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USER GUIDE

Solair particle counters

Lighthouse

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SOLAIR 3100/5100/Boulder Counter

AIRBORNE PARTICLE COUNTER







Operators Manual

LIGHTHOUSE WORLDWIDE SOLUTIONS

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Lighthouse Worldwide Solutions

Solair 3100/5100/Boulder Counter Gen E

Airborne Particle Counter

Operators Manual

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About This Manual

This manual describes the operation and use of the Lighthouse SOLAIR Gen E 3100/5100 and Boulder Counter Airborne Particle Counters. The word SOLAIR, unit or instrument may be used in place of a specific model. Screen examples will vary.

Additional Help

For more information about the Lighthouse Solair Airborne Particle Counters, contact:

Lighthouse Worldwide Solutions
Service and Support
Tel: 800-945-5905 (USA Toll Free)
Tel: 541-770-5905 (Outside of USA) techsupport@golighthouse.com

Text Conventions

Note and Warning

Note: A note appears in the sidebar to give extra information regarding a feature or suggestion.

Warning: A warning message appears that doing something incorrectly could result in personal injury, damage to the instrument or loss of data.

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Chapter 1 – General Safety

Safety Considerations

Warnings and cautions are used throughout this manual and the reader should become familiar with the meaning of a warning before operating the particle counter. Many warnings will appear in the left margin of the page next to the subject or step to which it applies, or they can appear in the body of text. Take care when performing any procedures preceded by or containing a warning. The classifications of warnings are defined as follows:

- LASER - pertaining to exposure to visible or invisible laser radiation
- Electrostatic - pertaining to electrostatic discharge
- Network Connect - pertaining to communication ports and instrument damage



Warning: There are no user-serviceable components inside the particle counter.



Warning: +24VDC is present on RS-232/485 IN port pin 7 when instrument power is applied.

LASER Safety Information

This product contains a laser-based sensor that is a Class 1 product (as defined by FDA 21 CFR, Chapter 1, Sub-Chapter J) when used under normal operation and maintenance. Performing service on the sensor can result in exposure to invisible radiation.

The particle counter has been evaluated and tested in accordance with EN 61010-1, “Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use” and IEC 60825-1, “Safety of Laser Products”.



Warning: The use of controls, adjustments, or procedures other than those specified within this manual may result in personal injury and/or damage to this instrument. Attempts by untrained personnel to disassemble, alter, modify, or adjust the electronics or optics may result in personal injury and damage to the instrument and will void its warranty.

There are no user-serviceable components inside the particle counter. Only factory authorized service personnel should repair or service this instrument and its optical system.

If replacement of the power supply AC power cord is required, replace it only with a cord having as good as or better rating than the cord provided by Lighthouse Worldwide Solutions. Attempting to use an under-rated cord can expose the instrument power supply, adjacent equipment or the user to dangerous shock and fire hazards. Failure to heed this warning can result in personal injury or death.

For further technical assistance, contact Lighthouse at 1-800-945-5905 (USA Toll Free) or 1-541-770-5905 (Outside of USA).

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The international Caution symbol is located on the rear of the instrument next to the RS-485 IN port. The symbol will be accompanied in this manual with a warning about +24VDC being present on the connector pin-7 when instrument power is applied.

Port-Connect Warning



Warning: Connect to the SOLAIR 1 CFM instrument using the Ethernet port (top RJ45), RS485 port (2nd RJ45) or USB port. The instrument will determine which port should be active and configure it accordingly. Only one interface can be active at a time. Do NOT attempt to use two or more of these connectors at one time.

It is suggested that power to the instrument be removed before changing from one port to another then power the instrument ON. This warning does NOT apply to the USB Flash Drive.

Electrostatic Safety Information

Electrostatic discharge (ESD) can damage or destroy electronic components. Therefore, any service or maintenance work should be done at a static-safe workstation. A static-safe workstation requires an ESD consultant to evaluate the work environment and propose the equipment and apparel needed for just such a workstation to be successful.

Chapter 2 – Introduction

Overview

This operating manual describes how to use the Lighthouse SOLAIR 1.0 CFM, Gen E portable particle counters, such as the SOLAIR 3100 and 5100 and the Boulder Counter.

The model number (except in the case of the Boulder Counter) signifies the minimum particle size measured by the instrument. The number "3100" indicates a 0.3 µm minimum channel size at 1.0 CFM. The number "5100" indicates a 0.5 µm minimum channel size at 1.0 CFM. The Boulder Counter, due to its large particle counting ability starting at 5.0 µm, does not use a model number, per sè.

All models discussed in this manual have a color touchscreen, may have the thermal printer option installed, may have the battery option installed and can store up to 3000 records. The Boulder Counter is an exception because it includes all the features.

SOLAIR 3100 and 5100 instruments support up to eight particle-size channels, four 4-20mA analog sensors, built-in thermal printer, and a rechargeable, removable Li-Ion battery. The Boulder Counter supports only six particle-size channels.

Note: For lists of the standard channel sizes available for each SOLAIR model, see the SOLAIR Specifications section in this chapter.

All SOLAIR instruments contain a microprocessor that controls all the instruments' functions. Count data is displayed in cumulative or differential mode as raw data or normalized in particles per cubic foot or per cubic meter.

SOLAIRs use the Extreme Life Laser Diode Technology for a laser life span of greater than 20 years and collection optics for particle detection. Particles are directed through the laser's beam and scatter its light. The collection optics collect and focus that light onto a photo diode that converts it into electrical pulses. The pulse height is a measure of particle size. Pulses are counted and their amplitude is measured for particle sizing. Results are displayed as particle counts in the specified size channel.

Utilizing a large touch screen interface, SOLAIR instruments are easy to configure and operate.

Each SOLAIR can store 3,000 records from up to 8 particle count channels and up to four 4-20mA analog sensors, including location information. All data can be quickly and reliably downloaded to a computer, stored on a Flash Drive or printed on an optional printer.

Instruments in the SOLAIR family allow users to:

- Set sampling and hold times.
- Configure the number of samples taken in a single location.
- Connect to four analog 4-20mA sensors.
- Connect an external alarm light, buzzer, or external remote control to a relay output.
- Print reports based on Federal Standard 209E (ft3), EU GMP Annex 1 (if unit has 0.5 and 5.0 channels) and ISO 146441-1 if the printer option is installed.
- Save data for historical data review.
- Print data tables using the included data transfer software; export data to Excel to build graphs or charts.
- Store data in *CSV and *LSD format to a USB Flash Drive.

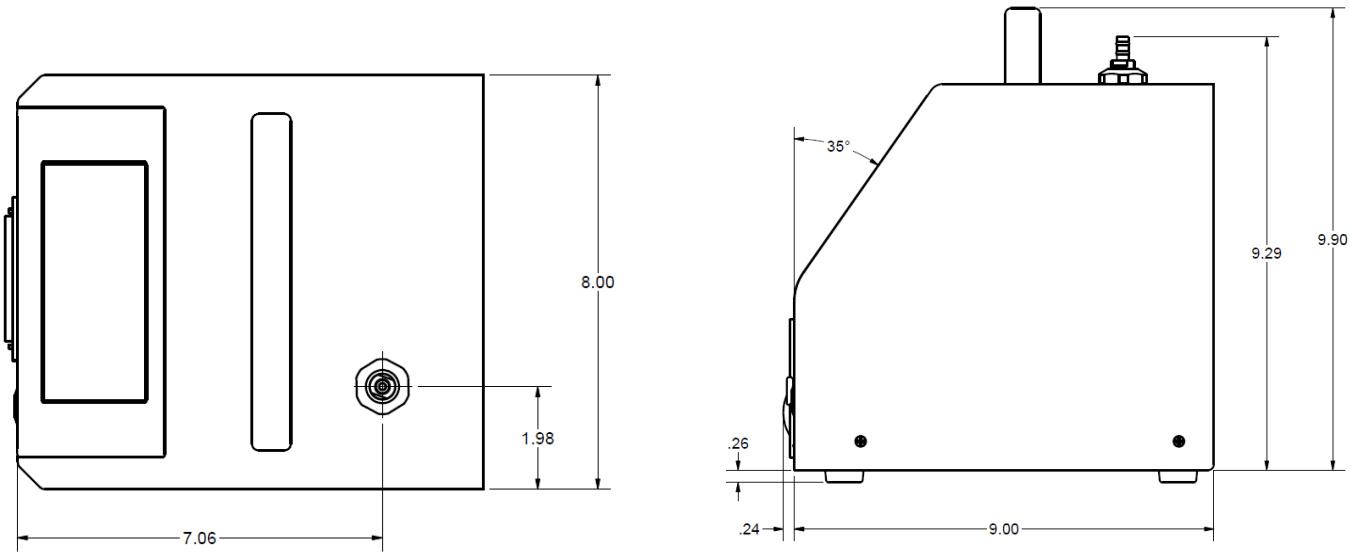


Figure 2-1 SOLAIR Dimensions (Side and Top)

SOLAIR Specifications

Solair 3100 Size Ranges	0.3 – 25.0µm
Channel Thresholds	Standard and Optional, 6 & 8 Channels: 0.3, 0.5, 0.7, 1.0, 2.0, 3.0, 5.0, 7.0, 10.0, 25.0µm
Solair 5100 Size Ranges	0.5 – 25.0µm
Channel Thresholds	Standard and Optional, 6 & 8 Channels: 0.5, 0.7, 1.0, 2.0, 3.0, 5.0, 7.0, 10.0, 25.0µm
Boulder Counter Size Range	5.0 – 100.0µm
Channel Thresholds	5.0, 10.0, 25.0, 40.0, 50.0, 100.0µm
Flow Rate	1.0 CFM (28.3 LPM)
Counting Efficiency	3100: 50% @ 0.3 µm; 100% for particles>0.45 µm (per ISO 21501-4) 5100: 50% @ 0.5 µm; 100% for particles > 0.75 µm (per ISO 21501-4)
Laser Source	Extreme Life Laser diode
Zero Count Level	<1 count/5 minutes (per ISO 21501-4)
Concentration Limits	500,000 Particles/ft3 @ 5% Coincidence Loss
Calibration	NIST Traceable
Count Modes	Concentration, manual, automatic, beep
Data Storage	Stores up to 3,000 sample records of particle & environmental data, plus location and time
Communication Modes	Ethernet TCP/IP, RS485/Modbus, RS232 via RJ-45 to PC, USB, USB Flash Drive
Supporting Software	LMS XChange Data Transfer Software, Optional: LMS Express/RT, LMSNet
External Connections	PIC connector; USB-B and Flash Drive USB-A; Ethernet RJ45, RS485 RJ45, Calibration port, 4-20 Analog ports, AC IN.
Analog Inputs	Up to four optional 4-20mA analog sensors
Touch Screen Display	5.7” (14.47 cm), 320 x 240 pixels
Printer	Thermal printer, optional, specify at time of order
Reports	FS-209E (ft), ISO 14644-1, EU GMP Annex 1
Key Software Features	Historical data review, password protection on power up, alphanumeric locations, Windows-like browser user interface
Enclosure	Stainless Steel
Sample Outlet	Internally filtered to HEPA standards (>99.97% @ 0.3µm)
Vacuum Source	Internal clean pump, flow controlled
External Power Supply	100-240 VAC, 50-60 Hz
Battery	Li-Ion, removable & rechargeable* *Average recharge time = 6 hours
Dimensions	9.24"(L) x 8.0"(W) x 10.16" (H) [23.5 cm x 20.32 cm x 20.81 cm]
Weight	Without battery: 11.5 lb (5.2 kg) With battery: 13.0 lb (5.89 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

Table 2-1 Solair Specifications

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Note: The manufacturer recommends that the Lighthouse instrument be calibrated annually by a Certified Lighthouse Service Provider to ensure it continues to perform within specifications. For information about returning instruments for calibration or service, please visit our RMA website, www.golighthouse.com/RMA.

For information about returning instruments for calibration or service, please visit our RMA website, www.golighthouse.com/RMA.

Chapter 3 – Unpacking, Inspecting, and Installing

Initial Inspection

The instrument is thoroughly inspected and tested at the factory and is ready for use upon receipt.

Unpacking

It is presumed that when the instrument was received, its shipping carton was inspected for damage. If the carton was damaged, the carrier was notified, and the carton was saved for carrier inspection. The instrument and other components were then removed from their packing materials and inspected for broken parts, scratches, dents, or other damage. Any damage was immediately reported to Lighthouse. Damaged cartons may be replaced by calling Lighthouse Sales. Keep an undamaged carton for reshipment of the instrument for its annual factory calibration.

Report damages to Lighthouse Technical Support at 1-800-945-5905 (USA Toll Free), 1-541-770-5905 (Outside of USA) before proceeding.

Verify Package Contents

Verify the contents of the package against the shipping list. If anything appears to be missing, please contact your sales representative at Lighthouse Worldwide Solutions immediately at 1-510-438-0500.

To maintain your warranty, keep the undamaged shipping container and all packing material for reshipment of the instrument for annual calibration. Order replacement containers and packing materials only from Lighthouse, directly, or from a Lighthouse-authorized distributor.

Keep the carton and all packing material for reshipment for the instrument's annual calibration



Warning: Always remove the battery prior to shipping the instrument.

Shipping Instructions

Should it become necessary to return the unit to the factory for any reason, contact Lighthouse Customer Service at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) or visit our website, www.golighthouse.com/rma, and obtain a Return Merchandise Authorization (RMA) number. Reference this number on all shipping documentation and purchase orders. After receipt of the RMA number, follow the shipping instructions below:

Warning: If the instrument is damaged during a return shipment due to inadequate user packing, the warranty may be voided and may result in additional repairs being billed to the customer.

1. Use the original container, nozzle caps and packing materials when-ever possible. Remove any instrument battery and package it to ship separately - refer to www.golighthouse.com/rma for detailed instructions. Remove attachments, such as TRH or Isokinetic probes, and package to prevent physical and ESD damage (TRH).
2. If the original container and packing materials are not available, wrap the unit in “bubble pack”, surround with 4-inch shock-absorbent material and place in a double-wall carton - the instrument should not rattle around when the carton is vigorously shaken. If the instrument is damaged during shipment due to inadequate user packing, the warranty may be voided and may result in additional repairs being billed to customer. Contact Lighthouse at800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) to purchase a replacement shipping container and nozzle caps.
3. Seal container or carton securely. Mark “FRAGILE” and write the Return Merchandise Authorization (RMA) number on any unmarked corner.
4. Return the instrument to the address provided by a Lighthouse representative or the RMA website.

Note: Before packing the Boulder Counter for return shipment, the ISP Filter Cap and ISO Probe must be removed from the instrument.

To remove the filter cap and probe, refer to pages 3-7 through 3-9 and reverse Steps 1 through 6.



Figure 3-1 Examples of SOLAIR 3100 and 5100

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Accessories

Several accessories may be ordered to tailor the instrument to specific needs. Some are optional and some are standard with each instrument.

- **Temp/RH Wand** (optional) - plugs into the instrument's rear panel. The 4-20mA probe monitors temperature (0° to 150° F or -17.8° to 65.6° C) and relative humidity (0% to 100%). Results are displayed, printed (if printer is available) and can be downloaded to the LMS XChange software for backing up and historical data review.

- **Air Velocity Probe** (optional) - plugs into the instrument's rear panel. The probe monitors air velocity up to 200 feet/minute (1.016 m/sec). Results are displayed, printed (if printer is available) and can be downloaded to the LMS XChange software for backing up and historical data review.

- **Differential Pressure Sensor** (optional) - plugs into the instrument's rear panel. Monitors range from 0 - 0.5" H2O (124.5 Pa). Results are displayed, printed (if printer is available) and can be downloaded using the LMS XChange software for backups and historical data review.

- **Isokinetic Sampling Probe** (standard) - for use in unidirectional air flow to maximize correlation between counts and actual particle-size distribution. Can also be hand-held for particle counting in specific locations.

- **ScanAir Filter Scanner** (optional) - for use in scanning HEPA /ULPA filters and seals for leaks and efficiency. Designed to sample up to eight different channel sizes at a flow rate of 1.0 CFM (28.3 LPM), the scanner can be remotely operated and programmed for five separate audible alarm threshold values.

- **ScanAir Pro Filter Scanner** (optional) - for use in scanning HEPA / ULPA filters and seals for leaks and efficiency (including PTFE Filter Media). Designed to sample up to eight different channel sizes at a flow rate of 1.0 CFM (28.3 LPM), the ScanAir Pro provides a programmable touchscreen interface with audible and visual alarms.

- **Particle Scanner Diluter** (optional) - Used in conjunction with a SOLAIR 1.0 CFM particle counter and the ScanAir/ScanAir Pro filter scanners, the integrated intelligent NIST Traceable diluter can be configured with a unit specific dilution ratio.

- **Shipping Case with Wheels** (optional)

- **Internal Printer** (Standard for Boulder Counter; optional for base models)

- **Printer Paper** (2 rolls; standard for Boulder Counter)

- **Cleanroom Printer Paper** (optional, must be ordered in quantity of 10 rolls or more)

- **Validation Documentation** (optional)

- **Li-Ion Battery**, removable and rechargeable (optional)

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- **External Battery Charger** (optional)
- **Cleanroom Cart** (optional)
- **USB "A to B" Communication Cable** (standard)
- **USB to RJ-45, RS-485 Serial Adapter** (optional)
- **USB to RJ-45, RS-232 Serial Adapter** for laptops that have only a USB port and do not have a 9-pin serial port for communications (optional)
- **DB-9 to RJ-45, RS-232 Serial Adapter** (optional)
- **Wireless Adapter** (optional)
- **LMS Express software** (standard), an analysis tool that allows the user to:

    1. Manually download data from the instrument
    2. Save data for historical review
    3. Have advanced reporting with standard reports and much more.

- **LMS Express RT software** (optional), an analysis tool that allows the user to perform the following:

    1. Download data from the instrument
    2. Collect data real time
    3. Save data for historical review
    4. Have advanced reporting with standard reports

To enquire about Accessories contact Lighthouse Worldwide Solutions at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for details.

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Installation

Connecting Power

The power input is 100-240VAC, 50-60Hz. An external Power Supply is included with the SOLAIR. The power switch is located on the front of the unit.

Lighthouse recommends using protected power to prevent damage to the instrument by voltage spikes. Using an uninterruptible power supply when the SOLAIR is kept in a stationary location will help prevent damage to the instrument or loss of data in the event of a power outage, especially for SOLAIRS that do not have the battery option.

Installing the Battery

If the SOLAIR 1.0 CFM was ordered with the rechargeable Li-ion battery, the battery needs to be installed before the instrument can be used for portable operation. The battery may not be fully charged. It can be charged when it is installed in the unit or by using an optional external battery charger. To charge the battery in the SOLAIR, install the battery then plug the SOLAIR into an AC power source.

To install the battery, first make sure that power switch on the front of the unit is in the OFF position and AC power is removed from the SOLAIR. Then follow these instructions:

1. Loosen the thumbscrews and remove the battery door.
2. Connect the terminals and fold the wires against the battery. Replace the battery door and tighten the thumbscrews. See Figure 3-3.

Note: To recharge the battery inside the unit, plug in the AC power source. The SOLAIR does not have to be powered on to recharge the battery.



Figure 3-2 Battery compartment door



Figure 3-3 Connect Terminals and Replace Door

Removing the Battery

To remove the battery, turn off the power switch, loosen the thumbscrews, remove the battery door, and disconnect the terminals. Slide the battery out as shown in Figure 3-4.

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Warning: Always remove the battery from the instrument prior to shipping. Do not ship the battery along with the instrument.

Be careful when removing or installing the battery not to damage the wires.



Figure 3-4 Removing the Battery

Connecting Isokinetic Probe

The SOLAIR 3100/5100 comes with an isokinetic sample probe and a tripod stand. The shipment includes 10 feet of sample tubing that is lined with a material that reduces electrostatic attraction and particle adhesion. It will fit over the sample inlet.

1. Attach one end of the tubing onto the barb connector of the isokinetic probe and attach the probe to the tripod.

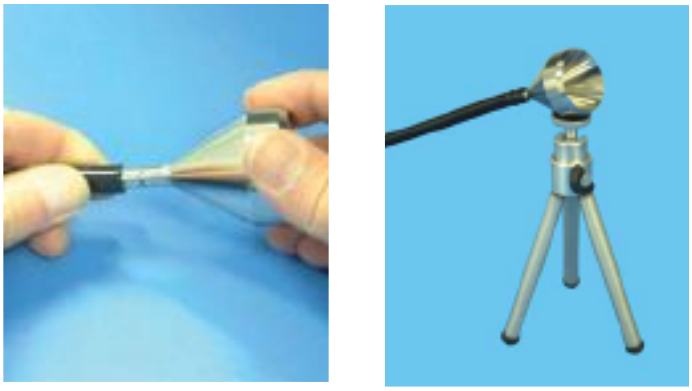


Figure 3-5 Preparing Isokinetic Probe for Use

2. Remove the protective cap from the sample inlet located on top of the unit and attach the other end of the sample tubing to the inlet port. Push gently until the end of the tubing covers the entire inlet.

Note: Replace the protective cap on the sample inlet when the sample tubing is removed.

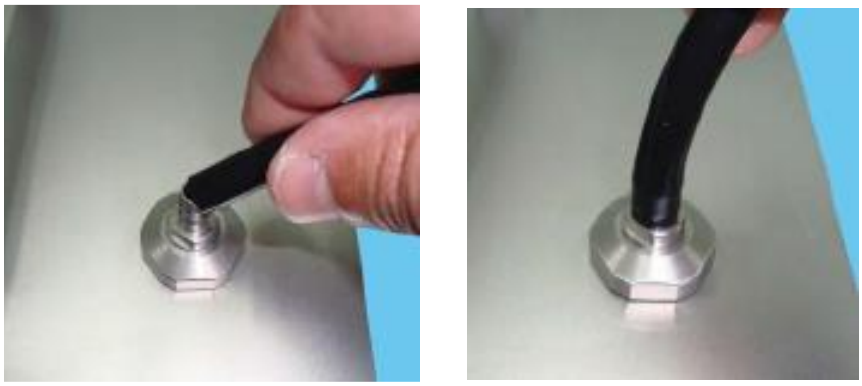


Figure 3-6 Attaching tubing to Inlet

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Direct Mount ISO Probe & ISP Filter Cap

The SOLAIR Boulder Counter comes with a direct mount isokinetic probe and an isokinetic cap with a 1.0 CFM purge filter. The components require installation onto the particle counter before operating the instrument.

1. Remove the black cap from the sensor inlet fitting. Confirm that the O-ring on the fitting is intact. See Figure 3-7.

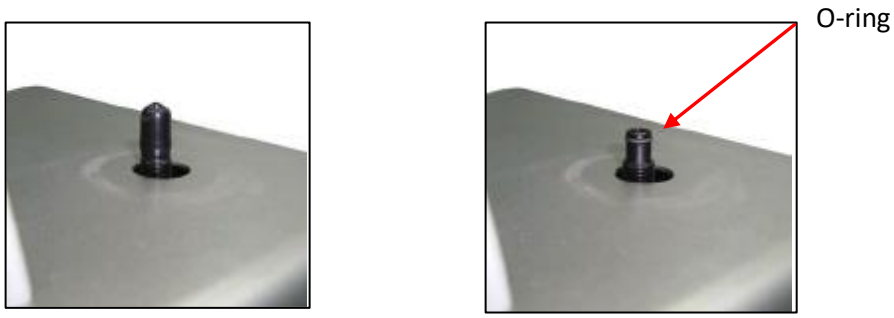


Figure 3-7 Sensor Fitting & O-ring

2. Thread the Seal Nut onto the ISO Probe until it stops, as shown in Figure 3-8.

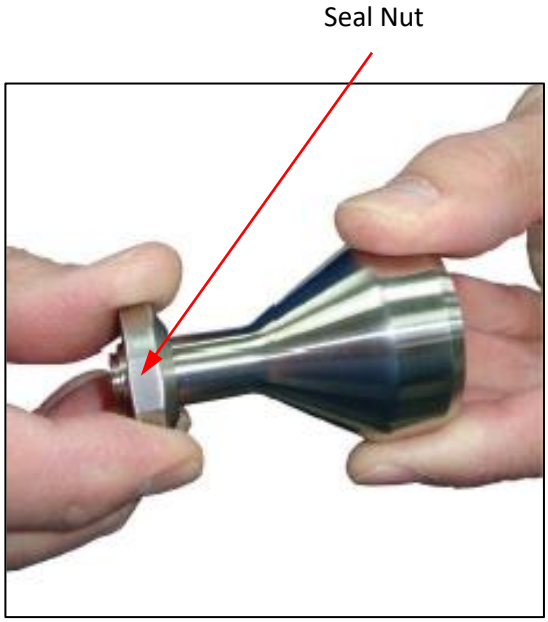


Figure 3-8 Seal Nut & ISO Probe

3. Thread the ISO Probe onto the sensor inlet fitting until it stops, as shown in Figure 3-9.



Figure 3-9 Install ISO Probe

Warning: Take care to prevent damage to the O-ring on the sensor fitting.

4. Thread the seal nut down onto the top cover until the seal nut O-ring makes contact. Tighten the seal nut an additional ½ turn.
5. Place the ISP Filter Cap over the ISO Probe and push down to seat the O-ring seal. See figure 3-10.



Figure 3-10 Attach ISP Filter Cap

6. The O-ring in the ISP filter cap will create a seal against the top of the ISO probe. See Figure 3-11.



Figure 3-11 ISP Filter Cap Installed

7. Reverse steps 1 through 6 to remove the filter cap and probe from the instrument.

Loading Printer Paper

The SOLAIR Boulder Counter comes standard with a built-in thermal printer. The printer is optional for Solair 3100, 5100.

To load the thermal paper, follow these directions.

1. Grasp each side of the top of the printer door and pull outward to open.

Note: Thermal paper must be used. The printer will not print on regular paper.



Figure 3-12 Opening printer door

2. Unroll the paper and place the roll in the printer with the paper feeding from the top.



Figure 3-13 Putting the paper into the printer.

3. Make sure that the paper is lined up straight with the cutting edge.

Note: The printer door must be securely closed to print. If attempting to print and nothing happens, press the corners of the door firmly against the chassis.



Figure 3-14 Aligning the paper

4. Close the printer door so that about ½ inch or 2 cm of paper protrudes from the opening.
5. Press the paper feed button to ensure that the paper is loaded correctly.



Figure 3-15 Advancing the Paper

6. Tear the leading edge off by pulling the paper up against the cutting teeth.



Figure 3-16 Trimming off extra paper

When the paper is torn off the door could open slightly, if left in this state the open door could prevent the instrument from printing.



Figure 3-17 Door latched in properly

Connecting Analog Sensors

The SOLAIR provides 4-20mA analog input ports on the back of the instrument. Specific details about these ports are described in Chapter 4.

Examples of analog sensors that can be used are Temperature, Relative Humidity, Air Velocity, Differential Pressure, ESD, Vibration, AMC Analyzer and others.

Please refer to each sensor manual for the appropriate pinouts.

Connecting an External Peripheral Device

An external peripheral device, such as a light stick, a buzzer or a remote-control device can be connected to the back of the SOLAIR via the Peripheral Interface Connector.

Information regarding the pinouts of this connector can be found in Chapter 4 under Peripheral Interface Connector, page 4-5.

Connecting to an External Computer or Facility Management System

SOLAIR family instruments can be connected to the Lighthouse Monitoring System, LMS Express/RT or the LMS XChange Data Transfer Software to download data.

The SOLAIR 1.0 CFM instruments have three ports available for flexible external data retrieval. It can connect to the Lighthouse Monitoring System, LMS Express/RT or the LMS XChange Data Transfer Software for data download.

By transferring the SOLAIR data to the Lighthouse Monitoring System (LMS) or LMS Express, the user can store historical data on a server or PC for future review and trending. In LMS XChange, data can be exported to a *.csv file for historical review. Up to 200 alphanumeric location names can be transferred between LMS XChange and the SOLAIR.

For specifics on connecting to the instrument, see “Overview” on page 5-1. Refer to the LMS, LMS Express or LMS XChange manual for specific information about their set up and use.



Warning: NOTE: +24VDC is present on Pin 7 of the RS-485 connector when power is applied to instrument.

Note: LMS Express allows download of data from the instrument; LMS Express RT provides real time data downloads.

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Chapter 4 – Setting up the Counter

Overview

This chapter duplicates and consolidates information provided elsewhere in this manual as a convenience to the reader.

Analog Sensors

The SOLAIR can be fitted with up to four 4-20mA Analog sensors. The Sensors are connected to the instrument using RJ-12 cables. The connector pinout is shown in Table 4-1.

Pin Number	Function
1	5VDC
2	Analog #1 In
3	24VDC (VCC)
4	GND (tied to Pin6)
5	Analog #2 In
6	GND

Table 4-1 Analog Connector Pinout

Note: Changes to the analog configuration will change historical environmental values in the data buffer.

Each port can be used for one dual-channel or two single-channel 4-20mA sensors (when wired correctly), two devices total per port. When each port is connected to two single-channel analog sensors, a total of four analog sensors may be connected to the SOLAIR. Otherwise, only one single-channel or one dual-channel device may be used at a time on each port. Please contact Lighthouse at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for additional information about converters and wiring.

Lighthouse sensors come complete with adapters and pre-wired cables.

If the user is wiring a cable to use with a sensor from another manufacturer, please bear in mind that the connectors on telephone cables are mirror images of each other. For that reason, we have not included color coding in the table. The figure below shows the pin numbering on the back of the SOLAIR; the cable must be wired accordingly.

Warning: Wiring the pins in reverse order may harm the instrument and/or the sensor.

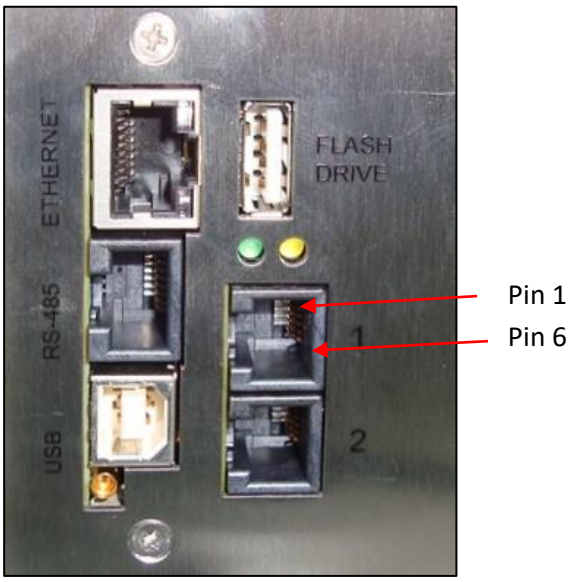


Figure 4-1 Analog Sensor Ports

Note that the ports are oriented with the locking tabs at the left side.

Analog Setup

When adding Analog Sensors to the SOLAIR's RJ-12 ports, the SOLAIR firmware must be set up to accept data from the sensors. The minimum and maximum values required for this will be found in the documents that are supplied with the devices. For example, the Calibration Certificate for the Lighthouse TRH Wand will provide temperature in both Celsius (C) and Fahrenheit (F) and relative humidity in percent (PCT). Make sure the data is entered appropriately; for example, do not use C as the UNITS for MIN and MAX values that are based on Fahrenheit (F). If the LWS TRH Wand is being used, set up the odd-numbered port (A1 or A3) as temperature and the even-numbered port (A2 or A4) as relative humidity.

The set-up process is as follows:

Analog channels are labelled in the settings as A1 through A4. A1 and A2 correspond to Analog port 1 on the chassis and A3, A4 correspond to port 2. A1 and A3 are the first channel and A2 and A4 are the second channel of these ports. So, if a single-channel sensor is attached to port 1 and is wired to connect to channel one, its data will be displayed on A1. If it is wired to operate on the second channel, its data will be displayed on A2.

If a dual-channel sensor, such as the Lighthouse TRH (temperature, relative humidity) probe, is connected to port 1, its temperature data will show up on A1 and its relative humidity data will be displayed on A2.

The setup process is as follows:

1. From the MAIN screen, press the CONFIG button.
2. On the CONFIGURATION screen, press the ANALOG button.
3. The Analog Configuration Screen displays Figure 4-2.



Figure 4-2 Analog Configuration Screen

4. Press the red "**X**" button to enable an analog channel.

5. Press the blank TYPE button next to the enabled analog channel to enter the label tag. Figure 4-3

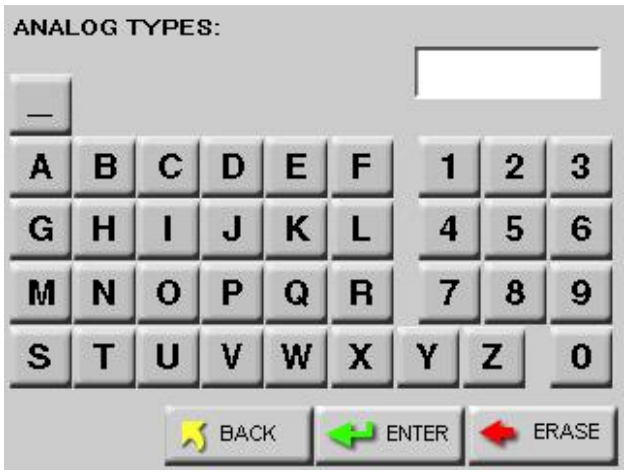


Figure 4-3 Analog Type Edit Screen

6. Type in the desired label tag for the analog channel; tag can be up to four characters.
7. Press ENTER when complete.
8. At the analog Configuration Screen, press the MIN value button.
9. Enter the minimum value of the sensor's data range found on its documentation and press ENTER.
10. Press the MAX value button.
11. Enter the maximum value of the sensor's data range found on its documentation and press ENTER. See Figure 4-4.

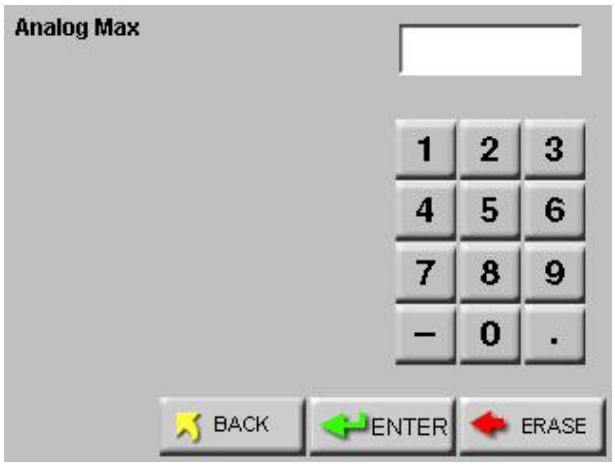


Figure 4-4 Max/Min Data Entry Screen

12. Press the UNITS button associated with the analog channel.
13. Enter the UNIT of measure (i.e., F for Fahrenheit, PCT for percent humidity, etc.) for the analog channel and press ENTER. See Figure 4-5.

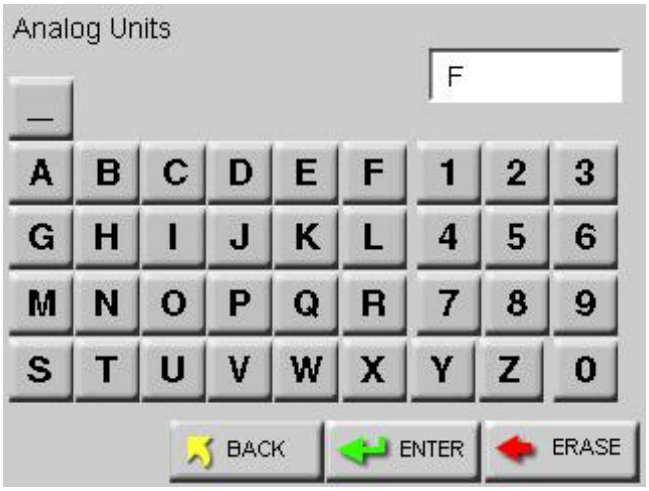


Figure 4-5 Analog Units Edit Screen

14. Continue in this same way to enable the other Analog channels as desired.
15. Press BACK to return to the MAIN screen.
16. The Analog data can be viewed in the Zoomed Data View by pressing on the white particle data area on the screen.
17. Press the Particle button to toggle to the Analog button.
18. Any of the enabled Analog channels will be displayed here.
19. Press anywhere on the white data screen to return to the MAIN screen.

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Peripheral Interface Connector

The back of the SOLAIR also contains a round, Peripheral Interface Connector (PIC) that can be used to connect an external peripheral device such as an alarm buzzer, alarm light or a remote start/stop controller.

These PIC pinouts are displayed in Table 4-2.

Pin	Connection
1	24 VDC
2	GND
3	Alarm+
4	Alarm-
5	Start/Stop
6	Not Connected
7	Not Connected
8	GND

Table 4-2 PIC Connector Pinouts

Using Report Parameters

The REPORTS screen is not just for printing reports. The data provided on the screen when various parameters are set will allow users to setup the counter to meet the requirements necessary for the report used in the Standard Operating Procedure.

For each report type, as the user changes the Room Area, the Class Level, and sometimes the Air Flow or the Room Status, the values for the Minimum Locations, Minimum Samples and Minimum Volume may change and will be correctly calculated for the requirements for each report type.

By confirming that the setup of the counter meets the requirements indicated on this screen, the user will ensure that the samples run will meet the requirements of the selected report.

Note: Due to rounding of values, the sample volume may occasionally need to be increased to meet the requirements.

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Basic Requirements

Each of the reports has some basic requirements that, if not met, will cause the report to FAIL the classification immediately.

Fed Std ft^3

This report requires a minimum of 2 locations measured.
At least 1 sample per location must be taken.
At least 5 samples in total must be taken in the cleanroom.
The minimum sample volume must be at least 0.1 cubic feet.
The 95% Upper Confidence Limit (UCL) must be calculated if the number of sampled locations is less than or equal to 9.
Air flow (Unidirectional vs. Non-unidirectional) will influence the minimum locations and minimum samples required. In general, the non-unidirectional option requires more of both locations and samples.
For the Fed Std ft3 report, the classification for a particle size is based on its samples taken from all locations in the cleanroom. Each particle size is given one of the following results:

- a classification rating which will be one of the possible classifications (1, 10, 100, 1000, 10000, 100000)
- "Unable to Classify" if it fails one of the above requirements
- an "Out of Range" if the calculated classification at that particle count exceeds 100,000

Table 4-3 Shows the minimum volume per channel size.

Channel Size (µm)	Minimum Volume (ft^3)
0.3	0.100
0.5	0.200
1.0	0.917
3.0	10.309
5.0	31.696
10.0	145.985

Table 4-3 Minimum volume per channel size

ISO 14644-1

For this report, a sufficient sample volume of air must be sampled at each sampling location. The sample volume must be sufficient to detect a minimum of 20 particles if the particle concentration for the largest considered particle size were at the class limit for the designated ISO class.

The single sample volume Vs per location is determined by using the following equation:

Note: When Vs is very large, the time required for sampling can be substantial. By using the sequential sampling procedure (see Annex F of the ISO 14644-1:1999-05-01 procedure), both the required sample volume and the time required to obtain samples may be reduced.

$$V_s = \frac{20}{C_{n,m}} \times 1000$$

V_s = the minimum single sample volume per location expressed in liters.

$C_{n,m}$ = the class limit (number of particles per cubic meter) for the largest considered particle size specified for the relevant class.

20 = the defined number of particles that could be counted if the particle concentration was at the class limit.

Note: The volume sampled at each location must be at least 2 liters. The minimum sampling time at each location must be at least 1 minute.

A minimum of three single sample volumes must be taken at a location, when only one sampling location is required.

Compute the overall mean of the averages, standard deviation and 95% upper confidence limit from the average particle concentrations for all locations, when the number of locations sampled is more than one and less than ten.

Table 4-3 specifies the concentration limits for particle sizes at a particular cleanliness class level. Limits not specified in the above table, such as the blank areas and particle sizes not listed in the table, are not supported by this standard.

EU GMP 2022

The SOLAIR supports EU GMP 2022. This standard applies only to 0.5µ and 5.0µ channel sizes.

Note: The EU GMP 2022 report does not apply to the Boulder Counter - it does not support a particle size of 0.5 µm

When set up for Grade A (in-operation and at-rest) and Grade B (at rest), 0.5µ is required and the user is allowed to choose whether to include the 5.0µ channel and what Target Limit that channel will have. The limit can be edited in the EU GMP 2022 setup screen.

If 0.5µ is not present or 5.0µ is not present and the unit is setup for Grade B (in operation), C, or D (at-rest), the report cannot classify the room. These requirements preclude running this report on the Boulder Counter – its size channels start at 5.0µ.

There are only 4 Grades: A, B, C, D, and 2 cleanroom states: At Rest and In Operation. There is no In Operation state for Grade D.

The standard defines a minimum sample size of 1m3 for the Grade A cleanroom and refers to ISO standards for the rest of the grades. In order to take a measurement, at least 1 location and 1 sample are required by the counter. The volume of air must be shown in liters.

The classification for a particle size is determined based on the mean of all average concentrations taken from all locations in the cleanroom. If the mean exceeds all limits, then the classification is “Out of Range”.

The counter will only print channel sizes of 0.5 µm and 5.0 µm in this report.

Ethernet Configuration

The SOLAIR comes pre-configured to use DHCP and receive an IP address automatically. If this is not a desired configuration, use this section to change these settings.

If the user does not understand these terms or the possible impact of changing the SOLAIR’s settings, do NOT proceed without contacting the facility’s IT personnel.

The following procedure requires pre-approval and planning by the IT department and a joint setup effort.

The Lighthouse Worldwide Solutions SOLAIR family of instruments incorporate MODBUS TCP/IP communication over Ethernet. Connecting a SOLAIR particle counter directly to an Ethernet network should only be done with the permission and guidance of the network administrator.

The primary advantage of using the SOLAIR on an Ethernet network is that a separate network does not have to be installed just for the instruments. Using the SOLAIR Ethernet Port allows the instruments to co-exist with computers, printers and servers on a LAN that is already in place, thereby reducing installation costs.

This document will explain how to program the Network Adapter through its TCP/IP interface. It will also list typical equipment required and provide some troubleshooting information. The end of the document includes examples of T568A and T568B wiring diagrams for straight-through and cross-over cables.

Ethernet Adapter

Use Lantronix DeviceInstaller to make configuration changes to IP Address and subnet with the RS485 Ethernet Adapter.

1. Start the Lantronix DeviceInstaller program. DeviceInstaller will automatically begin searching for attached devices. The Hardware Address (MAC Address) for the RS485 Ethernet Adapter will be displayed as shown in Figure 4-6.

    - Confirm the device by verifying that the Hardware address displayed in DeviceInstaller matches the address on the back of the Ethernet Adapter.

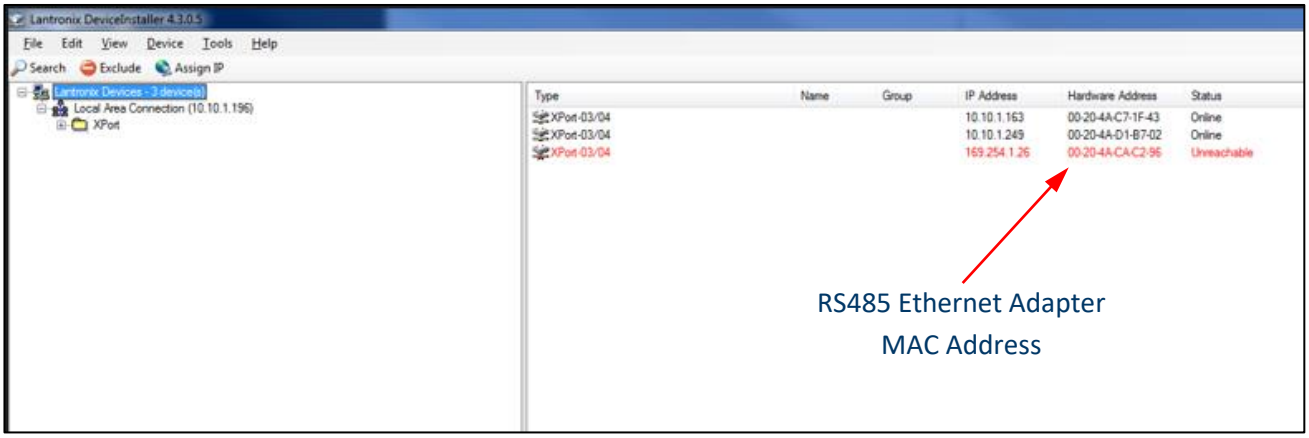


Figure 4-6 Detecting Attached Devices

2. Select and double-click the XPort for the RS485 Ethernet Adapter to open the Device Details tab.
    - Select the Web Configuration tab and then press the green arrow. The Windows Security Login will open.
    - Select OK without entering a username or password. See Figure 4-7

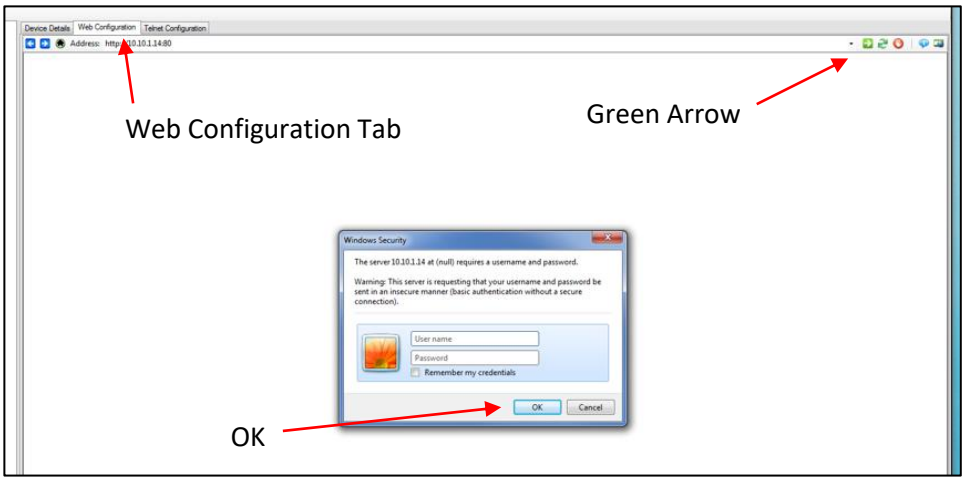


Figure 4-7 Web Configuration Tab

3. The Device Server Configuration Manager will open as shown in Figure 4-8

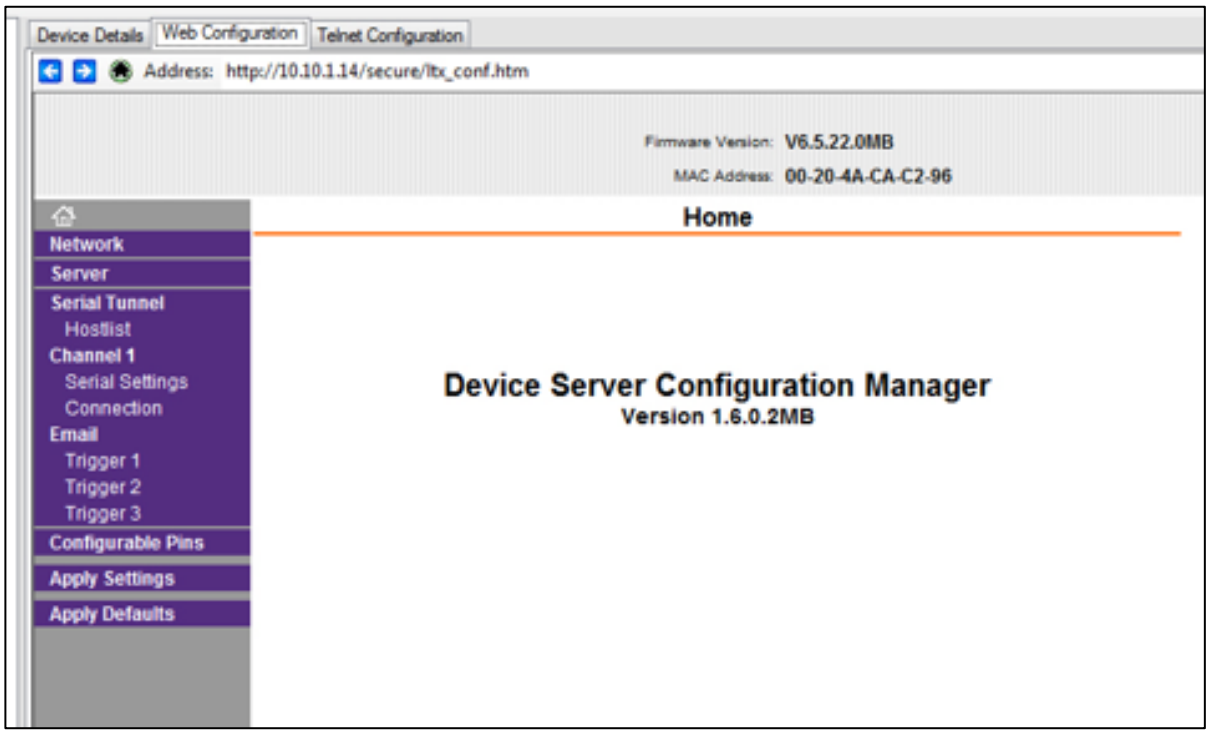


Figure 4-8 Device Server Configuration Manager

4. Select Network Settings and choose the Use the Following IP configuration: radio button.
   - Enter the IP Address: “XXX.XX.X.XX” and the Subnet Mask: “255.255.255.0”.
   - Leave the Default Gateway: blank unless the IT department indicates one is needed. If a gateway is needed, the IT department will provide one.
   - Press the OK button to save the settings. Network Settings will display Done! Figure 4-9.

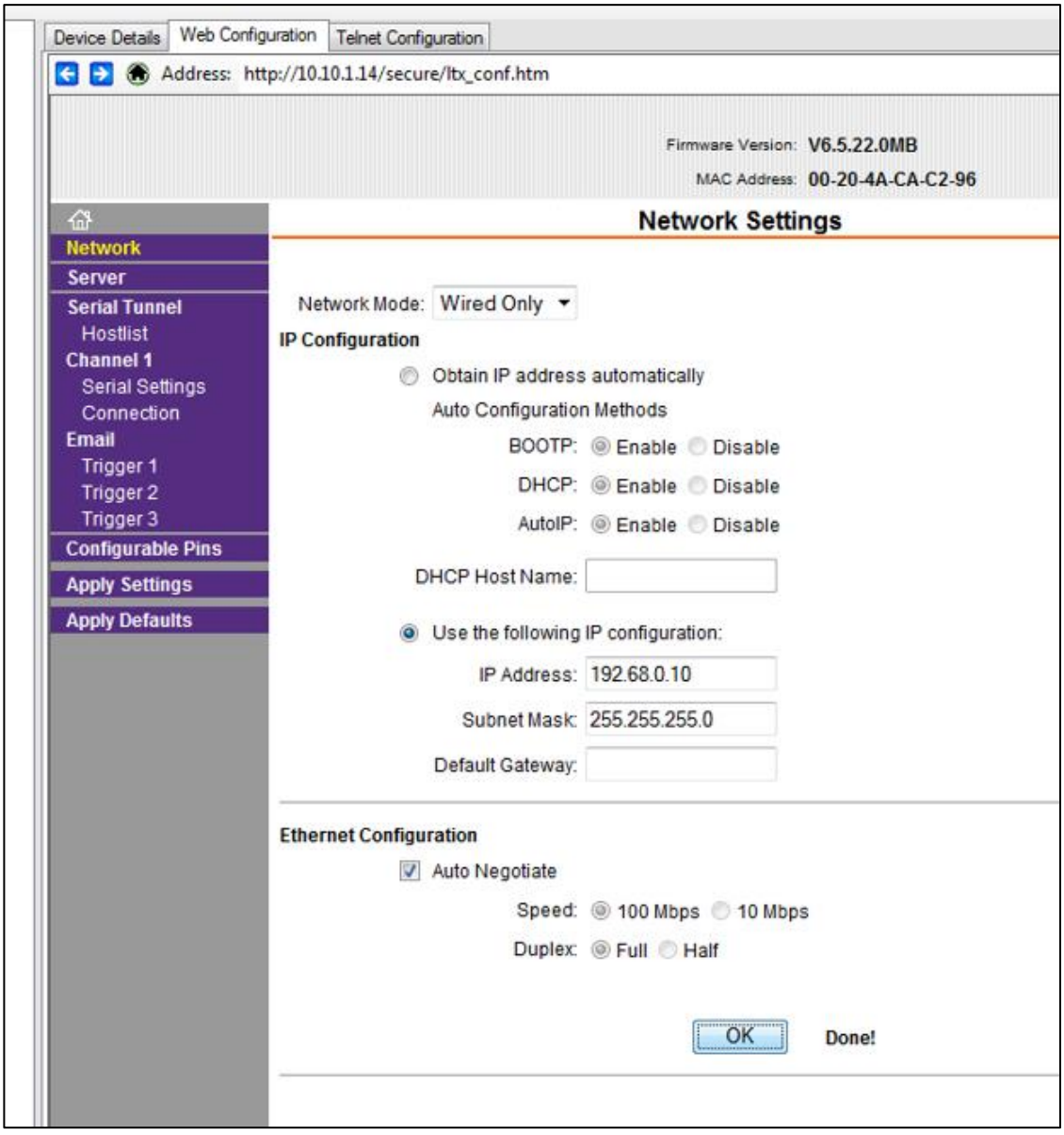


Figure 4-9 Network Settings

5. Select Serial Settings under Channel 1. Verify that the Port Settings are set to the following:
   - Protocol: RS485 – 2 wire
   - Flow Control: None
   - Baud Rate: 19200
   - Data Bits: 8
   - Parity: None
   - Stop Bits: 1
   - Press the OK button to save the settings. Serial Settings will display Done! See Figure 4-10.

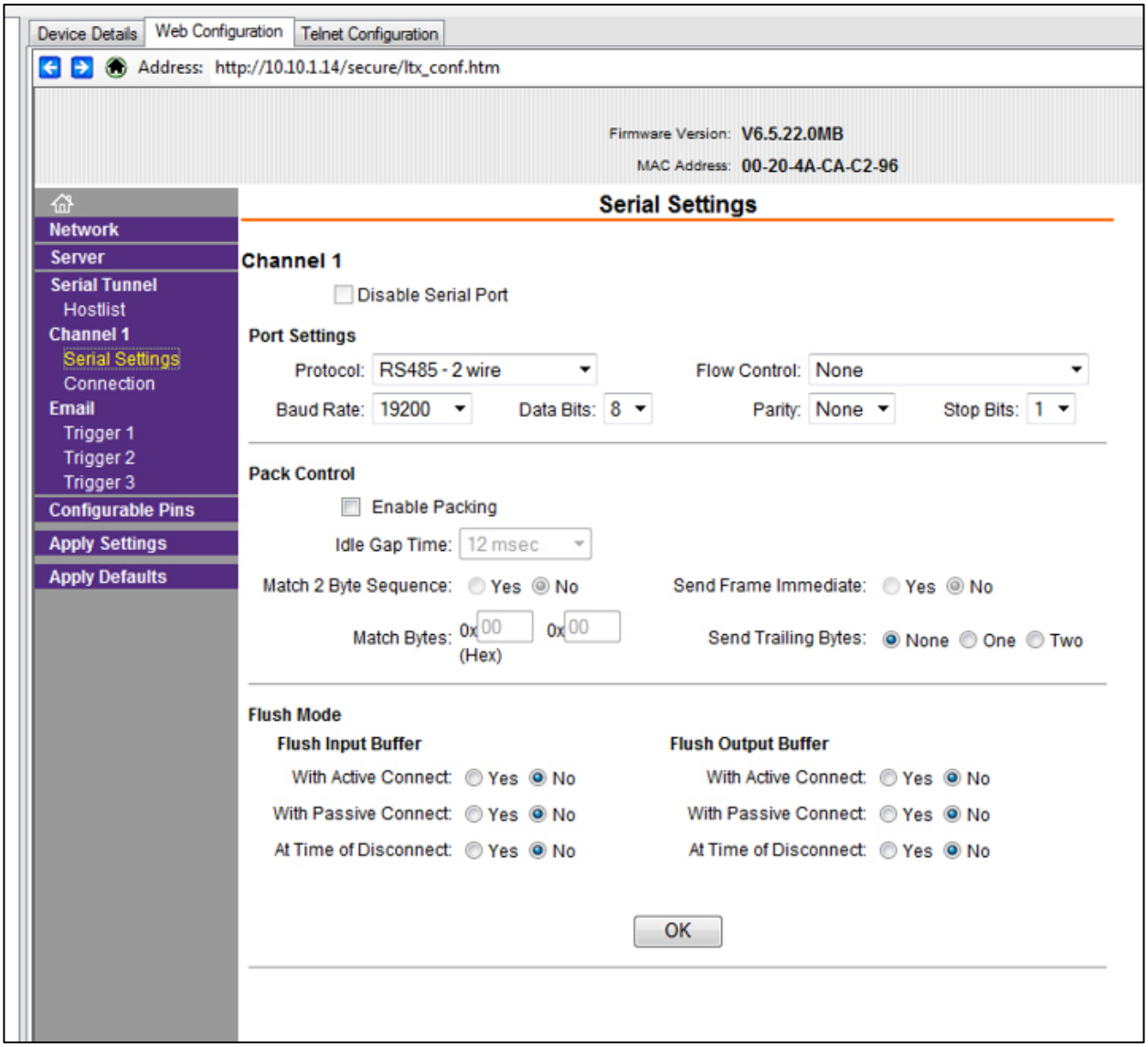


Figure 4-10 Serial Settings

6. Select Connections and verify that Connect Protocol and Connection settings are set to the following:

   - Protocol: Modbus
   - Local Port: 502
   - Accept Incoming: Yes
   - Under Modbus Mode, set the Message Timeout to “1000ms” if not already set.
   - Press the OK button. Connections Settings will display Done! as shown in Figure 4-11.

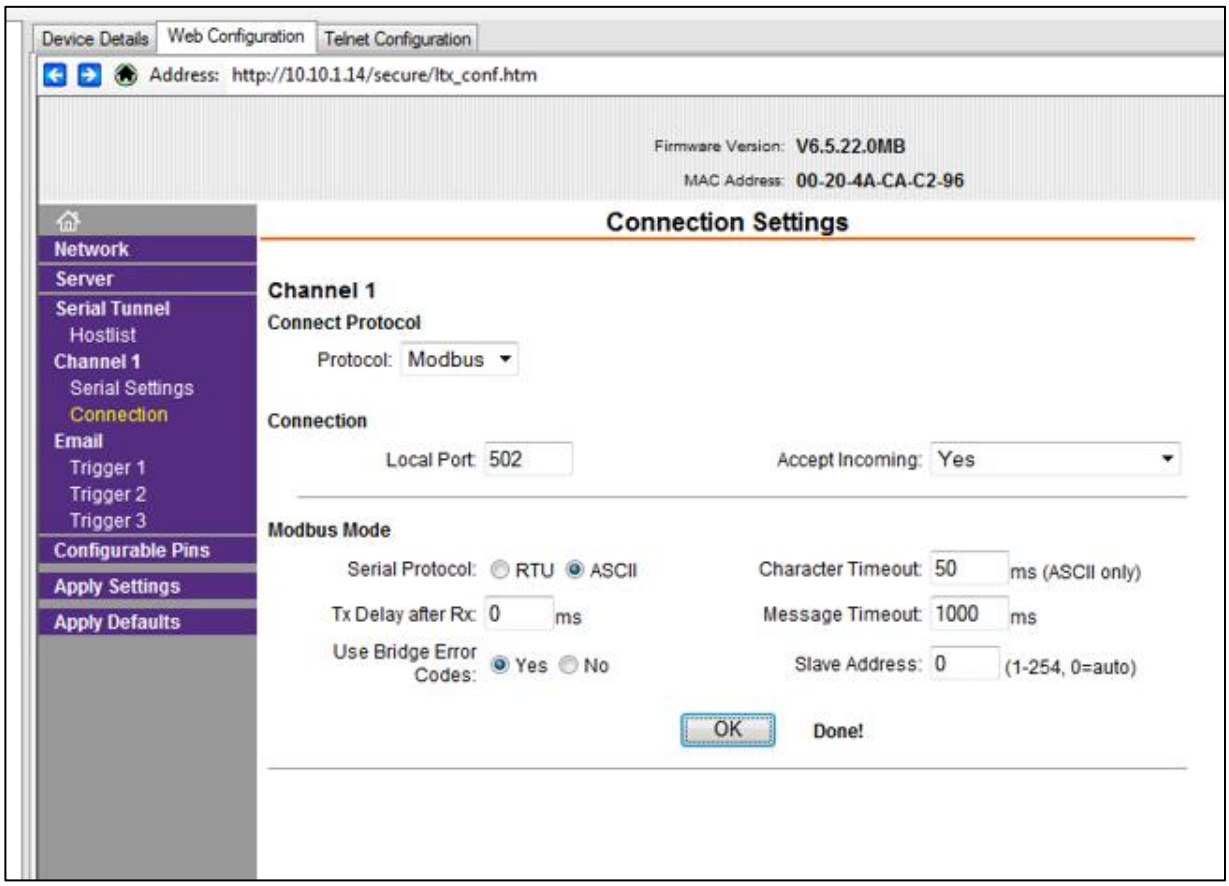


Figure 4-11 Connections

7. Select Apply Settings link to save the setting to the RS485 Ethernet Adapter as shown in Figure 4-12.

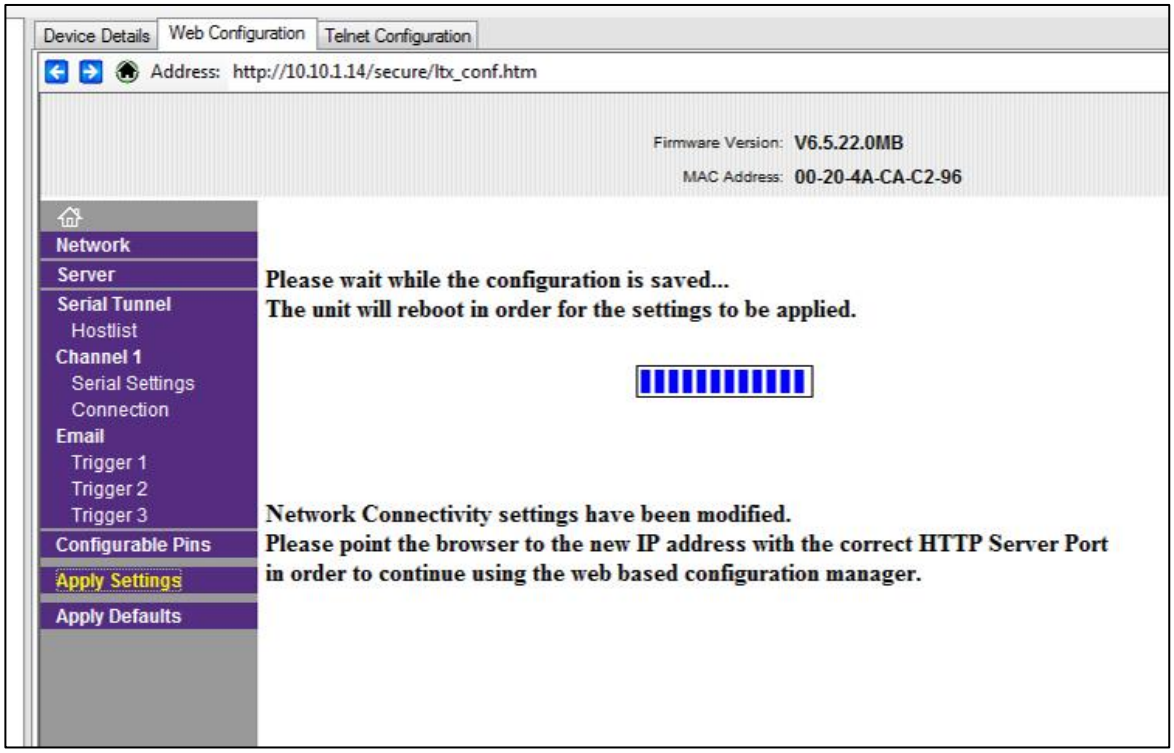


Figure 4-12 Apply Settings

8. Select the Search icon to refresh the attached devices and verify that the IP Address for the RS485 Ethernet Adapter has been changed.

Definitions of Terms Used

This list is provided for the convenience of the user or technician.

- **ARP** - Address Resolution Protocol, a program that can change the ARP Cache of a host by adding or removing IP addresses. Each IP address is associated to a MAC address.
- **ARP Cache** - List of IP addresses and their associated MAC addresses for hosts whose addresses cannot be resolved normally.
- **DHCP** - Dynamic Host Configuration Protocol, a program running on a server that issues IP addresses to computers or devices (Hosts) on its LAN.
- **Gateway** - a network device that controls traffic between two or more networks.
- **Hardware address** - a unique identifying code programmed by the factory into a network device, such as a network PCB, comprised of six two-digit groups of letters A-F and numbers 0-9.
- **Host** - a computer or device that allows access to itself via a LAN.
- **IP** (Internet Protocol) Address - a unique logical address used to identify a host on a TCP/IP network.
- **LAN** - Local Area Network, a group of computers or hosts connected together in a relatively small geographical area, such as a building or floor of a building.
- **MAC address** - the same as hardware address.
- **Netmask** - a logical hexadecimal number that prevents accessing hosts outside of its range. A bit value of zero allows access and a non-zero blocks access.
- **Subnet** - a logical grouping of hosts based on their IP addresses.
- **TCP/IP** - a communication protocol suite that is used for the Internet and a large number of LANs that allows hosts to share data.
- **Telnet** - a communication program used primarily to issue commands directly to a TCP/IP-based host.

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Preparing for Network Installation

Equipment Required

- Network enabled Personal Computer (IBM-compatible)
- SOLAIR 1.0 CFM
- Small 5-port hub or switch and two 3-foot long straight-through Cat5 Ethernet cables (For connection to a PC)

Software Required

Contact the network administrator if any of the following are not installed or not functional:

- Windows 2000, XP Professional, or Windows 7
- Telnet

Additional Requirements

1. Contact the network administrator and obtain administrator rights on the PC to be used for this procedure.
2. For each unit to be attached, obtain an unused static IP address, Gateway IP address and the appropriate Netmask for the LAN in which they will be installed.
3. Create a list and record the MAC address(es) for all SOLAIRs to be configured. It is suggested that the IP address that will be used for each SOLAIR be written next to the MAC address. This list can be provided to the network administrator for future reference.
4. The PC being used to program the SOLAIR must be using the same subnet that the adapter will use. See the network administrator for assistance with this.
5. The PC that will monitor or retrieve data from the instrument(s) must be using the same subnet and gateway programmed on the SOLAIR(s) network interface.

Configure Device

Ethernet Port Configuration

This section is organized based on the cable used to perform the SOLAIR programming.

Straight-through Cat5 requires a hub or switch and two straight-through Cat5 cables. Cross-over Cat5 connects the PC directly to the SOLAIR with no hub. Each will be explained separately. If troubleshooting is required, the cross-over cable technique is easier to use in the field because it requires fewer devices.

It cannot be stressed enough, however, that the instrument and PC be configured using the same IP scheme (IP range, Default Gateway and Netmask).

For troubleshooting outside of the LAN, it is suggested that the PC's IP address be used as the Default Gateway for both the PC and the SOLAIR.

Frequently, it is necessary to change the SOLAIR Ethernet parameters to allow for easier troubleshooting. When this is needed, make sure the instrument is reprogrammed to its previous network settings before reattaching to the LAN. Contact Lighthouse Technical Support at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) or the network administrator for additional information.

Straight-through Cat5 Setup:

This section requires the PC, two straight-through Cat5 cables and the hub or switch.

Note: Screens shown are examples only. Data displayed and command responses may differ.

1. Connect one end of a straight-through Cat5 cable to the SOLAIR's Ethernet Port.
2. The other end of the Cat5 cable should plug into one port on the hub or switch.
3. Attach another straight-through cable to the PC's RJ45 receptacle and an open port on the hub or switch.
4. Proceed to "Windows Telnet Programming:" on page __.

Cross-over Cat5 Setup:

1. Attach one end of the cross-over cable to the RJ45 receptacle on the PC.
2. Attach the other end of the cable to the SOLAIR Ethernet Port.
3. Apply power to the SOLAIR. Apply power to the PC if it is not already running. Observe the LEDs on the hub/switch RJ45 connector - blinking indicates network activity. Observe the network LEDs on the instrument's RJ45 receptacle - they should blink indicating activity. Proceed to next section.

Program the Interface

Windows Telnet Programming:

1. Start Windows.
2. On the Taskbar, click on Start.
3. Select Run as shown in Figure 4-13.



Figure 4-13 RUN Screen

4. In the Run window, type CMD and click OK. See Figure 4-14

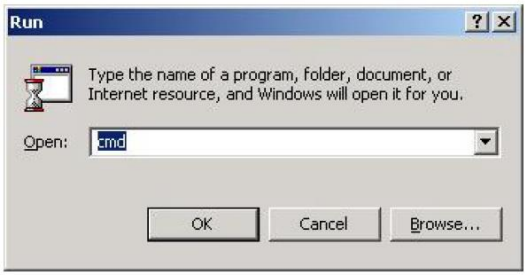


Figure 4-14 Starting the Command Console

5. A command prompt window will open. Clear the ARP Cache by typing arp -d* at the command line and press Enter. Ignore any error messages that indicate the address table doesn't exist or has no entries. See Figure 4-15.

```
C:\Documents and Settings\Administrator>arp -d *
```

Figure 4-15 Clear Address Table Command

6. The next step requires the unit's assigned IP and its MAC address. The MAC address is a group of six two-digit characters (0-9 and A-F) found on the back of the SOLAIR that may be referred to as the HW address.

7. The next step adds the IP and MAC addresses to the ARP Cache which allows direct communications with the instrument before an IP is programmed into its Ethernet interface.

8. Type arp –s xxx.xxx.xxx.xxx nn-nn-nn-nn-nn-nn and press Enter. Replace the x's with the desired IP address, such as 192.168.0.10 or 10.10.0.15, and the n's with the desired MAC address, such as 00-20-4a-8a-26-31. The IP address will be four segments total with up to 3 digits per segment, each segment separated by a period. Note that the MAC address segments are separated by dashes (-), not periods. See Figure 4-16.



Figure 4-16 ARP Command to Add New IP

9. Activate the SOLAIR Ethernet interface by typing, telnet xx.xx.xx.xx 1 (replace x's with the IP address to be used for the instrument) and press Enter. This command will cause a connect error but is required to establish communications. See Figure 4.17.

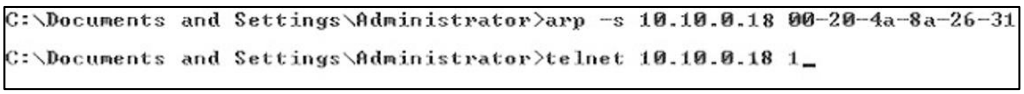


Figure 4-17 Telnet 1

10. Type telnet xx.xx.xx.xx 9999 and press Enter. This command accesses the telnet port of the instrument. The expected error message from Step 9 is shown in Figure 4-18

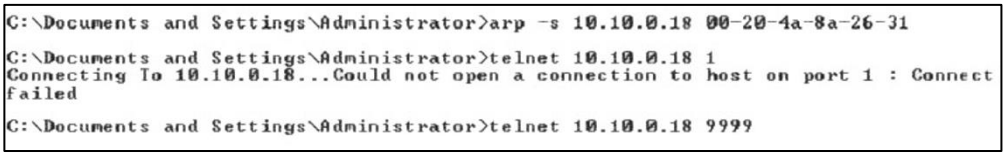


Figure 4-18 Telnet 9999

11. Press Enter to start the SOLAIR Ethernet interface setup program. Figure 4-19 displays some of the default settings – make no changes to these settings except as instructed.

```
Software version 02.3 (050420) XPTEX

Press Enter to go into Setup Mode

Model: Device Server Plus+! (Firmware Code:XA)

Modbus/TCP to RTU Bridge Setup
1) Network/IP Settings:
     IP Address ................... - 0.0.4.0/DHCP/AutoIP
     Default Gateway ............. --- not set ---
     Netmask ...................... 255.000.000.000
2) Serial & Mode Settings:
     Protocol ..................... Modbus/RTU,Slave(s) attached
     Serial Interface ............ 9600,8,N,1,RS232
3) Modem/Configurable Pin Settings:
     CP1 ...... Not Used
     CP2 ...... Not Used
     CP3 ...... Not Used
4) Advanced Modbus Protocol settings:
     Slave Addr/Unit Id Source .. Modbus/TCP header
     Modbus Serial Broadcasts ... Disabled (Id=0 auto-mapped to 1)
     MB/TCP Exception Codes ..... Yes (return 00AH and 00BH)
     Char, Message Timeout ...... 00050msec, 05000msec

D)efault settings, S)ave, Q)uit without save
Select Command or parameter set (1..4) to change: _
```

Figure 4-19 Starting thee Set Up Program

12. Type 1 to set the IP address. Type the desired IP address and press Enter. See Figure 4-20.

```
     Protocol ..................... Modbus/ASCII,Slave(s) attached
     Serial Interface ............ 19200,8,N,1,RS232
3) Modem/Configurable Pin Settings:
     CP1 ...... Not Used
     CP2 ...... Not Used
     CP3 ...... Not Used
4) Advanced Modbus Protocol settings:
     Slave Addr/Unit Id Source .. Modbus/TCP header
     Modbus Serial Broadcasts ... Disabled (Id=0 auto-mapped to 1)
     MB/TCP Exception Codes ..... Yes (return 00AH and 00BH)
     Char, Message Timeout ...... 01000msec, 05000msec

D)efault settings, S)ave, Q)uit without save
Select Command or parameter set (1..4) to change:

IP Address (010) 10.(010) 10.(000) 0.(018) 18
Set Gateway IP Address (Y) Y
Gateway IP Address : (010) 10.(010) 10.(000) 0.(001) 1
Set Netmask (N for default) (Y) Y
(255) 255.(255) 255.(000) 0.(000) 0
Change telnet config password (N)
```

Figure 4-20 Assigning IP Address

13. Type Y to set the Gateway IP address. Type the Gateway IP address and press Enter. See Figure 4-21.

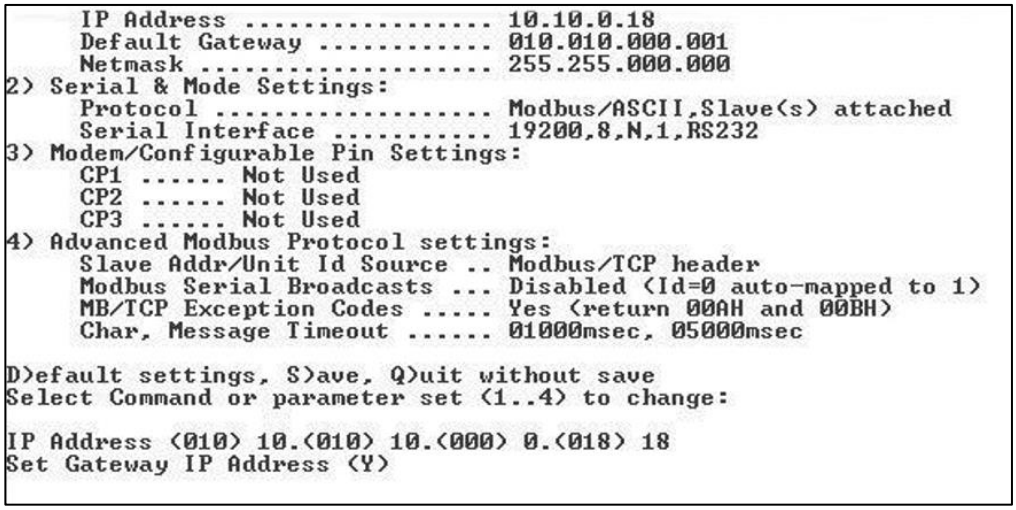


Figure 4-21 Assigning Gateway IP Address

14. Type Y to set the Netmask. Type the desired Netmask value and press Enter. See Figure 4-22.

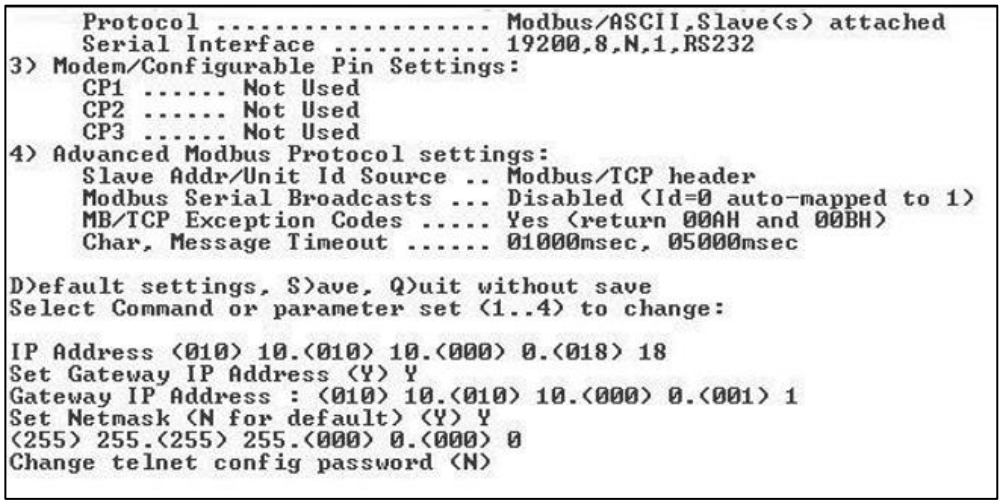


Figure 4-22 Assigning Netmask

15. Type N in response to “Change telnet config password” as shown in Figure 4-23. The instrument is shipped without a password. Changing the telnet password or providing one is discouraged, except for absolute security requirements. If a password is applied and forgotten, the instrument will have to be returned to Lighthouse to get the password cleared.

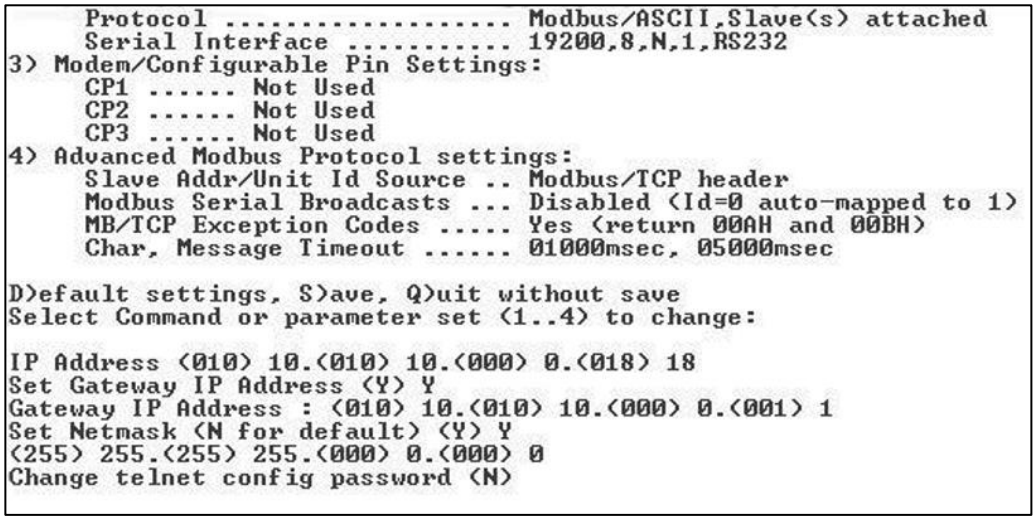


Figure 4-23 Telnet Config Password Screen

16. Type S to Save and restart and press Enter to save the changes. See Figure 4-24.

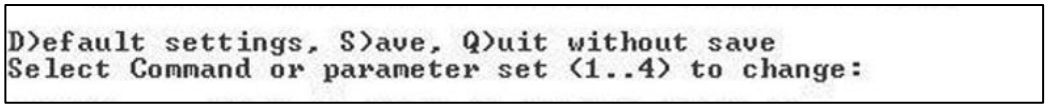


Figure 4-24 Saving the Settings

17. Perform Step 7 through Step 16 for each SOLAIR.
18. Clear the ARP Cache by type arp -d * and press Enter. If this is not done before quitting this process, the PC may create “ghost Ips” on the LAN and cause serious problems with the network.
19. Type Exit to quit the command console.

Warning: Step 18 is very important to prevent network address errors on the PC when the process is complete.

Note: When the Ethernet restarts, it will lose connection to the PC, reported as, “Connection to host lost”.

Connect SOLAIR to Ethernet LAN

Connect Ethernet Cable to Instrument

Power the SOLAIR OFF before connecting the instrument to a network then attach the network cable to the SOLAIR and the other end to the network receptacle. Apply power to the instrument and check the port LEDs to make sure the connection is working.

When all steps are completed, the SOLAIR will supply data to the LAN connection. After approximately 60 seconds, monitoring equipment and software should “see” the instrument and be able to retrieve data from it.

For additional information on data provided by the SOLAIR, see “Data View Buffer Screen” in “Operating Counter” on page 6-43 and the monitoring software’s Operating Manual for detail information regarding downloading of this data.

Contact Lighthouse Worldwide Solutions Technical Support at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for additional information or further assistance.

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Chapter 5 – Communications

SOLAIR Communication Mode

This chapter contains information on how to set up the SOLAIR 1.0 CFM instrument to program and communicate with it.

Overview

The communication ports are labelled as in Figure 5-1. The Ethernet port is used to connect the instrument to an Ethernet LAN; RS485 port is used to connect the unit to a PC COM port via an RS485 serial line or to an RS232 or RS485 network; the USB port is used to connect the instrument to a PC USB port.

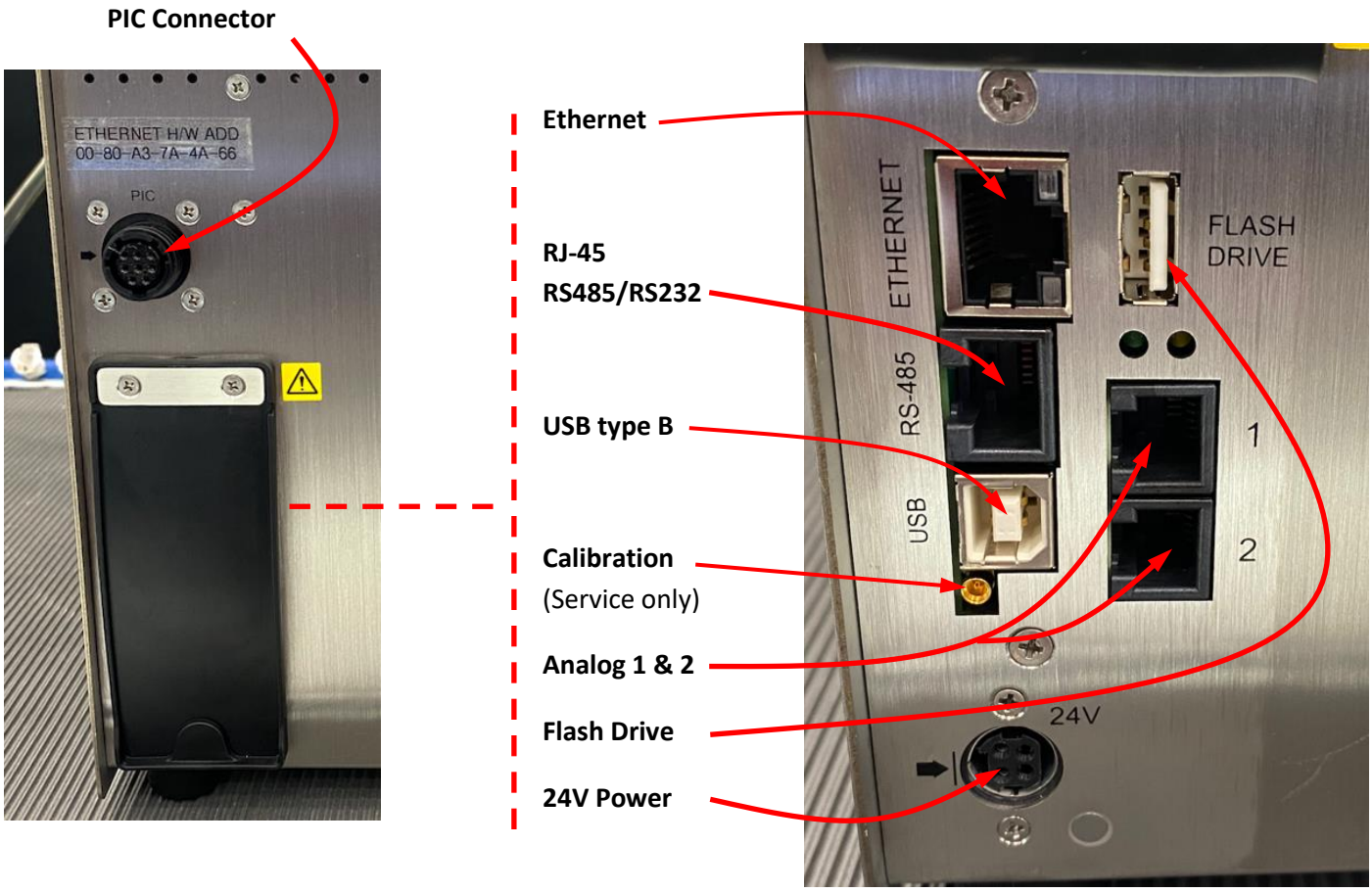


Figure 5-1 SOLAIR Communication Ports

Warning: DO NOT plug the USB cable into the Ethernet or RS-485 ports. THIS WILL SHORT out the pins inside these ports and cause damage to the instrument.

Warning: Please note that only one communication port may be used at one time. Attempting to simultaneously connect the instrument to multiple interfaces, such as Ethernet AND RS485 or USB and Ethernet or all three will fail. The instrument must be powered OFF before changing from one interface to another, such as from USB to Ethernet.

Ethernet Communications

The Ethernet RJ-45 connector (See Figure 5-1) provides Ethernet connectivity, over which the instrument uses the MODBUS over TCP/IP communication protocol. Communicating with the instrument on an Ethernet LAN requires a PC or server running a MODBUS communication package, such as LMS Express, Express RT or LMSNet connected to same LAN. Both must be configured to use the same IP address range, subnet and default gateway. It is strongly advised that the instrument be assigned a static IP so its address does not change and software programs monitoring its data will not lose contact with it due to a DHCP change. Contact the local IT or Network Admin staff for clarification and IP assignment or Lighthouse Technical Support at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for more information.

The instrument can be connected directly to a PC computer Ethernet port by using a crossover cable for testing and configuration purposes. It must use a 'standard' straight-through cable to attach to an Ethernet hub or switch.



Warning: Connect the Ethernet port ONLY to an Ethernet LAN.

RJ-45 Comm Port

The RJ-45 connector (see Figure 5-1) on the instrument's RS-485 port has both RS232 and RS485 lines. The pinouts are shown in Table 5-1.

RJ45 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	24VDC
8	GND

Table 5-1 RS232/RS485 – RJ45 Pinouts



Warning: +24VDC is present on RS-485 Port at Pin 7.

RS485 Communications

The instrument uses RS485 as one of its communication modes. Attaching the instrument to an RS485 network requires special attention to topology (wiring scheme of network) before and after the design phase to make sure the SOLAIR 1.0 CFM and other instruments perform as expected.

A standard Cat5 cable is used to connect the instrument to an RS485 network. Table 5-1 illustrates the RS232/RS485 RJ45 pins and the signals assigned.

RS232 Communications

The instrument can use RS232 as a communication mode by using the USB to RS232 Converter cable. The cable is connected to the RJ-45 Comm Port on the Solair and to any USB port on a PC.

Windows will detect that a new hardware device has been attached and will finalize the installation as needed. This is a routine “registering” of components that should only take a moment. An additional COM port will be added to the PC.

USB Communications

The SOLAIR provides point-to-point communications via the USB Port.

If it hasn’t been done, yet, install the USB driver provided on the product CD. Once it has been installed and the instrument is connected, the driver will be used to establish communications using a virtual COM port on the PC.

Using the USB Port to connect to a PC

To connect the instrument to a computer using the USB port, make sure that the driver has been installed first. Connecting the instrument to the PC and applying power before the driver has been installed will be problematic. Refer to the following:

1. Remove power from the instrument.
2. Connect Side B of a standard “A to B” USB cable to the instrument (only Side B will fit) See Figure 5-2.
3. Connect Side A to any available USB port on the PC.
4. Apply power to the instrument.
5. Windows will recognize that a new hardware device has been attached and will finalize the installation as needed. This is a routine “registering” of components that should take only a moment. An additional COM port will be added to the PC.
6. Identify the computer port that has been added to the PC by using the “Properties” of My Computer and examining the COM ports. USB ports are generally added to the bottom of the list and named USB COM port ‘x’. Refer to Figure 5-3 for screen examples (Windows XP).

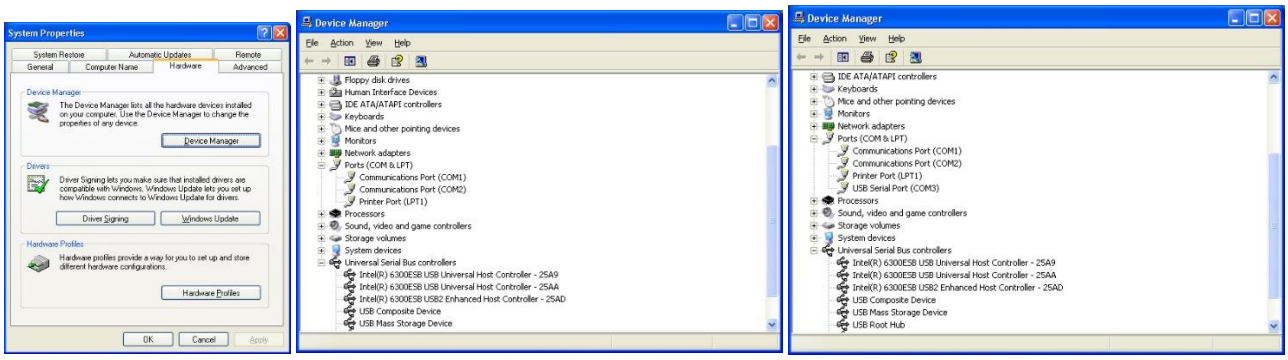


Figure 5-3 Example Device Manager Screens

7. Use LMS Xchange or one of the LMS Express products to connect to the instrument and retrieve data from it. Use the port assignment determined above.

USB Flash Drive

Reports can be set up to print to the printer or saved to the USB Flash Drive port. When the Flash Drive is selected, the report chosen can be saved in either a CSV (Comma Separated Value) formatted text file or an encoded LSD (Lighthouse Secure Data) non-human readable file that can be imported and decoded in LMS Express. See Figure 5-4



Figure 5-4 MAIN Screen, Flash Drive Attached, USB Mode

Connecting a USB flash drive will display the message “USB Drive Found” once the drive has been detected. Please wait to perform any transfers to the drive until the message has ended, which means the drive is ready. If the drive is not detected, try swapping it out for another flash drive. If the flash drive is still not detected after attaching a known good drive, contact Lighthouse Technical Support at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA).

Note: Make sure to use the supplied USB flash drive to ensure file transfer compatibility with the Solair.

Chapter 6 – Operating Counter

Using the Instrument for the First Time

This chapter describes how to use the SOLAIR 1.0 CFM Airborne Particle Counter. The SOLAIR is ready to use out of the box. To start using the instrument, proceed as follows:

1. Install the instrument's battery according to instructions in Chapter 3.
2. Position the instrument in the environment to be measured.
3. Plug in the external Power Supply.
4. Remove the protective cap from the inlet barb located on the top of the unit. If using an isokinetic probe, install the probe by connecting the probe tubing to instrument's inlet barb.
5. Set the front panel power switch to ON.
6. While booting, the unit displays a start-up screen.
7. The MAIN screen displays.



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 damage the instrument and void its warranty. Sampling any gas that is not the same density as ambient air can result in inaccurate data. Please contact Lighthouse at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for more information.



Warning: To prevent damage to the instrument, water, solvents, or other liquids of any type should never be allowed to enter the instrument via the inlet tube. Failure to heed this warning will void the warranty.

8. If analog sensor were ordered, plug them into the connectors labelled 1 or 2 on rear of the instrument.
9. On the touch screen, press the "START" button to start the instrument.
10. "STARTING" will display when the pump is initially turned on.



Warning: Never operate the instrument with the inlet tube capped or plugged. Failure to heed this warning may damage the internal pump and void the warranty.

11. When the SOLAIR start counting, "COUNTING" appears on the display. Particle counts are displayed according to the size of each particle.
12. If the instrument has been programmed with a delay before starting the pump, it displays, "DELAY".
13. If the 5-second Startup is set (default), "STARTING" will display for five seconds when the pump turns on.
14. IF the instrument is in AUTO mode with cycles and a hold time, "HOLDING" will display after each cycle and "FINISHED" will display when all the cycles are complete.
15. Press the "STOP" button to stop the instrument before the cycles are complete.

Touch Screen Overview

The SOLAIR incorporates a unique touch screen interface to control and configure the instrument.

This interface allows the user to easily view and configure the instrument to specific needs and applications. Figure 6-1 illustrates the menu tree.

Menu Map

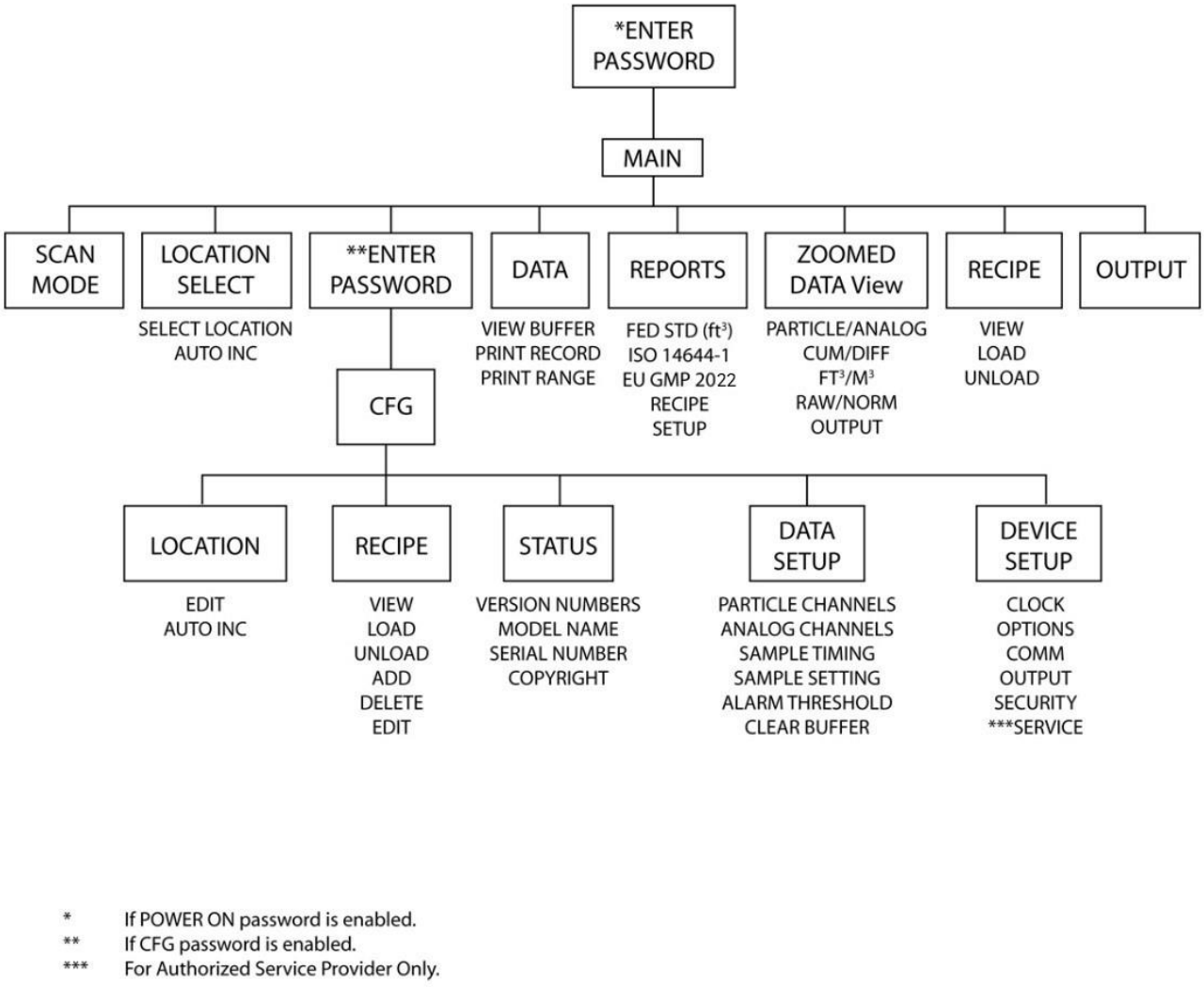


Figure 6-1 Menu Map

MAIN Screen

The MAIN screen provides the user a snapshot view of the status of the instrument. The instrument can be powered by AC power or an internal, removable battery. When the instrument is using battery power, the battery indicator will show the level of the battery charge remaining as shown in Figure 6-2.



Figure 6-2 MAIN Screen – Battery Operated

Note: The screen examples in this chapter are for visual reference. The values displayed may not be indicative of actual values.



Figure 6-3 MAIN Screen – AC in Use

When the AC indicator symbol is displayed, it indicates that the instrument is getting its power from an AC source. See Figure 6-3.

The **MAIN Screen** displays the following options and information:



- **LOCATION:** Displays the location that is currently being measured. Up to 200 alphanumeric locations can be configured.

- **LOCATION SELECT button:** Allows user to change location before sampling.



- **RECIPE button:** Allows the user to view, load and unload recipes that have been configured and saved in the recipe database.



- **PRINT LAST RECORD/SAVE LAST RECORD TO FLASH DRIVE:** Prints the last recorded sample using the current configuration to determine the type of data printed (i.e., cumulative vs. differential, raw vs. normalized, ft^3 vs. m^3). When the USB option is enabled, the last record is saved to a flash drive.

Note: Hard copy printouts are available only when the optional thermal printer is installed.

If the instrument is counting when the "X" appears in the battery indicator, the pump will automatically stop to prevent the battery from discharging completely.

If this happens, attach the unit to AC and make sure the front power switch is ON.

The unit will recharge completely in about 4-5 hours.

Users can continue to run samples and take counts while the unit is plugged in.

- The print and USB options are configured through the OUTPUT button in the CONFIG screen. For more details about printing, see the Configuration section later in this chapter.

- **Date/Time:** Displays the current date and time.

- **Battery Indicator:** Indicated that the instrument is being powered by a rechargeable battery. The amount of battery life left is denoted by the fill inside the battery icon. When the battery is low, the words "BATT LOW!" will appear on the screen and the unit will beep continually until it is plugged into its AC power cord for recharging. See Figure 6-4.



Figure 6-4 Battery Level Indicators

- **AC Indicator:** Indicates that the instrument is being powered with its AC power cord. If the battery is installed, the instrument will charge the battery when the instrument is plugged in.

- **Flow Status:** When the instrument is sampling, the Flow Indicator will display sufficient or insufficient flow


Sufficient


Insufficient

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- **Service Indicator:** Indicates that the instrument may need service. If the wrench icon displays, please contact an authorized Lighthouse Service Provider at 1-800-945-5905 (USA Toll Free) or 1-541-770-5905 (Outside of USA) for assistance or send an email to techsupport@golighthouse.com.

- **µm:** The mu symbol indicated the particle sizes, in micrometers, configured for the instrument. These sizes are pre-configured at the factory. To order an instrument with non-standard sizes, please contact a sales representative at Lighthouse 1-510-438-0500 (Sales).

- **DATA DISPLAY:** This indicates whether the counts are being displayed in Differential (Diff) mode or in Cumulative (Cuml) mode and if the counts are normalized to ft^3 or m^3.

 Differential

 Cumulative

 Normalized ft^3

 Normalized m^3

- **MODE:** Displays the current mode selected; possible modes are AUTO, MANUAL, CONCEN (Concentration) and BEEP.

- **CYCLES:** Indicates the number of times that the count will be taken at a given location in Auto mode. "1/3" indicates that the count is the first of three samples to be recorded at this location. The maximum number of cycles is 999. When set to 0, the unit will run in Auto mode continuously until the STOP button is pressed.

- **SAMPLE:** The Sample Time (hh:mm:ss) is the duration of one counting cycle. The Sample Time will count down on the MAIN screen when the instrument is in AUTO or Manual mode so the user can see how much time is remaining in the sample period. In Concentration mode, the Sample Time will count to 6 seconds per cycle.

Note: If Hold time is greater than 1 minute, the pump will stop during that time. At the end of the hold time, the pump will restart.

- **HOLD:** Displays the hold time in between cycles. The maximum hold time is 99 hours, 59 minutes, 59 seconds.

- **RECS:** This displays the current number of records stored in the instrument and the total number of records that can be stored. The data buffer is a circular buffer. The instrument can store up to 3,000 records. An asterisk (*) will appear in front of counts when the buffer wraps.

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- **START/STOP:** Press START button on the screen to start counting. When running, the instrument will display “COUNTING” in the lower right corner of the screen as shown in Figure 6-5. Press the STOP button to stop counting; the word “STOPPED” will display.

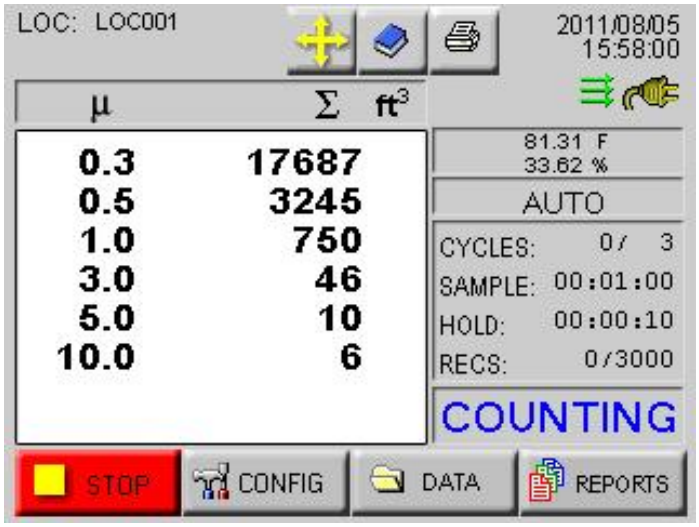


Figure 6-5 Counting Mode

LOCATION Selection

Changing Locations

The location number for the environment to be measured can be changed by pressing the LOCATION button at the top of the MAIN screen. Figure 6-6 displays the Select Location screen.

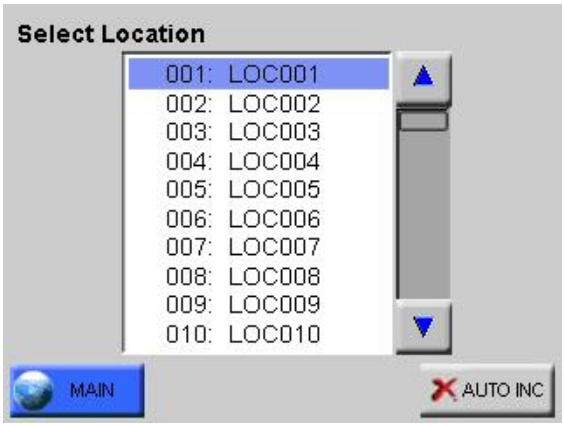


Figure 6-6 Location Select Screen

- The blue highlight indicates which location is currently selected.
- Use the UP and DOWN arrows to select a location. The single arrows will move the cursor up and down by a single line. Locations can also be selected by touching the location name on the screen.
- Recipes associated with a specific location may also be loaded when that location is selected.



- The AUTO INC button, when activated will allow the user to advance to the next location once the current cycle is completed.
- Press the MAIN button to return to the MAIN screen. Whichever location is currently selected will be the location displayed on the MAIN screen.

Locations in AUTO Mode

When the instrument is in Automatic Mode and the START button is pressed, the instrument will start counting particles automatically according to the SAMPLE time, HOLD time and number of cycles that are configured.

Zoomed Data View

There are 2 different Zoom views. The user can either view a single column of data (differential or cumulative) in a larger font, or they can view both differential and cumulative data on the same screen in a smaller font. Tap anywhere in the Particle Data area to display the Zoomed Data View. See Figure 6-7.

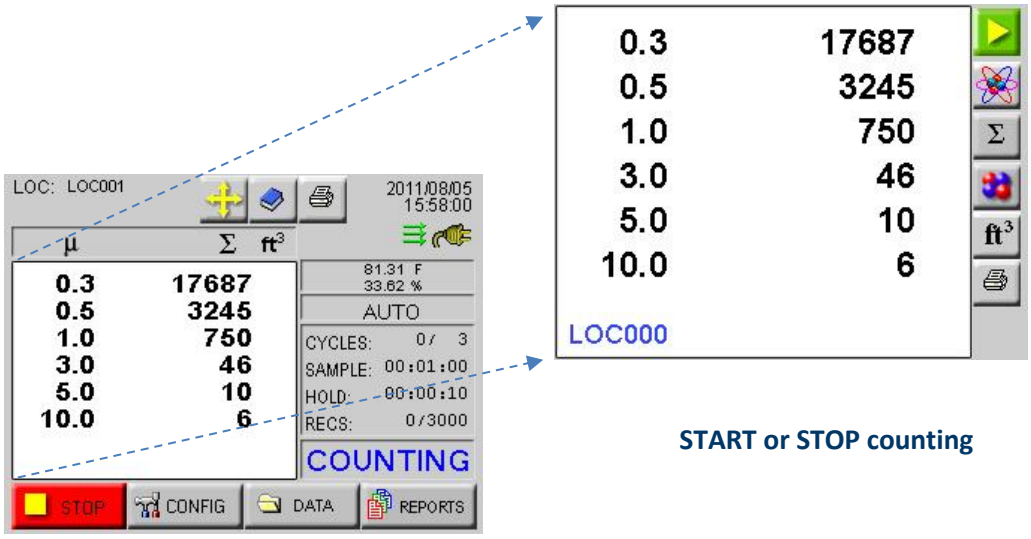


Figure 6-7 Zoomed Data View

In the Zoomed Data View, functions can be performed using the toggle buttons on the right-side bar. See Figure 6-8.

	**START or STOP counting**
	**Display Particle data or Analog data**
	**Display Cumulative / Differential data**
	**Display Raw / Normalized particle data**
	**Display ft3 / m3 when configured**
	**PRINT the last record**

Figure 6-8 Zoomed Data View Buttons

When the instrument is STOPPED or HOLDING, the user may also press anywhere in the white data area to return to the MAIN Screen view.

Viewing Two Columns of Data

The unit can display both Differential and Cumulative data at the same time on the Zoomed View screen. To enable this feature, go to the CONFIG screen and select the Options button. See Figure 6-9.

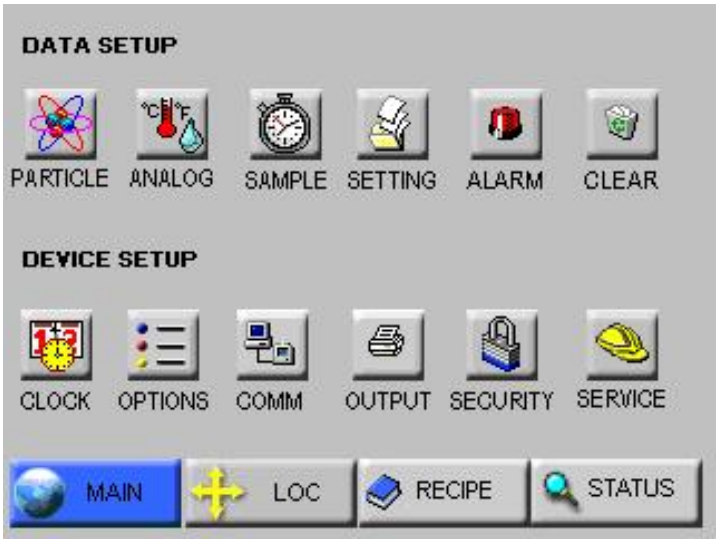


Figure 6-9 CONFIG: Options Button

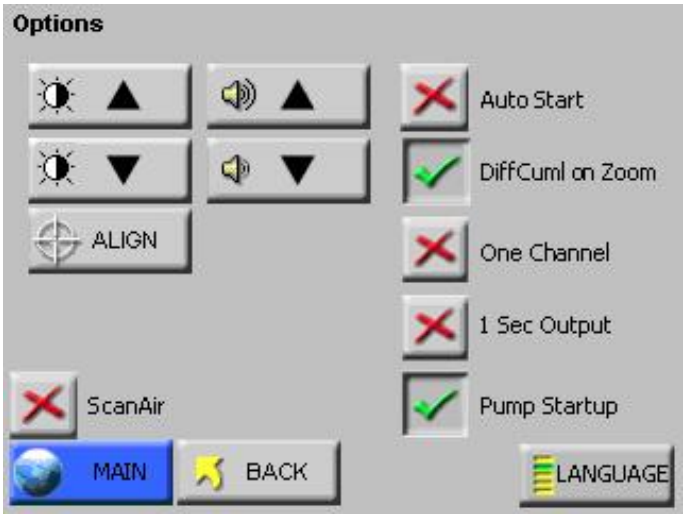


Figure 6-10 DiffCuml on Zoom Button

Select the button “DiffCuml on Zoom” as shown in Figure 6-10. This will display both differential and cumulative data on the Zoomed View screen as shown in Figure 6-11.

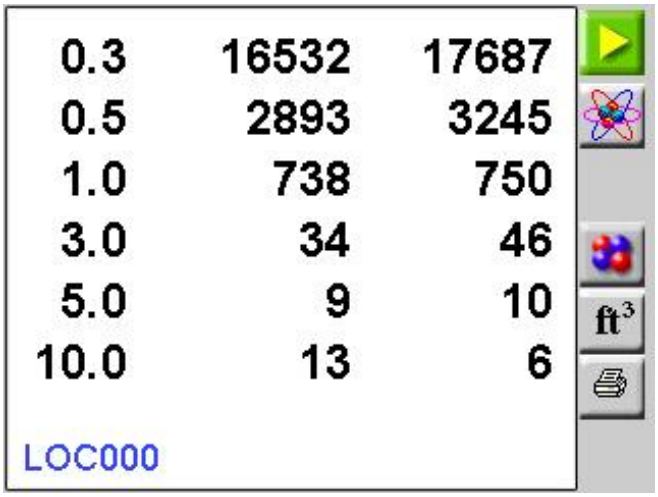


Figure 6-11 Differential and Cumulative Data in Zoomed View

The buttons available when touching the data area of the screen after selecting DiffCuml on Zoom are shown in Figure 6-12. Note the selections are different but their functions are the same as on dual display screen.

	**START or STOP counting**
	**Display Particle data or Analog data**
	**Display Cumulative / Differential data**
	**Display Raw / Normalized particle data**
	**Display ft³ / m3 when configured**
	**PRINT the last record**

Figure 6-12 Diff / Cuml Screen Button Actions

To return the instrument to the default single-column zoom view, return to the MAIN Screen, press CONFIG, Options and deselect the button “DiffCuml on Zoom” button. See Figure 6-13.

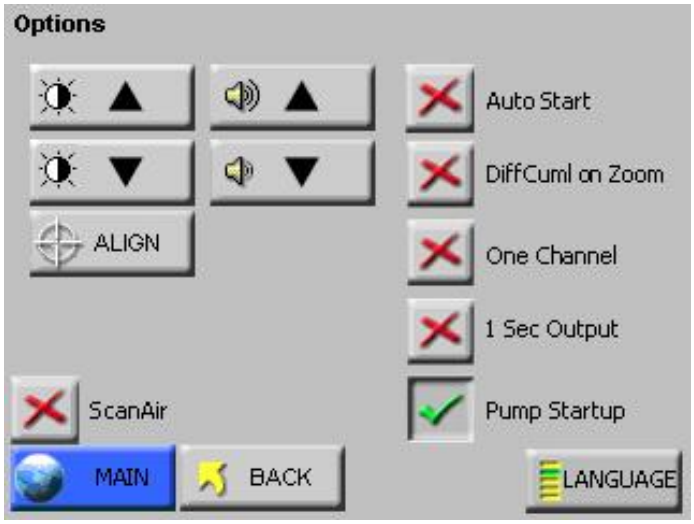


Figure 6-13 Disable DiffCuml on Zoom

Select the MAIN button to return to the MAIN Screen view or press BACK to return to the previous level. Here, the user can choose what data type is to be displayed in one column on the Zoomed View screen. Go to the Settings screen and select Differential or Cumulative for the data type. See Figure 6-14.

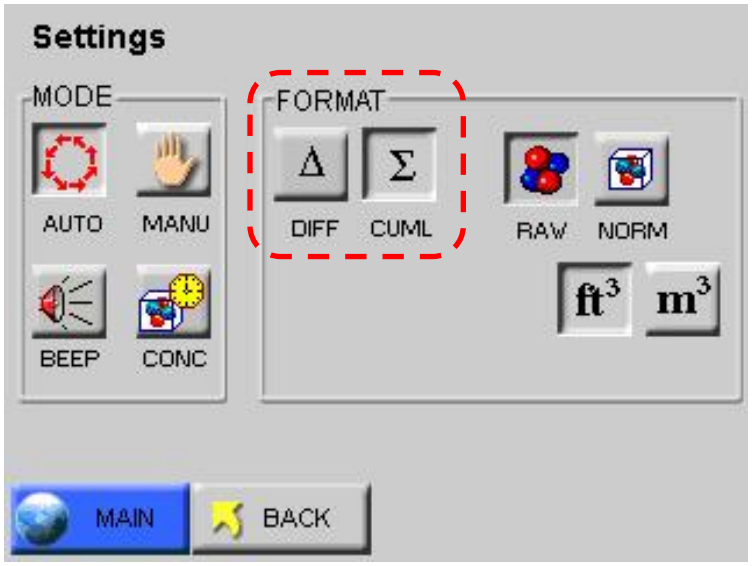


Figure 6-14 Settings Screen

Press the MAIN button, then tap in the data area to go into the Zoomed View. Only one column of data is displayed, See Figure 6-15.

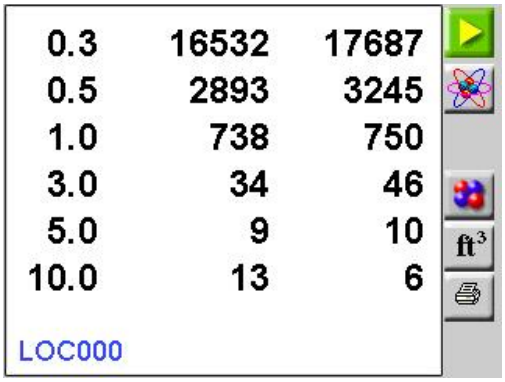


Figure 6-15 Zoomed View with only Cumulative Data

CONFIG (Configuration) Screen

Press CONFIG on the MAIN screen to display the Configuration screen as shown in Figure 6-16.

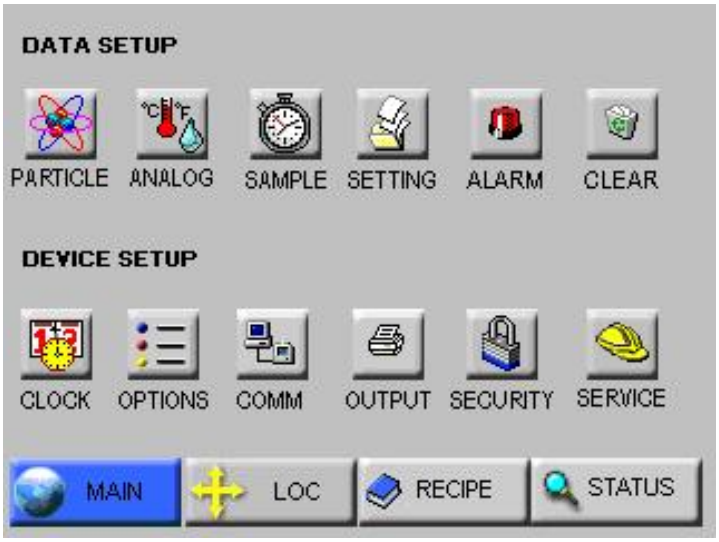


Figure 6-16 Configuration Screen

Data Setup includes buttons to enable/disable particle channels, configure analog channels, set sample record parameters, sample settings, thresholds, enable/disable alarms, and clear the data buffer.

Device Setup includes buttons to configure the instrument's date and time, set the LCD contrast, adjust the instrument's beep volume, enable the instrument to AutoStart, set it to display only one channel of data, enable real-time MODBUS output, set the instrument's communication address, enabling print or USB functions, enable password restrictions, and/or (with proper authorization) adjust service settings.

DATA SETUP

Figure 6-17 displays the Data Setup option buttons. These options allow the user to configure the parameters for data collection during a sample.

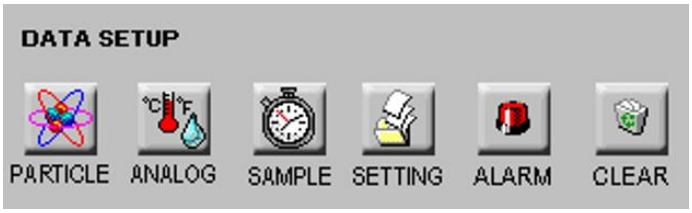


Figure 6-17 Data Setup Options



Particle Channels

The instrument's particle channels can be enabled or disabled on the Particle screen. A checkmark is displayed next to each enabled channel. See Figure 6-18.

Note: The data buffer is cleared when channels are enabled or disabled so that all the data in the buffer has the same number of channels.



Figure 6-18 Particle Channel Configuration

- The checkmark button next to each channel size is a toggle. Press it once to disable a channel and a red "X" will display, indicating that the channel is disabled. Press the button again and it will change back to the checkmark, enabling the channel.

- Pressing MAIN or BACK will prompt to clear all collected data as shown in Figure 6-19.



Figure 6-19 Clear Data screen

- From this screen, the user can press OK to clear the data.

  If the user selected the MAIN button from the Particle screen, then selecting OK will return to the MAIN screen. If the BACK button was selected, then selecting OK will return to the CONFIG screen.

  Selecting CANCEL will cancel any changes and return to the Particle screen. When channels are disabled, they are removed from the MAIN screen display, from the reports and from the printouts.

  The channel size for any disabled channels remains in the Data screen but the instrument does not record data for them.

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Analog Channels

Analog channels are set up in the CONFIG menu from Analog screen. The SOLAIR has two analog ports on the rear of the chassis as shown in Figure 6-20. Each port can be used for one dual-channel or two single-channel 4-20mA sensors (when wired correctly), two devices total per port. When each port is connected to two single-channel analog sensors, a total of four analog sensors may be connected to the SOLAIR. Otherwise, only one single-channel or one dual-channel device may be used at a time on each port.

Please contact Lighthouse at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for additional information about converters and wiring.

Note: Changes to the analog configuration will change historical environmental values in the data buffer.

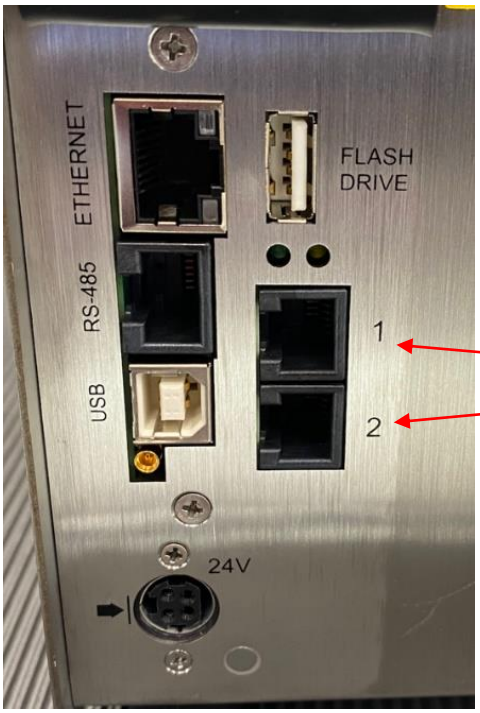


Figure 6-20 Analog Port Connectors

Analog channels are labelled in the settings as A1 through A4. A1 and A2 correspond to Analog port 1 on the chassis and A3, A4 correspond to port 2. A1 and A3 are the first channel and A2 and A4 are the second channel of these ports. So, if a single-channel sensor is attached to port 1 and is wired to connect to channel one, its data will be displayed on A1. If it is wired to operate on the second channel, its data will be displayed on A2.

If a dual-channel sensor, such as the Lighthouse TRH (temperature, relative humidity) probe, is connected to port 1, its temperature data will show up on A1 and its relative humidity data will be displayed on A2.

Touching the far-left column at the screen shown in Figure 6-21 enables or disables the channel. When enabled, the channel label appears. Channels must be enabled before their data will be stored in memory.



Figure 6-21 Analog Setting Screen

Touching the top row, second column will allow entering TYPE data. The example shown in Figure 6-22 illustrates entering a temperature probe type. Examples of types would be TEMP, RH, AIRV or AV and DP. Keep in mind that the 'type' applies to the channel being configured, as discussed earlier in this section.

Use the ERASE button to erase one character at a time and the ENTER to accept the value. The BACK button will return to the previous screen without making any changes.

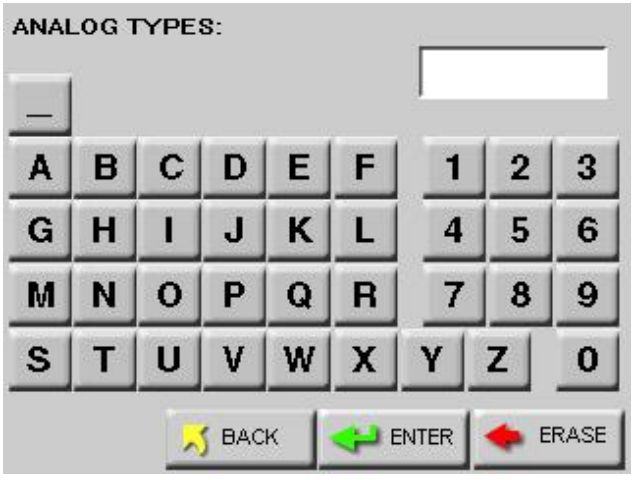


Figure 6-22 Analog Types Screen

Touching the UNITS column allows entering units for the channel, such as PCT, F, kPa and FPM (Maximum of three characters). The example shown in Figure 6-23 illustrates temperature in Fahrenheit using the letter 'F'.

Use the ERASE button to erase one character at a time and the ENTER to accept the value. The BACK button will return to the previous screen without making any changes.

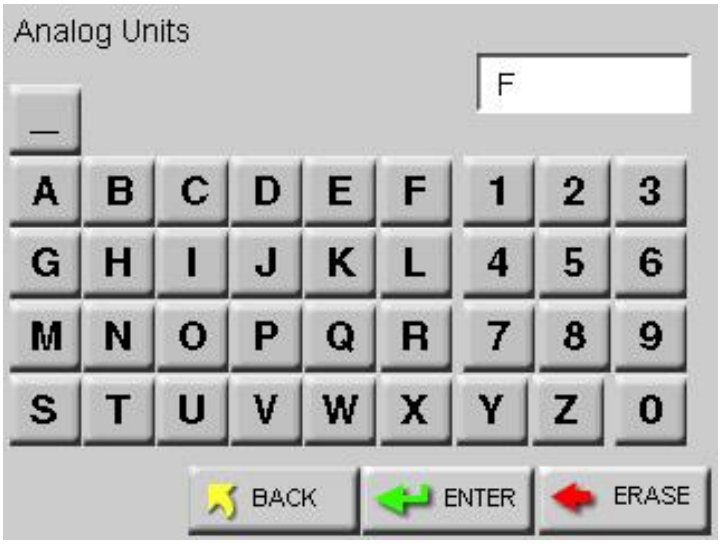


Figure 6-23 Analog Units Screen

Touching the MIN or MAX column button, activates the screen shown in Figure 6-24. Press the number buttons to enter the desired value followed by the ENTER button.

Press the ERASE button to erase the value, one character at a time or press BACK to return to the previous screen without making any changes.

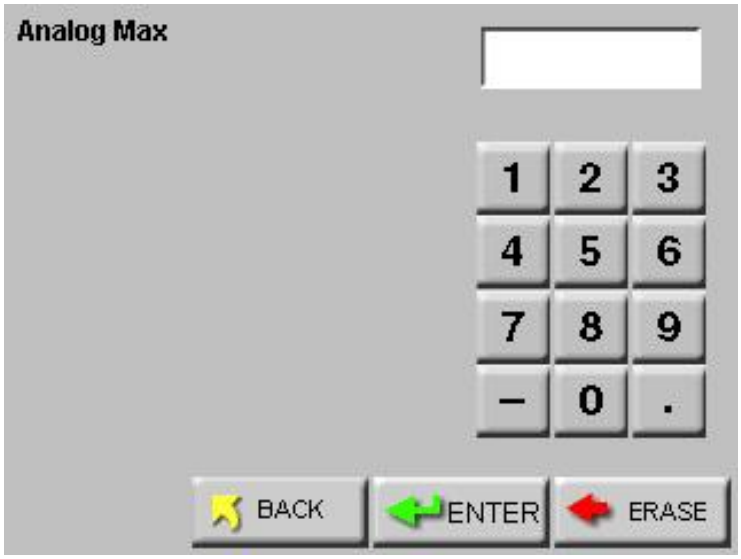


Figure 6-24 Analog Min / Max Values Setting Screen

When the desired settings are complete, a screen showing data like that shown in Figure 6-25 allow the user to review the settings. To return any of the screens to correct or change an entry requires only to press the corresponding button.



Figure 6-25 Analog Settings Complete Screen

Analog Data Display

Figure 6-26 shows the MAIN screen where the values for Analog 1 and Analog 2 are displayed above the instrument counting mode.

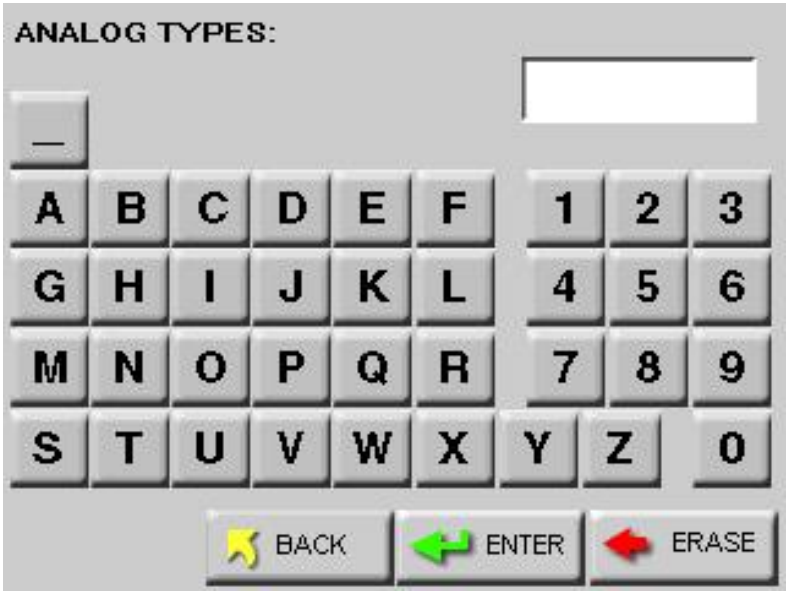


Figure 6-26 Analog Data Displayed

Zoomed Analog Data Display

When the instrument is Holding or is not Counting, the user can touch anywhere on the Particle Data display area to activate the Zoomed Data View. Touch the Particle button to switch view to analog data. See Figure 6-27.

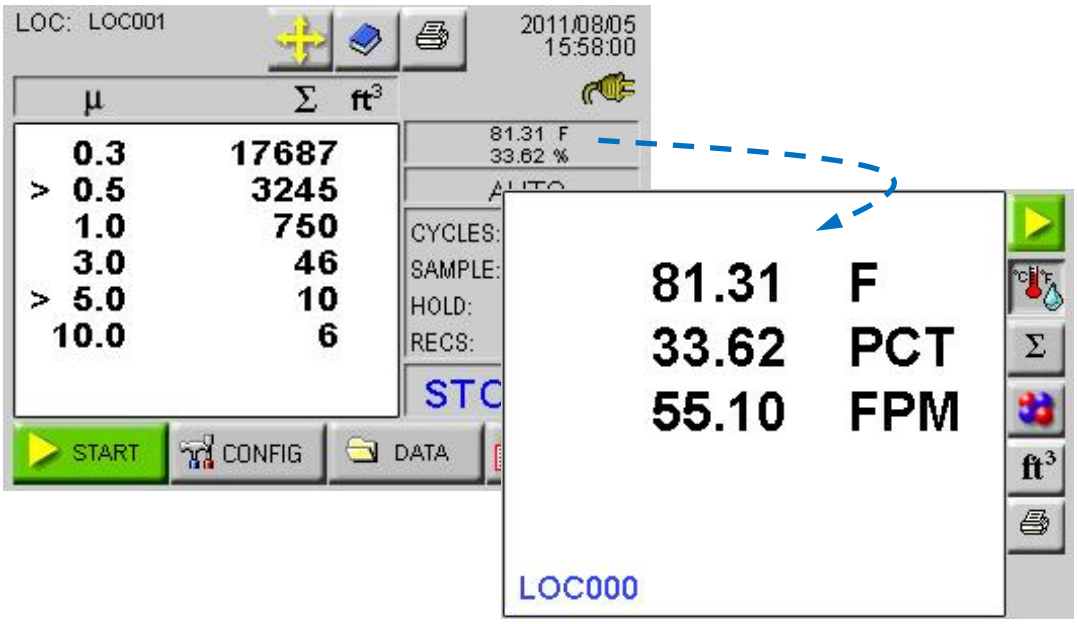


Figure 6-27 Zoomed Analog Data Displayed

SAMPLE

The SAMPLE screen allows the user to configure the number of cycles, count times and volumes when running a sample. See Figure 6-28.

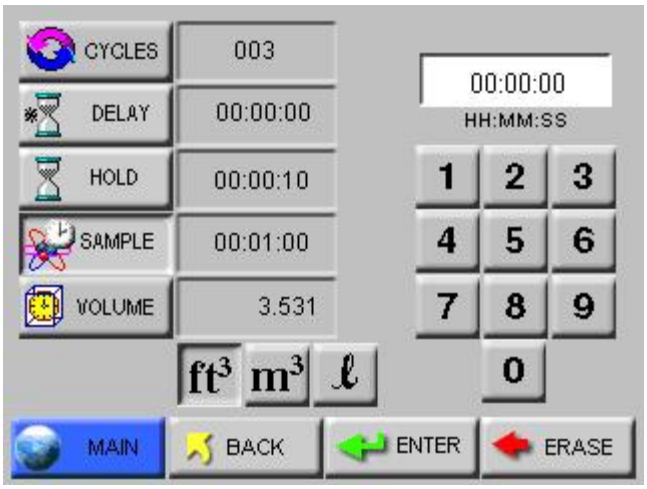


Figure 6-28 Sample Timing Configuration Screen

Note: The pump starts immediately when START is pressed. To operate properly when a Delay is set, the Delay should not be less than 5 seconds.

Note: If the Hold time is set to 00:00:00 in Auto Mode, the instrument will run the samples according to the sample time and the # of cycles, but with no hold time in between cycles.

Note: If the Hold time is greater than one minute, the pump will shut off during the specified hold time.

Note: The maximum Sample Time is 23:59:59.

- **CYCLES:** The number of cycles is set to determine how many times the instrument samples the air in a single location. This is used only in AUTO mode. The range is 0 - 999. When Cycles is set to 0, the instrument will continue running samples indefinitely until the STOP button is pressed.

- **Select the CYCLES button;** enter the number of desired cycles using the numeric keypad on the right. Press ERASE to erase a number, if needed. Press ENTER to set the Cycles.

- **DELAY:** The Initial Start Delay (hh:mm:ss) is the time between pressing the START button and when the unit starts counting. The Initial Start Delay gives the operator time to exit the area under test so that the measurement is taken under a controlled condition. The maximum delay time is 99 hours, 59 minutes, and 59 seconds. Select the DELAY button; enter the initial delay time in hours, minutes and seconds using the numeric keypad on the right. After the value is entered, press ENTER.

  The maximum hold time is 99 hours, 59 minutes, and 59 seconds. This field will count down to indicate how much time is left for the Hold period.

  Select the HOLD button; enter the time in hours, minutes and seconds using the numeric keypad on the right. Press ERASE to erase a number, if needed. Press ENTER to set the Hold Time.

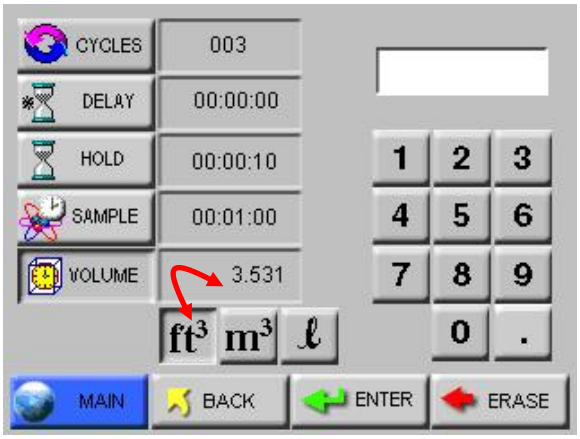
- **HOLD:** The Hold Time (hh:mm:ss) is the time between count cycles when the instrument is not counting particles.

- **SAMPLE:** The Sample Time (hh:mm:ss) is the duration of one counting cycle. The Sample Time will count down on the MAIN screen when the instrument is in Auto or Manual mode to indicate how much time is remaining in the Sample.

Select the SAMPLE button; enter the time in hours, minutes and seconds using the numeric keypad on the right. Press ERASE to erase a number, if needed. Press ENTER to set the Sample time.

- **SAMPLE VOLUME:** Instead of selecting a specific Sample Time, the instrument can be set to measure a specific Sample Volume in cubic feet (ft3), cubic meters (m3) or liters (l). When this is set, the corresponding Sample Volume will automatically be set. See Figure 6-29.

Note: When the particle volume is ft^3, the minimum sample volume is 0.1 ft^3.



Note: If the particle volume is liters or m^3, sample volume is displayed in liters.

If the particle volume is cubic feet (ft^3), the sample volume is displayed in cubic feet (ft^3).

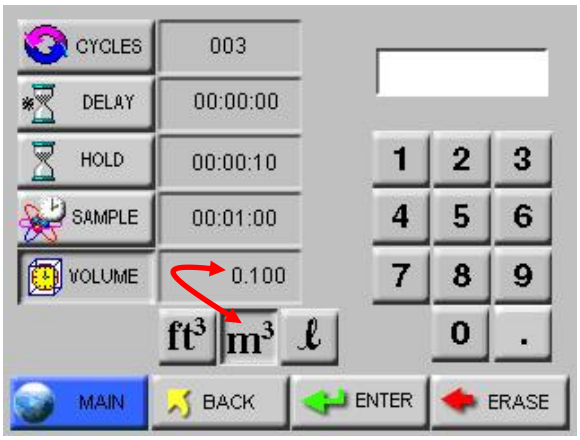


Figure 6-29 Changing Sample Volume Unit of Measure

Press Back to return to the Configuration screen or press MAIN to return to the MAIN screen.



SETTING

The Settings screen allows the user to configure the instrument to count in different modes and formats when running a sample. See Figure 6-30.

Note: The sample time for Auto, Manual and Beep modes count down and the sample times for Concentration mode count.

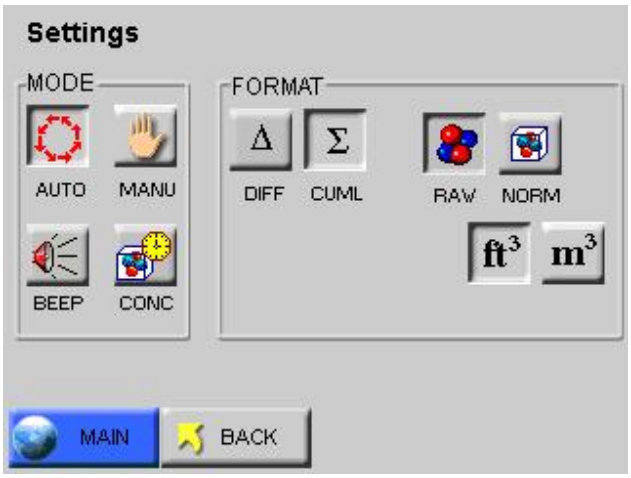


Figure 6-30 Sample Settings Screen

COUNT MODE

The following modes are available: Auto, Manual, Beep and Concentration.

- **AUTO** - When the instrument is in Automatic Mode and the START button is pressed, the instrument will start counting particles automatically according to the Sample Time, Hold Time and the number of Cycles that are configured.

  If Cycles are set to 0, the instrument will continue indefinitely in Auto Mode until the STOP button is pressed.

- **MANU** (Manual Mode) - When the instrument is in Manual Mode, it will start counting when START is pressed and stop at the end of one programmed Sample Time.

- **CONC (Concentration Mode)** - When the instrument is in Concentration mode, it gives a calculated value of the concentration of particles in a volume of air, measured and displayed on the MAIN screen in either counts per cubic foot or per cubic meter. Counting starts when the START button is pressed and it will continue until the STOP button is pressed. The sample time for Concentration mode is six seconds. As the sample time on the MAIN screen counts from one to six, the particle counts are updated continuously.

Concentration data will be recorded and can be viewed in the Data screen and on the printouts.

- **BEEP** - In this mode, the instrument is pre-configured to beep according to the alarm threshold set in the Alarm configuration and the instrument's sample time when the instrument is set to collect cumulative data. Counting starts one second after the START button is pressed and will continue until the STOP button is pressed or the number of configured cycles is reached.

Note: BEEP mode only works with CUMULATIVE data and for Sample Times equal to or greater than 6 seconds.

If no channel is set for alarming, when BEEP mode is selected the instrument will automatically select the smallest channel size, at whatever the alarm threshold is set to, to alarm on.

If alarming is enabled on more than one channel, when the instrument is in BEEP mode it will beep if the alarm threshold is exceeded on any of the channels enabled for alarming.

The data will be recorded, based on the set sample time and hold time, and can be viewed in the View Buffer and on the printouts, however there will be no indication on the record that the data was saved while the instrument was in BEEP mode.

Geiger Counter Mode

While in BEEP mode the instrument can be set to beep 1 to 4 beeps per second depending on the number of particles the instrument has counted per second.

To set up the instrument for Geiger Counter Mode:

1. Enable BEEP Mode
2. Set the smallest particle channel to 1.

In Geiger Counter Mode the instrument will beep from 1 beep up to 4 beeps per second if it counts from 1 particle up to 4 particles per second. The maximum beeps per second the instrument can emit are 4 per second even if the instrument counts 100 particles per second.

The value set in the smallest particle channel's alarm is the trigger for a single beep per second. If the smallest particle channel is set to 2, the instrument will beep once every second for every 2 particles the instrument counts per second.

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PARTICLE DISPLAY

Data on the instrument can be displayed in Differential (DIFF) or Cumulative (CUML) counts.

For example, the cumulative count for the 1µm channel is the sum of that channel's count + 2.5µm count + the 5µm count.

The differential count for the 1µm channel is the number of particles between 1µm and 2.5µm.

The data displays on the MAIN screen according to whichever is selected (DIFF or CUML).

The data format is either Raw (RAW) or Normalized (NORM). Raw data displays the actual number of particles counted. Normalized data shows particle concentrations calculated from the raw data based on the settings chosen (ft3 or m3).

Volume of Air = Sample time (minutes) x FlowRate (CFM)

Normalized Data = Number of Particles/Volume of Air

Press BACK to return to the Configuration screen or press MAIN to return to the MAIN screen.

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ALARM

The Particle Alarm screen allows the user to enable alarming on specific channels as shown in Figure 6-31.

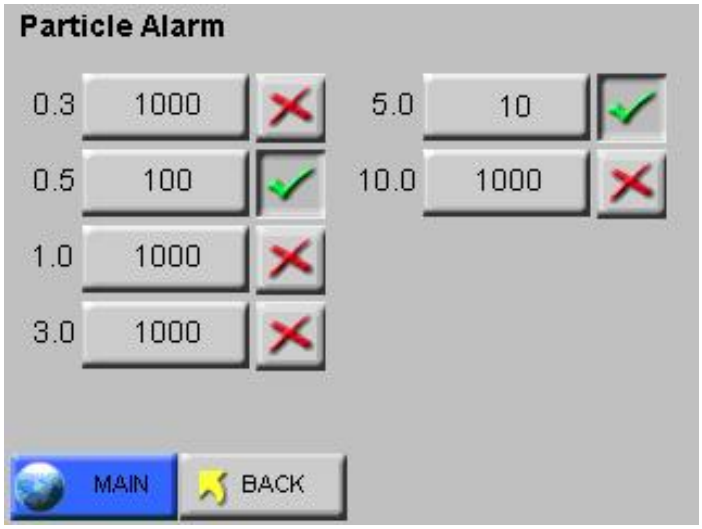


Figure 6-31 Particle Alarm Configuration Example

To enable the alarming for any channel, press the "X" next to that channel. When a checkmark is displayed, that channel is enabled for alarming. Press the checkmark to disable the alarming for that channel.

Alarm Threshold

Press the threshold button next to the enabled channel to set the alarm threshold for that channel. The Alarm Threshold screen will open as shown in Figure 6-32.

Note: If the particle volume is liters or m3, sample volume is displayed in liters.

If the particle volume is cubic feet (ft3), the sample volume is displayed in cubic feet (ft3).

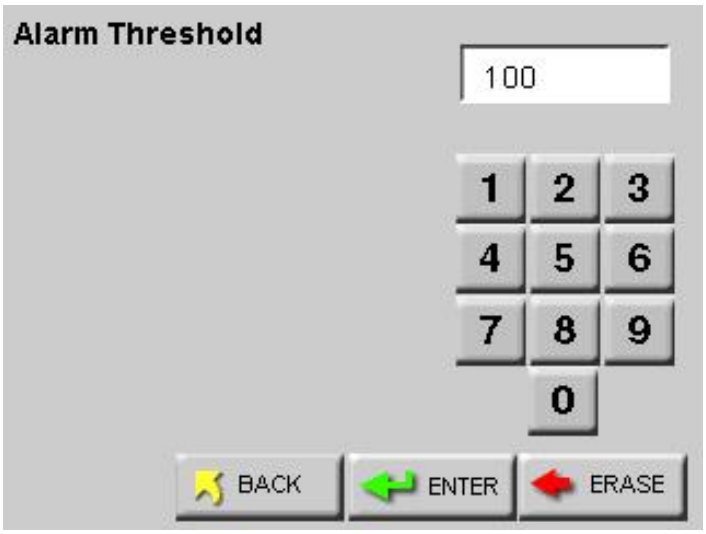


Figure 6-32 Configure Alarm Threshold

Enter the desired alarm threshold for the selected particle channel, in number of particles, then press ENTER. The threshold value will be updated on the Particle Alarm screen.

Press BACK to return to the Configuration screen or press MAIN to return to the MAIN screen. The alarm activated channels will display a selection cursor (>) as shown in Figure 6-33.

Note: To use alarms, the Sample Time must be greater than 1 second.

Note: Alarms are triggered per sample record. At the end of the sample time, the alarm is reset.



Figure 6-33 Channels Enabled for Alarming.

When a particle channel that is enabled for alarming goes into alarm, the selection cursor (>) and the channel size are highlighted in red. See Figure 6-34.

Note: If alarms are enabled on two channels and the user presses the screen to acknowledge the alarm when the first channel goes into alarm, the alarm will not sound if the second channel threshold is reached within the same sample period.



Figure 6-34 Channels in Alarm

When the instrument begins to beep in response to the Alarm settings, silence the beep by pressing anywhere on the MAIN screen. After acknowledging the alarm, the count will reset when the next sample cycle begins.



CLEAR BUFFER

To clear the data buffer on the instrument, press the Clear Buffer button. See Figure 6-35.



Figure 6-35 Clear Buffer Screen

Press OK to clear the data or press Cancel to exit screen without clearing the data.

DEVICE SETUP

The Device Setup buttons allow the user to set and adjust how the instrument operates when running samples. Specific functions can be enabled and disabled for display options, data output and security. See Figure 6-36.



Figure 6-36 Device Setup Options

CLOCK

The Date & Time screen allows the user to set the instrument's date and time. See Figure 6-37.

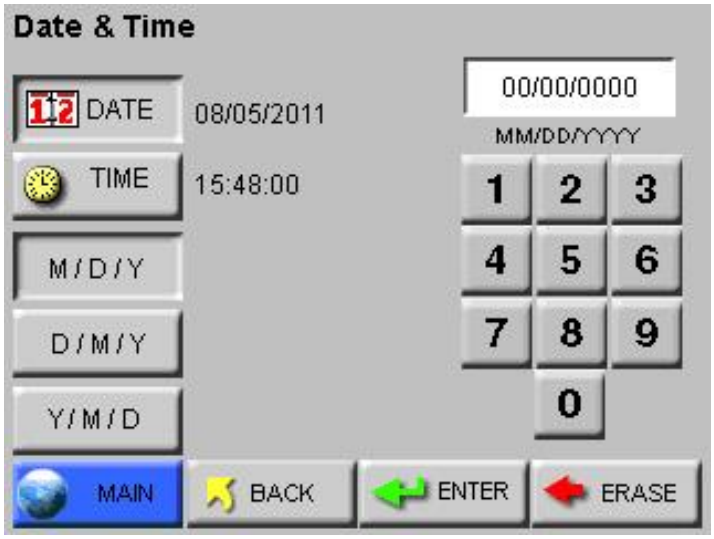


Figure 6-37 Date & Time Configuration Screen

Set the instrument's Date by entering values for the desired month, day and year and then press the ENTER button.

Change the Date's format by pressing the M / D/ Y button to display the date as month-first. Alternatively pressing the D / M/ Y button displays the Date as day-first and the Y / M/ D button displays the date year-first. See Figure 6-38 and Figure 6-39.

Note: MONTH 1ST (M/D/Y) is the default date format.

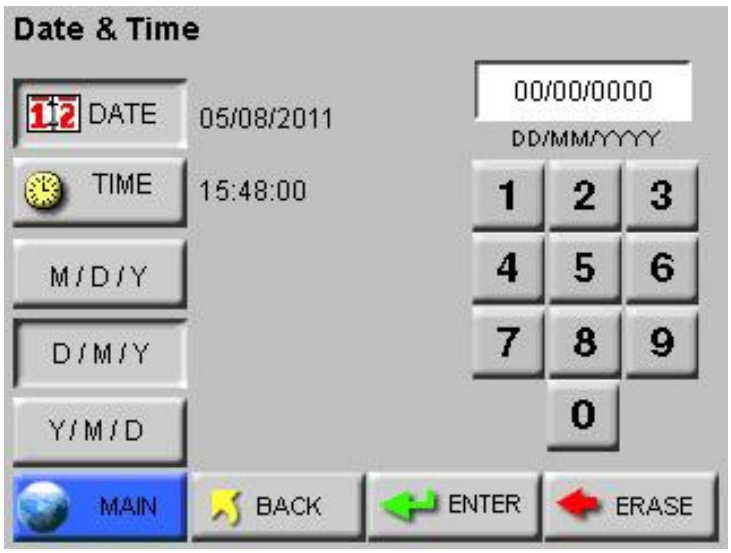


Figure 6-38 Date Option: Day First

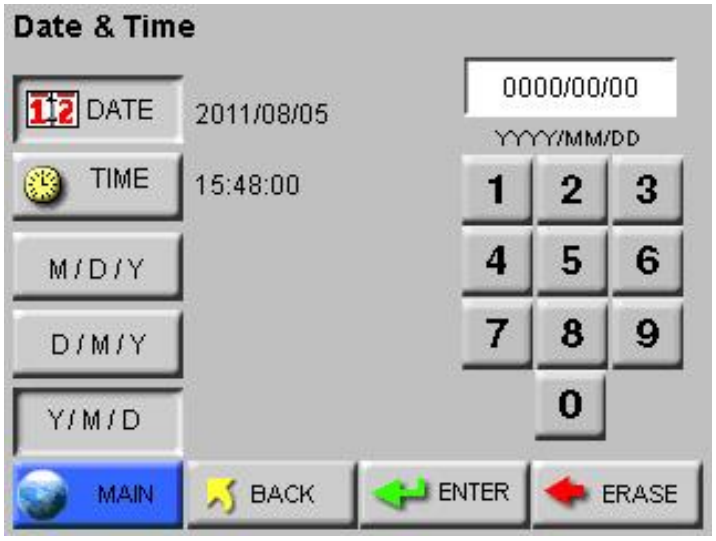


Figure 6-39 Date Option: Year First

Set the instrument's Time by pressing the TIME button. See Figure 6-40.



Figure 6-40 Configuring TIME

Enter the desired Time in hours, minutes and seconds then press ENTER to save the new time.

Press BACK to return to the Configuration screen or press MAIN to return to the MAIN screen.

OPTIONS

The Options screen allows the user to make visual and sound adjustments as well as selecting different language formats and start-up functions. See Figure 6-41.

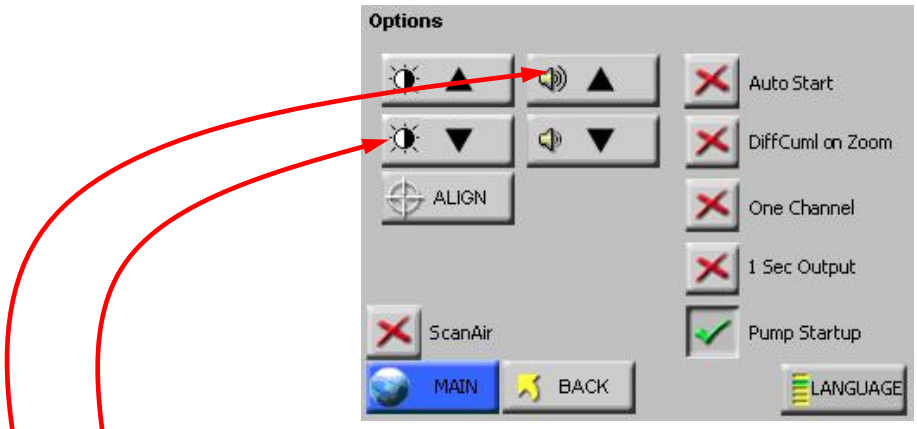


Figure 6-41 Options Configuration Screen

CONTRAST ADJUST

The contrast/brightness of the LCD screen can be adjusted by pressing the first set of UP and DOWN arrows.

AUDIBLE BEEP ADJUST

The audio level of the BEEP can be adjusted by pressing the second set of UP and DOWN arrows.



ALIGN TOUCH SCREEN

The ALIGN button allows the user to re-align the touch screen so the locations that they touch on the screen correspond to the expected button or function.

- Press the ALIGN button.
- The screen in Figure 6-42 appears. Touch anywhere on the screen to continue calibration.

Warning: Be careful to touch the screen at the specified locations only. If touching the screen elsewhere during this process, the screen will be incorrectly aligned.

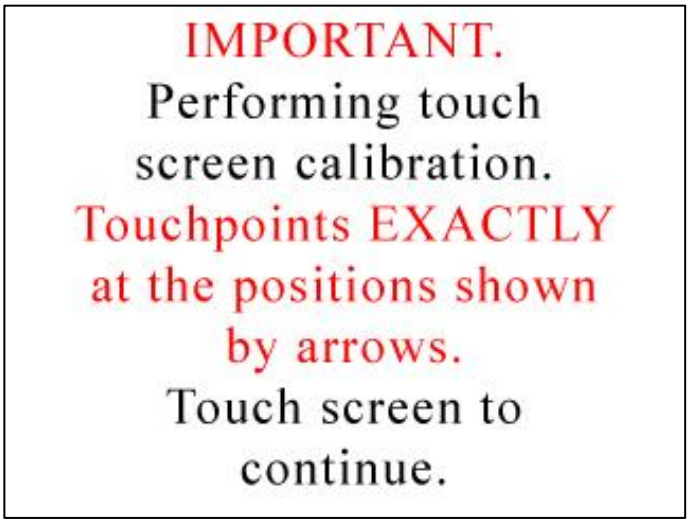


Figure 6-42 Alignment Screen 1

- At the next screen, touch the arrow displayed in the upper right corner. This need to be done a total of three times before continuing to the next alignment. See Figure 6-43.

Note: If the front panel is not responding to stimuli then with the unit powered off, press and hold center of touch screen. Then, power unit on and release screen and follow the instructions on screen.

Using a PDA Stylus provides higher accuracy to the touch screen interface.

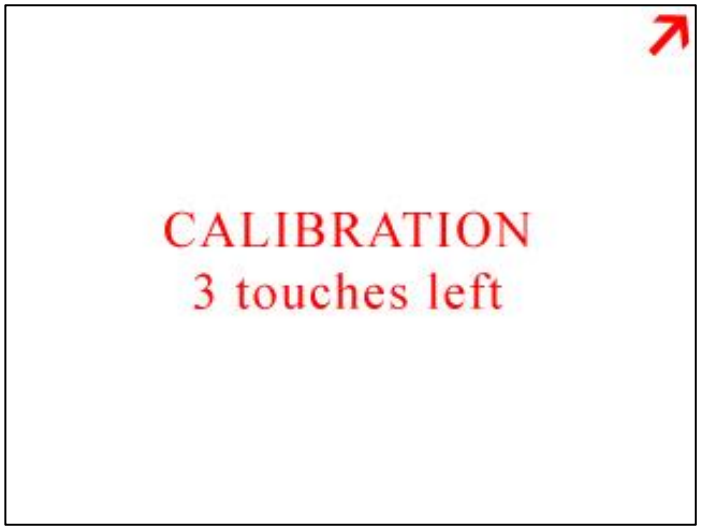


Figure 6-43 Alignment Screen 2

- The third screen displays the arrow in the upper left corner. The arrow will have to be touched three times to ensure calibration as Figure 6-44 illustrates this.

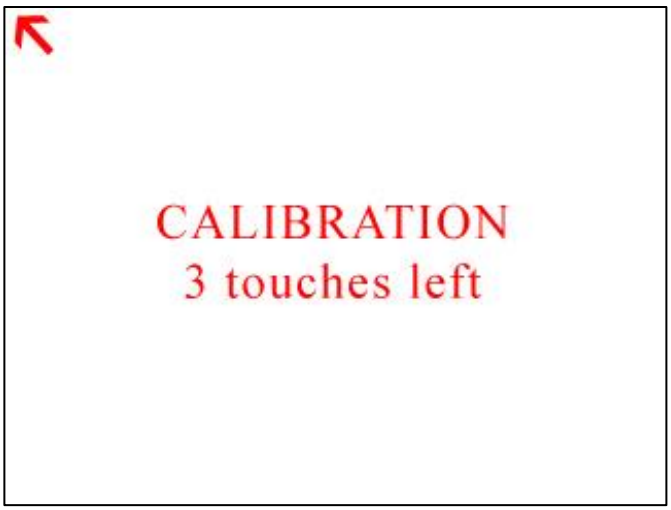


Figure 6-44 Alignment Screen 3

- The fourth alignment screen shown in Figure 6-45, displays the arrow in the at the bottom center of the screen. Touch the arrow three times to finish the alignment process.



Figure 6-45 Final Alignment Screen

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- Once the final alignment is complete, the following screen is displayed. See Figure 6-46. Touch anywhere in the screen to return to the OPTIONs screen.

Note: The screen alignment function can also be accessed by touching the screen when powering the instrument on.

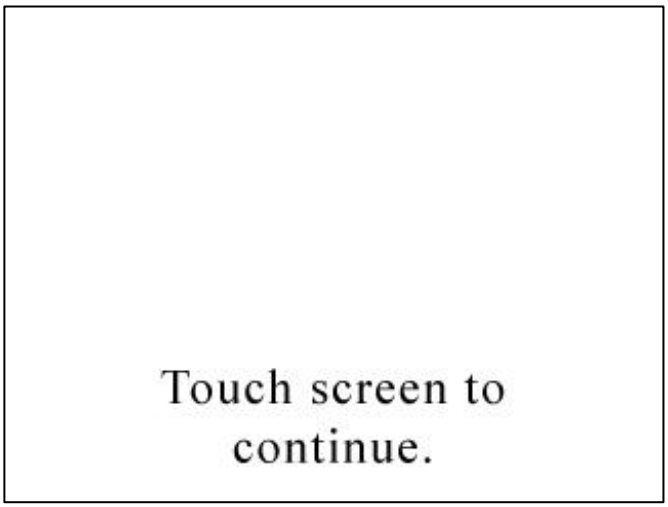
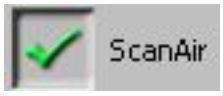


Figure 6-46 Alignment Saved Screen

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SCAN Mode

The Scan Mode option is available when the ScanAir button is enabled. The Scan Mode button shown in Figure 6-47 will appear on the Main screen next to the Location button.



Figure 6-47 Scan Mode Button

When Using the ScanAir Pro Filter Scanners in conjunction with 1 CFM particle counters, the Scan Mode button opens the Filter Media Scan Mode screen. See Figure 6-48.

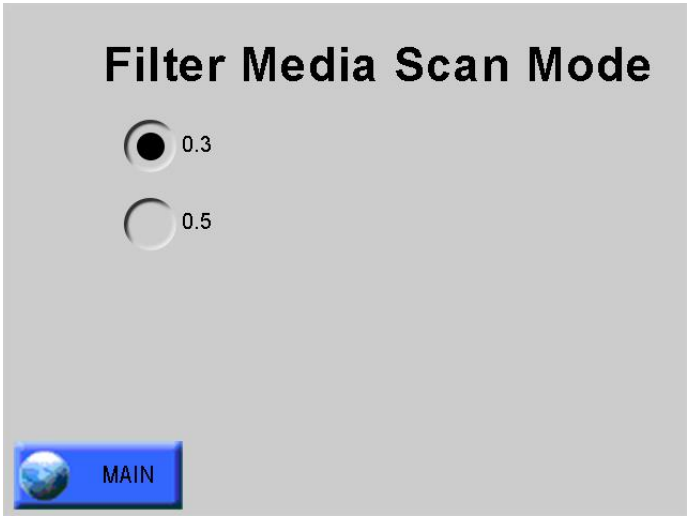


Figure 6-48 Filter Media Scan Mode

The filter scanner can scan for a specific micron particle size by selecting any of the available radio buttons.



AUTOSTART MODE

When Autostart mode is enabled, set the Delay time to at least 5 seconds.

If Autostart mode is enabled, when the instrument is powered on (or regains power after a power outage), the instrument will immediately begin sampling based its configured mode, delay, start, and hold times.



DiffCuml on Zoom

If DiffCuml on Zoom is enabled, the counter's display will show two columns of data simultaneously - Differential and Cumulative.



ONE CHANNEL

If One Channel is enabled, only the first channel will be displayed on the MAIN screen.

One Channel mode only affects how data is displayed on the MAIN screen. When the instrument is in One Channel mode, data will continue to be recorded, printed, and downloaded for all channels. See Figure 6-49.

Note: If the first channel is disabled, the display and zoomed data view will be blank.



Figure 6-49 One Channel Option Enabled



ONE SECOND REALTIME MODBUS OUTPUT

If One Second Real-time MODBUS Output is enabled, the instrument's settings reset to the following.

- Mode: AUTO
- Cycles: Zero
- Sample Time: One second
- Hold Time: Zero seconds
- Cumulative/Differential: Cumulative (CUML)
- Raw/Normalized: Raw

When counting, the MAIN Screen will update continuously, and data will not be recorded to the data buffer.

Note: Alarming is not available when One Second Real-time MODBUS Output is enabled. If any setting (mode, sample time, hold time, etc.) is changed, the One Second Real-time MODBUS Output mode will be automatically disabled.



Pump Start-up

Pump Start-up is ON by default and sets a pump ramp up time at the beginning of the first sample, or at the beginning of all samples if the HOLD time is greater than one minute, to stabilize the laser and air flow. This setting should be left in the default mode unless special applications, such as "surface scans", require it to be disabled.



Language

Pressing the LANGUAGE button allows the user to change the operating language displaying the screen shown in Figure 6-50.



Figure 6-50 Operating Language Screen

Press the desired language button then BACK or MAIN. The default is English.



COMM ADDRESS

The Communication screen allows the user to set the instrument's COMM address. When the SOLAIR is connected to a data collection system or daisy chained to other RS-485 instruments, the instrument's COMM address is used to identify it.

LMS XChange or LMS Express/RT will search for the instrument by the COMM Address specified on the Communication screen shown below. COMM addresses range from 1 to 63.

For RS-485 communications, each device on a multi-port chain must have a unique address. See Figure 6-51.

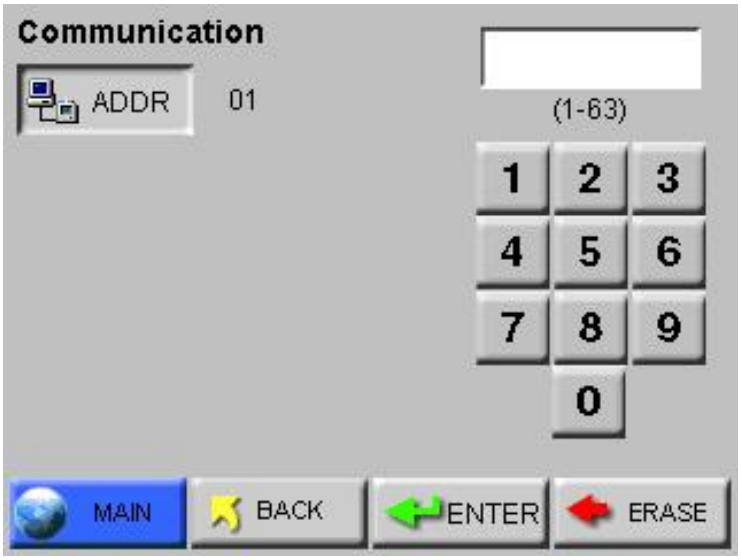


Figure 6-51 COMM Address Configuration Screen

Set the COMM Address by using the numeric keypad to select the address; press ERASE to erase a number, if needed. Press ENTER to accept the value. Press BACK to return to the Configuration screen or press MAIN to return to the MAIN screen.

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Output Setup

The Output Setup screen provides the option to send reports to a USB flash drive or to the thermal printer. If USB is chosen, the options are limited to Output on Sample or Output on Alarm. The report can be saved as either a CSV (Comma Separated Value) formatted text file or an encoded LSD (Lighthouse Secure Data) non-human readable file that can be imported and decoded in LMS Express. Figure 6-52 illustrates the USB options.

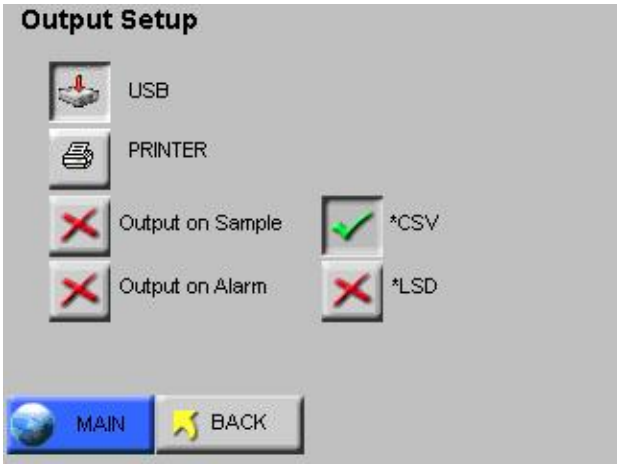


Figure 6-52 Output Setup Screen, USB Settings

Each Dataxxxx.csv file is managed separately, and data is added to the file while the flash drive is attached. When the drive is removed, the next insertion updates its index file and a new file is started. The next increment of the 'xxxx' file series is added. These 'csv' text files can be read on any system.

LSD files are securely encoded data files that can be downloaded from the SOLAIR onto a USB flash drive. The files include the following information:

- Model Name
- Serial Number
- Data Records including:
  - Time Stamp
  - Status
  - Location
  - Location Name
  - Sample Time
  - Particle Channel Data
  - Analog Data

LSD files require LMS Express to decode the information. LMS Express provides a new feature that allows the data from an LSD file to be imported into LMS Express. See Figure 6-53.



Figure 6-53 LMS Express LSD File Import

If a USB Flash Drive is attached to the SOLAIR, the PRINTER icon will change to a flash drive and the following message will display as shown in Figure 6-54.

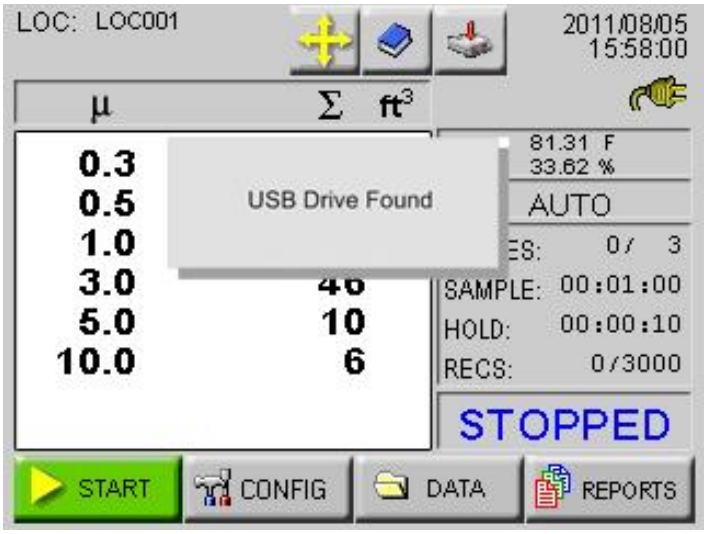


Figure 6-54 Flash Drive Attached, USB Mode

If PRINTER is selected, several options become available for formatting the data and information to be included in the printed reports, as shown in Figure 6-55.

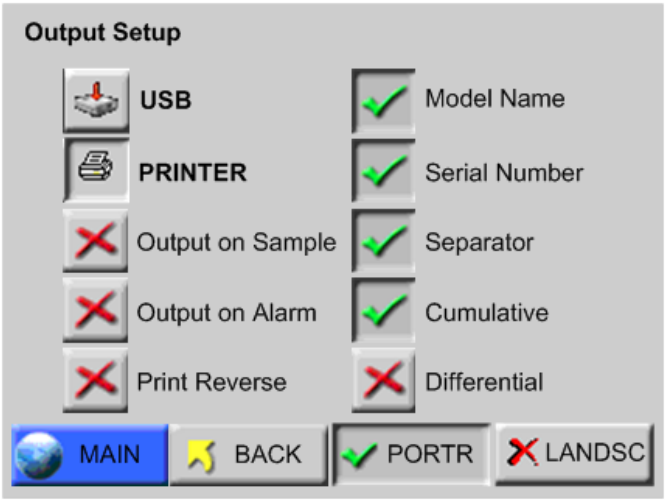
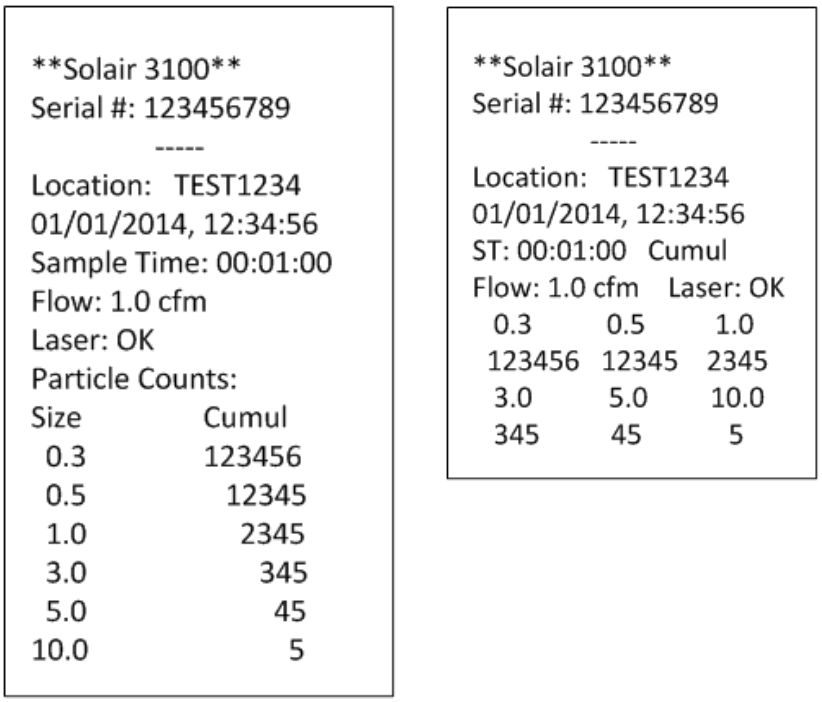


Figure 6-55 Output Setup Screen, Printer Settings

- **Output on Sample / Output on Alarm** - When Output on Sample is enabled, a single record will print at the end of every sample. When **Output on Alarm** is enabled, a single record printout will print at the end of any sample that experiences an alarm condition.
- **Print Reverse** - This option reverses the direction that the printouts of single records come out of the instrument. By default, Print Reverse is disabled. Since all reports calculate the data in the print range and generate results at the end of the report, all reports (Buffer and Standard) do NOT print in Print Reverse mode.
- **Model Name** - When enabled, the Model name of the instrument will print in the header of all printouts.
- **Serial Number** - When enabled, the Serial Number of the instrument will print in the header of all printouts.
- **Separator** - When enabled, a line separator will print after the Model Name and Serial Number in the header of all printouts.
- **PORTR** - Prints the report in portrait mode. See Figure 6-56.

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- **LANDSC** - Prints the report in landscape mode See Figure 6-56.



Solair 3100
Serial #: 123456789

Location: TEST1234
01/01/2014, 12:34:56
Sample Time: 00:01:00
Flow: 1.0 cfm
Laser: OK
Particle Counts:

Size	Cumul
0.3	123456
0.5	12345
1.0	2345
3.0	345
5.0	45
10.0	5

Solair 3100
Serial #: 123456789

Location: TEST1234
01/01/2014, 12:34:56
ST: 00:01:00 Cumul
Flow: 1.0 cfm Laser: OK

0.3	0.5	1.0
123456	12345	2345
3.0	5.0	10.0
345	45	5

Figure 6-56 Portrait and Landscape Print Examples

The user can select both Differential and Cumulative printing at the same time. For normalized values with more than 8 digits, only the whole number will be printed.

- Differential / Cumulative Toggle - This toggle option specifies how the data will appear on the printouts.
- Print Reverse - This option reverses the direction that the printouts of single records come out of the instrument. By default, Print Reverse is disabled. See Figure 6-57.



Print Reverse Enabled Print Reverse Disabled

Figure 6-57 Print Reverse Enabled/Disabled

Since all reports calculate the data in the print range and generate results at the end of the report, all reports (Buffer and Standard) do NOT print in Print Reverse mode.

Press BACK to return to the CONFIGURATION screen or press MAIN to return to the MAIN screen.

Trouble Shooting the Printer

Nothing Prints

- The printer door may not be completely closed.
  ACTION: close the door completely. See Figure 6-58.
- Print Output is directed to USB Flash Drive.
  ACTION: Redirect output to printer.



Figure 6-58 Door is Closed and Latched

- The printer paper may be loaded backwards
  ACTION: open the printer door and verify that the paper is feeding from the TOP of the roll. See Figure 6-59.



Figure 6-59 Correct Paper Loading Position

- Non-thermal paper might have been substituted.
  ACTION: replace non-thermal paper with Thermal paper.

Printing is Not Straight

- The Printer isn't aligned properly through the paper feed.
  ACTION: make sure the paper is lined up with the left and right sides of the paper feed. Figure 6-60.



Figure 6-60 Paper Alignment

- The roll could be nearly empty, leaving a lightweight core that might get off center if the printouts are torn off quickly.
  ACTION: put in a new roll of thermal paper.



SECURITY

The Security screen allows the user to restrict access to the instrument and/or configuring the instrument, the SOLAIR has two different password levels. See Figure 6-61.

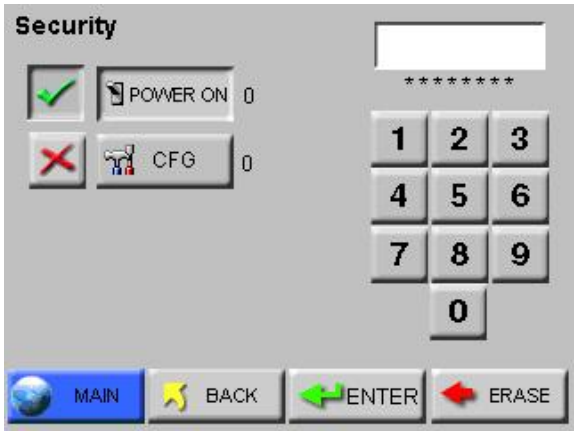


Figure 6-61 Security Password Configuration Screen

To restrict who can operate the instrument, enable the POWER ON password. When the POWER ON password is enabled, to use the instrument, the user will be required to enter the correct password each time the instrument is turned on.

To restrict who can configure the instrument, enable the Configuration password. When the Configuration password is enabled, the user will be required to enter the correct password before they can access the Configuration screen.

- To set the password for the POWER ON, select the POWER ON button, then type in a password using the numeric keypad. Press the ERASE button to delete the last character, if needed.
- Press ENTER to save.
- To set the Configuration password, select the CFG button, then type in a password using the numeric keypad.
- Press the ERASE button to delete the last character, if needed.
- Press ENTER to save the changes.
- Press the “X” button to enable either or both passwords.

Press BACK to return to the Configuration screen or press MAIN to return to the MAIN screen.

POWER ON PASSWORD

To require that a password must be entered before the instrument can be used, enable the POWER ON password. See Figure 6-62.

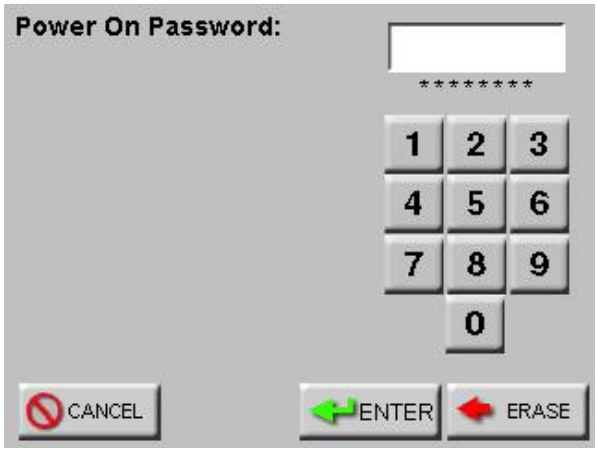


Figure 6-62 POWER ON Password Access Screen

When the POWER ON password is enabled, the user will see a password access screen just after they turn the unit on. The instrument will remain locked until the correct password is entered.

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CONFIGURATION PASSWORD

The Configuration password prevents unauthorized access to the Configuration screen. See Figure 6-63.

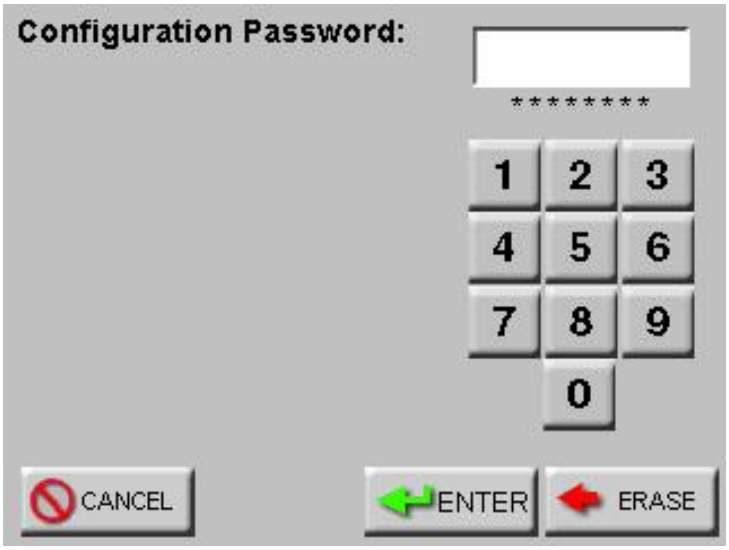


Figure 6-63 CONFIGURATION Password Access Screen



SERVICE

This section of the Configuration screen is reserved for Lighthouse Authorized Service Providers only. The correct service password must be entered to access this area.

Three options on the lower CONFIG screen, STATUS, RECIPE and LOC display the instrument's status, and allow the user to configure user recipes and locations respectfully.

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STATUS

Touching the STATUS button displays the Instrument programmed versions of the various firmware modules. This information is useful when contacting Lighthouse Technical Support personnel. See Figure 6-64.

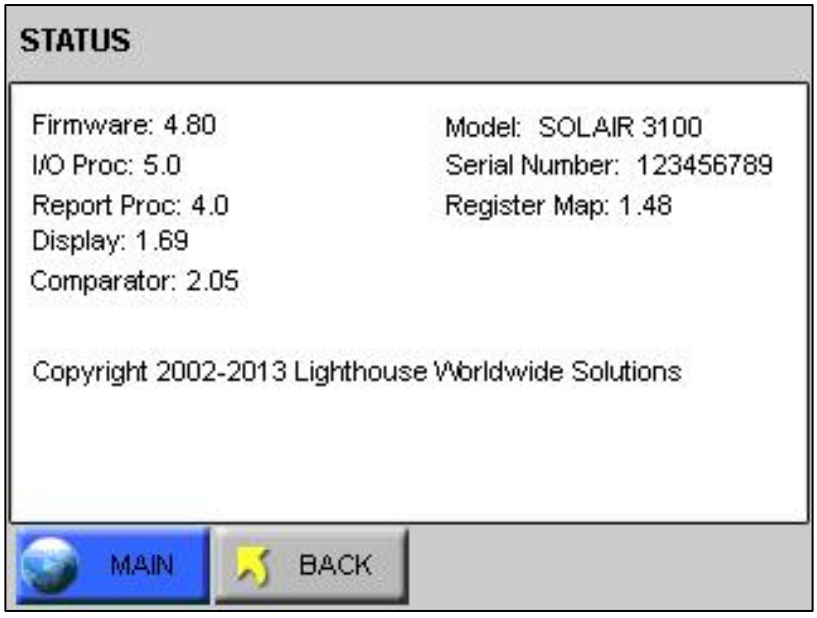


Figure 6-64 SOLAIR 3100 STATUS Screen

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RECIPE

Selecting the RECIPE button displays the Recipe setup screen. See Figure 6-65

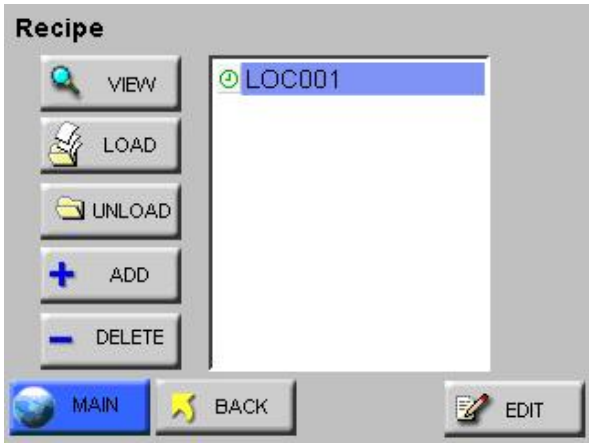


Figure 6-65 Recipe Setup Screen

The Recipe feature allows the user to save instrument settings for sampling and reports in a database that can store up to 50 recipes.



Selecting the ADD button displays the RECIPE text screen. See Figure 6-66. The recipe can be named using up to 12 characters.

Note: If the location selected is already assigned to another recipe or if there are no available free locations, the user will not be able to add a new recipe. The "Add" button will not be displayed.

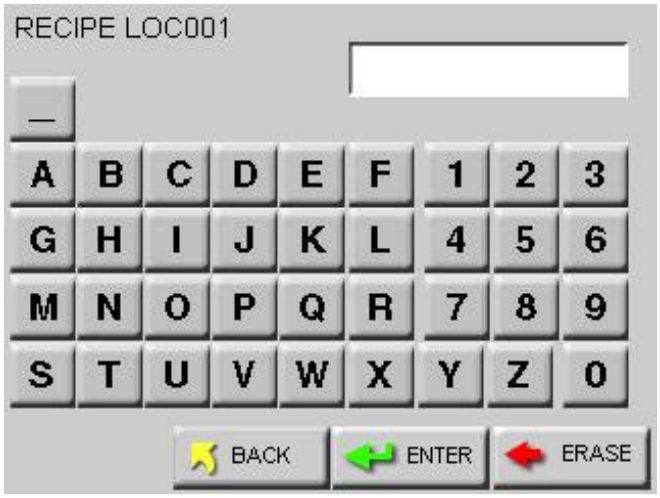


Figure 6-66 Recipe Name Screen

Pressing the ENTER button will add the recipe to the database and display the recipe CONFIG screen as shown in Figure 6-67. Each option allows the user to configure the instrument to the current recipe.

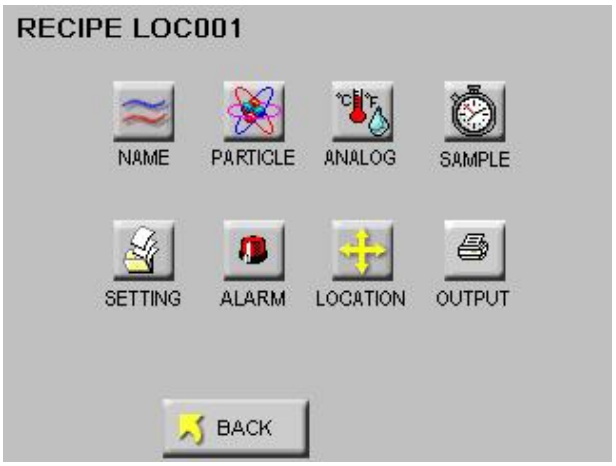


Figure 6-67 Recipe Configuration

Press the BACK button to save the settings and return to the RECIPE screen.



Pressing the EDIT button on the highlighted RECIPE will allow the user to change the recipe settings.



The LOAD and UNLOAD buttons add or remove the highlighted recipe as the instrument's current operating configuration.



The DELETE button will delete any highlighted recipes from the database.



If a recipe already exists, the VIEW button will display the current settings for it. See Figure 6-68.

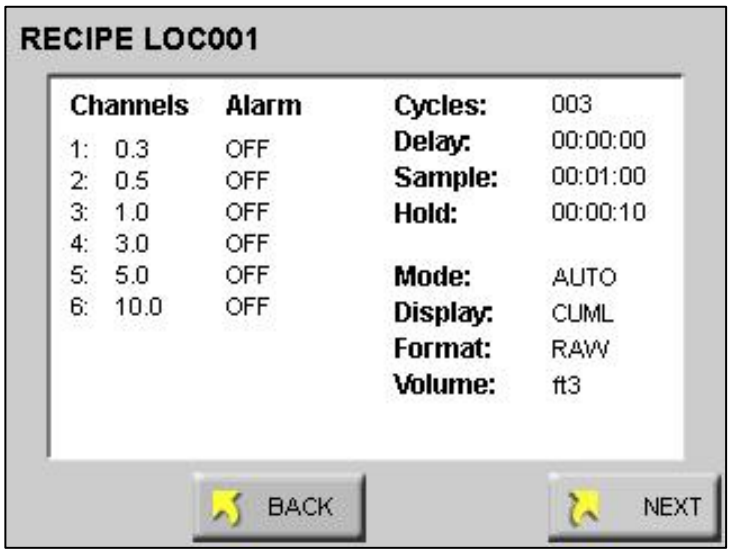


Figure 6-68 Recipe – Channel Settings

Press the NEXT button to view the analog and output settings. See Figure 6-69.

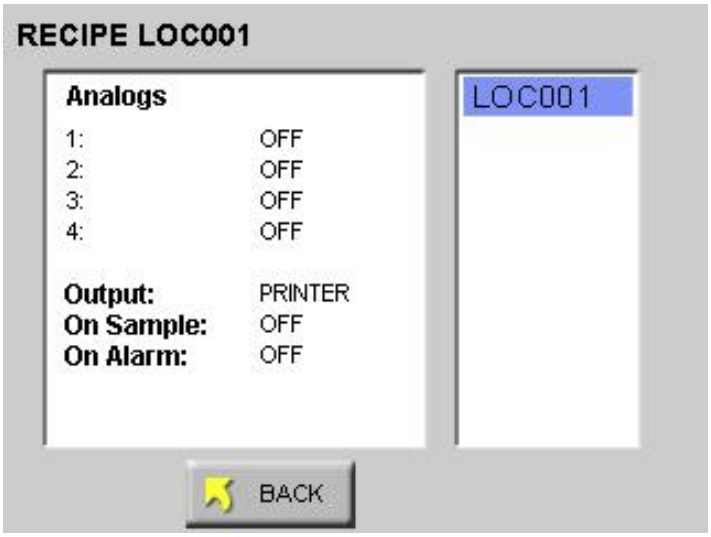


Figure 6-69 Recipe – Analog & Output Settings.

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LOCATION

The SOLAIR allows up to 200 different locations and associated alphanumeric labels.

Press the LOC button on the Configuration screen to display the Select Location screen as shown in Figure 6-70.

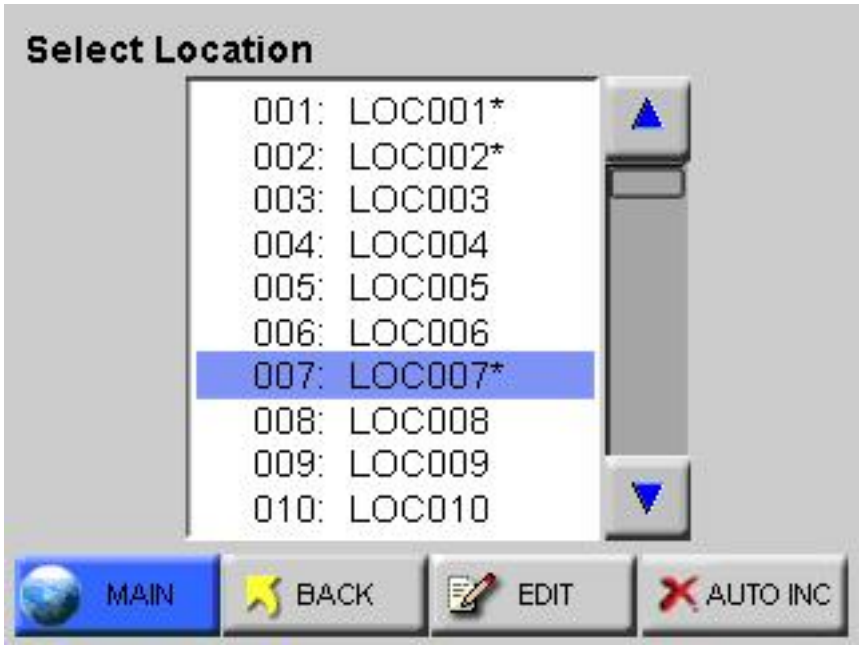


Figure 6-70 LOCATION Setup Screen

On the Select Location screen, the Location name can be selected using the UP and DOWN arrows or by touching the location name on the screen.

The following options can be enabled to configure locations for the SOLAIR.

- When enabled, the Auto Increment option will automatically select the next location after completing the programmed number of cycles. The default position is “off” when the unit is powered up.
- The unit can be configured for a maximum of 200 Locations. Each location name can be configured with a maximum of 8 characters per name.
- Recipes associated with a specific location are denoted by an asterisk (*) to the right of the location name.

- When selecting a location with a recipe, the user is provided with the option of loading the recipe as shown in Figure 6-71. If the user chooses not to load the recipe, the location can still be used with the current settings.

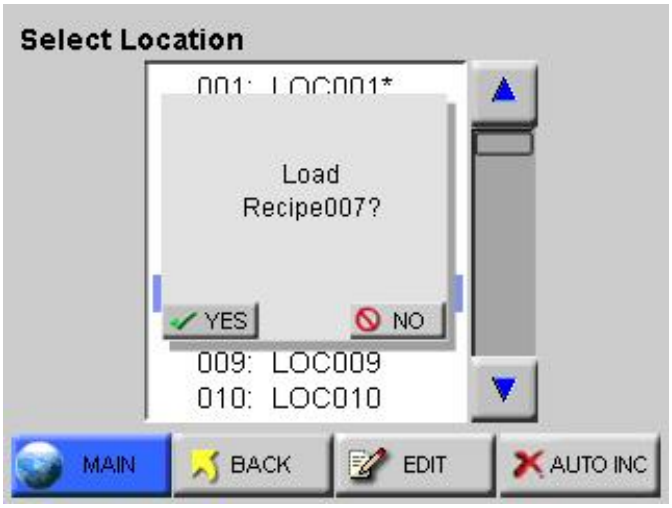


Figure 6-71 Location – Load Recipe

- If a recipe is loaded and a location is selected that is not associated with a recipe, the user is given the option to unload the current recipe. If the user chooses to keep the loaded recipe, the location will adopt the current recipe settings.



To create a name for a location, press the EDIT button to display the Edit screen shown in Figure 6-72.

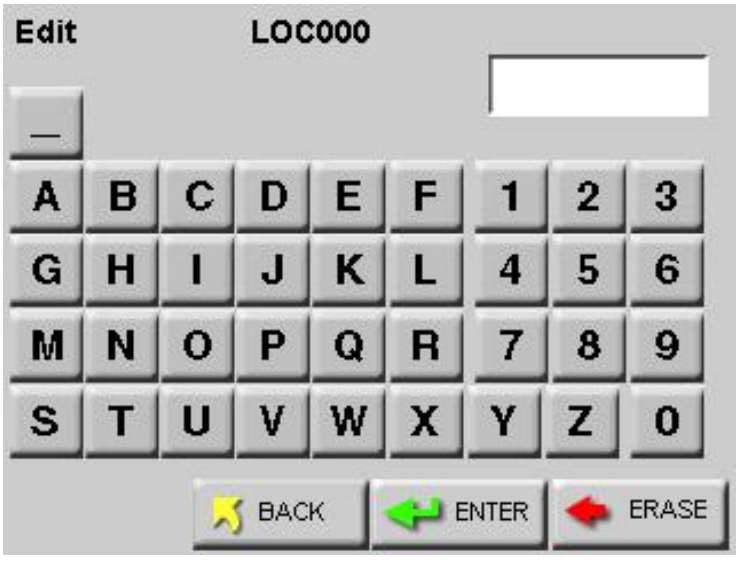


Figure 6-72 LOCATION Edit Screen

- Type in the name of the location using the alphanumeric and underscore keys.
- Press the ERASE button to erase the last character typed, if needed.
- Press ENTER.

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- Use the Arrow keys to go to the next location to be edited and press the EDIT button. Continue in the same way to edit as many Locations as desired.

Press the BACK button to return to the Configuration screen or the MAIN button to return to the MAIN screen.



Activating the AUTO INC button allows the user to select the next location once the number of cycles is completed.

The user is prompted to move to the next location after the programmed number of cycles. See Figure 6-73.



Figure 6-73 Auto Increment Prompt

The Auto Increment mode will select the next corresponding location and continue to sample using the current configuration. If the current location is using a recipe, the user will be prompted to unload the recipe before moving to the next location.

Data View Buffer Screen

Data stored on the instrument is viewed in the Data View Buffer. New records overwrite the first records stored after the buffer fills to its limit (3000 records). An asterisk (*) next to the word "Records" on the MAIN screen indicates the Buffer is full and data has wrapped. The first record shown in the Data View Buffer after data has wrapped will be the most current record and not the first record stored. In this case, older data will be lost if it hasn't been printed or transferred to a PC or management system.

Particle concentration data displays and prints in ft3 if the Particle Volume is set to ft3. If the Particle Volume is set to m3 or Liters, data displays and prints in m3.



Press the DATA button on the MAIN screen to display the Data View Buffer.

Depending on the sample setting configuration, the data displays in either RAW data mode as shown in Figure 6-74 or NORMALIZED to ft3 or m3 as shown in Figure 6-75.

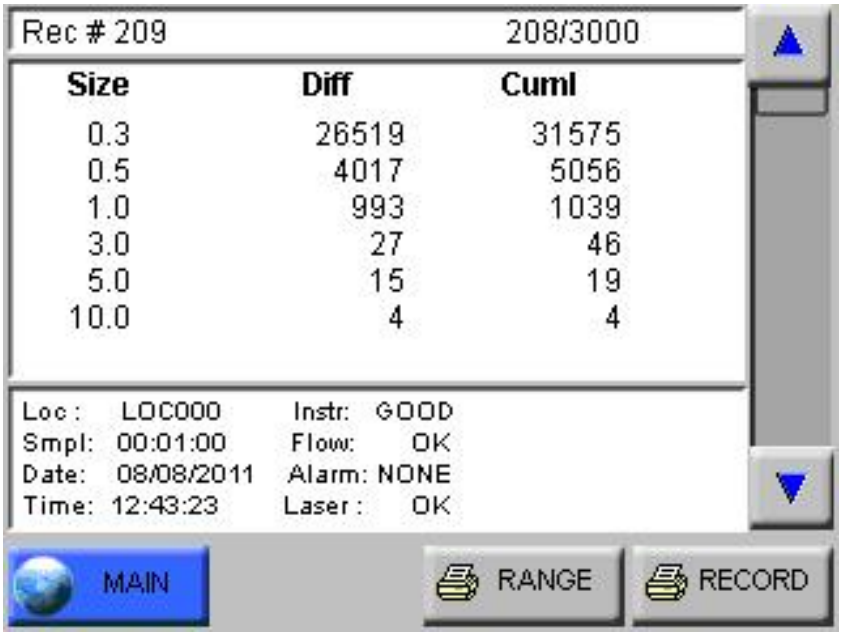


Figure 6-74 Data Screen – RAW Data

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Scroll through the data using the UP and DOWN arrow buttons.

- The single arrow moves one record at a time.

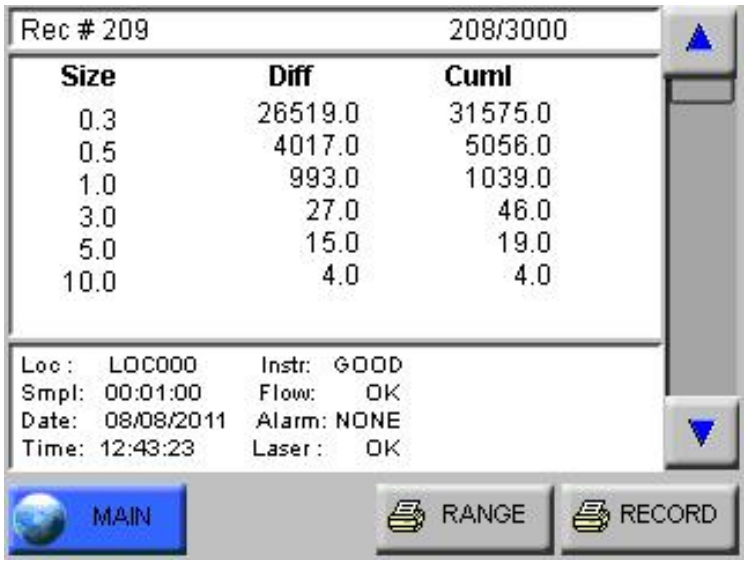


Figure 6-75 Data Screen – Normalized Data in ft³

The Data screen displays the following information for each data record.

Note: When the buffer has wrapped, the record that is first displayed in the Data screen is the first record in the data buffer. This may not be Rec#1.

If the single down arrow button is pressed once, the instrument will display the last record in the data buffer.

- **Rec#** - Identifies which record is currently viewed.
- ***Recs** - Displays how many records are currently stored in the SOLAIR's buffer. When there is an asterisk (*) next to the word "Recs", this means that the 3,000-record data buffer has wrapped, and older data is being overwritten. The basic concept is First In, First Out (FIFO).
- **Size** - Lists the channel sizes configured on the instrument.
- **Diff#, Diff/ft3, Diff/m³** - Indicates that each channel size's data is displayed in differential mode. If a channel was disabled, then there is a blank space in is column; # indicates raw counts; ft^3 and m^3 indicate normalized counts.
- **Cuml#, Cuml/ft3, Cuml/m³** - Indicates that each channel size's data is displayed in cumulative mode. If a channel was disabled, there will be a blank space in this column. # indicates raw counts while ft^3 and m^3 indicate normalized counts.
- **Loc** - Indicates the location at which the data record was recorded. The Location name listed is the alphanumeric label that was saved.
- **Smpl** - Indicates the Sample Time (HH:MM:SS) at which the data record was sampled.

- **Date** - Indicates the instrument date on which the data was recorded. The date will display in the format selected in the configuration (MM/DD/YYYY, DD/MM/YYYY or YYYY/MM/DD).

- **Time** - Indicates the instrument time at which the data was recorded (HH:MM:SS).

- **Instr** - Indicates the state of the instrument at the time the data was recorded. Instrument states include GOOD or SRVC.

  If **SRVC** appears, printouts will say “Service Required” and the sensor may need cleaning. Please contact Lighthouse Technical Support at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA).

- **Flow** - Indicates the flow state of the instrument at the time the data record was recorded. Flow is recorded as OK or ALRM. If the flow was in alarm, it will print as Flow: Alert on the printouts.

- **Alarm** - Indicates (NONE or YES) if the data record exceeded any of the alarm thresholds of any of the channels that were enabled for alarms. If the data record exceeded alarm thresholds, printouts show "Alarm: Yes".

- **Laser** - Indicates the status of the laser at the time the data record was recorded; possible laser states include OK or SRVC. If the laser needs to be serviced, it will print as Laser: Service.

  If laser state is SRVC, please contact Lighthouse Technical Support at 1800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA).

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Printing Data View Buffer Reports

The SOLAIR 1.0 CFM instruments store up to 3000 records in the data buffer.

The Buffer Report prints all or a range of the records in the buffer in the format specified by selections in the Print Configuration menu. At the end of the Buffer Report, a Summary will display or print the following information:

- Data displayed in Cumulative or Differential mode
- Raw ("Particle Counts") or Normalized ("Particles/ft3" or "Particles/m3")
- # of samples in the report

At each channel size:

- Maximum Value
- Minimum Value
- Average
- Standard Deviation

The UCL calculation will be printed for each channel size if the number of locations in the range is 2 through 9. The calculation will only print if the Format settings (Setting screen) are set to CUML and NORM. Any other format settings or locations less than 2 and greater than 9 will print N/A for each channel.

View the same data in different formats just by changing the Particle Display options in the Sample Setting screen in CONFIGURATION.

The Summary of the data can be viewed in the following combinations:

Note: Whatever is set up in the Configuration menu will display in the Data View Buffer and on the printout.

- Raw Counts, Differential Data
- Raw Counts, Cumulative Data
- Normalized Counts, Differential Data, Particles/ft3
- Normalized Counts, Differential Data, Particles/m3
- Normalized Counts, Cumulative Data, Particles/ft3
- Normalized Counts, Cumulative Data, Particles/m3



Print Record

When the user presses the PRINT RECORD button, whatever record is currently displayed on the Data View Buffer screen will print as a single sample record. The record will print according to the settings in the Print Configuration.

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Print Range

- To print a range of data from the buffer, first use the arrows on the Data screen to scroll to the first record to be included in the range. The printout will start with the record that is displayed on the Data screen.
- Determine how many records to print. Using the arrows to scroll up and down will help but make sure the screen displays the starting record before proceeding to the next step.
- Press the RANGE button. The Print Range screen displays as shown in Figure 6-76.

Note: Print Reverse does not apply to printing a range of data.

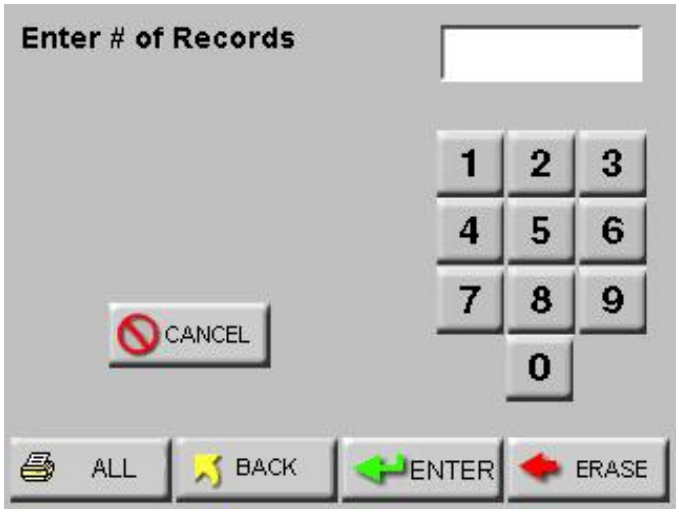


Figure 6-76 Print Range Screen

- Enter the number of records to print and press the ENTER button. The printer will print the number of records desired, starting with the record displayed on the Data View Buffer screen.
- Use the ERASE button to backspace and erase a number.
- Press CANCEL to cancel printing.
- Press BACK to return to the Data View Buffer screen without printing the report.
- If the entire buffer is to be printed, press ALL to print all of the stored records.

Note: Printing ALL records may take some time if the buffer is full.

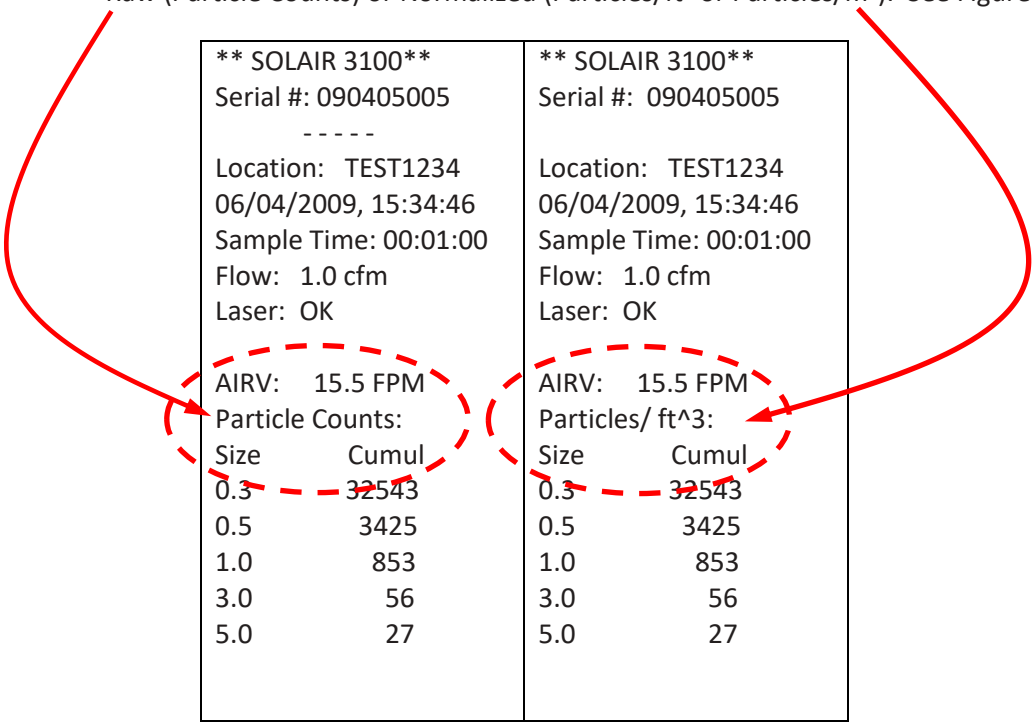
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PRINT RANGE (BUFFER Report)

The instrument stores up to 3000 records in its data buffer. The Buffer Report prints all or a range of the records in the buffer in the format specified by the selections in the Configuration.

At the end of the Buffer Report, the following summary information is printed.

- Data displayed in Cumulative or Differential mode
- Raw (Particle Counts) or Normalized (Particles/ft^3 or Particles/m^3). See Figure 6-77.



** SOLAIR 3100**	** SOLAIR 3100**
Serial #: 090405005	Serial #: 090405005
- - - - -	
Location: TEST1234	Location: TEST1234
06/04/2009, 15:34:46	06/04/2009, 15:34:46
Sample Time: 00:01:00	Sample Time: 00:01:00
Flow: 1.0 cfm	Flow: 1.0 cfm
Laser: OK	Laser: OK
AIRV: 15.5 FPM	AIRV: 15.5 FPM
Particle Counts:	Particles/ ft^3:
Size Cumul	Size Cumul
0.3 32543	0.3 32543
0.5 3425	0.5 3425
1.0 853	1.0 853
3.0 56	3.0 56
5.0 27	5.0 27

Figure 6-77 Sample Report Formats

- # of samples in the report
- For each channel size:
  - Maximum Value
  - Minimum Value
  - Average
  - Standard Deviation

View the same data in different formats just by changing the Particle Display options on the Sample Setting screen.

The Data Summary can be viewed as:

- Raw Counts, Differential Data
- Raw Counts, Cumulative Data
- Normalized Counts, Differential Data, Particles/ft3
- Normalized Counts, Differential Data, Particles/m3
- Normalized Counts, Cumulative Data, Particles/ft3
- Normalized Counts, Cumulative Data, Particles/m3

Printing Buffer Report

- To print a range of data from the buffer, scroll to the first data record to be included in the range.
- Press the RANGE button. The Print Range screen will display as shown in Figure 6-78.

Note: Print Reverse does not apply to printing a range of data.

Note: Printing ALL records may take some time if the buffer is full.

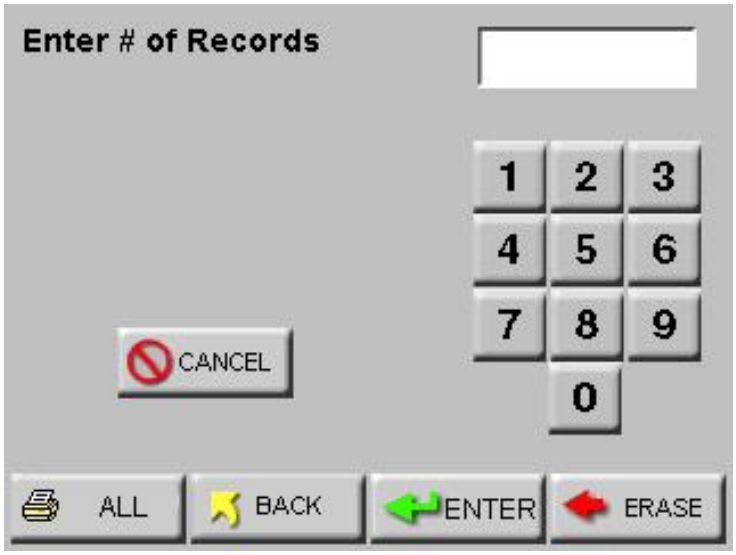
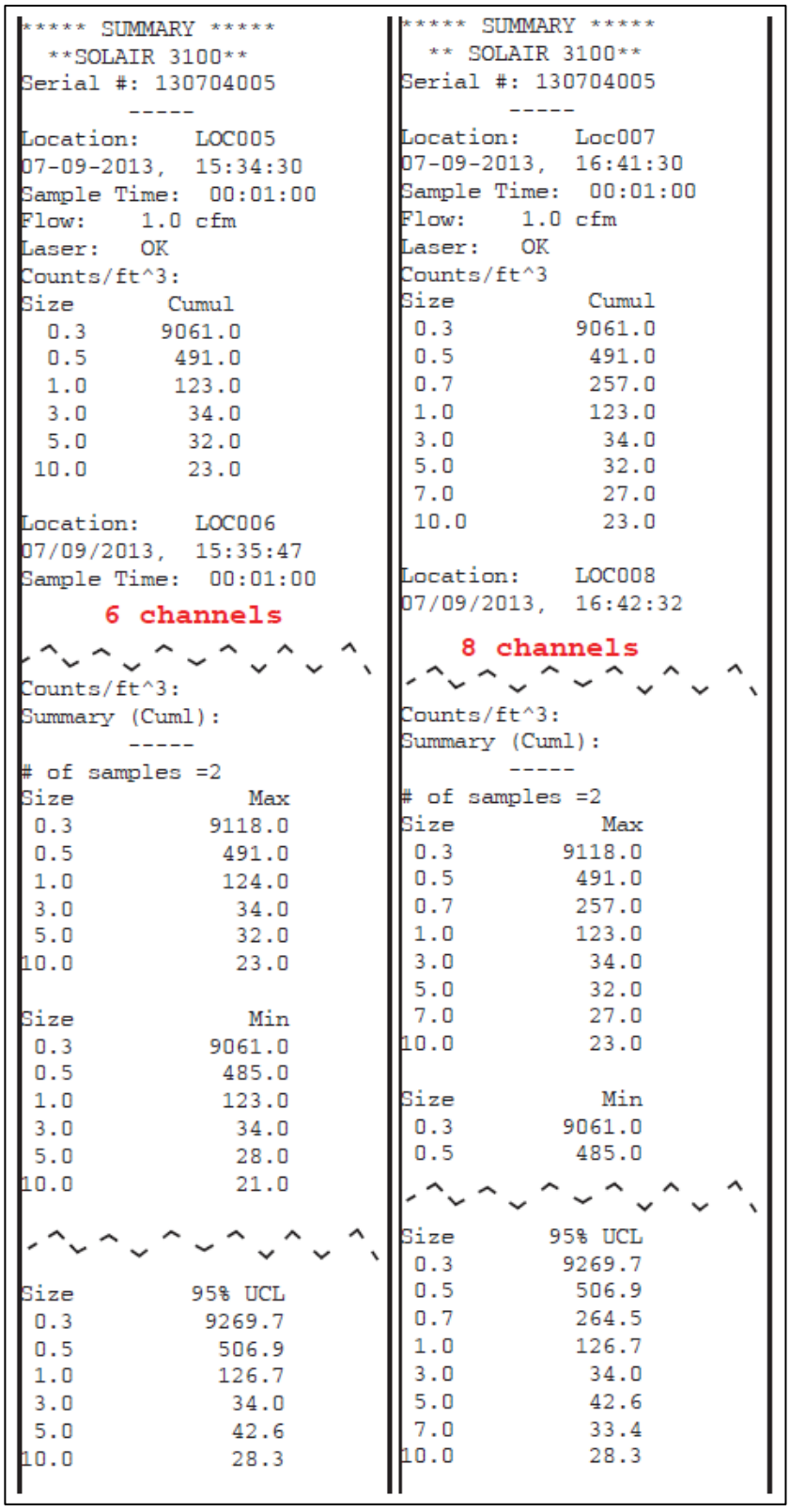


Figure 6-78 Print Range Screen – Buffer

- Enter the number of records to print and press the ENTER button.
- Press ALL to print all records in the buffer.
- Press CANCEL to cancel printing.
- Press BACK to return to the View Buffer screen without printing the report.
- Figure 6-79 below, displays sample buffer reports.



```
***** SUMMARY *****
  **SOLAIR 3100**
Serial #: 130704005
        -----
Location:    LOC005
07-09-2013,  15:34:30
Sample Time:  00:01:00
Flow:    1.0 cfm
Laser:   OK
Counts/ft^3:
Size       Cumul
  0.3     9061.0
  0.5      491.0
  1.0      123.0
  3.0       34.0
  5.0       32.0
 10.0       23.0

Location:    LOC006
07/09/2013,  15:35:47
Sample Time:  00:01:00
     6 channels
Counts/ft^3:
Summary (Cuml):
        -----
# of samples =2
Size            Max
 0.3          9118.0
 0.5           491.0
 1.0           124.0
 3.0            34.0
 5.0            32.0
10.0            23.0

Size            Min
 0.3          9061.0
 0.5           485.0
 1.0           123.0
 3.0            34.0
 5.0            28.0
10.0            21.0


Size        95% UCL
 0.3         9269.7
 0.5          506.9
 1.0          126.7
 3.0           34.0
 5.0           42.6
10.0           28.3
```

```
***** SUMMARY *****
  ** SOLAIR 3100**
Serial #: 130704005
        -----
Location:    Loc007
07-09-2013,  16:41:30
Sample Time:  00:01:00
Flow:    1.0 cfm
Laser:   OK
Counts/ft^3
Size          Cumul
 0.3         9061.0
 0.5          491.0
 0.7          257.0
 1.0          123.0
 3.0           34.0
 5.0           32.0
 7.0           27.0
 10.0          23.0

Location:    LOC008
07/09/2013,  16:42:32
     8 channels
Counts/ft^3:
Summary (Cuml):
        -----
# of samples =2
Size           Max
 0.3        9118.0
 0.5         491.0
 0.7         257.0
 1.0         123.0
 3.0          34.0
 5.0          32.0
 7.0          27.0
10.0          23.0

Size           Min
 0.3        9061.0
 0.5         485.0


Size       95% UCL
 0.3        9269.7
 0.5         506.9
 0.7         264.5
 1.0         126.7
 3.0          34.0
 5.0          42.6
 7.0          33.4
10.0          28.3
```

Figure 6-79 Sample Buffer Reports

REPORTS



The SOLAIR can print the following Cleanroom Classification to Standards reports:

Federal Standard ft3
ISO 14644-1
EU GMP 2022

Note: The EU GMP 2022 report is only valid if the instrument is configured with the 0.5 and 5.0 µm channel sizes.

Reports General Settings

Enable the Reports feature by pressing the red "**X**" (Default position) located at the top left of the screen. The button will display a check mark indicating the feature is enabled. See Figure 6-80.

Note: If the user sets the counter for a minimum volume and takes the exact number of minimum locations and samples, the user could get a "Cannot Classify: too few locations" error if the minimum volume rounds the sample time down so that not enough samples at the minimum volume are taken.

In this case, add one or two seconds to the sample time so that the user is not at the exact minimum volume.

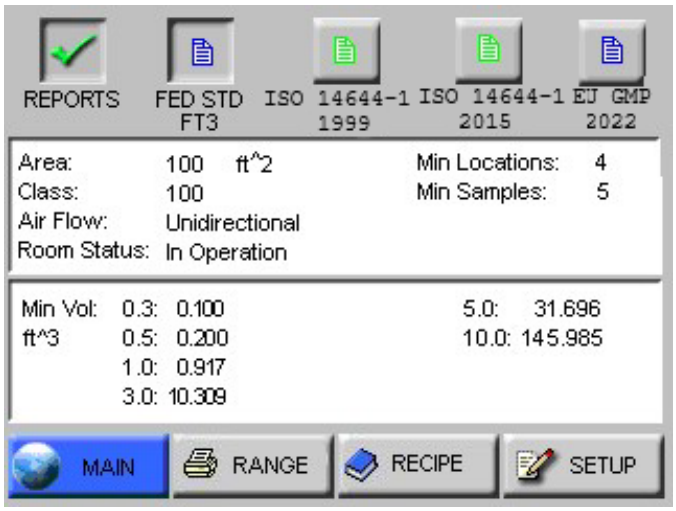


Figure 6-80 Typical Reports Screen

- Depending on the report requirements, the number of cycles and minimum sample time will be calculated when the reports mode is enabled.
- The number of required locations will be automatically assigned to the report. The user may change locations via the reports SETUP screen.
- The display format will be changed to Normalized (normalized to ft3 for FED-209 and m3 for ISO and EU GMP). The user may change the display mode from the report SETTINGS screen.

- When the reports mode is enabled, the currently selected report type and minimum required samples will be displayed on the MAIN screen as shown in Figure 6-81.

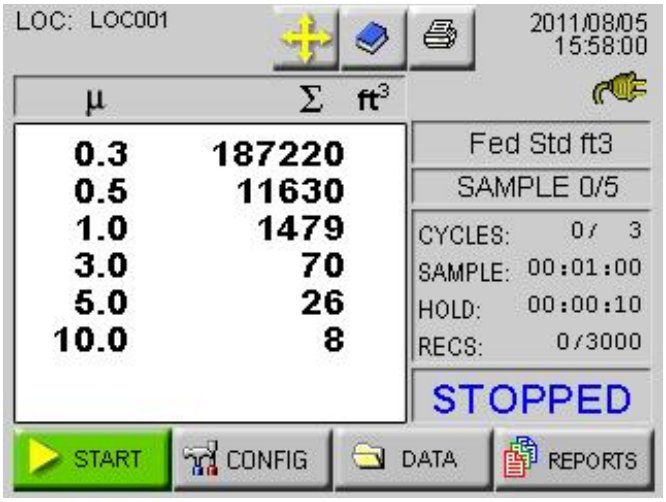


Figure 6-81 Reports Data

- The instrument keeps track of and will display on the MAIN screen the number of samples taken for the report.
- If Auto Increment is enabled, the user will be prompted to move the particle counter to the next assigned location after the completed number of cycles.
- If Printing is enabled and Auto Increment is enabled, the report will be printed after the required number of samples are completed.
- After the required number of samples have been completed, the instrument will prompt the user to disable Reports Mode as shown in Figure 6-82.

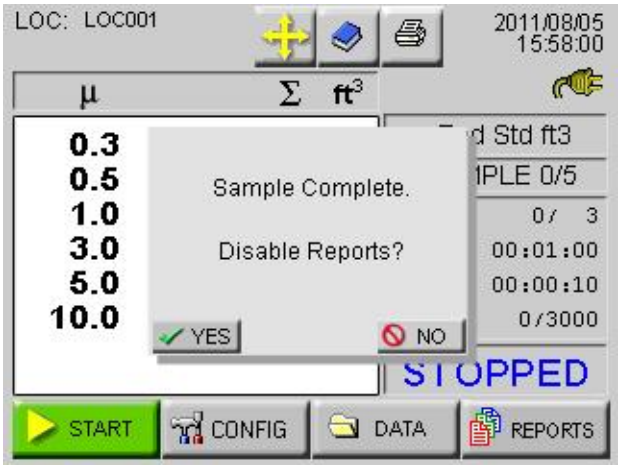


Figure 6-82 Disable Reports Prompt

When one of the report options buttons is pressed, the instrument uses the current Room Area, Class Level, Air Flow and Room Status parameters to determine the minimum number of locations, samples, and volume per channel to classify a cleanroom with that standard.

Use these displayed minimum values to configure the instrument so that the minimum requirements needed to classify the cleanroom will be met.

To set parameters for a report, follow these steps:

- Select the desired report.
- Press the SETUP button; the Report Setup screen displays as shown in Figure 6-83.

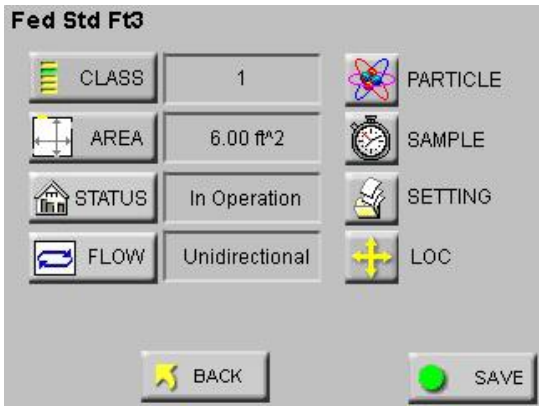


Figure 6-83 Report Setup Screen

- Press the CLASS button and the Select Class screen displays as shown in Figure 6-84.

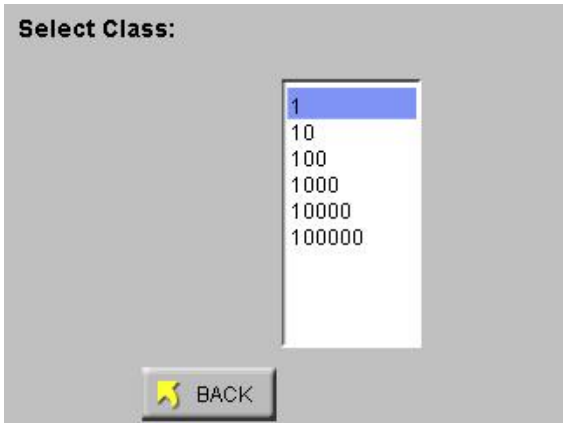


Figure 6-84 Select Class Level

- Press the displayed values to select the desired Class Level. The selected level will be highlighted in blue.

Class Levels vary based on which standard has been selected in the PRINT REPORT field. Below are the available Class Levels, per standard:

FED_209E ft^3- 1, 10, 100, 1000, 10000, 100000
ISO14644-1 - 1, 2, 3, 4, 4.8, 5, 6, 7, 8, 9
EU GMP - A, B, C, D (Rev 2022)

Changing the Class Level will also change the minimum number of locations, minimum number of samples and the minimum sample volume per channel size required to satisfy the requirements of the chosen report.

- Press the BACK button.
- Press the AREA button to display screen shown in Figure 6-85.

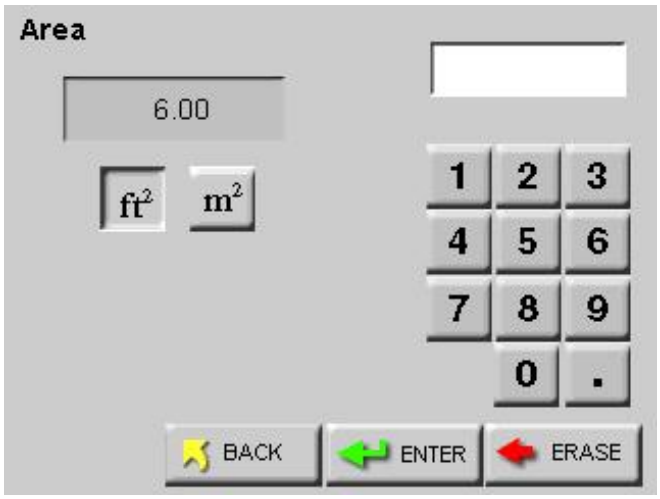


Figure 6-85 Reports Area Setup Screen

- Select the appropriate unit of measure (ft2 or m2) and type in the area using the keypad. Press ENTER to display the value on the screen.
- Press the BACK button.

- Press the STATUS button to display screen shown in Figure 6-86.

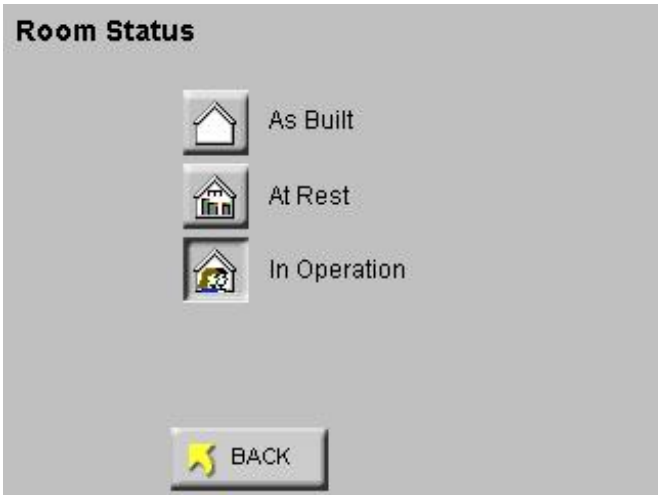


Figure 6-86 Reports Room Status Screen

- Select appropriate room status (As Built, At Rest, In Operation).
- Press the BACK button.
- Press the FLOW button to display screen shown in Figure 6-87.

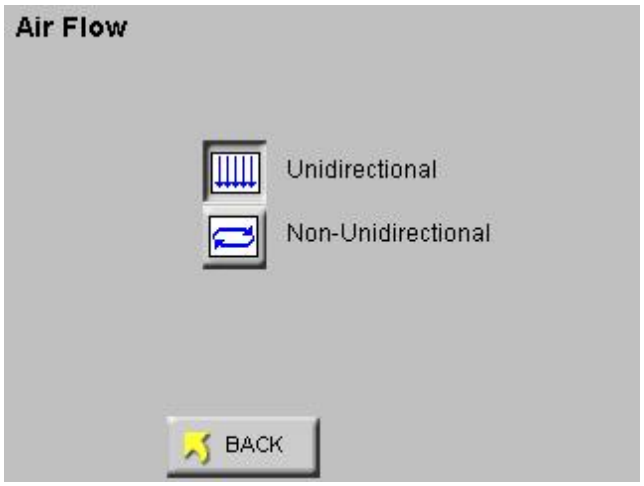


Figure 6-87 Reports Air Flow Screen

- Choose the appropriate type of air flow (Unidirectional, Non-Unidirectional), then press the BACK button to return to the SETUP screen.

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- The SETUP screen shown in Figure 6-88 will display the values that were configured in the display fields.

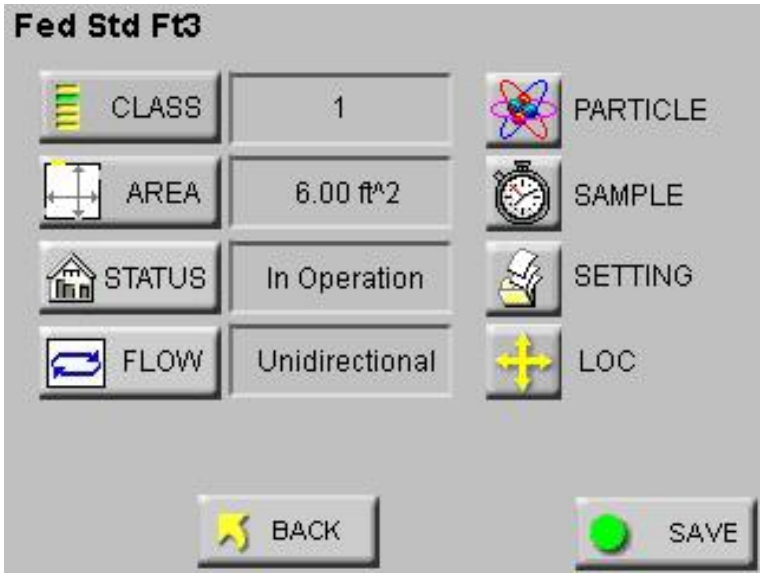


Figure 6-88 Configure the Instrument

Use this information to set up the instrument to meet or exceed the minimum requirements.

- Select the PARTICLE button to enable or disable particle channels as shown in Fig. 6-89.



Figure 6-89 Reports Particle Screen

- Press the BACK button.

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- Select the SAMPLE button to configure the number of Cycles, Delay time, Hold time, Sample time and Volume. See Figure 6-90.

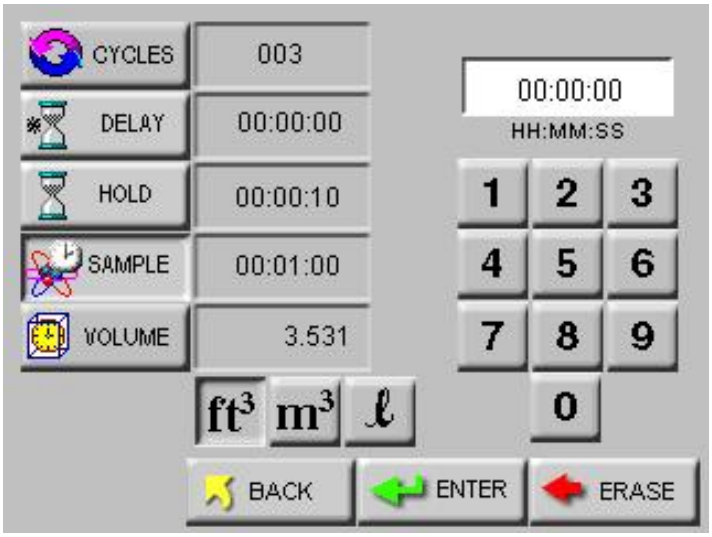


Figure 6-90 Reports Sample Screen

- Press the BACK button.
- Select the SETTING button to format the instrument for CUML/DIFF, RAW/NORM, ft^3/m^3 as shown in Figure 6-91.

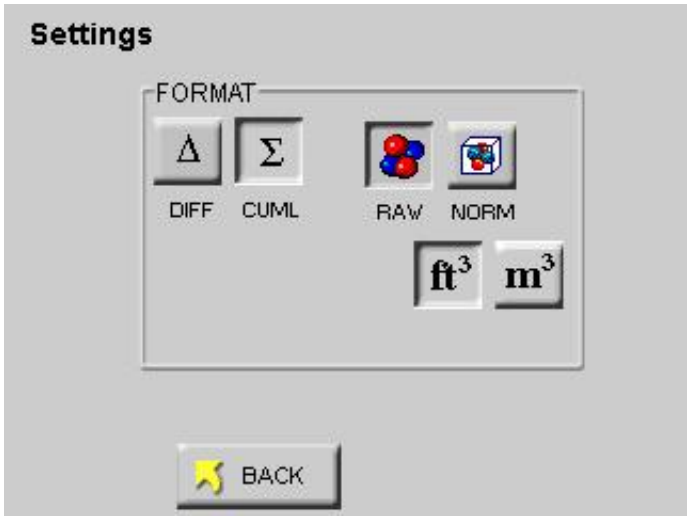


Figure 6-91 Reports Settings Screen

- Press the BACK button.
- Select the LOC button to select, add or delete locations or enable Auto Inc as shown in Fig. 6-92.

Note: If the location is already assigned to another recipe or if there are no available free locations, the user will not be able to add a new recipe. The "ADD" button will not be displayed.

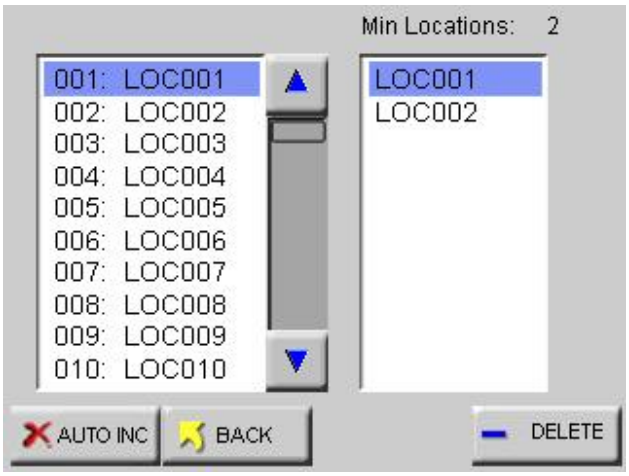


Figure 6-92 Reports Location Screen

- Press the BACK button then select BACK to return to the main REPORTs screen or select SAVE to save the configuration in the Recipe database. See Figure 6-93.

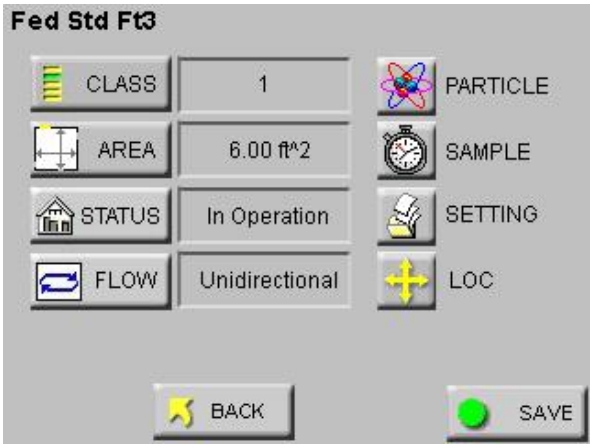


Figure 6-93 Reports Setup Screen

- When "REPORTS" are enabled, the "LOC" and "SAVE" buttons are displayed only when there are at least the minimum number of locations needed for the recipe area available. See Figure 6-94.

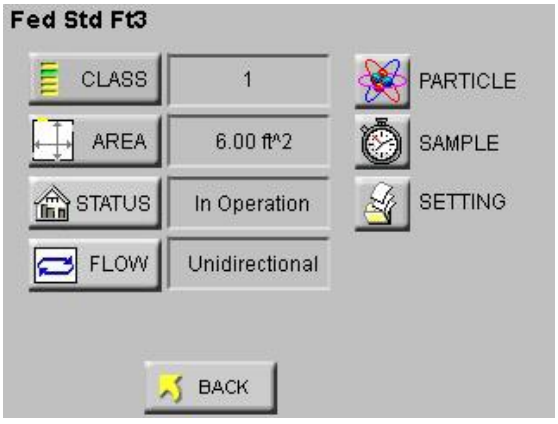


Figure 6-94 Reports Setup Screen No Locations

Setting up Counter to Run Reports

For this example, the FED STD FT^3 report will be used. See Figure 6-95.

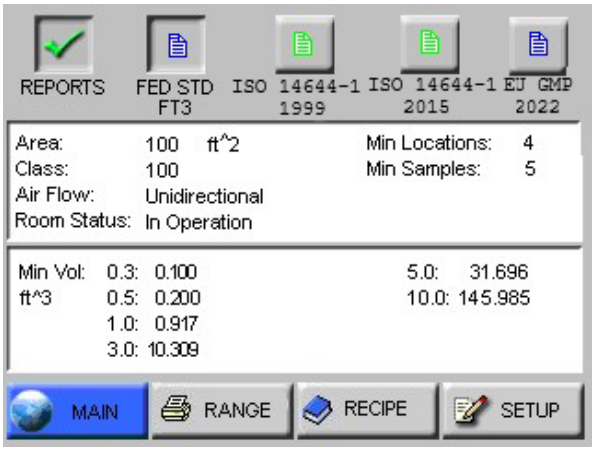


Figure 6-95 FED STD FT3 Report Screen

- Set the instrument for the Fed Std ft^3 report, 100 ft^2, Class 100, unidirectional air flow, operational room status.
- This will generate the following minimum requirements:
  - Min Locations: 4
  - Min Samples: 5

Note: The Minimum Volumes are measured in the standard measurement required by each specific report.

The number of digits allowed for area to calculate volume is limited to a 5-digit value for ft^2 and a 4-digit value for m^2.

Channel Size (µm)	Minimum Volume (ft^3)
0.3	0.100
0.5	0.200
1.0	0.917
3.0	10.309
5.0	31.696
10.0	145.985

Table 6-1 Minimum Volume per Channel Size

Based on the minimum requirements displayed Table 6-1, configure the instrument as follows:

Note: The Sample time automatically changes to 1:28 (1 minute, 28 seconds).

Note: This is all that is needed to meet the minimum requirements to classify the report.

Increase any of the configuration parameters to meet additional reporting needs.

- Press MAIN to return to the MAIN screen.
- Press CONFIG to enter the Configuration screen.
- Press SAMPLE to set the Sample time.
- Press the VOLUME button to set the instrument's sample volume.
- Type in 146 and press ENTER. This sets the instrument for the channel size with the largest minimum volume requirement.
- Press the CYCLES button.
- Set the CYCLES value for 1 and press ENTER.
- Press the MAIN button.
- Press the Location Select button at the top of the screen.
- Select the location where the first measurement will be taken.
- Press START. Let the instrument record 1 sample at the first location.
- After the instrument has recorded the sample, change the Location using the Location Select button.
- Then move the instrument to the second location and press START.
- After the instrument has recorded the second sample, continue to change the Location setting before recording at the next location, then move it to the third and forth locations, taking at least one sample at each location. At one location take 2 samples.
- After the instrument finishes recording at the last location, and the instrument has a total of at least 5 samples, the instrument is ready to print the report.

Report Output Setup

The Report output can be directed to either the thermal printer or to a USB flash drive. To change the destination, press CONFIG then OUTPUT. Choose USB to output reports to the Flash Drive.

Printing a Report

To print a report, the user can choose to either clear the data before starting the test or run the samples and then select the range of data to include in the report.

- Once the user has collected the necessary samples, press REPORTS from the MAIN screen.
- Press the RANGE button on the REPORTS screen
- Using the ARROW buttons, scroll to the first record in the range of data for the report.
- Press the RANGE button on the Data View Screen.
- Type in the number of records to be included in the range.
- Press ENTER.
- The display will return to the main REPORTS screen and start printing the report.
- To stop printing, press the CANCEL button.

Report Requirements

Fed Std ft3

This report requires a minimum of 2 locations be measured, at least 1 sample be taken per location and at least 5 samples total be taken in each cleanroom at a minimum sample volume of 0.1 cubic feet.

The 95% Upper Confidence Limit (UCL) will be calculated by the SOLAIR if the number of sampled locations is equal to or less than 9.

Air flow (Unidirectional vs. Non-unidirectional) will have an effect on the minimum locations and minimum samples required. In general, the Non-unidirectional option requires more of both locations and samples.

For the Fed Std ft3 report, the classification for a particle size is based on its samples taken from all locations in the cleanroom. Each particle size is given one of the following results:

- a classification rating which will be one of the possible classifications (1, 10, 100, 1000, 10000, 100000)
- “Unable to Classify” if it fails one of the above requirements
- an “Out of Range” if the calculated classification at that particle count exceeds 100,000

ISO 14644-1

The ISO14644-1 standard requires a minimum of 60 second Sample Time for each sample recorded.

EU GMP 2022

The EU GMP Standard Report requires that the unit has the channel sizes 0.5µ and 5.0µ as these are the only channels that apply to this standard.

The EU GMP Report has different concentration limits for cleanroom status “At Rest” versus “In Operation”. When the cleanroom is “In Operation”, Class D is not available. The standard is not defined for Class D in an operational cleanroom.

Note: The EU GMP 2022 report is only valid if the instrument is configured with the 0.5 and 5.0 micron channel sizes.

Note: If CANCEL is pressed, the report may not stop printing right away. It will continue until there is a break in the report processing.

Sample Printouts of Standard Reports

Figure 6-96, Figure 6-97 and Figure 6-98 are examples of a Federal Standard Ft3, ISO 14644-1 and EU GMP 2022 reports.

Note: If a recipe is loaded, the name of the recipe will be printed on the report.

```
************************
Federal Standard Ft^3
**SOLAIR 3100**
Serial #:  090405005
Targeted Class:   10000
Room Area:    10.00ft^2
Room Stat: Operational
Air Flow: Unidirect
Min Loc: 2
Min Samples/Room: 5
Recipe: FED TEST
        -----
07/10/2013, 12:35:47
        -----

Particle Size: 0.3
Cumulative, p/ft^3
Vol Req:      0.100 ft^3
Concen Limit:      30800
        -----
  Loc  Samples AvgConcen
 LOC001  5        8003.5
 LOC002  5        6524.5
        -----
Mean:            7264.0
StdDev:          1045.8
StdError:         739.5
95% UCL:        11930.2
Min Vol:       1.467 ft^3
        -----

Particle Size: 0.5
Cumulative, p/ft^3
Vol Req:      0.100 ft^3
Concen Limit:      10000
        -----

  Loc  Samples AvgConcen
 LOC001  5         328.4
```

Figure 6-96 Sample Federal Standard ft³ Report

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```
**********
ISO 14644-1
**SOLAIR 3100**
Serial#:  090405005
Targeted Class: 8
Room Area:      1.49 m^2
Room Stat: Operational
Air Flow: Unidirect
Min Loc: 2
Min Samples/Room: 2
Recipe: ISO TEST
        -----
07/10/2013, 13:10:17
        -----

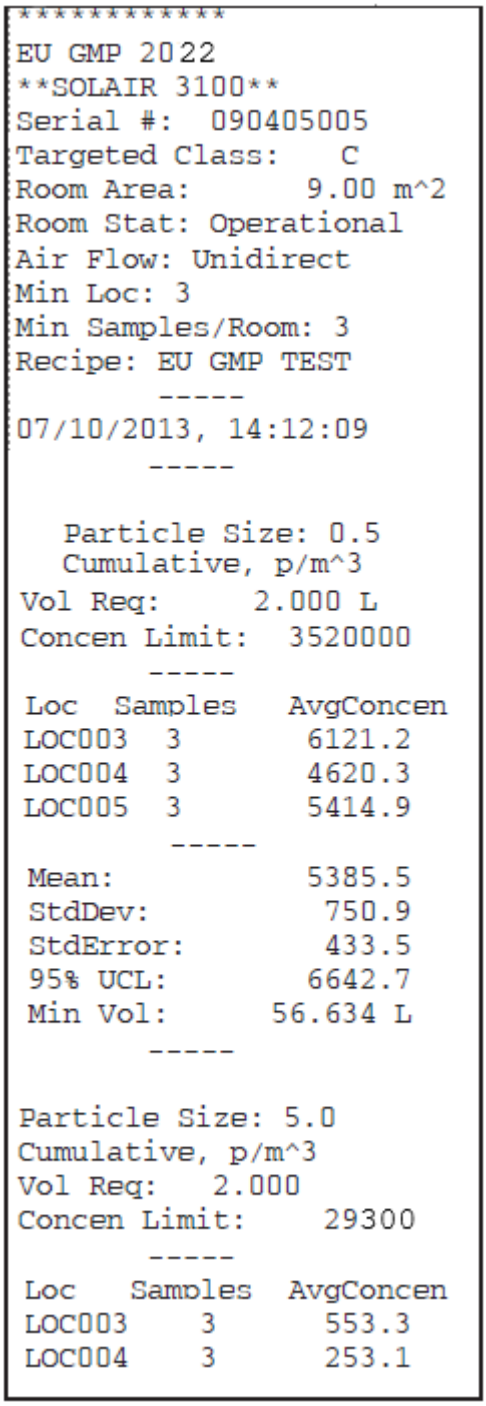
Particle Size: 0.5
Cumulative, p/m^3
Vol Req:       2.000 L
Concen Limit: 3520000
        -----
Loc    Samples AvgConcen
LOC001  3         8781.6
LOC002  1        12271.8
        -----
Mean:            10526.7
StdDev:           2468.0
StdError:         1745.1
95% UCL:         21521.0
Min Vol:        28.317 L
       -----

Particle Size: 1.0
Cumulative, p/m^3
Vol Req:      2.000 L
Concen Limit:  832000
        -----
Loc   Samples  AvgConcen
LOC001  3          361.2
LOC002             947.1
        -----
Mean:              2816.3
StdDev:             187.3
StdError:           132.4
```

Note: If a recipe is loaded, the name of the recipe will be printed on the report.

Figure 6-97 Sample ISA 14644 Report

Note: If a recipe is loaded, the name of the recipe will be printed on the report.



```
************
EU GMP 2022
**SOLAIR 3100**
Serial #:  090405005
Targeted Class:    C
Room Area:       9.00 m^2
Room Stat: Operational
Air Flow: Unidirect
Min Loc: 3
Min Samples/Room: 3
Recipe: EU GMP TEST
        -----
07/10/2013, 14:12:09
        -----

   Particle Size: 0.5
   Cumulative, p/m^3
Vol Req:      2.000 L
Concen Limit:  3520000
        -----
Loc   Samples   AvgConcen
LOC003  3        6121.2
LOC004  3        4620.3
LOC005  3        5414.9
         -----
Mean:             5385.5
StdDev:            750.9
StdError:          433.5
95% UCL:          6642.7
Min Vol:       56.634 L
        -----

Particle Size: 5.0
Cumulative, p/m^3
Vol Req:   2.000
Concen Limit:     29300
        -----
Loc    Samples  AvgConcen
LOC003    3       553.3
LOC004    3       253.1
```

Figure 6-98 Sample EU GMP Report, Revision 2022

Power Shutdown Levels

When the instrument is powered by its rechargeable battery, only, a Power Shutdown feature protects the battery from discharging completely. A complete discharge could damage the battery.

The battery levels are displayed in Table 6-2.

Battery Icon	Description
	FULL
	75%
	50%
	25%
	Empty; at this level, the instrument will begin to beep and will display "BATT LOW!" on the main screen. It is recommended to connect the AC cord and plug it into an outlet at this level.
	Pump Shutdown: if the instrument is currently on and sampling the pump will turn off and the instrument will shut down.

Table 6-2 Levels of Battery Life

After the pump shutdown level and before the battery reaches its critical low point, the instrument will shut down all power. To prevent loss of power, attach the AC cord and plug into an outlet as soon as the BATT LOW! message appears on the screen.

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Chapter 7 – Programming

General Information

The SOLAIR can be programmed and operated using the MODBUS Protocol. The full MODBUS protocol is detailed in Appendix B.

This chapter contains the information needed to program the basic configuration for the instrument to meet the user's needs.

Communicating with the Instrument

The Solair can connect to a COM port on a desktop or laptop PC through the RJ-45 connector marked "RS-485" on the instrument. See Figure 7-1.



Figure 7-1 The Communication Ports

Warning: +24VDC is present on RS-485 Port pin 7 when instrument power is applied.

Note: See section "Configuring the RS485 Ethernet Adapter" in Chapter 4 for setting up Ethernet Communications.

RJ-45 Comm Port

The RJ-45 connector (See Figure 7-1) on the instrument's RS-485 port has both RS232 and RS485 lines. The pinouts are as follows:

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	24VDC
8	GND

Table 7-1 RS232/RS485 – RJ-45 Pinouts



Warning: +24VDC is present on RS-485 Port at Pin 7.



Warning: Contact Lighthouse Technical Support at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for the correct instrument configuration BEFORE attempting to use RS485 COM mode with a PC. Failure to heed this warning can result in damage to PC, instrument, or both.

RS485 Communications

The instrument uses RS485 as one of its communication modes. Attaching the instrument to an RS485 network requires special attention to topology (wiring scheme of network) before and after the design phase to make sure the SOLAIR 1.0 CFM and other instruments perform as expected.

A standard Cat5 cable is used to connect the instrument to an RS485 network. Table 7-1 illustrates the RS232/RS485 RJ45 pins and the signals assigned.

RS232 Communications

The instrument can use RS232 as a communication mode by using the optional USB to RS232 Converter cable. The cable is connected to the RJ-45 Comm Port on the Solair and to any USB port on a PC.

Windows will detect that a new hardware device has been attached and will finalize the installation as needed. This is a routine "registering" of components that should only take a moment. An additional COM port will be added to the PC.

USB Communications

The SOLAIR provides point-to-point communications via the USB Port.

If it hasn't been done, yet, install the USB driver provided on the product CD. Once it has been installed and the instrument is connected, the driver will be used to establish communications using a virtual COM port on the PC.

Using USB Port to connect to a PC

To connect the instrument to a computer using the USB port, make sure that the driver has been installed first. Connecting the instrument to the PC and applying power before the driver has been installed will be problematic. Refer to the following:

1. Remove power from the instrument.

2. Connect Side B of a standard "A to B" USB cable (See Figure 7-2) to the instrument (only Side B will fit).



Figure 7-2 "A to B" USB Cable

3. Connect Side A to any available USB port on the PC.

4. Apply power to the instrument.

5. Windows will recognize that a new hardware device has been attached and will finalize the installation as needed. This is a routine "registering' of components that should take only a moment. An additional COM port will be added to the PC.

6. Identify the computer port that has been added to the PC by using the “Properties” of My Computer and examining the COM ports. USB ports are generally added to the bottom of the list and named USB COM port ‘x’. Refer to Figure 7-3 for screen examples (Windows XP).

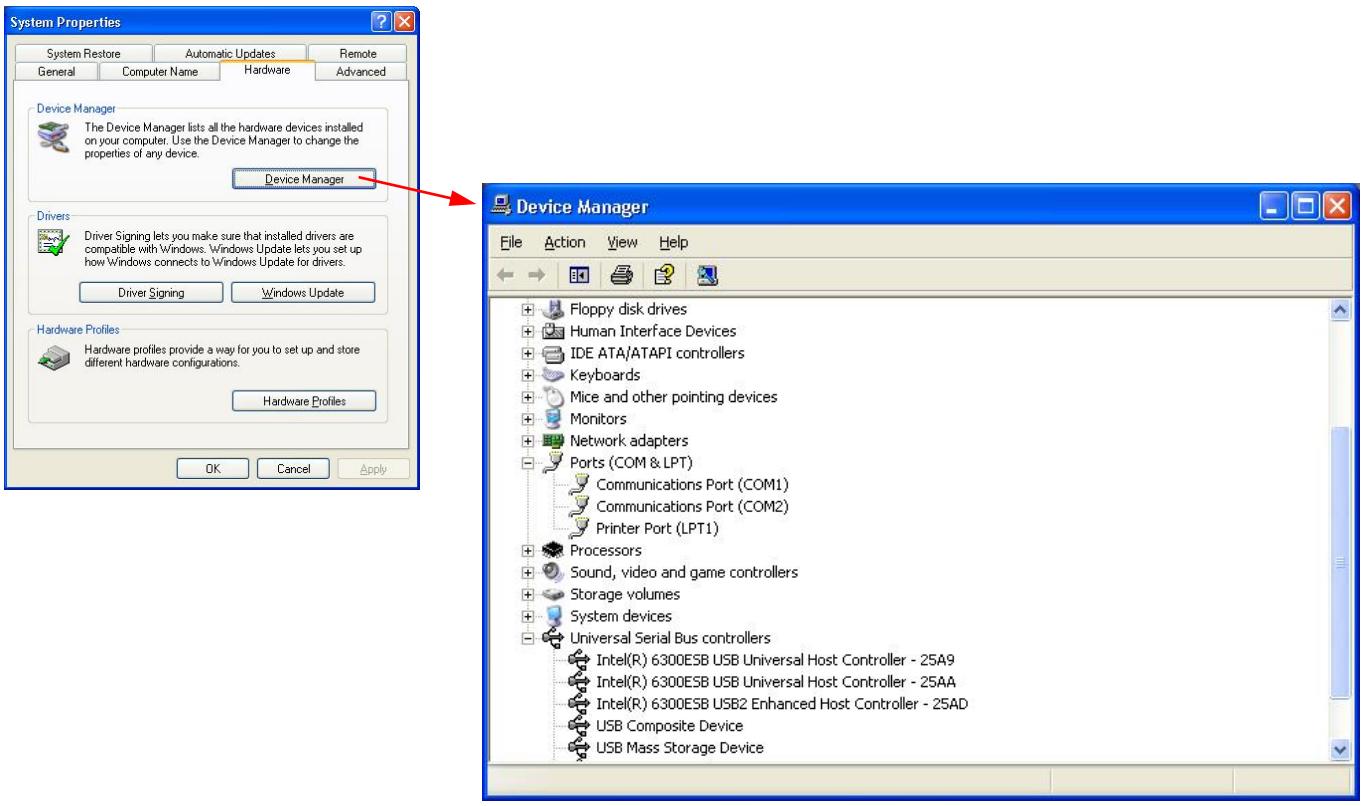


Figure 7-3 Example Device Manager Screens

7. Use LMS XChange or one of the LMS Express software products to connect to the instrument and retrieve data from it. Use the port assignment determined from Device Manager.

Configuring with the MODBUS Protocol

When powering up the instrument, the pump will automatically turn on after 3 seconds, and it will begin sampling using the default configuration:

- Location = 0
- Sample Time = 60 seconds
- Hold Time = 0 seconds
- Initial Delay = 0 seconds

To stop the pump and the sampling, send the command 12 to command register 40002.

Note: For the full MODBUS v.1.45 register map, please refer to Appendix B.

Note: The automatic starting of the sampling accommodates systems that do not send a START command, but just polls the instrument for its data.

Setting the Real Time Clock

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

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

Table 7-2 Real Time Clock Registers

Note: The Real Time Clock can also be set on screen by accessing the CONFIG screen and selecting the Clock button.

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 7-3 Data Set Registers

Changing the Default Instrument Parameters

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).

The main instrument parameters involved with the operation of the REMOTE counter are Location, Sample Time, Hold Time, and Initial Delay.

The Location is set by writing an unsigned integer to register 40026. The range of values is from 0 to 999.

Sample Time, Hold Time and Initial Delay all use 2 registers, a high word, and a low word. 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).

The low word register for Sample Time is 40034.
The low word register for Hold Time is 40032.
The low word register for Initial Delay is 40030.

Register	Data Type	Description
40026	Unsigned Integer	Location number: Specifies location of Particle Counter.
40029	Unsigned Integer	Initial Delay [high]. Works in conjunction with 40030. Number of second to wait before starting the first sample. Max value is 359,999 with equals 99h 59m 59s.
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 99h 59m 59s.
40032	Unsigned Integer	Hold Time [high]
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 7-4 Instrument Parameters

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Running the Instrument

The SOLAIR can be run in a few different ways. The applicable action commands are discussed here:

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, 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.
8	Stop pump.
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 counts since External Start.
11	Instrument Start. Uses defined Initial Delay, 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 7-5 Action Commands

There are 2 basic modes of operation: Manual counting and Automatic counting. Write each of the described action commands to the command register (40002).

MANUAL Counting Mode

In Manual counting mode, the sample time is based on when the counter is instructed to stop counting. At this point, a data record is recorded, and the sample time is the interval between the command to start counting and the command to stop counting.

7 Start Pump
9 Start Manual Count
10 Stop Manual Count; writes a data record, uses the time interval as the sample time.

The “hold” time is effectively the time between a STOP and a START command.
After the last desired sample is taken, send the following to stop the pump:

8 Stop Pump

AUTOMATIC Counting Mode

In Automatic counting mode, the instrument uses the configured sample time, hold time, and initial sample delay to record samples.

The instrument will continue running samples until it receives a stop command. When the stop command is given, since the device will not have completed a full sample cycle, the most current data will not record to the buffer.

After setting all the instrument parameters, run these commands:

11 Start Instrument; to start recording
12 Stop Instrument; to stop recording

Chapter 8 – Maintenance Procedures

Introduction

This chapter provides instructions for routine maintenance that may be required for the SOLAIR 1.0 CFM particle counter.

The maintenance procedures described in this chapter are not required on regular or prescribed intervals and should be performed only if the Service Wrench icon is displayed on the MAIN screen, or if the user has been requested to do so by Lighthouse Technical Support personnel or the user has reason to question the data they are receiving from the instrument.

Safety

Before performing any of the maintenance tasks described in this chapter, read Chapter 1 of this manual and become familiar with the warnings and caution labels discussed throughout this manual.

Maintenance

Calibration

To maintain optimum performance of this instrument, it should be recalibrated annually by a Lighthouse Authorized Service Provider.

Purge Count Test

This section will provide the user with the procedure to check the counter for zero counts. A purge filter must be attached to the instrument and fifteen (15), five (5) minute samples must be taken. There should be no more than 1 count on average per five-minute sample.

1. Connect the Purge filter to the sample inlet.
2. Connect the Purge filter.
3. Apply power to the instrument.
4. Configure the unit to sample for 30 minutes.
5. Allow the instrument to sample through a 30-minute period. This time allows the unit to warm up and purge any residual particles that might be inside it.
6. Configure the unit to sample for 5 minutes with a 10-second hold.
7. Set Cycles to 6 so the instrument will take 6 samples.
8. If more than one count per five-minute period is reported, allow the instrument to sample for 30 minutes to purge it, then repeat the test.
9. After the instrument has met the requirement of the Purge Count test, return the instrument to its normal location and operating status.

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Troubleshooting

If the instrument does not pass the Purge Count test, please perform the following procedure:

1. Check the data over the last 6 five-minute sample times.
2. If sporadic counts over all or several channels are occurring, the unit may still have particles inside it. Allow the unit to sample overnight with the purge filter attached before retesting it. If the counts are still high after the overnight purge, call Lighthouse Technical Support for assistance.
3. If the data shows consistent counts in the smallest channel only, the instrument may have electrical problems and may need to be returned to Lighthouse. Call a Lighthouse Service Representative at 800-945-5905 (USA Toll Free) or 541-770-5905 (Outside of USA) for assistance.

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Appendix A – Default Settings

Default Settings for SOLAIR Particle Counters

MENU ITEM	VALUE
LOC	LOC001
PARTICLE CHANNELS	ALL CH ENABLED
ANALOG CHANNELS	ALL CH DISABLED
# OF CYCLES	10
DELAY TIME	00:00:04
HOLD TIME	00:00:10
SAMPLE TIME	00:01:00
SAMPLE VOLUME	FT^3
COUNT MODE	AUTO
PARTICLE DISPLAY	CUML
DATA FORMAT	RAW
PARTICLE VOL	FT^3
PARTICLE ALARMS	ALL DISABLED
ALL THRESHOLDS	1000
DATA FORMAT	MONTH 1^{ST}: MM/DD/YYYY
AUTOSTART	DISABLED
ONECHANNEL	DISABLED
1 SEC REALTIME MODBUS OUTPUT	DISABLED
5 SEC STARTUP	ENABLED
COMM ADDR	01
POWER ON PASSWORD	DISABLED: 00000000
CFG PASSWORD	DISABLED: 00000000
PRINT ON SAMPLE	DISABLED
PRINT ON ALARM	DISABLED
PRINT REVERSE	DISABLED
MODEL NAME	ENABLED
SERIAL NUMBER	ENABLED
SEPARATOR	ENABLED
DIFFERENTIAL	DISABLED
CUMULATIVE	ENABLED

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Appendix B – MODBUS Register v1.48

COMM Settings

Lighthouse particle counters using MODBUS require the following communications settings:

Baud Rate	19200
Data Bits	8
Stop Bits	1
Parity	None
Hardware Protocol	RS485, USB and Ethernet
Software Protocol	MODBUS ASCII, (supports upper and lower case) MODBUS TCP

Table B-1 MODBUS Communication Settings

The MODBUS slave address is set on the particle counter.

Supported MODBUS Commands

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

Table B-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/writable. Not all holding registers are writable. Table B-3 describes the contents 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, bit 3=DEVICE ERROR]
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 chare[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 B-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	Unsigned Integer	Record Count. Total number of records stored in the counter.
40025	Unsigned Integer	Record Index. Zero based index to data in 30xxx register series. Must be lower than the record count (register 40024). Set this index to expose a counter's record in the 30xxx registers. Set to -1 to retrieve last record stored in the counter.
40026	Unsigned Integer	Location number. Particle Counters: Specifies location of Particle Counter. Must be 1 to 200 (maps to location names associated with registers 40200 - 40999). Manifold Controller: Specifies Manifold position. Values 1-32 for the Universal Manifold and values 1-6 for the MiniManifold Controller moves the arm to that position on the manifold. Value 0 moves arm to Home position.
40027	Signed Integer	Real Time Clock (RTC) [high]. Updates instrument's real-time clock. Works in conjunction with 40028. Displays date and time, in number of seconds since midnight, 1/1/1970. Can be generated by ANSI C/C++ time() function.
40028	Signed 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 99h 59m 59s.
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 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.

Table B-3 Sensor Settings Registers

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Register	Data Type	Description
40034	Unsigned Integer	Sample Time [low]
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]
40037	Unsigned Integer	Alarm Mode. Type of alarming performed
40038	Unsigned Integer	Alarm Parameter. Control parameter for given alarm mode.
40039	Unsigned Integer	Laser Reference Voltage (minivolts)
40040	Unsigned Integer	View Volume. Divide by 100 to get percentage. For example: 6550d = 65.50%
40041	Unsigned Integer	Flow Unit. Defines unit as cfm, lpm, mlpm char[0], char[1](NULL terminated string).
40042	Unsigned Integer	Flow Unit. char[2], char[3]
40043	Unsigned Integer	Calibration Reference Voltage (millivolts)
40049	ASCII String	Printer Options
40050	ASCII String	Device Options: Bit 3 - Number of Locations (1-400 locations with four-character names, 0-200 locations with eight-character names)
…		
40199	Unsigned Integer	Number of Available location names (0=not supported)
…		Registers 40200-40999: If number of available locations is 200, Registers 40200-40999 used for 8-character names associated with location index. If number of available locations is 400, Registers 40200-40999 used for 4-character names. (200 Locations Available (Register 40050 Bit 3=0)
40200	ASCII String	Location_1_char[0], char[1] (NULL terminated string)
40201	ASCII String	Location_1_char[2], char[3]
40202	ASCII String	Location_1_char[4], char[5]
40203	ASCII String	Location_1_char[6], char[7]
…		
40996	ASCII String	Location_200_char[0], char[1] (NULL terminated string)
40997	ASCII String	Location_200_char[2], char[3]
40998	ASCII String	Location_200_char[4], char[5]
40999	ASCII String	Location_200_char[6], char[7]
		400 Locations Available (Register 40050 Bit 3=1)
40200	ASCII String	Location_1_char[0], char[1]
40201	ASCII String	Location_1_char[2], char[3]
…		
40998	ASCII String	Location_400_char[0], char[1]
40999	ASCII String	Location_400_char[2], char[3]

Table B-3 Sensor Setting Registers

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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.

Printer Options (40049) displays the configuration of the instrument's printer function.

Bit	Description
0	Unused – non-writable
1	Print on Sample (1=Enabled, 0=Disabled)
2-15	

Table B-4 Printer Options

If Bit-1 of Register 40049 is set, the instrument will print the last recorded data at the end of each sample. This feature cannot be enabled if the One Second Data Update feature is enabled.

Device Options (40050) displays the instrument's device configuration.

Bit	Description
0	Fast Download (1=Enabled, 0=Disabled) non-writable
1	One Second Data Update (1=Enabled, 0=Disabled)
2	Display Data Record Using Index/Record (1-Record, 0-Index)
3	Number of Locations (1-400 locations with four-character names, 0-200 locations with eight-character names)
4-15	Reserved

Table B-5 Device Options

If bit 0 of Register 40050 is set, it indicates that the instrument is capable of Fast Download.

If Bit 1 of Register 40050 is set, the instrument will display and update the data registers every second. No data will be recorded in the data buffer. Enabling this feature disables the Print on Sample feature.

If Bit 2 of Register 40050 is set, the value in Register 40052 will be used to access data in the buffer to be displayed in data registers 3xxxxx. If Bit 2 is 0, the index value in Register 40025 will be used to access data in the buffer.

If Bit 3 of Register 40050 is set, the number of locations available

Register 40199 is set to 400 and **Registers 40200-40999** are used for four-character names associated with location index values. For example, the name for location 3 would be located at registers 40204-40205.

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If Bit 3 of Register 40050 is 0, up to 200 locations can be specified. Registers 40200-40999 are reserved for eight-character names associated with location index values. Thus, the name for location=3 would be located at registers 40208-40211. Register 40199 indicates the number of location names supported on this device.

Registers 40200-40999 are reserved for eight-character names associated with location index values. Thus, the name for location =3 would be located at registers 40208-40211. Up to two hundred locations can be specified.

Register 40199 indicates the number of location names supported on this device.

Device Status

The Device Status register (40003) displays the status of the device.

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
1	SAMPLING: This is set only when the instrument is 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 B-6 Device Status

Command Register

The Command Register (40002) is used to make the device perform an action. 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	Start local pump, if applicable - perform before 9 below.
8	Stop pump, if applicable - perform after 10 below.
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.
14	Manifold Controller: Clear data register bank. Bank is reset and remains 0 until ne data is available or index registers are changed.
192	Changes instrument baud rate to 19200K upon command execution.
576	Changes instrument baud rate to 57600K upon command execution.
1152	Changes instrument baud rate to 115200K upon command execution.

Table B-7 Command 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. Byte and word order for integer data 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>**

IEEE floating point has big-endian byte order and little-endian word order. Thus, analog data items are formed by placing the low bytes in front of the high bytes.

Example: **<Low Bytes><High Bytes> = <4 Byte Data Item>**

Not all particle and analog channels are necessarily 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	Data Status [high]
30008	Unsigned Integer	Data 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]
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]
…		
30074	Unsigned Integer	Valid Particle Channels
30076	Unsigned Integer	Alarm Flags – Particle Channels

Table B-8 Data Registers

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.

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

Data Status Byte (30007 – 30008)

The registers used for the Data Status Byte are 30007 and 30008.

The bit order of the Data Status Byte is 7 to 0, where bit 7 is the most significant bit and bit 0 is the least significant bit.

The bits within the Data Status Byte are flagged to indicate 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).

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

Bit	Description
0	Laser Alert Status: 0 = OK, 1 = Alert
1	Flow Alert Status: 0 = OK, 2 = Alert
2	Particle Overflow Status: 0 = No Overflow, 1= Overflow occurred
3	Instrument Service Status: 0 = Working Correctly, 1 = Malfunction Detected
4	Threshold High Status: 0 = Threshold not exceeded; Threshold exceeded
5	Threshold Low Status: 0 = Threshold not exceeded; Threshold exceeded
6	Instrument Sampler Status: 0 = Nominal Operation; 1 = Sampler Error

Bits 7 to 31 are currently unused.

Table B-9 Data Status Byte

Valid Data in Channels (30074)

Register 30074 represents the flag bits corresponding to valid data present in the particle register range.

Alarm Flags in Channels (30076)

Register 30076 represents the flag bits corresponding to particle channels that have exceeded the threshold [Threshold High Registers (45xxx series)] based on alarm mode

Data Type Registers

The 41xxx register series is used to identify the type of data items 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. Note that a Data Type using all four characters will not end with a NULL character.

Note: All data records have the same data types assigned to them.

The user does not have to read the data type registers for every record.

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 B-10 Data Types

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

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

String	Description
0.3	Particle type of size 0.3 micron
1.0	Particle type of size 1.0 micron
20.0	Particle type of size 20.0 micron
0.015	Particle type of size 0.015 micron or 15 nanometer

Table B-11 Examples of Particle Data Items

Data Units Registers

Note: Not all data types have units.

LWS Particle Counters may use units not on the table.

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

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.

The table 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
Ft^3	Cubic Feet	mV	Milli-volts
M^3	Cubic Meters	A	Amperes
L	Liters	mA	Milli-ohm
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	LPM	Liters per minute
PCT	Percent	MLPM	Milliliters per minute
SEC	Seconds	IHG	Inches of mercury
p/L	Particle per liter	p/ml	Particles per milliliter

Table B-12 Data Units

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Data and Alarm Registers

Data and Alarm Enable Registers

The Data and 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:

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

The 43xxx register series is used to determine which particle data channel is ENABLED and which are set to ALARM ENABLE. These registers supersede the older Data Enable Registers (31xxx) which have been obsoleted.

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

Table B-13 Enable/Disable Bits

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

The user can enable multiple particle channels for alarming at the same time.

Note: Alarm Enable currently only works for Particle Channels.

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

Register	Data Type	Description
43009	Unsigned Integer	Enable for Particle Channel 1 [high] (Smallest particle size starts here)
43010	Unsigned Integer	Enable for Particle Channel 1 [low]
43011	Unsigned Integer	Enable for Particle Channel 2 [high]
43012	Unsigned Integer	Enable for Particle Channel 2 [low]
43013	Unsigned Integer	Enable for Particle Channel 3 [high]
43014	Unsigned Integer	Enable for Particle Channel 3 [low]
43015	Unsigned Integer	Enable for Particle Channel 4 [high]
43016	Unsigned Integer	Enable for Particle Channel 4 [low]
43017	Unsigned Integer	Enable for Particle Channel 5 [high]
43018	Unsigned Integer	Enable for Particle Channel 5 [low]
43019	Unsigned Integer	Enable for Particle Channel 6 [high]
43020	Unsigned Integer	Enable for Particle Channel 6 [low]
43021	Unsigned Integer	Enable for Particle Channel 7 [high]
43022	Unsigned Integer	Enable for Particle Channel 7 [low]
43023	Unsigned Integer	Enable for Particle Channel 8 [high]
43024	Unsigned Integer	Enable for Particle Channel 8 [low]
43041	Unsigned Integer	Enable for Analog Channel 1 [high]
43042	Unsigned Integer	Enable for Analog Channel 1 [low]
43043	Unsigned Integer	Enable for Analog Channel 2 [high]
43044	Unsigned Integer	Enable for Analog Channel 2 [low]
43045	Unsigned Integer	Enable for Analog Channel 3 [high]
43046	Unsigned Integer	Enable for Analog Channel 3 [low]
43047	Unsigned Integer	Enable for Analog Channel 4 [high]
43048	Unsigned Integer	Enable for Analog Channel 4 [low]

Table B-14 Alarm Enable Registers

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Enable Alarming for a Channel

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

To disable alarming on the third channel and enable alarming on the second channel, disable Bit 1 for register 43014 and enable Bit 1 for register 43012.

To disable alarming completely, disable Bit 1 for register 43012. Now, no channels are enabled for alarms.

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 B-15 Example of Alarming on Channel 2

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

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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.

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 Integer	Threshold for Particle Channel 1 [high] (Smallest particle size starts here)
45010	Unsigned Integer	Threshold for Particle Channel 1 [low]
45011	Unsigned Integer	Threshold for Particle Channel 2 [high]
45012	Unsigned Integer	Threshold for Particle Channel 2 [low]
45013	Unsigned Integer	Threshold for Particle Channel 3 [high]
45014	Unsigned Integer	Threshold for Particle Channel 3 [low]
45015	Unsigned Integer	Threshold for Particle Channel 4 [high]
45016	Unsigned Integer	Threshold for Particle Channel 4 [low]
45017	Unsigned Integer	Threshold for Particle Channel 5 [high]
45018	Unsigned Integer	Threshold for Particle Channel 5 [low]
45019	Unsigned Integer	Threshold for Particle Channel 6 [high]
45020	Unsigned Integer	Threshold for Particle Channel 6 [low]
45021	Unsigned Integer	Threshold for Particle Channel 7 [high]
45022	Unsigned Integer	Threshold for Particle Channel 7 [low]
45023	Unsigned Integer	Threshold for Particle Channel 8 [high]
45024	Unsigned Integer	Threshold for Particle Channel 8 [low]

Table B-16 Alarm Threshold Registers

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

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Setting the Alarm Threshold Value

The Alarm Threshold Value is set in the low register of the channels.

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 B-17 Alarm Threshold Registers set to default value

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Appendix C – Real Time Flow and Laser Current via MODBUS

This Appendix will provide the user with the procedure to read the SOLAIR 1.0 CFM counter's flow and laser current in real time through MODBUS.

Required Equipment and Software

- PC with an available RS-232C or USB COM port
- LWS232 DB9-RJ45 4-wire adapter or LWS232 and USB-serial adapter
- CAT5 data cable
- SOLAIR
- MANIFOLD CONTROLLER and MANIFOLD (if the flow is read through the MANIFOLD CONTROLLER)
- MODBUS software tool.

Procedure for Computer to Instrument only

1. Attach the LWS232 to the computer's COM port. If a USB port is to be used, attach the LWS232 to the USB-serial adapter, then to the computer's USB port.
2. Attach one end of the CAT5 data cable to the RJ45 connector of the LWS232.
3. Attach the free end of the CAT5 data cable to the RS232/485 IN port of the SOLAIR.
4. Apply power to the SOLAIR.
5. Press START in the MAIN screen of the SOLAIR.
6. Start the MODBUS software tool on the computer system.
7. For flow values, read registers 30067 and 30068 as Float32:
   - Flow value will be shown in CFM, for example:
   - Flow rate = 1.0 CFM displays 1;
   - Flow rate < 1.0 CFM displays 0.9;
   - Flow rate > 1.0 CFM displays 1.1
8. For laser values, read registers 30069 and 30070 as Float32:
   - Laser value is displayed as a percentage of the value set during calibration of the instrument. For example, if the value during calibration is 1.0V and the current value is 1.20V, the display will show 120.000. If the current value is 0.5V, the displayed value will be 50.000.



Warning: There is +24VDC on Pin 7 of the RS-232/485 IN port.

Note: Data obtained from a SOLAIR directly through MODBUS is real time and has not been stored on the SOLAIR. Data format is "little-endian" - refer to Appendix B, MODBUS Register Map v1.48 for more information.

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Appendix D – Limited Warranty

Limitation of Warranties:

A. Lighthouse Worldwide Solutions (LWS) warrants that all equipment shall be free from defects in material and workmanship under normal use for a period of two years from date of shipment to Buyer except that LWS does not warrant that operation of the software will be completely uninterrupted or error free or that all program errors will be corrected. Buyer shall be responsible for determining that the equipment is suitable for Buyer's use and that such use complies with any applicable local, state, or federal law. Provided that Buyer notifies LWS in writing of any claimed defect in the equipment immediately upon discovery and any such equipment is returned to the original shipping point, transportation charges prepaid, within two years from date of shipment to Buyer and upon examination LWS determines to its satisfaction that such equipment is defective in material or workmanship, i.e. contains a defect arising out of the manufacture of the equipment and not a defect caused by other circumstances, including, but not limited to accident, misuse, unforeseeable use, neglect, alteration, improper installation, improper adjustment, improper repair, or improper testing, LWS shall, at its option, repair or replace the equipment, shipment to Buyer prepaid. LWS shall have reasonable time to make such repairs or to replace such equipment. Any repair or replacement of equipment shall not extend the period of warranty. If the Instrument is modified or in any way altered without the explicit written consent of LWS then the warranty is null and void. This warranty is limited to a period of two years, except as noted below, without regard to whether any claimed defects were discoverable or latent on the date of shipment. The length of warranty for pumps in handheld particle counters is one (1) year. Batteries and accessories with all products are warranted for one (1) year. Fuses and purge filters carry no warranty. If a third-party battery is used in the product, the product warranty is null and void. If the battery is charged by a third-party battery charger the battery warranty is null and void.

B. If Buyer shall fail to pay when due any portion of the purchase price or any other payment required from Buyer to LWS under this contract or otherwise, all warranties and remedies granted under this Section may, at LWS's option, be terminated.

C. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER REPRESENTATIONS, WARRANTIES AND COVENANTS, EXPRESS OR IMPLIED WITH RESPECT TO THE EQUIPMENT AND ANY DEFECTS THEREIN OF ANY NATURE WHATEVER, INCLUDING AND WITHOUT LIMITATION WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. LWS SHALL NOT BE LIABLE FOR, AND BUYER ASSUMES ALL RISK OF, ANY ADVICE OR FAILURE TO PROVIDE ADVICE BY LWS TO BUYER REGARDING THE EQUIPMENT OR BUYERS USE OF THE SAME. UNDER NO CIRCUMSTANCES SHALL LWS BE LIABLE TO BUYER UNDER ANY TORT, NEGLIGENCE, STRICT LIABILITY, OR PRODUCT LIABILITY CLAIM AND BUYER AGREES TO WAIVE SUCH CLAIMS. LWS's SOLE AND EXCLUSIVE LIABILITY AND BUYERS SOLE AND EXCLUSIVE REMEDY, FOR ANY NONCONFORMITY OR DEFECT IN THE PRODUCTS OR ANYTHING DONE IN CONNECTION WITH THIS CONTRACT, IN TORT, (INCLUDING NEGLIGENCE), CONTRACT, OR OTHERWISE, SHALL BE AS SET FORTH IN THE SUBSECTION A HEREOF AS LIMITED BY SUBSECTION B HEREOF. THIS EXCLUSIVE REMEDY SHALL NOT HAVE FAILED OF ITS ESSENTIAL PURPOSE (AS THAT TERM IS USED IN THE UNIFORM COMMERCIAL CODE) PROVIDED THAT THE SELLER REMAINS WILLING TO REPAIR OR REPLACE DEFECTIVE EQUIPMENT (AS DEFINED IN SUBSECTION A) WITH A COMMERCIALLY REASONABLE TIME AFTER RECEIVING SUCH EQUIPMENT. BUYER SPECIFICALLY ACKNOWLEDGES THAT SELLER'S PRICE FOR THE EQUIPMENT IS BASED UPON THE LIMITATIONS OF LWS'S LIABILITY AS SET FORTH IN THIS CONTRACT.

Warranty of Repairs After Initial Two (2) Year Warranty

A. Upon expiration of the initial two-year warranty, all parts and repairs completed by an authorized Lighthouse repair technician are subject to a six (6) month warranty.

B. Other than the above, LWS makes no warranty of any kind, expressed or implied, except that the products manufactured and sold by LWS shall be free from defects in materials and workmanship and shall conform to LWS's specifications; Buyer assumes all risk and liability resulting from use of the products whether used singly or in combination with other products. If instrument is modified or in any way altered without the explicit written consent of LWS, then the warranty is null and void.

C. WARRANTY REPAIRS SHALL BE COMPLETED AT THE FACTORY, BY AN AUTHORIZED SERVICE LOCATION, BY AN AUTHORIZED SERVICE TECHNICIAN, OR ON SITE AT BUYER'S FACILITY BY A LIGHTHOUSE AUTHORIZED EMPLOYEE. BUYER PAYS FREIGHT TO FACTORY; SELLER WILL PAY STANDARD RETURN FREIGHT DURING THE WARRANTY PERIOD. BUYER MAY SELECT A FASTER METHOD OF SHIPMENT AT ITS OWN EXPENSE.

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