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USER GUIDE

ApexR remote particle counters

Lighthouse

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Operating Manual

ApexRemote

AIRBORNE PARTICLE COUNTERS



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WORLDWIDE SOLUTIONS

Lighthouse Worldwide Solutions

ApexRemote Airborne Particle Counter

Operating Manual

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Manufactured by:

Lighthouse Worldwide Solutions

300 West Antelope Road

White City, Oregon 97503

LWS Part Number 248083447-1 Rev 2

LIGHTHOUSE
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EU DECLARATION OF CONFORMITY

Manufacturer's Name: Lighthouse Worldwide Solutions, Inc.

Manufacturer's Address: Lighthouse Worldwide Solutions, Inc.
300 West Antelope Road
White City, Oregon 97503

Declares that the product:

Product Name: REMOTE Airborne Particle Counter

Model Number(s): *ApexRemote* Series

Conforms to the following Product Specifications:

SAFETY	EN61010-1:2010	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1: General Requirements IEC 61010-1:2010
	CAN/CSA C22.2 No. 1010.1-1992	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements
LASER SAFETY	IEC 60825-1 Am. 2 IEC 60601-2-22 (Laser Notice 50)	Guidance on Laser Products: Conforms to FDA 21 CFR Chapter 1 Subchapter 1
EMC	EN61326-1:2006	Electrical Equipment for Measurement, Control and Laboratory Use EN 61326-1:2006

UL 61010A-1 - UL Standard for Safety Electrical Equipment for Laboratory Use; Part 1: General Requirements
Replaces UL 3101-1

Supplementary information
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC amended by Directive 93/68/EEC and the EMC Directive 89/336/EEC amended by Directive 93/68/EEC and carries the CE marking accordingly.



Fremont, CA. Feb 19, 2015

Hanford Choy - Director Engineering

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About this Manual

This manual describes the detailed operation and use of the Lighthouse ***Apex****Remote* Airborne Particle Counters.

Text Conventions

The following typefaces have the following meanings:

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

WARNING: ***A warning appears in a paragraph like this and indicates a condition, which if not met, could cause serious personal injury or death, and damage to the instrument.***

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

Additional Help

For more information about Lighthouse ***Apex****Remote* Airborne Particle Counters, contact Lighthouse Worldwide Solutions.

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

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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. Most warnings will appear in the left margin of the page next to the subject or step to which it applies. Take care when performing any procedures preceded by or containing a warning. The classifications of warnings are defined as follows:

WARNING: ***There are no user-serviceable components inside the particle counter***

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

LASER Safety Information

This product is considered to be a Class 1 LASER product (as defined by FDA 21 CFR, §1040.10) when used under normal operation and maintenance. Performing service on the internal sensor can, however, result in exposure to invisible radiation.

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.***

The particle counter has been evaluated and tested in accordance with EN 61010-1:2012, “Safety Requirements For Electrical Equipment for Measurement, Control and Laboratory Use” and IEC 60825-1:2007, “Safety of LASER Products”.

For further technical assistance, contact our Technical Support Team at 800-945-5905 (USA Toll Free), 541-770-5905 (Outside of USA).

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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.

Review Lighthouse specifications before installing a DC power supply, gateway or PoE switch that will be designated as a power source for the ApexRemote. Attempting to use under-rated power source equipment can expose the instrument, adjacent equipment and the user to dangerous shock and fire hazards. Failure to meet the specifications as provided by Lighthouse Worldwide Solutions will void the instrument Warranty and CE certification and may cause serious personal injury.

WARNING: ***The ApexRemote PoE can use a standard Ethernet Cat6 cable and separate 24V AC-DC power supply. Standard power supply connects to the round connector shown on the right in Figure 1-1. The symbol shows the voltage and polarity of supplied power. Handle with care and keep away from water or conductive liquids.***

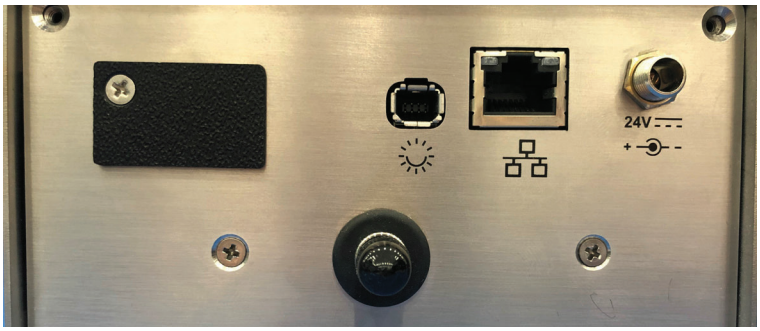


Figure 1-1 PoE Comm Cable, Ethernet, and 24VDC Power Connectors

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 work station. A static-safe work station requires an ESD consultant to evaluate the work environment and propose the equipment and apparel needed for just such a work station to be successful.

2 Introduction

Overview

This operating manual introduces the Lighthouse ***ApexRemote*** family of ***PoE*** and ***Serial*** models of Airborne Particle Counters and includes instructions for inspecting, installing, using and maintaining the instrument.

Description

The ***ApexRemote*** instrument comes standard with two particle-size channels based on channel sizes ordered and one of two flow rates of 0.1 or 1.0 CFM. Optionally, the ***ApexRemote*** can be shipped with up to four particle-size channels. Figure 2-1 shows the standard configuration as well as the optional display configuration. Table 2-1 lists features and specifics about the ***ApexRemote***.



Figure 2-1 *ApexRemote* Airborne Particle Counter

The instrument uses a LASER diode light source and LASER beam shaping optics to illuminate a cross section of the air flow path. As particles move along this path, they cross the LASER beam and scatter light. The light scattered is collected by an optical imaging system onto a photodiode. The photodiode converts the image into a current which is converted to a voltage and amplified by an electronic circuit.

The result is the electronic circuit outputs a voltage pulse each time a particle crosses the LASER beam. The amplitude of the voltage pulse is proportional to the light scattered which in turn is proportional to the size of the particle.

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The voltage pulses created by the particles are then processed by additional electronics that analyze the height of each pulse and therefore the size of each corresponding particle. The result is that the number of particles of various sizes is determined.

These instruments are effective in both ultra-clean areas (such as ISO Class 1 or Grade A) and also in more traditional cleanzones rated as ISO Class 3 or higher. Refer to Specifications tables in this manual for additional instrument information.The ***ApexRemote*** line of Airborne Particle counters was created for continuous operation 24 hours per day, 7 days per week.

Note: *Use of the terms **ApexRemote** and instrument are interchangeable.*

Using an external vacuum source, the instrument provides versatile mounting options and can be installed where space is at a premium. The ***ApexRemote*** integrates seamlessly with large facility monitoring/ management systems and transfers particle count data using RS-485 (using MODBUS RTU or ASCII protocols) or PoE (**P**ower **o**ver **E**thernet) via MODBUS/TCP.

Accessories

Several optional accessories can be ordered to tailor the instrument to specific needs. These accessories are listed here:

- **(Specify Flow Rate) Isokinetic Sampling Probe**
- **Sample Tubing, per foot**
- **Cable, per foot**
- **SmartBracket**
- **0.1µm Purge Filter Assembly (Specify Flow Rate) with Tubing**
- **Configuration Kit** (one included per order)**:**
  - Communication cable
  - 24VDC Power Supply
  - USB Flash Drive with Operating Manual and Configuration Software
  - Read Me First
  - Parts List

ApexRemote Specifications

Size Range	0.2 - 2.0 µm
Channel Thresholds	Standard 2-channel: 0.2µ, 0.3µm Standard 4-channel: 0.2µ, 0.3µ, 0.5µ, 1.0µm Optional 6-channel: 0.2µ, 0.3µ, 0.5µ, 0.7µ, 1.0µ, 2.0µm
Flow Rate	0.1 CFM (2.83 LPM)
Counting Efficiency	50% @ 0.2 µm, 100% for particles > 1.5x first channel particle size (per ISO 21501-4)
Data Storage	Rotating Buffer, 3000 records
Light Source	LASER diode
Zero Count Level	< 1 count / 5 minutes (meets specifications of JIS B 9921 and reporting requirements of IS 21501-4 Annex C)
Calibration	NIST Traceable
Communication Modes	MODBUS ASCII; MODBUS RTU; MODBUS TCP
ISO Probe Maximum Tubing Length	From ***ApexRemote*** Inlet to ISO Kinetic Probe = 10 ft (3.0 M)
Supporting Software	LMS Pharma/Pro v7.3.1 or higher, LMS Express 7.5 or higher; LWS Instrument Setup Tool 1.3.5 or higher
Power Input Requirements	24VDC ±5% @ 250mA via LMS 485 Gateway for ***ApexRemote Serial***, **PoE**switch for ***ApexRemote PoE*** (IEEE 802.3af compliant) or AC/DC supply for ***ApexRemote PoE***
Power Supply Specifications	Optional Listed LPS Power Supply, Output 20-26VDC 400mA (10W) min, ***ApexRemote PoE***
Enclosure	Stainless Steel, VHP compatible
Dimensions	6.38” (w) x 4.59” (h) x 2.94” (d) [16.21 x 11.66 x 7.5 cm]
Weight	1.4 lbs (0.63 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 *ApexR02* Specifications

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Size Range	0.3 - 5.0 µm
Channel Thresholds	Standard 2-channel: 0.3µ, 0.5µm Standard 4-channel: 0.3µ, 0.5µ, 1.0µ, 5.0µm Optional 6-channel: 0.3µ, 0.5µ, 0.7µ, 1.0µ, 3.0µ, 5.0µm
Flow Rate	0.1 CFM (2.83 LPM)
Counting Efficiency	50% @ 0.3 µm, 100% for particles > 1.5x first channel particle size (per ISO 21501-4)
Data Storage	Rotating Buffer, 3000 records
Light Source	LASER diode
Zero Count Level	< 1 count / 5 minutes (meets specifications of JIS B 9921 and reporting requirements of IS 21501-4 Annex C)
Calibration	NIST Traceable
Communication Modes	MODBUS ASCII; MODBUS RTU; MODBUS TCP
ISO Probe Maximum Tubing Length	From ***ApexRemote*** Inlet to ISO Kinetic Probe = 10 ft (3.0 M)
Supporting Software	LMS Pharma/Pro v7.3.1 or higher, LMS Express 7.5 or higher; LWS Instrument Setup Tool 1.3.5 or higher
Power Input Requirements	24VDC ±5% @ 250mA via LMS 485 Gateway for ***ApexRemote Serial***, **PoE**switch for ***ApexRemote PoE*** (IEEE 802.3af compliant) or optional AC/DC supply for ***ApexRemote PoE***
Power Supply Specifications	Optional Listed LPS Power Supply, Output 20-26VDC 400mA (10W) min, ***ApexRemote PoE***, only
Enclosure	Stainless Steel, VHP compatible
Dimensions	6.38” (w) x 4.59” (h) x 2.94” (d) [16.21 x 11.66 x 7.5 cm]
Weight	1.4 lbs (0.63 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 2-2 *ApexR03* Specifications

Size Range	0.5 - 5.0 µm
Channel Thresholds	Standard 2-channel: 0.5µ, 5.0µm Standard 4-channel: 0.5µ, 1.0µ, 5.0µ, 10.0µm Optional 6-channel: 0.5µ, 0.7µ, 1.0µ, 3.0µ, 5.0µ, 7.0µ, 10.0µm
Flow Rate	0.1 CFM (2.83 LPM)
Counting Efficiency	50% @ 0.5 µm, 100% for particles > 1.5x first channel particle size (per ISO 21501-4)
Data Storage	Rotating Buffer, 3000 records
Light Source	LASER diode
Zero Count Level	< 1 count / 5 minutes (meets specifications of JIS B 9921 and reporting requirements of IS 21501-4 Annex C)
Calibration	NIST Traceable
Communication Modes	MODBUS ASCII; MODBUS RTU; MODBUS TCP
ISO Probe Maximum Tubing Length	From ***ApexRemote*** Inlet to ISO Kinetic Probe = 10 ft (3.0 M)
Supporting Software	LMS Pharma/Pro v7.3.1 or higher, LMS Express 7.5 or higher; LWS Instrument Setup Tool 1.3.5 or higher
Power Input Requirements	24VDC ±5% @ 250mA via LMS 485 Gateway for ***ApexRemote Serial***, **PoE**switch for ***ApexRemote PoE*** (IEEE 802.3af compliant) or optional AC/DC supply for ***ApexRemote PoE***
Power Supply Specifications	Optional Listed LPS Power Supply, Output 20-26VDC 400mA (10W) min, ***ApexRemote PoE***, only
Enclosure	Stainless Steel, VHP compatible
Dimensions	6.38” (w) x 4.59” (h) x 2.94” (d) [16.21 x 11.66 x 7.5 cm]
Weight	1.4 lbs (0.63 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 2-3 *ApexR05* Specifications

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Size Range	0.3 - 5.0 µm
Channel Thresholds	Standard 2-channel: 0.3µ, 0.5µm Standard 4-channel: 0.3µ, 0.5µ, 1.0µ, 5.0µm Optional 6-channel: 0.3µ, 0.5µ, 0.7µ, 1.0µ, 3.0µ, 5.0µm
Flow Rate	1.0 CFM (28.3 LPM)
Counting Efficiency	50% @ 0.3 µm, 100% for particles > 1.5x first channel particle size (per ISO 21501-4)
Data Storage	Rotating Buffer, 3000 records
Light Source	LASER diode
Zero Count Level	< 1 count / 5 minutes (meets specifications of JIS B 9921 and reporting requirements of IS 21501-4 Annex C)
Calibration	NIST Traceable
Communication Modes	MODBUS ASCII; MODBUS RTU; MODBUS TCP
ISO Probe Maximum Tubing Length	From ***ApexRemote*** Inlet to ISO Kinetic Probe = 10 ft (3.0 M)
Supporting Software	LMS Pharma/Pro v7.3.1 or higher, LMS Express 7.5 or higher; LWS Instrument Setup Tool 1.3.5 or higher
Power Input Requirements	24VDC ±5% @ 250mA via LMS 485 Gateway for ***ApexRemote Serial***, **PoE**switch for ***ApexRemote PoE*** (IEEE 802.3af compliant) or optional AC/DC supply for ***ApexRemote PoE***
Power Supply Specifications	Optional Listed LPS Power Supply, Output 20-26VDC 400mA (10W) min, ***ApexRemote PoE***, only
Enclosure	Stainless Steel, VHP compatible
Dimensions	6.38” (w) x 4.59” (h) x 2.94” (d) [16.21 x 11.66 x 7.5 cm]
Weight	1.6 lbs (0.73 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 2-4 *ApexR3* Specifications

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Size Range	0.5 - 10.0 µm
Channel Thresholds	Standard 2-channel: 0.5µ, 5.0µm Standard 4-channel: 0.5µ, 1.0µ, 5.0µ, 10.0µm Optional 4-channel: 0.5µ, 0.7µ, 1.0µ, 3.0µ, 5.0µ, 7.0µ, 10.0µm
Flow Rate	1.0 CFM (28.3 LPM)
Counting Efficiency	50% @ 0.5 µm, 100% for particles > 1.5x first channel particle size (per ISO 21501-4)
Data Storage	Rotating Buffer, 3000 records
Light Source	LASER diode
Zero Count Level	< 1 count / 5 minutes (meets specifications of JIS B 9921 and reporting requirements of IS 21501-4 Annex C)
Calibration	NIST Traceable
Communication Modes	MODBUS ASCII; MODBUS RTU; MODBUS TCP
ISO Probe Maximum Tubing Length	From ***ApexRemote*** Inlet to ISO Kinetic Probe = 10 ft (3.0 M)
Supporting Software	LMS Pharma/Pro v7.3.1 or higher, LMS Express 7.5 or higher; LWS Instrument Setup Tool 1.3.5 or higher
Power Input Requirements	24VDC ±5% @ 250mA via LMS 485 Gateway for ***ApexRemote Serial***, **PoE**switch for ***ApexRemote PoE*** (IEEE 802.3af compliant) or optional AC/DC supply for ***ApexRemote PoE***
Power Supply Specifications	Optional Listed LPS Power Supply, Output 20-26VDC 400mA (10W) min, ***ApexRemote PoE***, only
Enclosure	Stainless Steel, VHP compatible
Dimensions	6.38” (w) x 4.59” (h) x 2.94” (d) [16.21 x 11.66 x 7.5 cm]
Weight	1.6 lbs (0.73 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 2-5 *ApexR5* Specifications

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3 Get Started

Unpacking and Initial Inspection

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

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.

Identify the *ApexRemote* Model

The ***ApexRemote*** is available in two models: ***Serial*** and ***PoE***. The ***ApexRemote Serial*** requires +24VDC to be supplied through its RJ45 connector or the included powered communication cable. The ***ApexRemote PoE*** requires a customer-supplied PoE network switch or the 24VDC Power Supply shipped with the ***ApexRemote*** and a Cat6 cable to a non-PoE switch. All models can be equipped at the factory with an optional display.

Compare Contents

Compare the contents with the pack slip / invoice / parts list. Report immediately any missing or wrong parts to Lighthouse Support at 1-800-945-5905 in the USA or 1-541-770-5905 outside of USA.

Configuration Kit

Each order is shipped with a ***Configuration Kit***, which includes a communication cable, software on a USB Flash Drive, and a 24VDC Power Supply.

To properly use the kit, the software on the Flash Drive must be installed on a computer that will act as a configuration station. Running the ***LWS Instrument Setup Tool*** software will install the FTDI USB drivers and the ***Instrument Setup Tool*** software required to communicate with the instrument through the communication cable. This cable and the software are required to set up all ***ApexRemote*** instruments for use.

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Software and communication cable Setup

Note: *All ApexRemote instruments must use the communication cable to modify their Alarms and Alarm thresholds. All of the ApexRemote **PoE** must use the **communication cable** to set their IP addresses. The communication cable requires the **Instrument Setup Tool** to perform these actions.*

1. Place the USB Flash Drive into the configuration computer's USB port. Access the Flash Drive on the computer, open the ApexR Instrument Tool folder, and run the *ApexR_InstrumentSetupTool.msi* file. Follow any prompts to install the Setup Tool software.

2. Refer to Figure 3-1 and insert the communication cable's USB connector into a USB port on the computer. The computer should acknowledge the cable and report that it has found a new device, a Serial USB cable, and is installing its drivers. A COM port will be assigned to the cable.

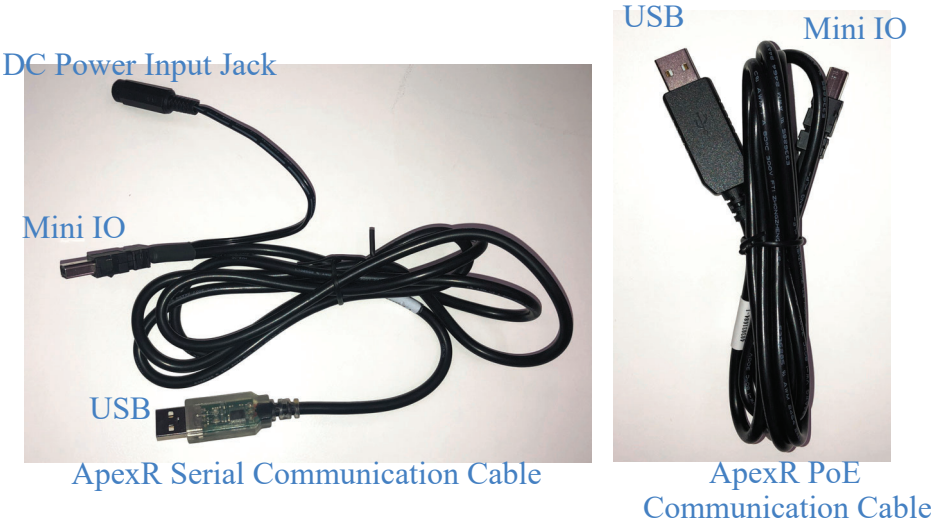


Figure 3-1 Communication cable Connections

NOTE: ALL ApexRemote instruments require the communication cable to set or change the Alarms and Alarm Thresholds. Changes to MODBUS registers are the only other way to make these changes. Once changes are made, Update the ApexRemote to save settings. The cable must be removed before standard power connections are made to the instruments. If this condition is not met, peripheral equipment and/or the ApexRemote may be seriously damaged and their respective warranties voided. Disconnect the cable BEFORE connecting the ApexRemote to the instrument network!

3. View the COM port assigned by using *Computer|Properties|Device Manager*. It will show as a USB Serial COM Port with a COM port number (see Figure 3-2).

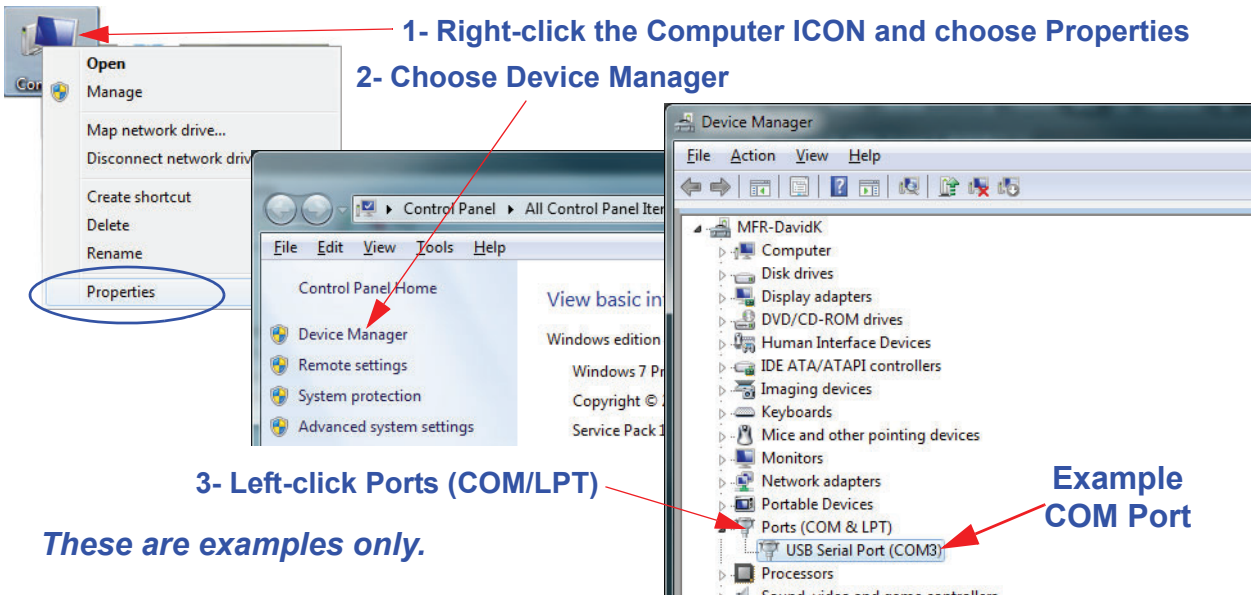


Figure 3-2 Viewing COM Port Assigned

4. While the USB connector is inserted in the computer port receptacle, its assignment will be displayed. If it is disconnected, the assignment will disappear until it is reconnected. Using this technique can quickly identify the correct port to use at the start of the ***LWS Instrument Setup*** program. This is handy if several ports are shown during this step.

5. The communication cable can be used on all ***ApexRemote*** sensors and must be used to set the ***PoE ApexRemote***'s IP address and all ***ApexRemote*** Alarm and Alarm Threshold settings.

6. Locate the Mini IO port on the bottom of the ***ApexRemote*** as shown in Figure 3-3.

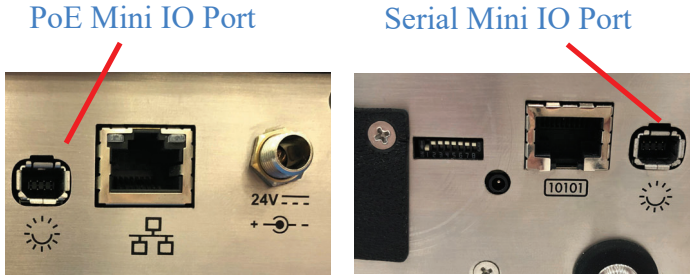


Figure 3-3 Mini IO Port Location

7. Connect the communication cable to the Mini IO port as shown in Figure 3-4.

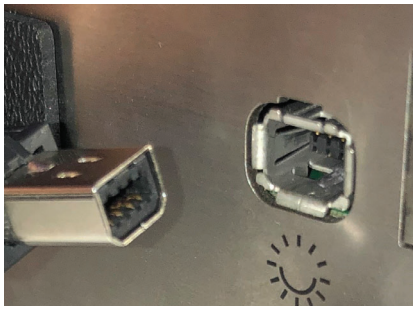


Figure 3-4 Communication cable into Mini IO Port

8. To use the Power port of the Apex Serial communication cable, insert the 24VDC power supply's DC output connector into the communication cable's power input connector as shown in Figure 3-5.



Figure 3-5 Connect Power Supply to Serial communication cable

---

WARNING: ***Do NOT attempt to use the communication cable power and power from the ApexRemote Serial's RJ45 port at the same time or serious damage to the ApexRemote and support devices may occur!***

9. For the Apex PoE, connect the DC adapter's power output connector into the DC Power Port on the unit.

10. Attach the Power Supply to AC power. Verify the ***ApexRemote*** Power LED comes on solid after a few seconds.

11. Make sure power is applied to the ***ApexRemote*** before attempting to run the LWS ***Instrument Setup Tool*** or the program will not "see" the instrument and report an error, requiring another COM port to be selected.

12. On the configuration computer navigate to the Start menu, All Programs. Navigate to Lighthouse Worldwide Solutions, click and choose LWS ***Instrument Setup Tool***.

13. When it starts, the program will require the COM port number that the communication cable is using. Choose the correct COM port number from the dropdown as shown in Figure 3-6.

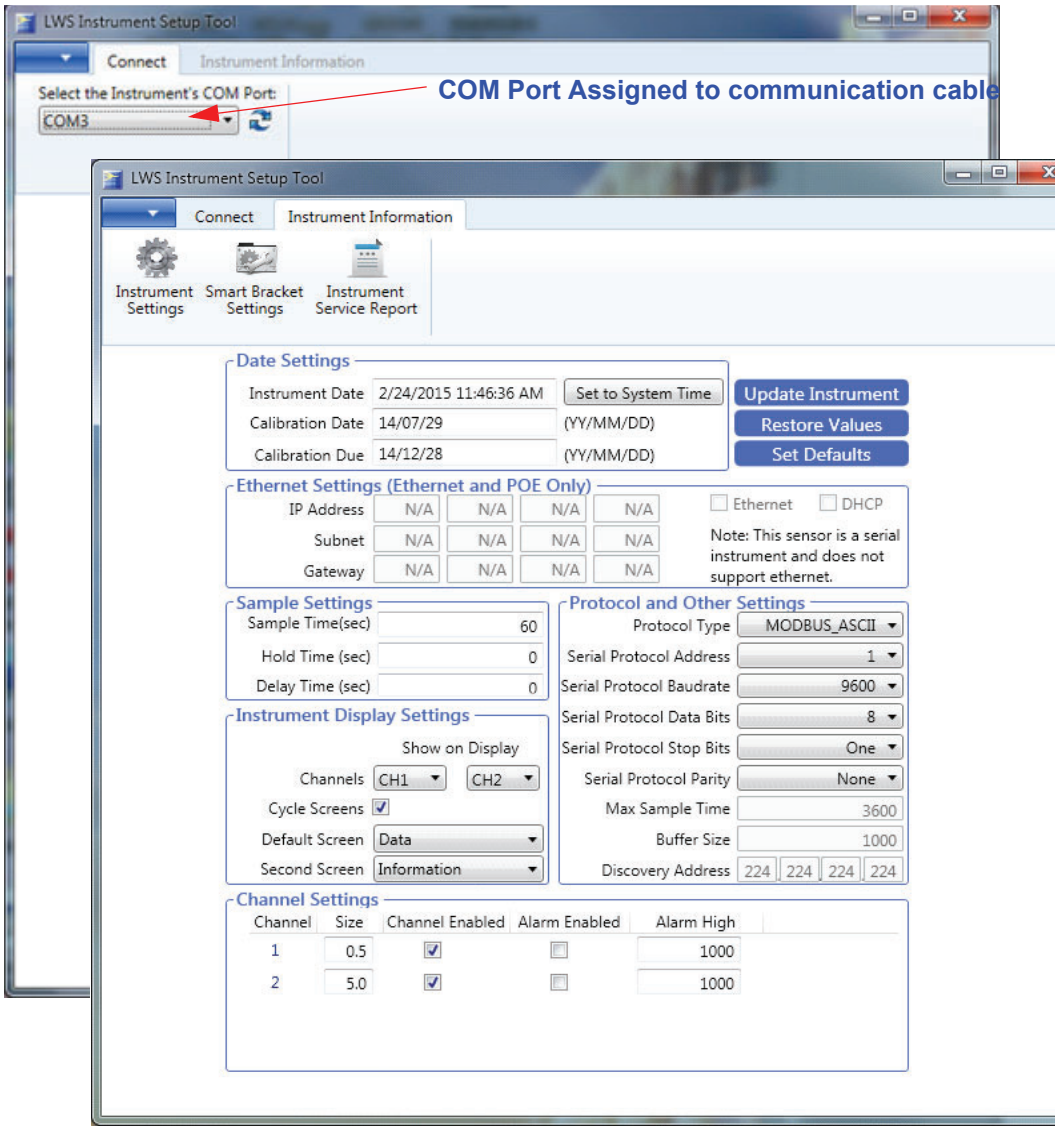


Figure 3-6 Instrument Setup Tool Screen

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WARNING: ***Do NOT attempt to use the communication cable power and power from the ApexRemote Serial's RJ45 port at the same time or serious damage to the ApexRemote and support devices may occur!***

Date Settings:

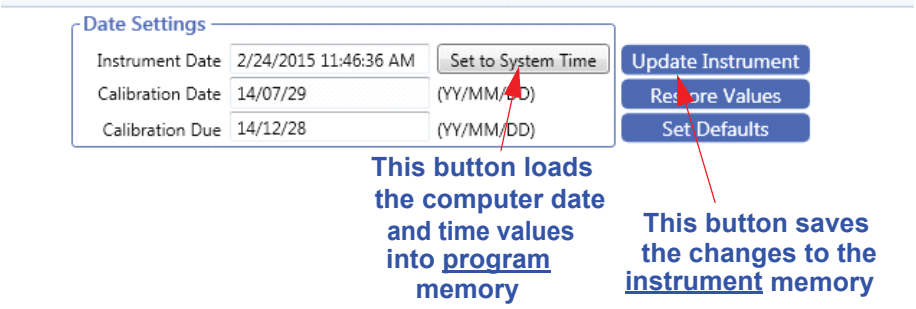


Figure 3-7 Instrument Date and Time Settings

Note: *Make sure to update the instrument settings before the communication cable is disconnected from the ApexRemote.*

All ***ApexRemote*** products can have their date and time settings changed in this screen. Refer to Figure 3-7 to change the Instrument Date / Time by using the **Set to System Time.** Corrections to errors can be reversed by clicking **Restore Values**. Make sure that desired changes are followed by clicking the **Update Instrument** button to save the changes to the instrument memory. If the instrument is not updated before the communication cable is disconnected, the changes will be lost.

Factory Standard Settings

ApexRemote PoE Model:

The ***ApexRemote PoE*** standard network settings are set to the same values for all ***ApexRemote***s shipped. These values are 10.10.x.xxx for IP, 255.255.0.0 for netmask and 0.0.0.0 as Default Gateway setting. To view the ***ApexRemote*** web page, type its IP address into a web browser on a computer in the same network subnet.

The IT group should provide IP, Mask and Default Gateway values that meet the local network needs. The ***ApexRemote*** must be changed to meet these requirements. Each device will require the IP to be changed to a new IP, as shown in Figure 3-8, to prevent address conflicts.

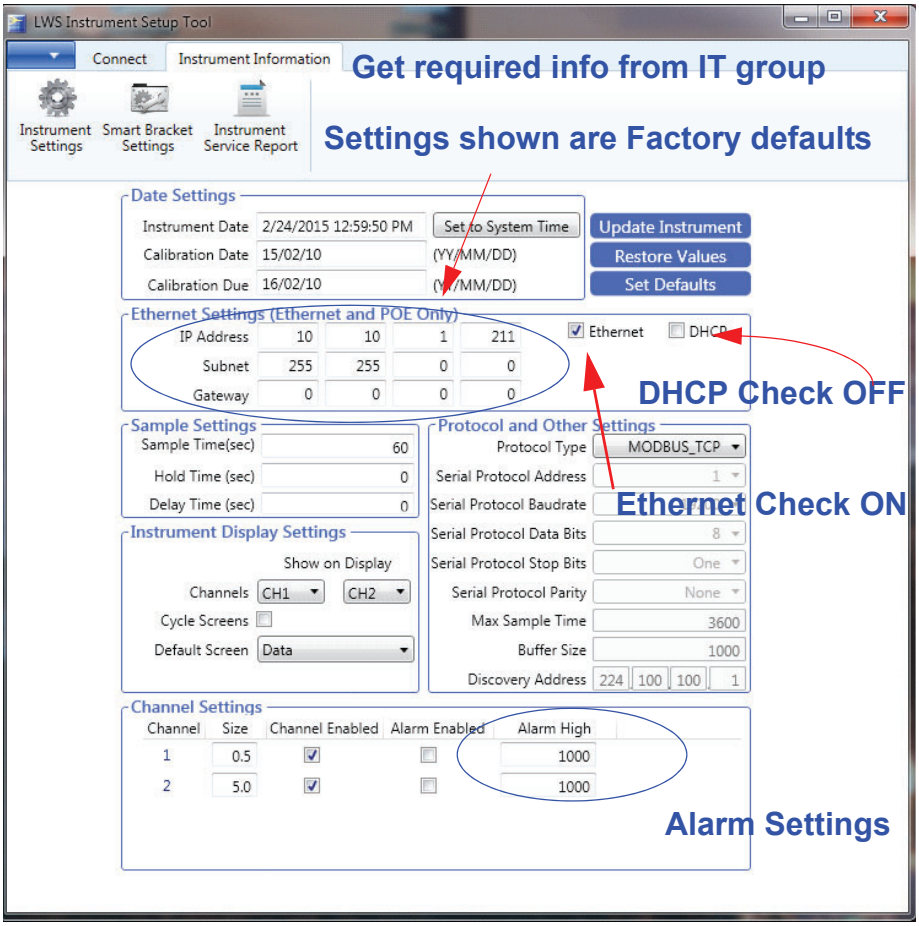


Figure 3-8 ***ApexRemote PoE* Default Settings**

Default Alarm and Threshold settings for the ***PoE*** model are the same as all ***ApexRemote*** models: Ch1 threshold = 1000, Ch2 threshold = 1000 and channel alarms are disabled. If the Alarm is enabled, the Alarm LED will turn on solid green until that Alarm's threshold value is exceeded, in which case the LED will turn red.

ApexRemote *Serial*:

The ***Serial*** version of ***ApexRemote*** standard threshold settings are the same as for the ***PoE*** models. See Figure 3-9.

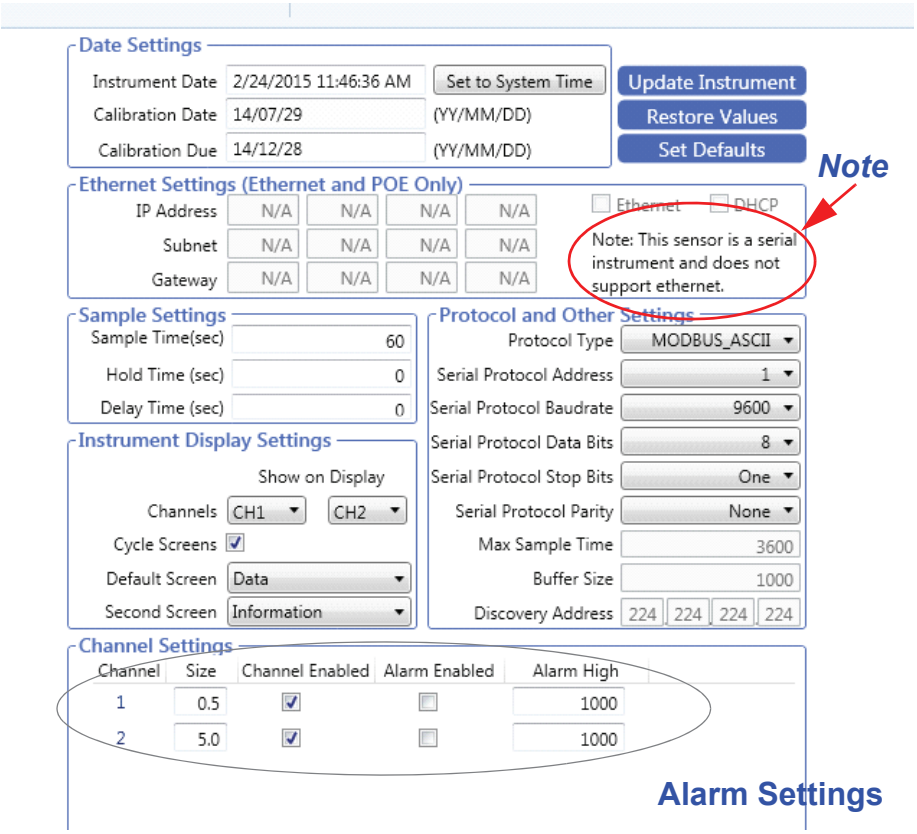


Figure 3-9 *ApexRemote Serial* Default Settings

The ***ApexRemote Serial*** address is set via the switches on the bottom of the instrument or through the ***Setup Tool*** program, based on Switch 7's state (see Table 4-1 on page 4-2). The Address can be shown in the Display Window, if this option is installed.

The ***ApexRemote Serial*** must have its address set to a correct value or it won't be recognized by various management programs, including LMS Express and LMS Express RT. The full switch address list can be found in Table 4-3 on page 4-3.

Make sure that changes are saved to the instrument by pressing the Update Instrument button on the screen shown in Figure 3-9.

Remove the commmunication cable after settings are completed - do NOT leave it connected to the ***ApexRemote*** during operation or the resultant damage will void the instrument's warranty!

Operation

Understanding the LEDs

The ***ApexRemote*** LEDs have specific meanings when illuminated. Figure 3-10 below shows the location of the LEDs and gives a brief description of their meaning.

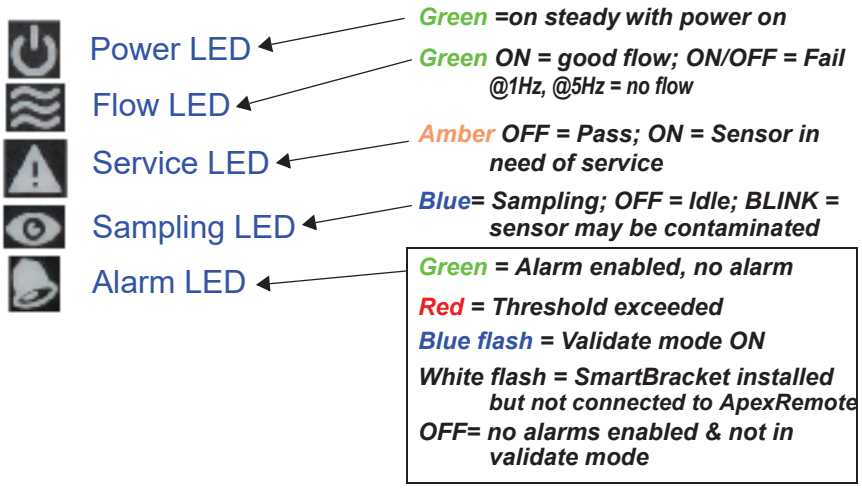


Figure 3-10 Front Panel LEDs

- The green POWER LED turns on steady when the instrument is powered on and OFF when power is removed.
- The green FLOW LED turns on steady when the flow is within specification and will blink if the flow is out of specification.
- The amber SERVICE LED will be OFF under normal operating conditions and will turn on steady during sampling if LASER power or current is out of range, LASER supply or photoamp supply is out of range or the photoamp health is bad. The Service LED will blink at 1Hz when the sensor background voltage is out of range, indicating the sensor optics are dirty or the view volume contains foreign objects.
- The blue SAMPLING LED is ON when sampling and OFF when the ***ApexRemote*** is idle.
- The Alarm LED is OFF when no alarms are enabled, green when alarms are set but not exceeded, and red when a set threshold has been exceeded. A 5Hz blue flashing means ***ApexRemote*** is in validation mode and 5Hz white flashing when the unit is in ***SmartBracket*** mode but a ***SmartBracket*** can't be detected.

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4 Communications

This chapter contains information regarding how to set up the various equipment to communicate with the ***ApexRemote*** instrument.

ApexRemote *Serial* DIP Switches

The ***ApexRemote*** ***Serial*** uses DIP switches to set up a portion of the ***ApexRemote***'s functions. The DIP switches are shown Figure 4-1.

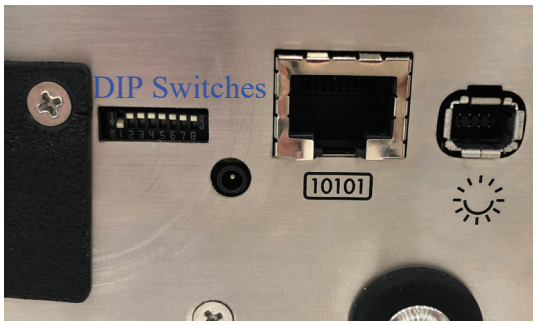


Figure 4-1 *ApexRemote* Serial Connectors and DIP Switch

Refer to Table 4-1 for detailed DIP switch settings, their meaning and effects.

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DIP Switch Definitions

Table 4-1 displays the general DIP Switch settings. OFF (UP) = 0, ON (DOWN) = 1

Note: *Use a tool with a very small pointed tip in order to change the DIP Switch positions.*

Table 4-1 DIP Switch settings

Position #	Description	Setting
1	Binary Bit 0	Addressing, OFF=0, ON=1
2	Binary Bit 1	Addressing, OFF=0, ON=1
3	Binary Bit 2	Addressing, OFF=0, ON=1
4	Binary Bit 3	Addressing, OFF=0, ON=1
5	Binary Bit 4	Addressing, OFF=0, ON=1
6	COM Mode	See Table 4-2
7	Serial Protocol	UP = use DIP Switch Addressing DOWN = Serial Settings from Instrument Setup Tool
8	Reserved	

Communication Modes

There are three communication modes for the ***ApexRemote*** family. The ***ApexRemote Serial*** has options for MODBUS ASCII and MODBUS RTU. Table 4-2 displays those modes. The ***ApexRemote PoE*** communicates using MODBUS TCP.

Table 4-2 DIP Switch Settings for *ApexRemote Serial* COM Mode

COMMUNICATIONS MODE	DIP SW 6
MODBUS ASCII (UP)	OFF
MODBUS RTU (DN)	ON

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DIP Switch Addressing

Note: *Because Address 0 is reserved for broadcasting in MODBUS RS-485 communications, Address 1 is the lowest DIP switch setting that can be used. All switches OFF can cause communication failures on the network and must not be used.*

Table 4-3 details the addresses set by the binary DIP switches 1-5.

Table 4-3 DIP Switch Addressing

DIP SWITCHES 1 2 3 4 5	ADDRESS	DIP SWITCHES 1 2 3 4 5	ADDRESS
0 0 0 0 0	DoNot Use	0 0 0 0 1	16
1 0 0 0 0	1	1 0 0 0 1	17
0 1 0 0 0	2	0 1 0 0 1	18
1 1 0 0 0	3	1 1 0 0 1	19
0 0 1 0 0	4	0 0 1 0 1	20
1 0 1 0 0	5	1 0 1 0 1	21
0 1 1 0 0	6	0 1 1 0 1	22
1 1 1 0 0	7	1 1 1 0 1	23
0 0 0 1 0	8	0 0 0 1 1	24
1 0 0 1 0	9	1 0 0 1 1	25
0 1 0 1 0	10	0 1 0 1 1	26
1 1 0 1 0	11	1 1 0 1 1	27
0 0 1 1 0	12	0 0 1 1 1	28
1 0 1 1 0	13	1 0 1 1 1	29
0 1 1 1 0	14	0 1 1 1 1	30
1 1 1 1 0	15	1 1 1 1 1	31

Communicating with *ApexRemote Serial* Instrument

Serial Data / Power Port

The ***ApexRemote Serial*** is equipped with the Serial COM Port shown in Figure 4-2 to communicate to an RS-485 network incorporating LMS equipment, such as the LMS 485 Gateway and Lighthouse System Control Cabinet. The instrument receives data and power through this port, simplifying cabling and eliminating the need for an external power supply.

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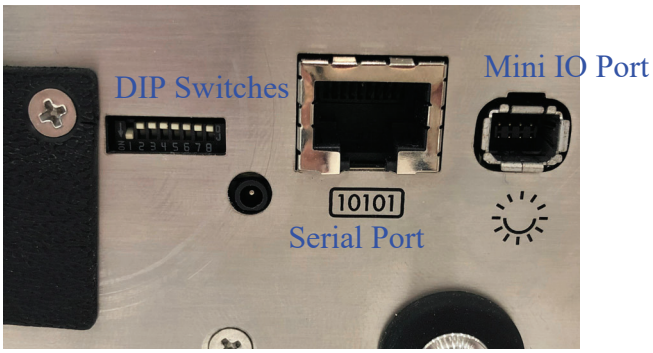


Figure 4-2 Serial COM Port

The connector pinouts are shown in Table 4-4.

Table 4-4 RJ45 Pinouts

RJ45 Pin	Signal Name
1	RS-232-TX (Output)
2	RS-232 RX (Input)
3	RESERVED for future use
4	RS-485B
5	RS-485A
6	RESERVED for future use
7	24VDC
8	GROUND

To connect the instrument to an RS-485 network:

1. Make sure the communication cable is disconnected from the instrument.

2. Install the ***ApexRemote*** in a perpendicular position with its Inlet barb upward. Connect one end of a CAT5e cable to the Serial COM port on the instrument (shown in Figure 4-2).

3. Connect the other end of the cable to an available RS485 port on an ***LWS 485 Gateway***, an ***LWS System Control Cabinet RS485*** port or other similar equipment port.

RS-485 Communications

RS-485 must be used if the instrument is more than 50 feet from a computer or is installed in an industrial network. Refer to Table 4-5 for specifics about RS-485. Contact Lighthouse Technical Support for more information.

Table 4-5 shows the Electronics Industry Association (EIA) industry standards RS485 specifications.

Table 4-5 EIA Industry Standards for RS-485 Communications

SPECIFICATIONS	RS-485
Mode of Operation	Differential
Total Number of Drivers and Receivers on One Line (One driver active at a time for RS-485 networks)	32 Drivers 32 Receivers
Maximum Cable Length	4000 ft (1,219.2 m)
Maximum Data Rate (40 ft - 4000 ft for RS422/RS-485)	100Kbs - 10Mbs
Maximum Driver Output Voltage	-7V to +12V
Driver Output Signal Level (Loaded Min.): LOADED	+/-1.5V
Driver Output Signal Level (Loaded Max.): UNLOADED	+/-6V
Driver Load Impedance (Ohms)	54
Max Driver Current in High Z State (POWER ON)	+/-100µA
Max Driver Current in High Z State (POWER OFF)	+/-100µA
Receiver Input Voltage Range	-7V to +12V
Receiver Input Sensitivity	+/-200mV
Receiver Input Resistance (Ohms), (1 Standard Load for RS-485)	≥12k

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Communicating with *ApexRemote* PoE Instrument

ApexRemote PoE Communications

The ***ApexRemote PoE*** eliminates the need for an external power supply by getting its data and power via its connection to a PoE switch. This allows a convenient installation because only one CAT6 cable is required. It can also use a non-powered Ethernet connection with an external 24VDC power supply. Figure 4-3 shows the ***ApexRemote PoE*** Mini IO Port, PoE/Ethernet RJ45 port, and Power Input jack.

WARNING: ***The ApexRemote PoE can use a standard Ethernet Cat6 cable and separate power supply, which connects to the round connector shown in Figure 4-3. The symbol shows the voltage and polarity of supplied power. Handle with care and keep the connector away from water or conductive liquids.***

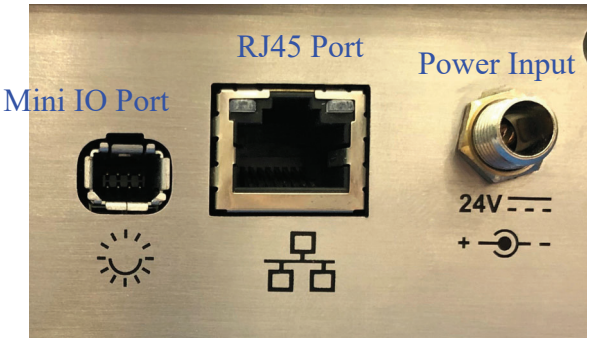


Figure 4-3 ***ApexRemote PoE*** **Connectors**

Note: *Category 6 (CAT6) (22AWG) must be used when cabling facilities for PoE devices such as the* ***ApexRemote****.*

Setting up the ***ApexRemote*** for use on an Ethernet LAN requires knowledge of the network's topology and access to network components to which most users do not have access. It is advisable that the local IT administration group be contacted and get involved to ensure greater success.

The ***ApexRemote*** should be set up with a static IP so the software to hardware interface is less complicated. Instrumentation networks need to have addresses predefined so the measuring devices can always be found and their data can be reliably transferred to the management software.

The ***Instrument Setup Tool*** User Interface is shown in Figure 4-4. The COM port assignment is established when the cable is plugged into an available USB port and FTDI drivers have been installed on the configuration computer.

Review the upper screen and note the options available. The screen items are addressed starting on page 4-8. The top sections set up or adjust the settings needed for the ***ApexRemote*** with some items requiring extra care and advice from the IT group before making the changes.

Ethernet Settings:

The ***ApexRemote PoE*** comes with the **Ethernet Enabled** checkbox enabled (default) and the **DHCP** disabled. Enter the correct settings in **IP Address**, **Subnet, Gateway**. The IT group should provide these numbers to prevent conflicts with devices already on the network. All TCP/IP values should be static. Checking the DHCP checkbox (Figure 4-4) can cause the instrument and its data to become 'lost' when its IP is changed during updates from the DHCP server. Ensure DHCP is OFF and click **Update Instrument** when done.

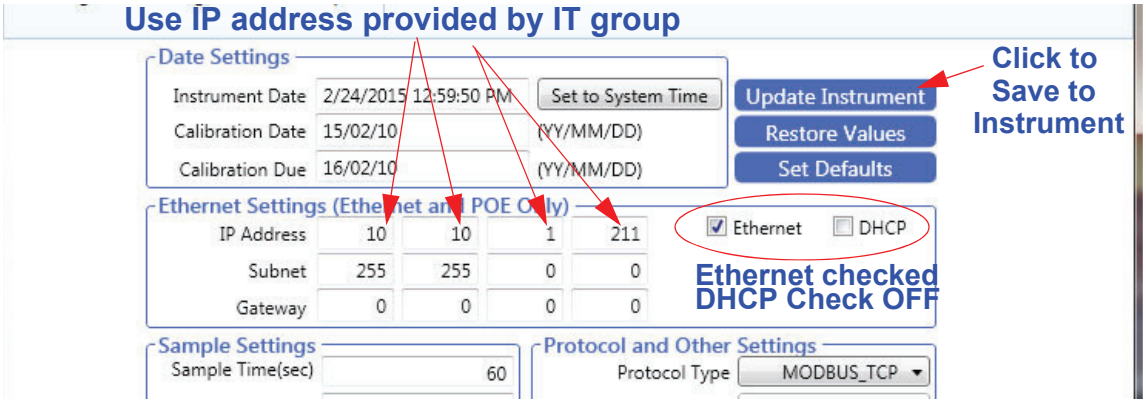


Figure 4-4 ***Instrument Setup Tool*** **TCP/IP Set Up Screen**

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ApexRemote Web Page Interface

Another feature of the ***ApexRemote PoE*** is the Web Interface that allows real time monitoring of the instrument's data. All monitor points will show current record data, last 5 data records, location bracket info, serial number, model, sampling parameters, location status, flow status, service status and alarm status. All diagnostic results will also be displayed.

NOTE: It has been learned that certain antivirus programs may block, interrupt or seriously affect ApexRemote's web server functions.



Figure 4-5 *ApexRemote* Data and Status Web Pages

5 Maintenance Procedures

Introduction

This chapter provides routine maintenance instructions that the ***ApexRemote*** instrument require.
The maintenance procedures described in this chapter are not required on regular or prescribed intervals and should be performed only if the user has reason to question the data they are receiving.

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.

Maintenance

Calibration

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

Zero Count Test

This section will provide the user a procedure to determine if the ***ApexRemote*** can successfuly complete several zero counts. A purge filter must be attached to the instrument and six (6) 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. Apply power to the instrument.
3. Configure the unit to sample for 30 minutes.
4. 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.
5. Configure the unit to sample for 5 minutes with a 10-second hold.
6. Allow the instrument to take 6 samples.
7. If an average of 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 (Steps 5 & 6).

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8. After the instrument has met the requirement of the Purge Count test, return the instrument to its normal location and operating status.

Fault Isolation

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

1. Verify that the Inlet and Outlet barbs are finger-tight - do NOT over tighten.

2. Check the data over the last 6 five-minute sample times.

3. If sporadic counts are occurring over all channels, 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.

4. 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 for assistance.

Instrument Service Report

The Instrument Service Report screen shows ***ApexRemote***-specific and diagnostics information info. The displayed information can be saved to a pdf file by clicking the "save report" button (see Figure 5-1).

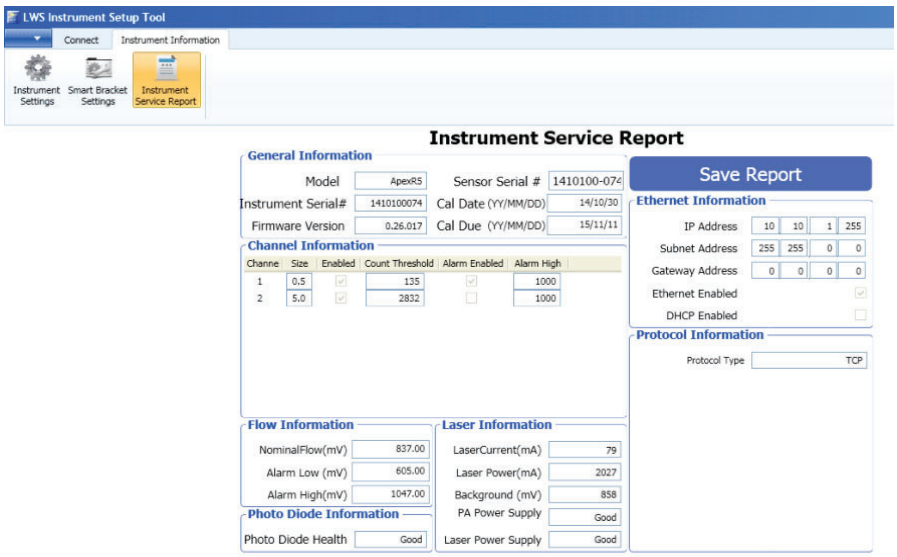


Figure 5-1 Instrument Service Report Screen

6 Program with the MODBUS Protocol

The ***ApexRemote*** family of instruments can be programmed using the MODBUS Protocol. The full protocol, as used, is detailed in Appendix A: “ApexRemote MODBUS Register Map v1.50” on page A-1.

This chapter contains the information needed to program the basic configuration for the instrument using the MODBUS protocol.

DIP Switches

During power-up and reset, the ***ApexRemote Serial*** reads the DIP switches.

Note: *When changing the DIP switch settings, the instrument power must be power-cycled.*

Protocol Settings

The MODBUS Protocol is defined through an RS-232 or RS-485 interface with:

- Baud Rate: 19200
- Data Bits: 8
- Stop Bits: 1
- Parity: None
- Flow Control: None

Power On/ Auto Start

When powering up the instrument, it will begin sampling using the default configuration:

- Sample Time = 60 seconds
- Hold Time = 0 seconds
- Alarm Channel = Disabled

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

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

Stopping the sampling will set the Device Status bit in Register 40003 to 0.

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Running the Instrument Using MODBUS

The applicable action commands are displayed in Table 6-1.

Table 6-1 Action Commands

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, and Location.
11	Instrument Start (Automatic Counting). Uses defined Hold Time and Sample Time. Instrument executes samples and holds until an Instrument Stop command is issued.
12	Instrument Stop. Aborts current sample. Stops data collection.

Each of the described action commands above are written to the command register (40002).

AUTOMATIC Counting Mode

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

The instrument will continue running samples at the configured sample time until it receives a stop command. When the stop command is given, any partial data will not record to the buffer.

After setting all the instrument parameters as described in “Changing the Default Instrument Parameters” on page 6-4, write these commands to the Command register (40002):

11 Start Instrument; to start recording

12 Stop Instrument; to stop recording

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Configuring with the MODBUS Protocol

Setting the Real Time Clock

The Real Time Clock (RTC) can be read in registers 40027 and 40028 as shown in Table 6-2.

Register 40027 is the high word for the real time clock; 40028 is the low word. The date/time is calculated as the number of seconds since midnight of 1/1/1970.

The date & time is stored in a 4-byte unsigned integer or as a 32-bit unsigned integer.

Table 6-2 Real Time Clock Registers

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

In order to change the RTC to the current local date/time, enter the high and low values as unsigned integers to registers 40035 and 40036 respectively, which are the Data Set registers. See Table 6-3.

Table 6-3 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]

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 Real Time Clock can also be set in the Configuration Software Tool.

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Changing the Default Instrument Parameters

The main instrument parameters involved with the operation of the ***ApexRemote*** are Location, Sample Time and Hold Time. See Table 6-4.

The Location is writable only when the ***SmartBracket*** is not attached and is set by writing an unsigned integer to register 40026. The range of values is from 0 to 999.

Sample Time and Hold Time both use 2 registers, a high word and a low word. If the desired value for any of these parameters is less than or equal to 9 hours, 6 minutes and 7 seconds (32,767 seconds), then only the low word register needs to be written with the value in seconds.

The low word register for Sample Time is 40034.

The low word register for Hold Time is 40032.

Table 6-4 Instrument Parameters

Register	Data Type	Description
40026	unsigned integer	**Location number (low)** Provides Location ID for where data was recorded. When SmartBracket is not used, state is read/write. When Bracket Mode is used, the location value is read-only in 40054-40055 and low is duplicated in 40026.
40031	unsigned integer	**Hold Time [high].** Works in conjunction with 40032. Number of seconds to wait between sample periods. Max value is 359,999, which equals 99h 59m 59s
40032	unsigned integer	**Hold Time [low]**
40033	unsigned integer	**Sample Time [high].** Works in conjunction with 40034. Number of seconds to sample. Max value is 86,399, which equals 23h 59m 59s.
40034	unsigned integer	**Sample Time [low]**

Using Sensor Setting Registers

Certain configuration settings can be sent to the counter through these registers.

Sensor Setting Registers 40001 and 40003 through 40023 are protected and should not be changed.

Location (Register 40026)

For Particle Counters, this value specifies the location where a sample was recorded.

Hold Time (Registers 40031, 40032)

The Hold Time is used for pausing in between samples for multiple cycles.

This time is specified in seconds. The maximum value is 359,999 seconds (high word: 5, low word: 32319) which is 99 hours, 59 minutes, and 59 seconds. To set the Hold Time to a value less than 9 hours, 6 minutes, 7 seconds, enter the number of seconds in the *low register* (40032).

During Hold Time, the Device Status bit is 0 (Idle).

Sample Time (Registers 40033, 40034)

The Sample Time specifies the time period of each sample. This time is specified in seconds. The maximum value of the sample time is 86,399 seconds (high word: 1, low word: 20863) which is 23 hours, 59 minutes, 59 seconds.

To set the Sample Time to a value less than 9 hours, 6 minutes, 7 seconds, enter the number of seconds in the *low register* (40034).

During the Sample Time, the Device Status is 1 (Sampling).

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Alarm and Threshold Registers

Alarm Enable Registers

The Alarm Enable input registers (43xxx series) shown in Table 6-5 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 channels are set to ALARM ENABLE.

Table 6-5 Alarm Enable/Disable Bits

Bit	Description
0	Channel Enable (0=disable, 1=enable), works in conjunction with Alarm Enable.
1	Alarm Enable (0=disable; 1=enable), requires channel enable, as well.
2	RESERVED

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

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

Enabling the Alarm for a particle channel requires the channel be enabled, as well, setting the bit in the low word of that channel. The user can enable any or all active particle channels at a time and can set a different alarm threshold for each.

Particle data registers for the Alarm Enable setting start at 43009 for the high word and 43010 for the low word for channel 1. See Table 6-6.

Table 6-6 Alarm Enable Registers

Register	Data Type	Description
43009	unsigned int	Alarm Enable for Particle Channel 1 [high] (smallest particle size starts here)
43010	unsigned int	Alarm Enable for Particle Channel 1 [low]
43011	unsigned int	Alarm Enable for Particle Channel 2 [high]
43012	unsigned int	Alarm Enable for Particle Channel 2 [low]

Enable Alarming for a Channel

Alarm and threshold registers are independent of each other. Any one register's settings will not affect the others and any channel alarms may be enabled or disabled as the user requires. For example, to enable alarming on just the first particle channel as shown in Table 6-7, the user would enable Bit 1 by writing the value of '3' to register 43010. To disable alarming on the first channel and enable alarming on the second channel, write a '1' to register 43010 and a '3' to register 43012. To enable all alarms, write a '3' to each of the registers 43010 and 43012.

To disable alarming completely, write a '1' to the enabled register or registers (43010, 43012, 43014 or 43016).

Table 6-7 Example of Alarming on Channel 2

Registers	Particle Channel	Bit 1 Enabled
43009 - 43010	1	0
43011 - 43012	2	1

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

Threshold Setup Registers

Threshold data is stored in the input registers in the 45xxx series which are read/write. All threshold data items are 4 bytes long and are stored across 2 registers. Byte and word ordering is big-endian.

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 Data Status flag is set if any of the channels have a threshold exceeded state as true.

Note: *The ApexRemote comes standard with 2 particle channels.*

The threshold registers (45xxx series) shown in Table 6-8, run in parallel with the data registers (30xxx series). For example, data register 30010's corresponding threshold register would be 45010. Data

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register 30016's threshold register would be 45016.

Table 6-8 Alarm Threshold Registers

Register	Data Type	Description
45009	unsigned int	Threshold for Particle Channel 1 [high] (smallest particle size starts here)
45010	unsigned int	Threshold for Particle Channel 1 [low]
45011	unsigned int	Threshold for Particle Channel 2 [high]
45012	unsigned int	Threshold for Particle Channel 2 [low]
45013	unsigned int	Threshold for Particle Channel 3 [high]
45014	unsigned int	Threshold for Particle Channel 3 [low]
45015	unsigned int	Threshold for Particle Channel 4 [high]
45016	unsigned int	Threshold for Particle Channel 4 [low]

Setting the Alarm Threshold Value

The Alarm Threshold Value is set in the low register of the channels. Each channel has independent threshold value registers. Since any or all channels can be enabled for alarms at any given time, each threshold value applies to the corresponding channel. Setting a value for channel 1 as 100 will not affect channel 2 setting of, say, 500. See Table 6-9.

Table 6-9 Alarm Threshold Registers set to 1000

Registers	Particle Channel	Threshold Value
45009 - 45010	1	1000
45011 - 45012	2	1000

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7 Install

Install the *ApexRemote*

Installation Basics:

This section is provided as an example of a typical ***ApexRemote*** installation. The tools and hardware shown are examples and may not apply to all installations. It is suggested that safety glasses and other equipment be used to prevent injury. Do ***NOT*** attempt to drill into a wall that may have live AC power behind the wallboard being drilled. Contact Facilities Management personnel to have the area made safe before beginning installation.

WARNING: ***Make sure the installation point for the ApexRemote does not prevent easy disconnect of the instrument power.***

The ***ApexRemote*** must be mounted on a vertical flat surface and must have the Inlet to Outlet path be as close to vertical as possible.

ApexRemote Power Supply specifictions are 100-120VAC, 47-63Hz, 0.5A input, 24VDC 750mA output (18W max). Replacing with a power supply that does not meet these specifications may void the ApexRemote warranty and risk exposing equipment and users to fire and shock hazard.

If replacement of the power supply or its AC power cord is required, replace only with a power supply or cord having as good as or better ratings than the items provided by Lighthouse Worldwide Solutions. Attempting to use an under-rated power supply or 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.

Installing the *SmartBracket/ApexRemote*

Tools/Hardware Required:

Every installation of measuring instruments is dependent upon facility surroundings, construction materials and points of placement. Due to these differences, specific instructions cannot be supplied in this document. However, the listed tools and hardware shown in Figure 7-1

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are typical for most installations.

- Optional SmartBracket
- Self Drilling Drywall & Stud Anchors
- Phillips Screwdriver
- Pen or Pencil

Not shown:
- Drill Motor
- 3 Inch drill bit



Figure 7-1 Required Tools and Hardware

WARNING: ***Make sure target location is electrically safe for drilling. Wear safety goggles while drilling.***

1. Find a point convenient to necessary connections, such as network, vacuum and AC power, and where the instrument can be easily accessed by operators or technical support personnel. The power input connection must allow safe and easy manual disconnect of power if needed.

2. If the optional ***SmartBracket*** was not ordered, the body of the ***ApexRemote*** can be used as a template to mark the two mounting holes. Make sure the instrument is level then use a pencil to mark the center of the mounting holes. The distance between the holes should be 5.75". Proceed to step 4.

3. If the ***SmartBracket*** was ordered, use the ***SmartBracket*** as a template. Make sure it is level then use a pen or pencil to mark the center of the mounting holes. The ***SmartBracket*** has 3/16" holes and has been designed to accept 3/16-24, #8 or #10 flat head screws. See Figure 7-2.

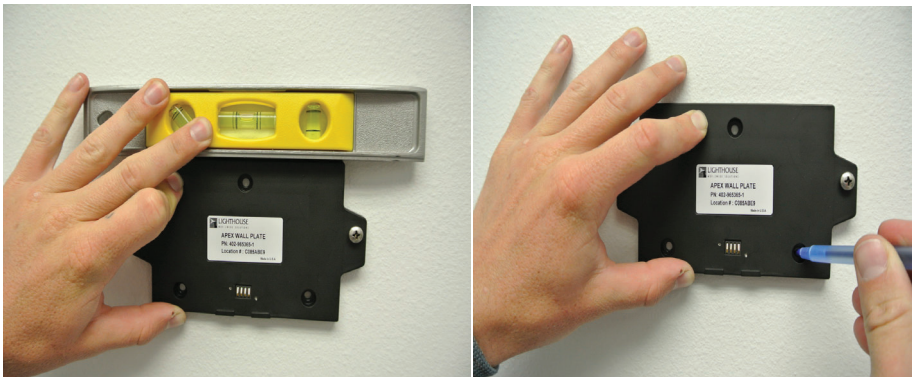


Figure 7-2 Mark Location of Mounting Holes

4. Use the appropriate size drill bit and drill the holes as marked. Install the anchors into the drilled holes. See Figure 7-3.



Figure 7-3 Drill and Prepare Mounting Holes

5. For ***ApexRemote*** installation without ***SmartBracket***, install the ***ApexRemote*** using the installed anchors and appropriate screws. Proceed to step 8.

6. For ***SmartBracket*** installation, attach the ***SmartBracket*** using the installed anchors. Make sure to use flat head screws to maintain clearance from the rear of the ***ApexRemote***. Refer to Figure 7-4.



Figure 7-4 Attach *SmartBracket* to Wall

7. Attach the ***ApexRemote*** to the ***SmartBracket*** by slipping it over the mounting screws provided and sliding it downward on the Bracket. Tighten the two screws. See Figure 7-5.

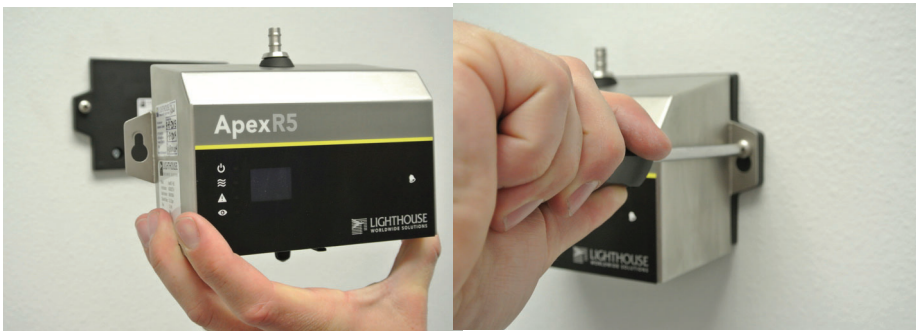


Figure 7-5 Attach *ApexRemote* to *SmartBracket*

8. The ***ApexRemote*** is now ready for connection to the network.

Installing *ApexRemote* without *SmartBracket*

1. Using a bubble level to ensure ***ApexRemote*** is level, place the ***ApexRemote*** against the vertical surface upon which it will be mounted.

2. Mark the center of each mounting tab's larger hole then remove the ***ApexRemote*** from the surface and drill pilot holes for the mounting hardware.

3. Install the mounting hardware then the ***ApexRemote***, snugging the instrument to prevent wobble or movement while it is in use.

4. Install the necessary cable and vacuum tubing.

5. The instrument is ready for connecting and integrating into the instrumentation network.

Connections

The top of the instrument has one connection: the inlet nozzle for sample input shown in Figure 7-6.



Figure 7-6 Connections on Top

The sensor can be used with a direct-mount 1.0 CFM isokinetic probe or the probe can be attached via 1/4" ID tubing to a 1/4" barbed inlet ISO Probe.

Figure 7-7 shows the bottom connections for the ***ApexRemote Serial*** and Figure 7-8 shows the bottom connections for the ***ApexRemote PoE***.

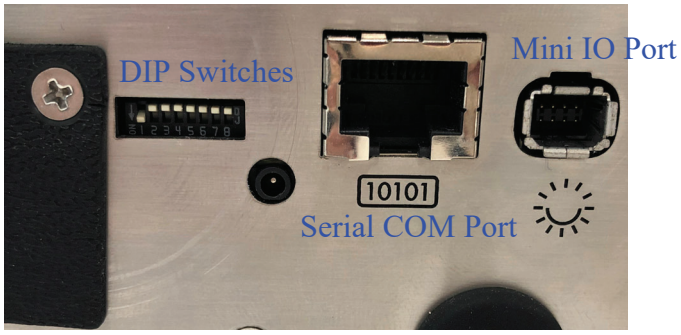


Figure 7-7 *Serial* Instrument Connections

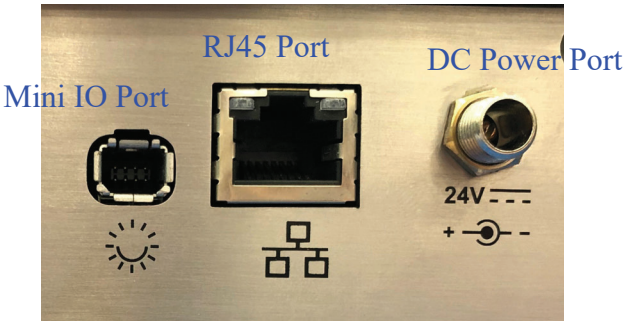


Figure 7-8 *PoE* Instrument Connections

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Communication Ports

ApexRemote *Serial*:

The Serial Data / Power Connect RJ45 is a dual purpose connection, providing the serial data communication path and a 24VDC power source connection. It is a hybrid of the MODBUS over Serial standard incorporating both short distance point-to-point RS-232 and long distance multi-point RS-485.

The RS-232 connection is provided for simple cable connections to a standard PC COM port or via a USB-to-serial converter cable.

The RS-485 connection is provided for industrial applications with multiple devices on the same bus. The RS-485 connector allows for connections using standard CAT5e patch cables to connect to a 485 Gateway or LWS System Cabinet or equivalent equipment.

For more information, refer to the chapter titled Communications starting on page 4-1.

ApexRemote *PoE*:

The ***ApexRemote PoE*** uses **P**ower **o**ver **E**thernet (PoE) to provide the power and communications needed to operate the ***ApexRemote***. This offers a convenient means of connecting the ***ApexRemote*** to an Ethernet network by using a CAT6 patch cable. If PoE power is not available, a standard Ethernet connection can be used with the external 24VDC power supply supplied with the instrument.

Power Consumption:

The ***ApexRemote Serial*** uses external 24VDC supplied via the Serial Data / Power Connect cable from an appropriate power source, such as the ***LWS 485 Gateway***. The ***ApexRemote PoE*** uses power from a PoE switch port or from an external 24VDC power supply.

In all cases, the nominal power consumed is 6W.

Outlet Port (Vacuum Input)

The vacuum inlet uses 1/4" ID tubing. The vacuum source required must be $\geq$ 18" (45.7 cm) of mercury (Hg) to maintain 1.0 CFM through the sensor. The flow is controlled by an internal critical orifice.

If vacuum does not meet minimum specifications to provide 1.0 CFM, the FLOW LED will blink. In this case, contact Lighthouse Worldwide Solutions Technical Support via email at techsupport@golighthouse.com.

SmartBracket Settings

When the ***ApexRemote*** is attached to a ***SmartBracket***, enable the ***SmartBracket*** by placing a checkmark in the Enable box or remove the checkmark to disable the attached ***SmartBracket***. Disabling the ***SmartBracket*** will drop its unique ID from the network and from any monitoring software display/status. When the ***SmartBracket*** mode is enabled and the ***ApexRemote*** does not find a ***SmartBracket***, the Alarm LED will blink white. Figure 7-9 shows Attached and Not Attached conditions.

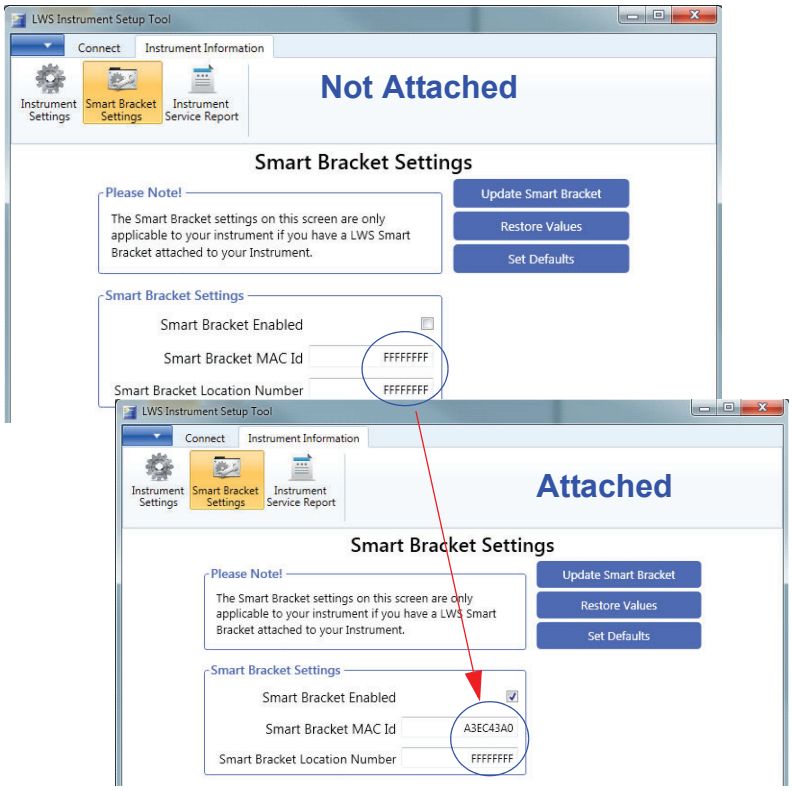


Figure 7-9 *SmartBracket* Setup Screens

Realtime LMS Pro/Pharma Data Download

Lighthouse offers several software products to download, monitor and manage data gathered by the ***ApexRemote*** instruments, as well as other RS-485/MODBUS particle counters. When these instruments are connected to an RS-485 or ethernet network that is monitored and managed by a PC running the Lighthouse Monitoring System (LMS) Express or Express RT (Real Time), they can be identified and controlled by the software. Data can be downloaded from the instruments and put into graphs and charts and archived for future use. Make sure the COM port is set to 19200 BAUD to connect to the USB-to-RS-485 converter.

For 3rd-party software use, contact Lighthouse Sales and Support (refer to Additional Help starting on page -i).

Shipping Instructions

Should it become necessary to return the unit to the factory for any reason, contact Lighthouse Customer Service or visit our website, www.rma.golighthouse.com, and obtain a Return Material 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 result in additional repairs being billed to the customer.***

1. Use the original container, nozzle caps and packing materials whenever possible. Remove attachments, such as TRH or Isokinetic probes, and package to prevent physical and ESD damage.
2. If the original container and packing materials are not available, contact Lighthouse to purchase a replacement shipping container and nozzle caps. If it necessary, wrap the unit in “bubble pack”, surround with shock-absorbent material and place in a double-wall carton - the instrument should not rattle around when the carton is vigorously shaken.
3. If the instrument is damaged during shipment due to inadequate user packing, the warranty may be voided and result in additional repairs being billed to the customer.
4. Seal container or carton securely. Mark “FRAGILE” and write the Return Material Authorization (RMA) number on any unmarked corner.
5. Return the instrument to the address provided by a Lighthouse representative or the RMA website.

A

ApexRemote MODBUS Register Map v1.50

COMM Settings

Lighthouse particle counters with MODBUS use the following communications settings:

Table A-1 MODBUS Communications Settings

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

Note: *ApexRemote currently supports only upper case.*

The MODBUS slave address is set on the particle counter.

Supported MODBUS Commands

Table A-2 MODBUS Registers

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

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

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Register Map

Sensor Settings Registers

Instrument settings are stored in holding registers (the 40xxx series), which are mostly read/writable. Not all holding registers are writable. Table A-3 describes the content of these registers.

Table A-3 Sensor Settings 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, 135d = v1.35.
40002	unsigned integer	Command register. Makes the counter execute a command. See the description of this register in the table below.
40003	unsigned integer	Device Status. [bit 0=RUNNING, bit 1=SAMPLING, bit 2=NEW DATA]
40004	unsigned integer	Firmware version. Major version digits are hundreds. Minor version digits are tens and ones. For example, 235d=v2.35
40005	unsigned integer	Serial Number [high]
40006	unsigned integer	Serial Number [low]
40007	ASCII string	Product Name char[0], char [1] (NULL terminated string)
40008	ASCII string	Product Name char[2], char [3]
40009	ASCII string	Product Name char[4], char [5]
40010	ASCII string	Product Name char[6], char [7]
40011	ASCII string	Product Name char[8], char [9]
40012	ASCII string	Product Name char[10], char [11]
40013	ASCII string	Product Name char[12], char [13]
40014	ASCII string	Product Name char[14], char [15]
40015	ASCII string	Model Name char[0], char [1] (NULL terminated string)
40016	ASCII string	Model Name char[2], char [3]
40017	ASCII string	Model Name char[4], char [5]
40018	ASCII string	Model Name char[6], char [7]
40019	ASCII string	Model Name char[8], char [9]
40020	ASCII string	Model Name char[10], char [11]

Table A-3 Sensor Settings Registers

Register	Data Type	Description
40021	ASCII string	Model Name char[12], char [13]
40022	ASCII string	Model Name char[14], char [15]
40023	unsigned integer	Flow Rate. See registers 40041-40042 for flow rate units. Liquid Particle Counters and Samplers: Value equals flow rate. For example: 100d=100 All Other Instruments: Divide by 100 to get flow rate. For example: 100d=1.00
40024	signed integer	Record Count. Total number of records stored in the counter
40025	signed integer	Record Index. Zero based index to data in 3xxxx register series. Must be lower than the record count (register 40024). Set this index to expose a counter's record in the 3xxxx registers. Set to -1 to retrieve last record stored in the counter.
40026	unsigned integer	Location number Particle Counters: Specifies location of Particle Counter where data was recorded. Must be 1 to 200 (maps to location names associated with registers 40200 - 40999).
40027	signed integer	Real Time Clock (RTC) [high]. Displays 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.
40034	unsigned integer	Sample Time [low]

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Table A-3 Sensor Settings Registers

Register	Data Type	Description
40035	unsigned integer	Data Set [high]. Works in conjunction with 40036. Updates the instrument's real time clock. Setting is the number of seconds since midnight, 1/1/1970. This number can be generated by the ANSI C/C++ time() function.
40036	unsigned integer	Data Set [low]
...		
40039	unsigned integer	LASER Reference Voltage (millivolts)
...		
40041	ASCII string	Flow Unit - Defines the Unit that FlowRate value is based on. char[0], char[1]. (NULL-terminated string)
40042	ASCII string	Flow Unit. char[2], char[3]
40043	unsigned integer	Calibration Reference Voltage (millivolts)
...		
40047	signed integer	ApexRemote: Calibration Due Date [high]. Indicates when instrument is due for calibration. This number can be generated by the ANSI C/C++ time() function.
40048	signed integer	Calibration Due Date [low].
...		
40050	signed integer	Device Options
...		
40054	unsigned integer	Location ID[high]. Value is 0 when no location bracket is present.
40055	unsigned integer	Location ID[low]. Value is 0 when no location bracket is present. Value matches 40026 location number when bracket is present.
40056	unsigned integer	Device Status[high]
40057	unsigned integer	Device Status[low].
40058	unsigned integer	Serial number [high].
40059	unsigned integer	Serial number [low].

Table A-3 Sensor Settings Registers

Register	Data Type	Description
40060	signed integer	Last Sample Timestamp [high] (# of seconds since midnight, 1/1/1970.).
40061	signed integer	Last Sample Timestamp [low].
40062	signed integer	Last Setting Change Timestamp [high] (# of seconds since midnight, 1/1/1970.). Value indicates.
40063	signed integer	Last Setting Change Timestamp [low].
40064	signed integer	Run-time particle channel alarm high flags (bit 0 = channel 1, …).
40065	signed integer	Run-time particle channel alarm low flags (bit 0 = channel 1, …).
40066	signed integer	Run-time analog channel alarm high flags (bit 0 = channel 1, …).
40067	signed integer	Run-time analog channel alarm low flags (bit 0 = channel 1, …).
40068	unsigned integer	Software controlled RGB LED red channel. Uses values from 0-100 for duty cycle percentage every even second from UNIX time.
40069	unsigned integer	Software controlled RGB LED green channel. Uses values from 0-100 for duty cycle percentage every even second from UNIX time.
40070	unsigned integer	Software controlled RGB LED blue channel. Uses values from 0-100 for duty cycle percentage every even second from UNIX time.
40071	unsigned integer	Software controlled RGB LED red channel. Uses values from 0-100 for duty cycle percentage every odd second from UNIX time.
40072	unsigned integer	Software controlled RGB LED green channel. Uses values from 0-100 for duty cycle percentage every odd second from UNIX time.
40073	unsigned integer	Software controlled RGB LED blue channel. Uses values from 0-100 for duty cycle percentage every odd second from UNIX time.

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Table A-3 Sensor Settings Registers

Register	Data Type	Description
40074	signed integer	ApexRemote: Last Calibration Date [high]. Indicates when instrument was last calibrated. This number can be generated by the ANSI C/ C++ time() function.
40075	signed integer	ApexRemote: Last Calibration Date [low]

Device Options

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

Table A-4: Device Options

Bits	Description
5	ApexRemote: Software controlled RGB LED (1=Enabled, 0=Disabled)
6	ApexRemote: Location Bracket (1=Enabled, 0=Disabled)

Device Status

The Device Status registers (40003 and 40057) display the current status of the device (Table A-5). Additional status bits are shown in 40056 (Table A-6).

.

Table A-5 Device Status Status (40003/40057)

Bit	Description
0	**RUNNING:** Set when a start command is executed via Command 11 (instrument start) or through the user interface. The flag will remained set until a stop command is executed.
1	**SAMPLING:** This is set only when the instrument is actually sampling data that is to be recorded. Caution must be used in sending a command during this time that may invalidate current sample.

Table A-5 Device Status Status (40003/40057)

Bit	Description
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.
3	**DEVICE ERROR:** in the event that there is a failure on the device, this bit is set to indicate possible invalid data has been collected.
9	ApexRemote: **DATA VALIDATION:** Set to 1 when unit is in data validation mode, else set to 0.
10	ApexRemote: **LOCATION VALIDATION:** Set to 1 when unit is in Location Validation mode, else set to 0.
11	ApexRemote: **LASER STATUS:** Set to 1 when unit's LASER is out of spec, else set to 0.
12	ApexRemote: **FLOW STATUS:** Set to 1 when unit's flow is out of spec, else set to 0.
13	ApexRemote: **SERVICE STATUS:** Set to 1 when unit needs to be serviced, else set to 0.
14	ApexRemote: **THRESHOLD HIGH STATUS:** Set to 1 when unit's high alarm threshold is exceeded, else set to 0.
15	ApexRemote: **THRESHOLD LOW STATUS:** Set to 1 when unit's low alarm threshold is not met, else set to 0.

Additional status bits are shown in 40056 displayed in Table A-6.

Table A-6 Device Status Status (40056)

Bit	Description
0	ApexRemote: **LASER POWER STATUS**: Set to 1 when unit's LASER current is out of spec, else set to 0

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Table A-6 Device Status Status (40056)

Bit	Description
1	ApexRemote: **LASER CURRENT STATUS:** Set to 1 when unit's LASER power is out of spec, else set to 0
2	ApexRemote: **LASER SUPPLY STATUS:** Set to 1 when unit's LASER supply is out of spec, else set to 0
3	ApexRemote: **LASER LIFE STATUS:** Set to 1 when unit's LASER supply is out of spec, else set to 0
4	ApexRemote: **NO FLOW STATUS:** Set to 1 when unit's flow is below no flow threshold causing LASER to turn off, else set to 0
5	ApexRemote: **PHOTOAMP SUPPLY STATUS:** Set to 1 when unit's photoamp supply is out of spec, else set to 0
6	ApexRemote: **BACKGROUND STATUS:** Set to 1 when unit's photoamp background is out of spec, else set to 0
7	ApexRemote: **PHOTODIODE STATUS:** Set to 1 when photodiode has failed, else set to 0
8	ApexRemote: **CALIBRATION DUE DATE STATUS:** Set to 1 when unit is past calibration due date, else set to 0
9	ApexRemote: **LOCATION BRACKET STATUS:** Set to 1 when unit is in location bracket mode and bracket is missing, else set to 0

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

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response. When this register is read, it always returns a zero.

Table A-7 Command Register

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.
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.
17	Instrument Location Validation Start: ApexRemote: Start blinking Alarm LED blue.
18	Instrument Location Validation Stop ApexRemote: Stop blinking Alarm LED blue.
19	Instrument Data Validation Start ApexRemote: Start sampling with dummy data using current sampling parameters. Data is also tagged as validation.
20	Instrument Data Validation Stop ApexRemote: Stop sampling with dummy data using current sampling parameters. Data is also tagged as validation.

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Alarm and Threshold Registers

Alarm Enable Registers

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

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

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

The 43xxx register series is used to determine which particle data channels are set to ALARM ENABLE.

Table A-8 Alarm Enable/Disable Bits

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

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

Note: *Alarm Enable currently only works for Particle Channels. Any or all channels and their alarm thresholds can be enabled and configured independently of each other.*

To enable the Alarm for a particle channel, set the bit in the low word of that channel. Because Bit-0 is reserved and must always be ON, only Bit-1 will change for any channel alarm setting and Bit-0 must always be written as a '1'. What this means is that these registers will receive a '3' to turn the setting ON and a '1' to turn it OFF.

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

Table A-9 Alarm Enable Registers

Register	Data Type	Description
43009	unsigned int	Alarm Enable for Particle Channel 1 [high] (smallest particle size starts here)
43010	unsigned int	Alarm Enable for Particle Channel 1 [low]
43011	unsigned int	Alarm Enable for Particle Channel 2 [high]
43012	unsigned int	Alarm Enable for Particle Channel 2 [low]
43013	unsigned int	Alarm Enable for Particle Channel 3 [high]
43014	unsigned int	Alarm Enable for Particle Channel 3 [low]

Table A-9 Alarm Enable Registers

Register	Data Type	Description
43015	unsigned int	Alarm Enable for Particle Channel 4 [high]
43016	unsigned int	Alarm Enable for Particle Channel 4 [low]

Enable Alarming for a Channel

To enable alarming on particle channel #1, write a ’3’ to register 43010, which enables its Bit 1 and maintains Bit 0 as ’1’. To disable alarming on channel 1 and enable it on channel 2, write a ’1’ to register 43010 and a ’3’ to register 43012. To enable all, write a ’3’ to 43010, 43012, 43014 and 43016.

To disable alarming completely, write a ’1’ to disable Bit 1 to registers 43010, 43012, 43014 and 43016.

Table A-10 Example of Alarming on Channel 2

Registers	Particle Channel	Bit 1 Enabled
43009 - 43010	1	0
43011 - 43012	2	1
43013 - 43014	3	0
43015 - 43016	4	0

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

Threshold Setup Registers

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

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

For particle channels, the threshold value is a 32-bit unsigned integer. If the data value exceeds the threshold value and the alarm is enabled for that channel, the threshold flag in the Data Status register (30007-30008, bit 4) is set.

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Note: *The Table A-11 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.*

The Data Status flag is set if any of the channels have a threshold exceeded state as true.

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.

Table A-11 Alarm Threshold Registers

Register	Data Type	Description
45009	unsigned int	Threshold for Particle Channel 1 [high] (smallest particle size starts here)
45010	unsigned int	Threshold for Particle Channel 1 [low]
45011	unsigned int	Threshold for Particle Channel 2 [high]
45012	unsigned int	Threshold for Particle Channel 2 [low]
45013	unsigned int	Threshold for Particle Channel 3 [high]
45014	unsigned int	Threshold for Particle Channel 3 [low]
45015	unsigned int	Threshold for Particle Channel 4 [high]
45016	unsigned int	Threshold for Particle Channel 4 [low]

Setting the Alarm Threshold Value

Note: *Thresholds are independent of each so the value set for one channel does not affect another.*

The Alarm Threshold Value is set in the low register of the channels. Each channel has independent threshold value registers. Setting a value for channel 1 as 100 will not affect channel 2 setting of, say, 500.

Table A-12 Alarm Threshold Registers set to 1000

Registers	Particle Channel	Threshold Value
45009 - 45010	1	1000
45011 - 45012	2	1000
45013 - 45014	3	1000
45015 - 45016	4	1000

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 is big-endian. Thus, data items are formed by

placing the high bytes in front of the low bytes.

Example:

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

Not all particle and analog channels are active. Retrieving data from an inactive channel returns garbage. See the Data Enable Registers section of this document for details on how to record data from active channels.

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

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

Table A-13 Data Registers

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	Sample Status [high]
30008	unsigned integer	Sample 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]

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Table A-13 Data Registers

Register	Data Type	Description
30016	unsigned integer	Particle Channel 4 [low]
...		
30041	IEEE Float	Analog Channel 1 [high]
30042	IEEE Float	Analog Channel 1 [low]
30043	IEEE Float	Analog Channel 2 [high]
30044	IEEE Float	Analog Channel 2 [low]
30045	IEEE Float	Analog Channel 3 [high]
30046	IEEE Float	Analog Channel 3 [low]
30047	IEEE Float	Analog Channel 4 [high]
30048	IEEE Float	Analog Channel 4 [low]
...		
30063	IEEE float	LASER Supply [low]
30064	IEEE float	LASER Supply [high] (percentage based on LASER Supply Reference Value.
30065	IEEE Float	Background Voltage [low] (percentage based on Calibration Reference value) - ApexRemote
30066	IEEE Float	Background Voltage [high]
...		
30069	IEEE Float	LASER Voltage [low] (Percentage based on LASER Reference value)
30070	IEEE Float	LASER Voltage [high]

Table A-14: Instrument Current Status

Value	Action
0	Service LASER Status 0 = LASER is good. 1 - LASER needs to be serviced.
1	Bad Flow Status 0 = Flow rate is good. 1 = Flow rate is bad.

Table A-14: Instrument Current Status

Value	Action
2	Particle Overflow Status 0 = No overflow 1 = Overflow occurred.
3	Instrument Service Status 0 = Instrument is working correctly. 1 = Service light is on. Instrument malfunction detected.
4	Threshold High Status 0 = Threshold not exceeded. 1 = Threshold exceeded
5	Threshold Low Status 0 = Threshold not exceeded. 1 = Threshold exceeded.
6	Instrument Sampler Status 0 = Nominal Operation. 1 = Sampler Error.
7	ApexRemote: 0 = LASER power in spec. 1 = LASER power out of spec.
8	ApexRemote: LASER current status 0 = LASER current in spec. 1 = LASER power out of spec.
9	ApexRemote: LASER supply status 0 = LASER supply in spec. 1 = LASER supply out of spec.
10	ApexRemote: LASER life status 0 = LASER life in spec. 1 = LASER life out of spec.
11	ApexRemote: No flow status 0 = There is flow in the unit. 1 = no flow in unit.
12	ApexRemote: Photoamp supply status 0 = Photoamp supply in spec. 1 = Photoamp supply out of spec.
13	ApexRemote: Background status 0 = Photoamp background good. 1 = Photoamp background out of spec.

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Table A-14: Instrument Current Status

Value	Action
14	ApexRemote: Photodiode health status 0 = Photodiode good. 1 = Photodiode failure
15	ApexRemote: Validation mode status 0 = Normal operation data. 1 = Validation dummy data.
16	ApexRemote: Calibration due date status 0 = Unit has not passed calibration date. 1 = Unit has passed calibration.

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

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

Device Status Word

The registers used for the Sample Status Word are 30007-30008 to sample status.

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

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

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

Table A-15 Device Status Word

Bit	Description
0	LASER Alert Status 0 = LASER is good 1 = LASER Alert
1	Flow Alert Status 0 = Flow Rate is good 1 = Flow Rate Alert
3	Instrument Service Status 0 = Working correctly 1 = Instrument malfunction detected.

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Table A-15 Device Status Word

Bit	Description
4	Particle Threshold Exceeded Status 0 = Threshold not exceeded 1 = Threshold exceeded

Data Enable Registers

Note: *All data records have the same enable states. The user does not have to read the enable registers for every record.*

The 31xxx register series is used to determine which data items in 30xxx are enabled. Enabled items contain recorded data. Data retrieved from disabled items return garbage. Data items are disabled for particle and analog channels not supported by the device or when the device software is configured not to record data for those items.

The Enable Registers (31xxx series) run in parallel with the Data Registers (30xxx series). For example, Data Register 30010's Enable Register is 31010. Data Register 30016's Enable Register is 31016.

The 31xxx register states are:

00000000h = Disabled
FFFFFFFFh = Enabled

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B 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 hand held 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.

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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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