler, no adjustment is needed - press BACK or MAIN to exit.

After changing the Manifold position, press the SAVE button to save the new HOME position. When the H button is pressed, the Manifold position returns to the saved home channel (Channel 1 is the HOME default).

After alignment, press the BACK button to return to the Service Screen, or press the MAIN button to go back to the MAIN Screen.

Manifold Vacuum Settings

The Manifold Vacuum Setting provides a setpoint for the controller to detect when the system vacuum is too low. This step is critical to prevent counting failures. The balancing process described in Appendix B describes what value to use and how to determine that value.

Press the Manifold Vacuum Settings button to change / set the Vacuum Setting, as shown in Figure 6-25.

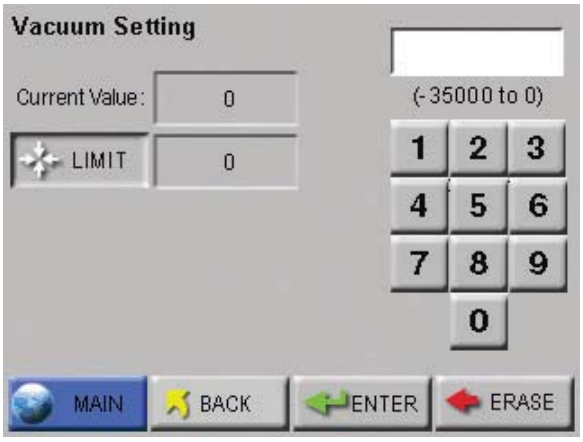


Figure 6-25 Vacuum Setting screen

Note: *The Current Value displays the relative pressure and not the ambient pressure in Pascals.*

The Current Value displayed is the pressure inside the manifold relative to ambient air pressure value expressed as a negative pressure in negative Pascals (as -Pa). This value is also displayed in the DATA and STATUS screens (Figure 6-26 and Figure 6-27) shown later in this chapter.

Note: *The Vacuum Limit value sets the vacuum alarm level for the Controller. When the Current Value meets or drops below the Limit Value, the Controller displays the Vacuum Error ICON on its screen, as shown on page 6-3.*

Use the keypad to set a new Vacuum Limit between -35000 and 0. The number entered is Pascals (Pa) and will appear as a negative number in the LIMIT field. Press ERASE to delete incorrect numbers and press ENTER when you have finished entering the desired setting. After the Vacuum Limit has been set, press the BACK button to return to the Service Screen or the MAIN button to return to the MAIN Screen.

This value is established during set up of the Manifold and the vacuum pump by measuring the airflow at the longest tubing run. Use an AFBU gauge to measure the air flow and adjust the pump to achieve the best flow at or above 1.5 CFM. Read the Pa value on the MC Vacuum Setting screen and enter this value plus an achievable percentage as the limit

Firmware Upgrade Interface

WARNING: ***This feature is for use by Lighthouse authorized Service Providers only.***

If the Manifold Controller requires a firmware upgrade, it must be returned to Lighthouse or a Lighthouse authorized Service Provider.

DATA

Press the DATA button on the MAIN Screen to view the data that the Manifold Controller has collected from the Sensor and Manifold, as shown in Figure 6-26.

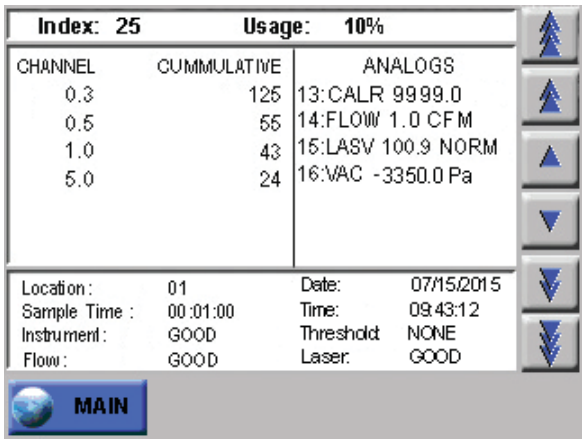


Figure 6-26 DATA screen

Note: *The double and triple arrow buttons move up or down 10 and 100 data records at a time, respectively.*

On the DATA Screen, use the UP and DOWN arrow buttons to scroll through and view each data record in the data buffer.

The Manifold Controller's data buffer is a First-In-First-Out (FIFO), meaning, when the Manifold Controller's buffer has filled to its limit the newest data overwrites the first records stored. Record #1 will always be the oldest record available. The largest index (upper left corner of the screen) is the most recent record available.

Each data record displays the following information from the Particle Counter:

Usage: The percentage of the buffer that is filled.

Channel table: For each enabled channel, the number of counts recorded by the Particle Counter are displayed. The values for each channel from the Particle Counter include:

Size: The channel size recorded, as sent by the Particle Counter.

Counts: The Cumulative count of the data, as sent by the Particle Counter.

Location: The Location (number) where the count was taken.

Sample Time: The length of the sampling period as set on the Particle Counter.

Instrument (GOOD/BAD): The status of the Particle Counter when the sample was recorded.

Note: *The word "Sensor" describes the Particle Counter.*

Flow (GOOD/BAD): The status of the flow rate of the Sensor when the sample was recorded. This status shows GOOD if the flow rate was uninterrupted during sampling, and BAD if there was a flow issue with the Sensor.

Time: Date and time the sample was taken, as recorded by the Particle Counter.

Threshold: (NONE/ALARM) The alarm status from the Particle Counter when the sample was recorded.

Laser (GOOD/BAD): The Sensor's laser voltage status at the time the sample was recorded.

After viewing the desired data records, press the MAIN button to return to the MAIN Screen.

STATUS

Press the STATUS button on the MAIN screen to display information about the attached components as shown in Figure 6-27. ,

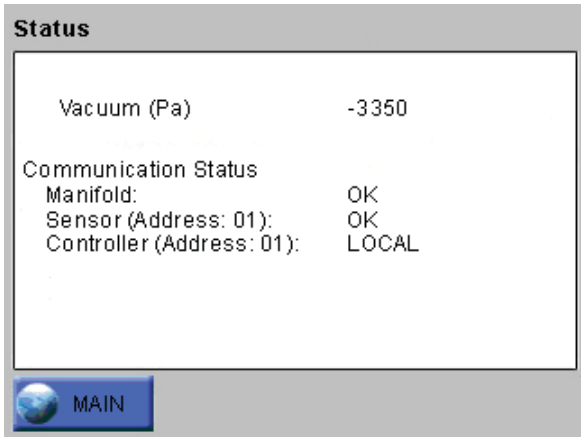


Figure 6-27 Status Screen

The Status screen displays the following fields:

Vacuum: The current vacuum reading. This is a relative pressure gauge between the atmospheric and the Manifold chamber.

Communication Status

Manifold: The current status of the Manifold - OK, TIMEOUT or ERROR.

Sensor: The current status of the Sensor - OK, TIMEOUT or ERROR.

Controller: The current status of the interface with the computer - REMOTE, LOCAL or ERROR.

REMOTE MODE

The Manifold Controller can be run from and controlled by the LMSNet, Pro or Pharma facility system or by LMS Express software.

When the Manifold Controller is run in this the MAIN Screen appears as shown in Figure 6-28. When the Manifold Controller is run remotely, the START, CONFIG and DATA buttons are disabled.

Note: *The START/ STOP, CONFIG and DATA buttons are disabled in Remote mode.*

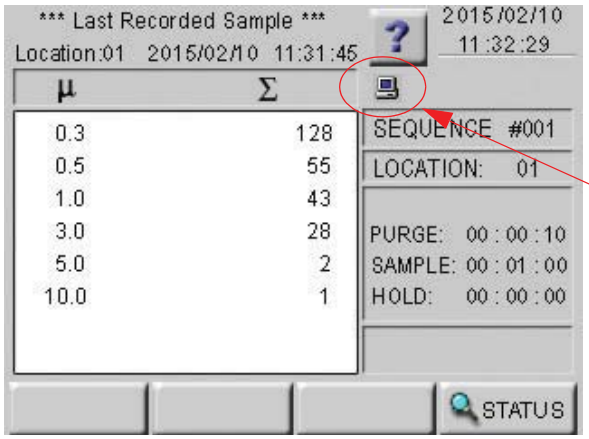


Figure 6-28 Manifold Controller in Remote Mode

PASSWORD ENABLED

When a password is configured and enabled for the instrument, the Configuration Password Access Screen shown in Figure 6-29 appears

when the CONFIG button is pressed.

Figure 6-29 Password Entry Screen

Enter the password using numeric keypad on the right side of the screen. If an incorrect number is entered, press the ERASE button to delete it. Press the ENTER button after entering the entire 8 digit password. If the password is correct, the CONFIG Screen displays.

Note: *Keep the password in a secure place. If the password is lost or forgotten, call your Lighthouse technical support representative for assistance.*

If an incorrect password is entered, the instrument will beep and the Configuration Password Access screen will remain displayed until the correct password is entered.

Press CANCEL to exit this window and return to the MAIN Screen without entering a password. This will display the Config Screen

Using the Instrument for the First Time

WARNING: ***Do not attempt to sample reactive gases (such as hydrogen or oxygen) with this instrument. Reactive gases create an explosion hazard in the instrument.***

Sampling any gas under pressure can cause damage to the instrument.

Sampling any gas that is not the same density as ambient air can result in inaccurate data.

Please contact Lighthouse for more information.

It is assumed that the connection setup was performed appropriately according to the installation procedures (Refer to Chapter 3: Installation).

Initial Sequence

1. From the HOME Screen press the CONFIG button to go to the Configuration Screen as shown in Figure 6-30.

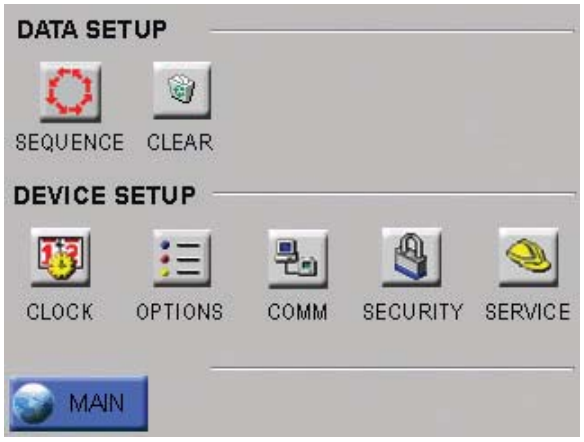


Figure 6-30 Configuration Screen

2. On the Configuration Screen, press the SEQUENCE button. The Manifold Sequence Screen shown in Figure 6-31 appears.

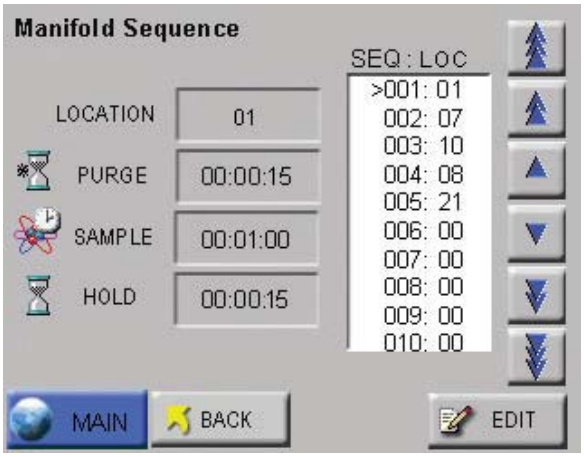


Figure 6-31 Manifold Sequence Screen

Note: *The single UP/ DOWN arrows scroll a single line at a time.*

The double arrows move up and down 10 lines at a time.

The triple arrows move up and down 100 lines at a time (when applicable).

3. On the Manifold Sequence Screen, press EDIT on the right corner of the screen to access the Sequence Timing Screen shown in Figure 6-32.

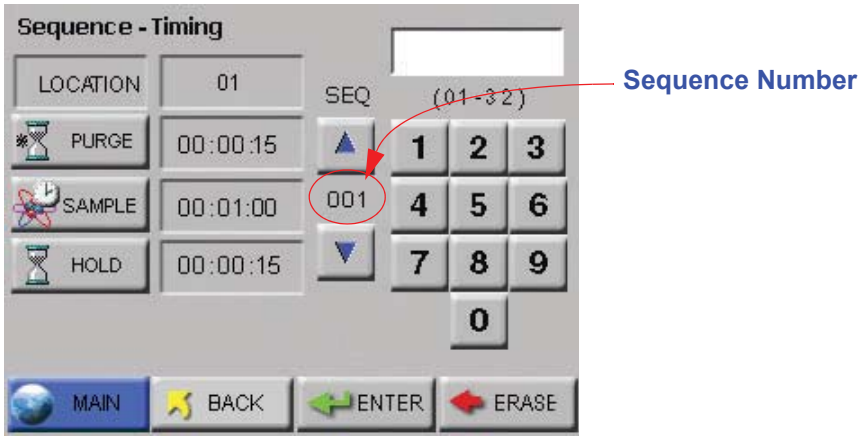


Figure 6-32 Sequence Timing Configuration Screen

4. Notice that the SEQ (sequence) numbers can be scrolled through by using the up and down arrows.

5. On the Sequence Timing Screen, press the LOCATION button. This allows the user to enter a Location value of the Manifold for the chosen sequence number.

6. Use the keypad to enter a location number (channel number on the Manifold), and press ENTER to accept the entry.

7. Press the PURGE button and use the keypad to enter the Purge Time. Press ENTER to accept the entry.

8. Press the SAMPLE button, and use the keypad to enter the Sample Time. Press ENTER to accept the entry.

9. Press the HOLD button, and use the keypad to enter the Hold Time. Press ENTER to accept the entry.

WARNING: ***To prevent damage to the instrument, water, solvents or other liquids of any type should never be put into the instrument.***

10. Scroll to another sequence number using the arrow keys and set the Location along with the Purge, Sample and Hold times for that sequence.

11. Press BACK to return to the Manifold Sequence Screen.

12. Verify that the sequence locations and times are saved in the Manifold Sequence Screen by looking at the SEQ List field.

Note: *Setting the Index Location = 00 designates the end of the defined sequence. When a location = 00 is reached, the Manifold Controller repeats the sequence, starting at 001.*

13. When the desired sequence configuration is completed, press the MAIN button to go back to the MAIN Screen.

14. Press the START button on the Manifold Controller's MAIN Screen to start sampling.

15. If a Purge Time was configured, PURGE is displayed (Figure 6-33) when the Manifold Controller moves to the next port in its sequence.

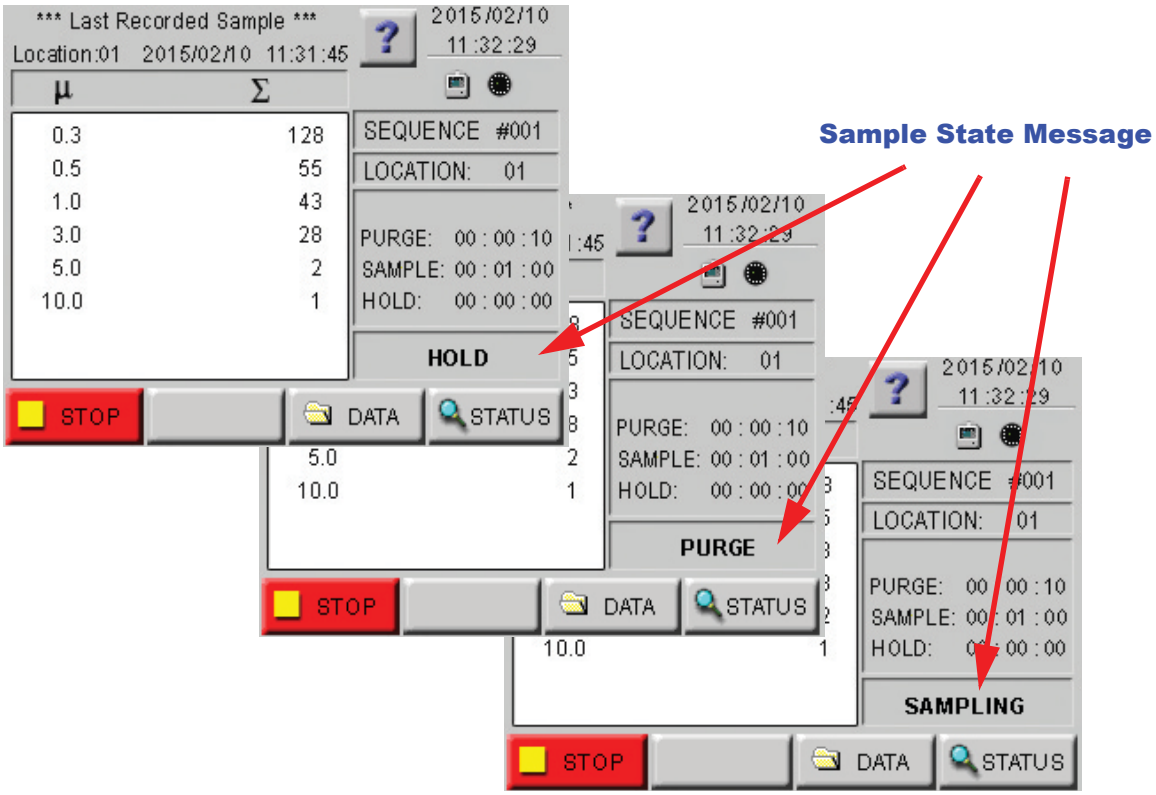


Figure 6-33 Sample State

Note: *Make sure that the Manifold moves to the configured locations, and that the Sensor starts when the Manifold Controller is activated. Press STOP when configured sequence repeats.*

16. SAMPLING follows (Figure 4-33) after the configured Purge Time. When the sampling starts, particle counts are displayed on the MAIN Screen.

17. HOLD is displayed (Figure 4-33) after each sampling cycle if a Hold Time was configured for the sequence.

18. Press the STOP button to stop the Manifold Controller.

Configuring with the MODBUS Protocol

The Manifold Controller can be configured using the MODBUS protocol.

Setting the Real Time Clock

The Real Time Clock (RTC) can be read in registers 40027 and 40028:

Register	Data Type	Description
40027	unsigned integer	Real Time Clock (RTC) [high]. Works in conjunction with 40028. Displays date and time, in number of seconds since midnight, 1/1/1970.
40028	unsigned integer	Real Time Clock [low]

Table 6-1 Real Time Clock Registers

In order to change the RTC to the current local date/time, enter the high and low values as unsigned integers to registers 40035 and 40036 respectively, which are the Data Set registers.

Register	Data Type	Description
40035	unsigned integer	Data Set [high]. Works in conjunction with 40036. Data entered here is applied to the device through the command register.
40036	unsigned integer	Data Set [low]

Table 6-2 Data Set Registers

Then write the command **13** to the command register 40002. This will write the values in the Data Set registers (40035 and 40036) to the RTC registers (40027 and 40028).

Changing the Default Instrument Parameters

The main instrument parameters involved with the operation of the Manifold Controller are:

- Sample Arm Position (Location)

  Specifies the Manifold Controller's channel position. It is set by writing an unsigned integer to register 40026. The range of values is from 0 to 999.

- PURGE Time

  The amount of time the Sensor's sample pump runs before sampling and counting a port location.

- SAMPLE Time

  The duration of time particles are counted in a particular location.

- HOLD Time

  The amount of time a port location holds before changing to the next port location. The Particle Counter does not count during Hold Time.

Sample Time, Hold Time and Purge Time all use 2 registers, a high word and a low word. Table 6-4 shows the registers used in each specific parameters.

If the desired value for any of these parameters is less than 9 hours, then only the low word register needs to be written (in seconds).

Register	Data Type	Description
40026	unsigned integer	Location number: Specifies location of Particle Counter.
40029	unsigned integer	Purge Time [high]. Works in conjunction with 40030. Number of seconds to wait before starting the next sample. Max value is 359,999, which equals 99h 59m 59s.
40030	unsigned integer	Purge Time [low]
40031	unsigned integer	Hold Time [high]. Works in conjunction with 40032. Number of seconds to wait between sample periods. Max value is 359,999, which equals 99h 59m 59s
40032	unsigned integer	Hold Time [low]
40033	unsigned integer	Sample Time [high]. Works in conjunction with 40034. Number of seconds to sample. Max value is 86,399, which equals 23h 59m 59s.
40034	unsigned integer	Sample Time [low]

Table 6-3 Instrument Parameters

Using MODBUS Control Mode

MODBUS control mode allows users to configure sample parameters using the MODBUS communication protocol. When MODBUS control mode is enabled, the instrument shall use the MODBUS sample parameters (purge, hold, and sample time) for all sample locations.

If Bit 4 of Register 40050 is set to 1 the Manifold Controller sample settings shall be configurable via MODBUS. The instrument shall use the same purge, sample, and hold time for each loction.

If Bit 4 of Register 40050 is set to 0 the Manifold Controller shall use the sample settings configured on the display.

Initialization and Operation using MODBUS Control Mode

The following is the recommended command sequence to initialize and program the Manifold Controller using MODBUS control mode:

1. Read general instrument info by reading holding registers 40001-40042.

2. Set to MODBUS mode. Write 16 to holding register 40050 (set Bit 4 to enable MODBUS mode).

3. Set to REMOTE mode. Write 5 to holding register 40002.

4. Delay for about 1 second for the mode to switch.

5. Send the STOP command. Write 12 to holding register 40002.

6. Delay for about 100 milliseconds for the STOP to complete.

7. Update the instrument’s clock use ANSI time (Unix time epoch) in "local time". Write date/time’s high word to holding register 40027. Write date/time’s low word to holding register 40028. Write 13 to holding register 40002 to update the clock.

8. Program the sequence registers.

   Example:

- To program manifold to sample at locations 1, 3, 5, 7
- Write 1 to register 46001
- Write 3 to register 46002

- Write 5 to register 46003
- Write 7 to register 46004
- Write 0 to register 46005 to restart the sequence.

9. Set the purge time in seconds. Write high word to holding register 40029. Write low word to holding register 40030.

10. Set the hold time in seconds. Write high word to holding register 40031. Write low word to holding register 40032.

11. Set the sample time in seconds. Write high word to holding register 40033. Write low word to holding register 40034.

12. Save the above settings to instrument EEPROM. Write 1 to holding register 40002.

13. Delay for about 500 milliseconds for the above operation to complete.

14. Set the data buffer index to always point to the newest data record. Write -1 to holding register 40025.

15. Start the particle counter. Write 11 to holding register 40002.

Running the Instrument

The instrument can be run in a few different ways using the command register 40002. The applicable action commands are discussed in Table 6-4:

Value	Action
1	Saves all writable 4xxxx register values to the EEPROM.
3	Clears the Data Buffer. Record count is set to zero.
4	Saves the instrument parameters in the 40xxx registers to the EEPROM. Parameters include Sample Time, Hold Time, Purge Time, and Sample Arm Position.

Table 6-4 Action Commands

Value	Action
7	External Pump On. The sensor pump is turned on without sampling until it receives an External Pump off command.
	External Pump Off. Turns the sensor pump off.
9	External Start Counter. The instrument samples continuously until it receives an External Stop Counter command. Does not turn on the pump. Ignores local timing parameters.
10	External Stop Counter. Records the number of counts beginning at External Startcounts.
11	Instrument Start. Uses defined Purge Time, Hold Time, Sample Interval and counting mode. Instrument executes samples and holds until an Instrument Stop command is issued. This command will start the pump.
12	Instrument Stop. Aborts current sample. Stops pump. Stops data collection.

Table 6-4 Action Commands

Configuring a Sequence

The sequence configuration process stores the entered location data into read-write input registers. This data defines location arrays that correspond to positions in the Manifold. When the sequence program is started, the sequence register data is used to position the sampling mechanism.

The Manifold Controller location sequence can be configured by writing an unsigned integer of 0 through 32 to register 46001 to 46256. Refer to *Appendix C "MODBUS Register Map v1.49"* for Modbus register details.

Register	Value
46001	1
46002	5

Table 6-5 Sample Sequence

Register	Value
46003	10
46004	17
46005	23
46006	32
46007	0

Table 6-5 Sample Sequence

An example sequence is shown in Table 4-5 where it starts with port 1, followed with port 5, 10, 17, 23 and 32. The last register 46007 has a value 0, which ends the sequence and repeats the sequence from the starting register.

A MODBUS Register Map v1.49

COMM Settings

Lighthouse particle counters with MODBUS have the following communication settings:

Baud Rate	19200
Data Bits	8
Stop Bits	1
Parity	None
Hardware Protocol	RS-232C or RS-485 Standard
Software Protocol	MODBUS ASCII (supports upper/lower case)

Table A-1 MODBUS Communications Settings

The MODBUS slave address is set on the particle counter. Valid addresses are 1-247. Address 0 is the broadcast address.

Supported MODBUS Commands

Hex Command	Description
03	Read Holding Registers
04	Read Input Registers
06	Write Single Holding Register

Table A-2 MODBUS Registers

See www.modbus.org for documentation on how to use these commands.

Register Map

Sensor Settings Registers

Instrument settings are stored in holding registers (the 4xxxx series), which are mostly read/write-able. Not all holding registers are writable. Table A-2 describes the content of these registers.

Register	Data Type	Description
40001	unsigned integer	MODBUS register map version. Matches the version number of this document. Major version digits are hundreds. Minor version digits are tens and ones. For example, v1.35 = 135d = 0087h.
40002	unsigned integer	Command register. Makes the counter execute a command. See the description of this register in the table below.
40003	unsigned integer	Device Status. [bit 0=RUNNING, bit 1=SAMPLING, bit 2=NEW DATA]
40004	unsigned integer	Firmware version. Major version digits are hundreds. Minor version digits are tens and ones. For example, 210 = V2.10.
40005	unsigned integer	Serial Number [high]
40006	unsigned integer	Serial Number [low]
40007	ASCII string	Product Name char[0], char [1] (NULL terminated string)
40008	ASCII string	Product Name char[2], char [3]
40009	ASCII string	Product Name char[4], char [5]
40010	ASCII string	Product Name char[6], char [7]
40011	ASCII string	Product Name char[8], char [9]
40012	ASCII string	Product Name char[10], char [11]
40013	ASCII string	Product Name char[12], char [13]
40014	ASCII string	Product Name char[14], char [15]
40015	ASCII string	Model Name char[0], char [1] (NULL terminated string)
40016	ASCII string	Model Name char[2], char [3]
40017	ASCII string	Model Name char[4], char [5]
40018	ASCII string	Model Name char[6], char [7]
40019	ASCII string	Model Name char[8], char [9]

Table A-3 Sensor Settings Registers

Register	Data Type	Description
40020	ASCII string	Model Name char[10], char [11]
40021	ASCII string	Model Name char[12], char [13]
40022	ASCII string	Model Name char[14], char [15]
40023	unsigned integer	Flow Rate. Divide by 100 to get rate in CFM. For example, 100 = 1CFM.
40024	signed integer	Record Count. Total number of records stored in the counter.
40025	signed integer	Record Index. Zero based index to data in 3xxxx register series. Must be lower than the record count (register 40024). Set this index to expose a counter's record in the 3xxxx registers. Set to -1 to retrieve last record stored in the counter.
40026	unsigned integer	Location number. Particle Counters: Specifies location of Particle Counter. Manifold Controller: Specifies Manifold position. Setting this value moves to that position on the manifold. Value 0 moves to home position.
40027	unsigned integer	Real Time Clock (RTC) [high]. Works in conjunction with 40028. Displays date and time, in number of seconds since midnight of 1/1/1970.
40028	unsigned integer	Real Time Clock [low]
40029	unsigned integer	Initial Delay [high]. Works in conjunction with 40030. Number of seconds to wait before starting the first sample. Max value is 359,999, which equals 99:59:59 (hh:mm:ss).
40030	unsigned integer	Initial Delay [low]
40031	unsigned integer	Hold Time [high]. Works in conjunction with 40032. Number of seconds to wait between sample periods. Max value is 359,999, which equals 99:59:59 (hh:mm:ss).
40032	unsigned integer	Hold Time [low]
40033	unsigned integer	Sample Time [high]. Works in conjunction with 40034. Number of seconds to sample. Max value is 86,399, which equals 23:59:59 (hh:mm:ss).
40034	unsigned integer	Sample Time [low]

Table A-3 Sensor Settings Registers

Register	Data Type	Description
40035	unsigned integer	Data Set [high]. Works in conjunction with 40036. Updates the instrument's real time clock. Setting is the number of seconds since midnight, 1/1/1970. Data entered here is applied to the device through the command register.
40036	unsigned integer	Data Set [low]
40037	unsigned integer	Alarm Mode. Type of alarming performed.
40038	unsigned integer	Alarm Parameter. Control parameter for given alarm mode.
40050	unsigned integer	Enables or Disables MODBUS control Mode. Bit 4 set as 1 - Enabled, 0 - Disabled

Table A-3 Sensor Settings Registers

Alarm Mode (40037) defines the type of calculation performed to define an alarm condition. Alarm mode = 0, corresponds to conventional threshold alarming; channel bit set if threshold exceeded for that given channel.

Alarm Parameter (40038) defines additional parameters that may be needed in defining an alarm mode. Alarm delay intervals can define in such a way.

MODBUS control Mode (40050) allows users to configure sample parameters using the MODBUS communication protocol. When MODBUS control is enabled, the instrument shall use the MODBUS sample parameters (purge, hold, and sample time) for all sample locations.

Device Status

The Device Status register (40003) displays the current status of the device (see Table A-4).

Bit	Description
0	**RUNNING:** Set when a start command is executed remotely via Command 9 (manual start) or Command 11 (instrument start) or through the user interface. The flag will remain set until a stop command is executed.

Table A-4 Device Status

Bit	Description
1	**SAMPLING:** This is set only when the instrument is actually sampling data that is to be recorded. Caution must be used in sending a command during this time that may invalidate current sample.
2	**NEW DATA:** Set to 1 to indicate that a new data record has been recorded and it hasn't been read via modbus yet. When a data record has been read via modbus (registers 30001 to 30999), then this flag is reset to zero.

Table A-4 Device Status

Command Register

The Command Register (40002) is used to make the device perform an action, indicated in Table A-5. The register performs an action when an integer value is written to it. The action is completed when the device sends a MODBUS response. When this register is read, it always returns a zero.

Value	Action
1	Saves all writable 4xxxx register values to the EEPROM.
2	Reserved for future use.
3	Clears the Data Buffer. Record count is set to zero.
4	Saves the instrument parameters in the 40xxx registers to the EEPROM. Parameters include Sample Time, Hold Time, Initial Delay and Location.
5	Enable Remote Control. Locks out the instrument's user interface. Can only change instrument parameters via MODBUS.
6	Enable Local Control. Unlocks the instrument's user interface. Instrument changes can be made at the device itself or through MODBUS.
7	Turns local pump on, if applicable.
8	Stop pump, if applicable.

Table A-5 Command Register

Value	Action
9	Manual Start. The instrument samples continuously until it receives a Manual Stop command. Ignores local timing parameters. Sets Sample Time for data record to equal the time interval between the Manual Start and Manual Stop command. If applicable to device, does not start pump.
10	Manual Stop. Stops sampling. Records counts since Manual Start.
11	Instrument Start (Automatic Counting). Particle Counters: Uses defined Initial Delay, Hold Time, Sample Interval and counting mode. Instrument executes samples and holds until an Instrument Stop command is issued. For instruments with pumps, this command will start the pump. Manifold Controller: Uses defined Manifold Sequence. Stops counting and changing position when Instrument Stop command is issued.
12	Instrument Stop. Aborts current sample. Stops pump, if applicable. Stops data collection.
13	Set Real Time Clock. Writes "Data Set" values (from Registers 40035 & 40036) to the local Real Time Clock. New time value is saved.

Table A-5 Command Register

Alarm and Threshold Registers

Alarm Enable Registers

The Alarm Enable input registers (43xxx series) are read/write. All enable data items are 4 bytes long and are stored across 2 registers. Byte and word ordering is big-endian. Thus, data items are formed by placing the high bytes in front of the low bytes. For example:

Note: *These registers currently apply only to ALARM enable/disable,* ***not*** *to Channel enable/disable.*

<High Bytes><Low Bytes> = <4 Byte Data Item>

The 43xxx register series is used to determine which particle data channel is set to ALARM ENABLE (see Table A-6).

Bit	Description
0	RESERVED
1	ALARM ENABLE (0=disable; 1=enable)

Table A-6 Alarm Enable/Disable Bits

Bit	Description
2-31	RESERVED

Table A-6 Alarm Enable/Disable Bits

These registers run in parallel with the data registers (30xxx series). For example, data register 30010's enable alarm register would be 43010. Data register 30016's enable alarm register would be 43016.

Note: *Alarm Enable currently only works for Particle Channels.*

To enable the Alarm for a particle channel, set the bit in the low word of the channel. You can only enable one particle channel at a time. Whichever channel is enabled last will be the channel that the alarm threshold will apply to.

Particle data registers for the Alarm Enable setting start at 43009 for the high word and 43010 for the low word for channel 1.

Register	Data Type	Description
43009	unsigned int	Alarm Enable for Particle Channel 1 [high] (smallest particle size starts here)
43010	unsigned int	Alarm Enable for Particle Channel 1 [low]
43011	unsigned int	Alarm Enable for Particle Channel 2 [high]
43012	unsigned int	Alarm Enable for Particle Channel 2 [low]
43013	unsigned int	Alarm Enable for Particle Channel 3 [high]
43014	unsigned int	Alarm Enable for Particle Channel 3 [low]
43015	unsigned int	Alarm Enable for Particle Channel 4 [high]
43016	unsigned int	Alarm Enable for Particle Channel 4 [low]
43017	unsigned int	Alarm Enable for Particle Channel 5 [high]
43018	unsigned int	Alarm Enable for Particle Channel 5 [low]
43019	unsigned int	Alarm Enable for Particle Channel 6 [high]
43020	unsigned int	Alarm Enable for Particle Channel 6 [low]
43021	unsigned int	Alarm Enable for Particle Channel 7 [high]
43022	unsigned int	Alarm Enable for Particle Channel 7 [low]
43023	unsigned int	Alarm Enable for Particle Channel 8 [high]
43024	unsigned int	Alarm Enable for Particle Channel 8 [low]

Table A-7 Alarm Enable Registers

Enable Alarming for a Channel

To enable alarming on the third particle channel, you would enable Bit 1 for register 43014.

To disable alarming on the third channel and enable alarming on the second channel, enable Bit 1 for register 43012. This will automatically disable the bit in register 43014.

To disable alarming completely, disable Bit 1 for register 43012. This will disable alarm in all channels. Table 5 shows the assignment for each channel.

Registers	Particle Channel	Bit 1 Enabled
43009 - 43010	1	0
43011 - 43012	2	1
43013 - 43014	3	0
43015 - 43016	4	0
43017 - 43018	5	0
43019 - 43020	6	0
43021 - 43022	7	0
43023 - 43024	8	0

Table A-8 Example of Alarming on Channel 2

Use the Threshold registers to set the alarm threshold value. This is described in the next section.

Threshold Setup Registers

Threshold data is stored in the input registers in the 45xxx series which are read/write. All threshold data items are 4 bytes long and are stored across 2 registers. Byte and word ordering is big-endian. Thus, data items are formed by placing the high bytes in front of the low bytes. For example:

<High Bytes><Low Bytes> = <4 Byte Data Item>

For particle channels, the threshold value is a 32-bit unsigned integer. If the data value exceeds the threshold value and the alarm is enabled for that channel, the threshold flag in the Data Status register (30007-

30008, bit 4) is set.

Note: *The table below shows the registers for an 8 channel particle counter. Counters with less channels do not use the extra registers. The smallest particle channel starts at the xxx09 position.*

The threshold registers (45xxx series) run in parallel with the data registers (30xxx series). For example, data register 30010's corresponding threshold register would be 45010. Data register 30016's threshold register would be 45016.

Register	Data Type	Description
45009	unsigned int	Threshold for Particle Channel 1 [high] (smallest particle size starts here)
45010	unsigned int	Threshold for Particle Channel 1 [low]
45011	unsigned int	Threshold for Particle Channel 2 [high]
45012	unsigned int	Threshold for Particle Channel 2 [low]
45013	unsigned int	Threshold for Particle Channel 3 [high]
45014	unsigned int	Threshold for Particle Channel 3 [low]
45015	unsigned int	Threshold for Particle Channel 4 [high]
45016	unsigned int	Threshold for Particle Channel 4 [low]
45017	unsigned int	Threshold for Particle Channel 5 [high]
45018	unsigned int	Threshold for Particle Channel 5 [low]
45019	unsigned int	Threshold for Particle Channel 6 [high]
45020	unsigned int	Threshold for Particle Channel 6 [low]
45021	unsigned int	Threshold for Particle Channel 7 [high]
45022	unsigned int	Threshold for Particle Channel 7 [low]
45023	unsigned int	Threshold for Particle Channel 8 [high]
45024	unsigned int	Threshold for Particle Channel 8 [low]

Table A-9 Alarm Threshold Registers

Setting the Alarm Threshold Value

The Alarm Threshold Value is set in the low register of the channels. Since only one channel can be enabled for the particle count alarm, setting any channel alarm threshold value will set all the other channels to the same value. When reading the threshold registers, all channels

will show the same 32 bit value.

Registers	Particle Channel	Threshold Value
45009 - 45010	1	1000
45011 - 45012	2	1000
45013 - 45014	3	1000
45015 - 45016	4	1000
45017 - 45018	5	1000
45019 - 45020	6	1000
45021 - 45022	7	1000
45023 - 45024	8	1000

Table A-10 Alarm Threshold Registers set to 1000

Sequence Registers

Sequence registers are used to position the sampling mechanism. Sequence data is stored in the input register (46xxx series), which are read/write.

Sequence data define a location array starting with register 46001. The location values are non-zero corresponding to position on the Manifold Controller (positions 1-32).

The sequence is terminated by a zero in the last register of the sequence. The Manifold Controller would sequence through this array until a zero is encountered, at which point the sequence will repeat from the starting register.

Data Registers

Data is stored in the input registers (30xxx series), which are read-only. All data items are four bytes long and are stored across two registers (see Table A-11 for details). Byte and word order is big-endian. Thus, data items are formed by placing the high bytes in front of the low bytes.

Example:

<High Bytes><Low bytes> = <4 Byte Data Item>

Not all particle and analog channels are active. Retrieving data from an inactive channel returns garbage. See the Data Enable Registers

section of this document for details on how to record data from active channels.

This entire series of registers represents one data record in the device. The Record Index Register (40025) must be changed to index other records here.

The first record in the data buffer is located at Index=0. The most recently saved value is at Index=1.

Register	Data Type	Description
30001	signed integer	Timestamp [high] (# of seconds since midnight, 1/1/1970)
30002	signed integer	Timestamp [low]
30003	unsigned integer	Sample Time [high] (In seconds)
30004	unsigned integer	Sample Time [low]
30005	signed integer	Location [high] (Place where data was recorded)
30006	signed integer	Location [low]
30007	unsigned integer	Device Status [high]:
30008	unsigned integer	Device Status [low]
30009	unsigned integer	Particle Channel 1 [high]
30010	unsigned integer	Particle Channel 1 [low]
30011	unsigned integer	Particle Channel 2 [high]
30012	unsigned integer	Particle Channel 2 [low]
30013	unsigned integer	Particle Channel 3 [high]
30014	unsigned integer	Particle Channel 3 [low]
30015	unsigned integer	Particle Channel 4 [high]
30016	unsigned integer	Particle Channel 4 [low]
30017	unsigned integer	Particle Channel 5 [high]
30018	unsigned integer	Particle Channel 5 [low]
30019	unsigned integer	Particle Channel 6 [high]

Table A-11 Data Registers

Register	Data Type	Description
30020	unsigned integer	Particle Channel 6 [low]
30021	unsigned integer	Particle Channel 7 [high]
30022	unsigned integer	Particle Channel 7 [low]
30023	unsigned integer	Particle Channel 8 [high]
30024	unsigned integer	Particle Channel 8 [low]
30041	IEEE Float	Analog Channel 1 [high]
30042	IEEE Float	Analog Channel 1 [low]
30043	IEEE Float	Analog Channel 2 [high]
30044	IEEE Float	Analog Channel 2 [low]
30045	IEEE Float	Analog Channel 3 [high]
30046	IEEE Float	Analog Channel 3 [low]
30047	IEEE Float	Analog Channel 4 [high]
30048	IEEE Float	Analog Channel 4 [low]
30049	IEEE Float	Analog Channel 5 [high]
30050	IEEE Float	Analog Channel 5 [low]
30051	IEEE Float	Analog Channel 6 [high]
30052	IEEE Float	Analog Channel 6 [low]
30053	IEEE Float	Analog Channel 7 [high]
30054	IEEE Float	Analog Channel 7 [low]
30055	IEEE Float	Analog Channel 8 [hight]
30056	IEEE Float	Analog Channel 8 [low]
30057	IEEE Float	Analog Channel 9 [high]
30058	IEEE Float	Analog Channel 9 [low]
30059	IEEE Float	Analog Channel 10 [high]
30060	IEEE Float	Analog Channel 10 [low]
30061	IEEE Float	Analog Channel 11 [high]
30062	IEEE Float	Analog Channel 11 [low]

Table A-11 Data Registers

Register	Data Type	Description
30063	IEEE Float	Analog Channel 12 [high]
30064	IEEE Float	Analog Channel 12 [low]
30065	IEEE Float	Analog Channel 13 [high]
30066	IEEE Float	Analog Channel 13 [low]
30067	IEEE Float	Analog Channel 14 [high]
30068	IEEE Float	Analog Channel 14 [low]
30069	IEEE Float	Analog Channel 15 [high]
30070	IEEE Float	Analog Channel 15 [low]
30071	IEEE Float	Analog Channel 16 [high]: Vacuum Index
30072	IEEE Float	Analog Channel 16 [low]
30073	unsigned int	Valid analog channel (bit 0 = channel 1, ..., bit 15 = channel 16)
30074	unsigned int	Valid particle channels
30075	unsigned int	Alarm Flags - Analog Channels (bit 0 = channel 1, ..)
30076	unsigned int	Alarm Flags - Particle Channels

Table A-11 Data Registers

Note: *Particle data is a cumulative raw count regardless of the instrument's settings.*

The timestamp field indicates when the data record was recorded. Timestamps are stored as the number of seconds since 1/1/1970, the Unix time epoch. This value can be written directly into a C/C++ time_t data type to be used by ANSI C time functions.

Register 30071 indicates the Vacuum Index. It is a pressure gauge between the atmosphere and the manifold chamber.

Device Status Word

Note: *Although MODBUS sends 4 bytes of status information, Lighthouse instruments only use the first (least significant) byte.*

The registers used for the Device Status Word are 30007 and 30008.

The bit order of the Device Status Word is 7 to 0 (right to left), where bit 7 is the most significant bit and bit 0 is the least significant bit (see Table A-12).

The bits within the Device Status Word are flagged to indicate particular conditions of the currently indexed data record.

If multiple states occur, the bits are added together. For example, a Flow Alert and a Particle Overflow would return a value of 6 in register 30008 (bits 1 and 2 are set TRUE).

Bit	Description
0	Laser Alert Status 0 = Laser is good 1 = Laser Alert
1	Flow Alert Status 0 = Flow Rate is good 1 = Flow Rate Alert
2	Particle Overflow Status 0 = No overflow 1 = Overflow occurred
3	Instrument Service Status 0 = Working correctly 1 = Instrument malfunction detected.
4	Particle Threshold Exceeded Status 0 = Threshold not exceeded 1 = Threshold exceeded

Table A-12 Device Status Word

Data Enable Registers

Note: *All data records have the same enable states. You do not have to read the enable registers for every record.*

The 43xxx register series is used to determine which data items in 30xxx are enabled. Enabled items contain recorded data. Data retrieved from disabled items return garbage. Data items are disabled for particle and analog channels not supported by the device or when the device software is configured not to record data for those items.

The Enable Registers (43xxx series) run in parallel with the Data Registers (30xxx series). For example, Data Register 30010's Enable Register is 31010. Data Register 30016's Enable Register is 31016.

The 43xxx register states are:

00000000h = Disabled
FFFFFFFFh = Enabled

Data Type Registers

Note: *All data records have the same data types assigned to them. You do not have to read the data type registers for every record.*

The 41xxx register series is used to identify the type of data in the 30xxx series. The Data Type registers run in parallel with the Data Registers. For example, Data Register 30041's Data Type register is 41041.

Data Types are assigned 4 ASCII characters across 2 registers. If a Data Type string contains less than 4 characters, then the rest of the string is padded with NULL characters (refer to Table A-13). Note that a Data Type using all four characters will not end with a NULL character.

String	Description
TIME	Timestamp
STIM	Sample Time
SVOL	Sample Volume
LOC	Location
STAT	Status
TEMP	Temperature
RH	Relative Humidity
AIRV	Air Velocity
DPRS	Differential Pressure
ESD	Electrostatic Discharge
FLOW	Flow Rate
LASV	Laser Voltage
VOLT	Voltage
PRES	Pressure

Table A-13 Data Types

Note: *Only Particle data types have numbers in their strings.*

Particle data items are typed specially. They contain numbers, sometimes a space and sometimes a period used as a decimal point (refer to Table A-14). These entries are used to identify particle channel sizes and are always expressed in microns. These types represent raw counts only.

String	Description
0.3	Particle type of size 0.3 micron
1.0	Particle type of size 1.0 micron

Table A-14 Examples of Particle Data Items

String	Description
20.0	Particle type of size 20.0 micron
0.015	Particle type of size 0.015 micron or 15 nanometer

Table A-14 Examples of Particle Data Items

Data Units Registers

The 42xxx register series identifies the units used by data items in the 30xxx series. The Units Registers run in parallel with the Data Registers. For example, Data Register 30010's Units Register is 42010.

Note: *Not all data types have units.*

Units are stored as 4 character ASCII strings across 2 registers. If the Units string contains less than 4 characters or no characters at all, the rest of the string is padded with NULLs. Note that a Units string using all 4 characters does not end with a NULL.

Note: *Be aware that LWS Particle Counters may use units not on the table.*

Table A-15 below shows units that may be sent by the device. Some of these units are not currently used but are reserved for future use.

Units	Description	Units	Description
#	Count (For Particles)	ft/m	Feet per minute
%	Percent	m/s	Meters per second
s	Seconds	"H2O	Inches of water
min	Minutes	"Hg	Inches of mercury
hour	Hours	mmWa	Millimeters of water
F	Fahrenheit	mmHg	Millimeters of mercury
C	Celsius	cmHg	Centimeters of mercury
K	Kelvin	Pa	Pascals
ft	Feet	kPa	Kilopascals
m	Meters	Bar	Bar
ft^2	Square feet	mBar	Milli-bar
m^2	Square meters	V	Volts

Table A-15 Data Units

Units	Description	Units	Description
ft^3	Cubic feet	mV	Milli-volts
m^3	Cubic meters	A	Amperes
L	Liters	mA	Milli-amps
CFM	Cubic feet per minute	Ohm	Ohms
CMM	Cubic meters per minute	mOhm	Milli-ohm
L/m	Liters per minute		
p/f3	Particles per cubic foot		
p/m3	Particles per cubic meter		

Table A-15 Data Units

B Troubleshooting

Overview

This chapter provides a troubleshooting guide for the UM-II Controller and the UM-II Manifold.

The scope of this chapter is to address issues involving these two components and addresses Manifold system balancing. Due to the complexity of the total system, a system-level approach to diagnosis is required, steps of which should be performed on-site.

General Steps

UM-II Manifold

The Manifold uses a precision Front plate incorporating 32 barb fittings, two Pushlok couplers, position-sensing electronics and motor to place a sampling tube over the desired port. The manifold is attached to a high volume blower that provides the system vacuum through all ports. For installation and set up of the system components, personnel should refer to the appropriate chapters.

Field repair of the Manifold is not practical, which requires it be returned to Lighthouse Worldwide Solutions® Service Department for repair.

Manifold Controller

No Power Up

1. If this is a DOA (Dead On Arrival), check power requirements for the country of use and verify the UMC (Universal Manifold Controller) is configured correctly.

2. Check AC input fuse and replaced as required.

Instruments Do Not Show on Screen

1. Make sure the addresses of each are correct - see “Set Particle Counter COMM Address” in “Particle Counter Install” on page 3-4.

2. Make sure the Cat5e cabling is intact and installed in the correct port on the instrument.

System Balancing

Balancing a particle sampling system such as the UM-II 32 Port Universal Manifold system requires good planning and proper implementation of the sample tube network. It also requires proper handling and setup of the components.

Basic Installation Parameters

Certain conditions or parameters must be met or adhered to when designing manifold-based sampling networks. The following points are provided to assist during the design phase and to help troubleshoot failures. Keep in mind that the total number of active ports, tube length attached to those ports and the combined length of all tubes impacts the system performance. A change in any one factor affects the system.

A. The maximum recommended total length of all tubing runs is 4,000 feet or 1216 meters;

B. Maximum recommended length for any run is 125 feet or 38 meters;

C. Shortest recommended length for any run is 10 feet or 3 meters;

D. All sample points should have isokinetic probe tips installed;

E. Flow at the manifold (through sample tubes) must be between 1.5 CFM (42.5 lpm) and 4 CFM (113.3 lpm).

Note:
Before attempting to balance a sampling network, it is strongly recommended that a check of the sample tube installation be made. Not doing so can invalidate testing and adjustments if sags, kinks or sharp angles were introduced during the installation of tubing runs. For details see “Installation and Set Up” in “Manifold Install” on page 2-2.

Preliminary Checks

1. If power is applied to any of the system components, remove power to all components in this order: 1- Manifold Controller, 2- Sensor, 3- Pump. After setup is satisfactory, apply power in the reverse order: 1- Pump, 2- Sensor, 3- Manifold Controller.

2. Have enough additional Bevaline tubing available to duplicate the longest and shortest runs in the sample network, just in case either or both are suspect.

3. Use an Air Flow Balancing Unit to measure the flow rate through each of the two test sample tubes. The Air Flow Balancing Unit (AFBU) will provide an accurate flow rate for the Manifold. Using any other device to measure the flow rate will produce an invalid reading.

4. Check the flow rate scale on the AFBU to determine which end is the input - lower numbers indicate Input end, which should be on the bottom end. Attach the Sample tube to be tested to the Input and the Output end of the AFBU to the Manifold port under test.

Flow-Measure Longest and Shortest Runs

For details of tubing installation, see “Installation and Set Up” in “Manifold Install” on page 2-2.

1. Remove the shortest run and attach the AFBU (Air Flow Balancing Unit) to the sample tube. Insert the short length of tubing from the AFBU into the port assigned to that run.
2. Apply power to the equipment in this order: 1- Pump, 2- Sensor, 3- Manifold Controller.
3. Next, review“Manual Manifold Interface” on page 6-17 and select the port to be tested.
4. Enable Manual Mode.
5. Set the purge time to 10 minutes. This runs the Sensor sampling pump, which affects flow, but the Sensor will not count.
6. Return to the Main screen and press Start.
7. The AFBU should indicate between 1.5 and 4 CFM. Record the sample tube’s flow rate.
8. Press Stop on the Manifold Controller.

9. Remove the longest run and attach the AFBU to the sample tube. Insert the short length of tubing from the AFBU output into the port assigned to the run and go back to the Manual Manifold Interface screen.
10. Select the longest sample run port, verify Purge time is 10 minutes, return to the Main screen and press Start.
11. The AFBU should indicate between 1.5 and 4 CFM. Record the sample tube's flow rate.

Successful Flow Check

If both sample ports are reading between 1.5 and 4 CFM, no adjustment to the blower may be required. The longest run will have the lowest flow rate and the shortest will have the highest flow rate. Repeat steps 3. through 8. for each port in use. All ports should be checked to make sure there are no restrictions or breaks in any tubing runs.

WARNING: ***Before leaving this screen, disable Manual Mode.***

After successful completion of the total system check, return the AFBU to the sample tube having the lowest flow rate. Reduce the blower's flow by increasing the bypass until the AFBU reads 1.5 CFM on this port. Go to the CONFIG, Service, Manual Manifold settings screen and observe the Pa reading on the screen. Enter this value plus an achievable percentage as the Alarm Limit.

Reattach tubing to the assigned ports.

Resolving Flow Issues

If both readings are high or low, adjusting the blower should bring the readings within the specified range. If, however, the short length is too high and adjusting the system vacuum down causes the longest length to fall out of spec, a flow-restrictor may be required on the short length. Contact Lighthouse for the availability of this option.

If the longest run is reading too low and the blower is adjusted to its maximum output, verify the installation by duplicating the run and attaching to the same port. If flow is corrected, replace the affected run. If this does not show improvement to the flow, the design of the system may be inadequate. Reducing the number of ports in use, reducing the total run length or replacing the vacuum pump with a higher output unit should be considered.

When issues are resolved, go to "Successful Flow Check".

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Service and Support
Tel. 1-800-945-5905 (USA Toll Free)
Tel. 1-541-770-5905 (Outside of USA)
techsupport@golighthouse.com
www.golighthouse.com

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