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REMOTE - 2

PN Series

Airborne Particle Counter

Operating Manual

Lighthouse Worldwide Solutions

REMOTE-2 PN Series Airborne Particle Counter

Operating Manual

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EU DECLARATION OF CONFORMITY

Manufacturer's Name: Lighthouse Worldwide Solutions, Inc.

Manufacturer's Address: Lighthouse Worldwide Solutions, Inc.
1221 Disk Drive
Medford, OR 97501 USA

Declares that the product:

Product Name: Remote Airborne Particle Counter
Model Number(s): REMOTE 3012PN, 3102PN, 5012PN, 5102PN, 50102PN

Conforms to the following Product Specifications:

<u>SAFETY</u>	EN61010-1:2001	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use Part 1: General Requirements IEC 61010-1:2000
	CAN/CSA C22.2 No. 1010.1-1992	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements
<u>LASER SAFETY</u>	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
<u>EMC</u>	EN61326	Electrical Equipment for Measurement, Control and Laboratory Use EMC Requirements Part 1: General Requirements Includes Amendment A1:1998; IEC 61326:1997 + A1:1998

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. March 7, 2008

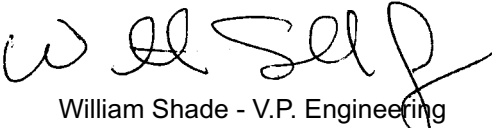

William Shade - V.P. Engineering

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About This Manual

This manual describes the detailed operation and use of the Lighthouse REMOTE-2 PN Series 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*

italics

Represents information not to be typed or interpreted literally. For example, *file* represents a file name. Manual titles are also displayed in italics.

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

boldface

Introduces or emphasizes a term.

`Courier font`

Indicates command syntax or text displayed by the diagnostic terminal.

Bold Courier

Indicates commands and information that you type. You can use uppercase or lowercase letters; in this manual, commands are shown in uppercase.

Helvetica Italics

Indicates a comment on a command or text output.

Additional Help

For more information about Lighthouse REMOTE-2 PN Series Airborne Particle Counters, contact Lighthouse Worldwide Solutions.

(800) 945-5905 Sales and Service
(510) 438-0500 Outside of USA

techsupport@golighthouse.com
www.golighthouse.com

1

General Safety

Safety Considerations

Warnings and cautions are used throughout this manual. Familiarize yourself with the meaning of a warning before operating the particle counter. All warnings will appear in the left margin of the page next to the subject or step to which it applies. Take extreme care when doing any procedures preceded by or containing a warning.

There are several Warnings within this manual.

- Laser - pertaining to exposure to visible or invisible laser radiation
- Data Loss - pertaining to loss of data
- Handling - pertaining to instrument damage

Laser Safety Information

This product contains a laser-based sensor that is a Class 1 product (as defined by 21 CFR, Subchapter J of the Health and Safety Act of 1968) when used under normal operation and maintenance. Service procedures on the sensor can result in exposure to invisible radiation. Service should be performed only by factory-authorized personnel.

The particle counter has been evaluated and tested in accordance with EN 610109-1:1993, "Safety Requirements For Electrical Equipment for Measurement, Control, and Laboratory Use" and IEC 825-1:1993, "Safety of Laser Products".

WARNING: *The use of controls, adjustments or performance of procedures other than those specified within this manual may result in exposure to invisible (infrared) radiation that can quickly cause blindness.*



Figure 1-1 Laser Warning Label on Unit

For further technical assistance, contact our Technical Support Team at (800) 945-5905.

2

Introduction

Overview

This operating manual introduces the reader to the Lighthouse REMOTE-2 PN Series of two-channel Airborne Particle Counters. Also included in this manual are instructions for inspecting, using and maintaining the instrument. Any instrument design changes that may affect its operation are covered at the back of this manual.

Description

References are made to the REMOTE-2 PN Series, which includes the NEMA enclosure, and the Rxxx2, which is only the particle counter inside the NEMA enclosure. The Rxxx2 cannot be replaced by a "standard" REMOTE xxx2. The REMOTE enclosed was designed specifically for this application.

The REMOTE 3012PN (R3012PN) is manufactured to count particles of 0.3 and 0.5 microns; the REMOTE 5012PN (R5012PN) counts particles of 0.5 and 5.0 (or 10.0) micron at 0.1 CFM. The REMOTE 3102PN (R3102PN) is manufactured to count particles of 0.3 and 0.5 microns, the 5102PN (R5102PN) counts particles of 0.5 and 5.0 (or 10.0) micron and the 50102PN counts particles of 5.0 microns and larger at 1.0 CFM.

This instrument is effective in ultra-clean areas (such as Class 1 or Class 10) and in more traditional cleanzones rated as Class 100 or

higher. Refer to the Specifications table for additional information.



Figure 2-1 REMOTE 5102PN Particle Counter

REMOTE-2 PN instruments use the Elite™ laser diode light source and collection optics for particle detection. The collection optics collect and focus light scattered by the particles onto a photo diode that converts the bursts of light into electrical pulses. The pulse height is a measure of particle size. Pulses are counted and their amplitude is measured for particle sizing.

The REMOTE-2 PN Series of particle counters were designed for continuous trouble-free operation using an internal flow-controlled vacuum pump and a standard NEMA style 316L stainless steel enclosure. This design provides an industry standard mounting configuration and can be installed where space is limited. REMOTE-2 PN Series instruments integrate seamlessly with large facility monitoring and management systems and transfer up to 2 channels of simultaneous particle count data using 4-20mA output.

Accessories

The REMOTE-2 PN Series instrument supports remote monitoring when equipped with a tubing kit of 3 meters.

Several accessories can be ordered to tailor the instrument to your needs. Please contact your Sales Engineer for these options.

Annual Calibration

The manufacturer recommends that your Lighthouse instrument be calibrated annually by a Certified Lighthouse Service Provider to ensure that it continues to perform within specification.

REMOTE 3012PN Specifications

Size Range	0.3 - 0.5 μ m
Channel Thresholds	Standard: 0.3, 0.5 μ m
	Other sizes available; specify at time of order
Flow Rate	0.1 CFM (2.83 LPM)
Counting Efficiency	50% (per JIS)
Light Source	Elite™ Laser Diode
Zero Count Level	<1 count/5 minutes (per JIS)
Vacuum	Internal flow-controlled pump
Calibration	NIST Traceable, per ISO 21501-4
Communication Modes	4-20mA: Ch1, Ch2
Alarms	Ch1, Ch2 Count Overflow Alarm
Alerts	Service Alert
Enclosure	316L Stainless Steel, NEMA
Power	Instrument Power: +6V to +30VDC Chassis Power: 100-220VAC
Dimensions	10" (W) x 12" (H) x 6.9" (D) [25.4 x 30.4 x 14.9 cm]
Weight	20 lbs (9.6 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 REMOTE 3012PN Specifications

REMOTE 3102PN Specifications

Size Range	0.3 - 0.5µm
Channel Thresholds	Standard: 0.3, 0.5µm
	Other sizes available; specify at time of order
Flow Rate	1.0 CFM (28.3 LPM)
Counting Efficiency	50% (per JIS)
Light Source	Elite™ Laser Diode
Zero Count Level	<1 count/5 minutes (per JIS)
Vacuum	Internal flow-controlled pump
Calibration	NIST Traceable, per ISO 21501-4
Communication Modes	4-20mA: Ch1, Ch2
Alarms	Ch1, Ch2 Count Overflow Alarm
Alerts	Service Alert
Enclosure	316L Stainless Steel, NEMA
Power	Instrument Power: +6V to +30VDC Chassis Power: 100-220VAC
Dimensions	10" (W) x 12" (H) x 6.9" (D) [25.4 x 30.4 x 14.9 cm]
Weight	20 lbs (9.6 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 REMOTE 3102PN Specifications

REMOTE 5012PN Specifications

Size Range	0.5 - 10.0 μ m
Channel Thresholds	Standard: 0.5, 5.0 or 0.5, 10.0 μ m
	Other sizes available; specify at time of order
Flow Rate	0.1 CFM (2.83 LPM)
Counting Efficiency	50% (per JIS)
Light Source	Elite™ Laser Diode
Zero Count Level	<1 count/5 minutes (per JIS)
Vacuum	Internal flow-controlled pump
Calibration	NIST Traceable, per ISO 21501-4
Communication Modes	4-20mA: Ch1, Ch2
Alarms	Ch1, Ch2 Count Overflow Alarm
Alerts	Service Alert
Enclosure	316L Stainless Steel, NEMA
Power	Instrument Power: +6V to +30VDC Chassis Power: 100-220VAC
Dimensions	10" (W) x 12" (H) x 6.9" (D) [25.4 x 30.4 x 14.9 cm]
Weight	20 lbs (9.6 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 REMOTE 5012PN Specifications

REMOTE 5102PN Specifications

Size Range	0.5 - 10.0 μ m
Channel Thresholds	Standard: 0.5, 5.0 or 0.5, 10.0 μ m
	Other sizes available; specify at time of order
Flow Rate	1.0 CFM (28.3 LPM)
Counting Efficiency	50% (per JIS)
Light Source	Elite™ Laser Diode
Zero Count Level	<1 count/5 minutes (per JIS)
Vacuum	Internal flow-controlled pump
Calibration	NIST Traceable, per ISO 21501-4
Communication Modes	4-20mA: Ch1, Ch2
Alarms	Ch1, Ch2 Count Overflow Alarm
Alerts	Service Alert
Enclosure	316L Stainless Steel, NEMA
Power	Instrument Power: +6V to +30VDC Chassis Power: 100-220VAC
Dimensions	10" (W) x 12" (H) x 6.9" (D) [25.4 x 30.4 x 14.9 cm]
Weight	20 lbs (9.6 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 REMOTE 5102PN Specifications

REMOTE 50102PN Specifications

Size Range	5.0 - 100.0 μ m
Channel Thresholds	Standard: 5.0, 30.0 μ m
	Other sizes available; specify at time of order
Flow Rate	1.0 CFM (28.3 LPM)
Counting Efficiency	50% (per JIS)
Light Source	Elite™ Laser Diode
Zero Count Level	<1 count/5 minutes (per JIS)
Vacuum	Internal flow-controlled pump
Calibration	NIST Traceable, per ISO 21501-4
Communication Modes	4-20mA: Ch1, Ch2
Alarms	Ch1, Ch2 Count Overflow Alarm
Alerts	Service Alert
Enclosure	316L Stainless Steel, NEMA
Power	Instrument Power: +6V to +30VDC Chassis Power: 100-220VAC
Dimensions	10" (W) x 12" (H) x 7.9" (D) [25.4 x 30.4 x 20.1 cm]
Weight	20 lbs (9.6 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 REMOTE 50102PN Specifications

Interface Pin Assignments

Data Port

Table 2-2 shows the signal assignments for the REMOTE-2 PN Series external 8-pin connector.

Pin #	Signal
1	CH-1
2	CH-2
3	VLOOP
4	GND
5	Status
6	N/C
7	Alarm-
8	Alarm+

Table 2-6: 4-20mA External Connector Pin Assignments

Programming Port

The Rxxx2 Programming Port RJ45 pin assignments are shown below:

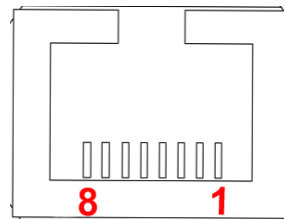


Figure 2-2 Programming Port RJ45 Pinouts

Table 2-7 shows the signals and pin numbers of the RJ45 and their corresponding connections on a DB9 connector.

RJ45 Pin	Signal Name	DB-9 Pin
1	TX	2
2	RX	3
8	Ground	5

Table 2-7 RJ45 to DB-9 Connections

3

Getting Started

Unpacking and Initial Inspection

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

When received, inspect the shipping carton for damage. If the carton is damaged, notify the carrier and save the carton for carrier inspection. Inspect the unit for broken parts, scratches, dents, or other damage.

If the carton is not damaged, keep it for reshipment when you return the instrument for the annual factory calibration or a Return Merchandise Authorization for repair. Replacements are available for purchase.

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.golighthouse.com/rma, and obtain a Return Merchandise Authorization (RMA) number. Reference this number on all shipping documentation and purchase orders. After receipt of the RMA number, follow the shipping instructions below:

WARNING:

If the instrument is damaged during a return shipment due to inadequate user packing, the warranty may be voided and all repairs required may be charged to the customer.

1. Use the original container, nozzle caps and packing materials whenever possible. If your instrument contains a battery, remove it before packing the instrument. If the battery needs to be shipped, package it separately and refer to www.golighthouse.com/rma for detailed instructions.
2. If the original container and packing materials are not available, 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. If the instrument is damaged during shipment due to inadequate user packing, the warranty may be voided and all repairs required will be at cost. You may contact Lighthouse to purchase a replacement shipping container and nozzle caps.
3. Seal container or carton securely. Mark "FRAGILE" and write the Return Merchandise Authorization (RMA) number on any unmarked corner.
4. Return the instrument to the address provided by your Lighthouse representative or the RMA website.

Applications

The following pages illustrate how to wire J10 for two wire and three wire systems.

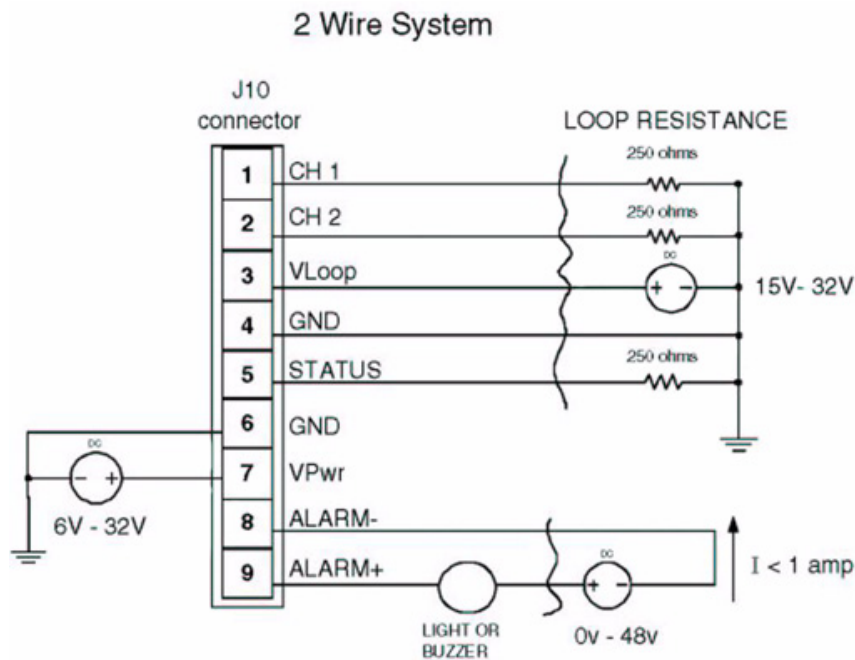


Figure 3-1 Application for a Two Wire System

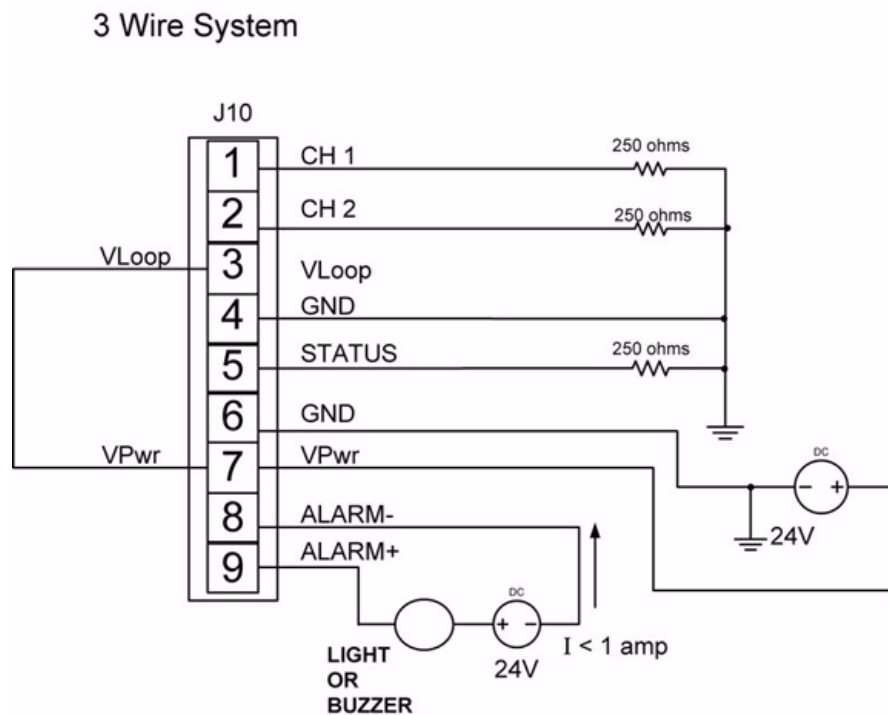


Figure 3-2 Application for a Three Wire System

Mount REMOTE-2 PN Series

The REMOTE-2 PN Series use a standard NEMA footprint and mounting to a flat vertical surface is required for proper operation. Pump flow control is managed by the REMOTE-2 PN Series pump controller. Power to the REMOTE-2 PN Series is managed by a power switch inside the NEMA enclosure. The cover lock uses a flat blade or coin to turn the latch to the open or closed position. Do NOT apply power to the REMOTE-2 PN Series until cables are attached properly at both ends.

Sample tubing runs should terminate at the instrument location and should use Bevaline tubing to prevent static and particle dropout. The REMOTE-2 PN Series instrument supports remote monitoring when equipped with a tubing kit of 3 meters.

If the Inlet tubing is run over walls or around corners, keep the bend radius greater than ninety degrees and three feet.

Do not patch sections together and keep the tubing supported to prevent sagging and kinking over time.

Typical installations use a short length of tubing and a barbed ISO probe that is either handheld or supported on a tripod.

Connecting the tubing to the instrument Inlet requires removing the cap from the Inlet connector and installing the ferrule and nut assemblies on the tubing as shown in Figure 3-3. This may be done with the Outlet connector, as well, if the pump output requires that it be exhausted to another area. The procedure is the same for the Outlet. Review the photos in Figure 3-4 and Figure 3-5.



Figure 3-3 Nut and Ferrule Installed on Tubing

Connect Interface and Power Cables

After the ethernet and AC Power cables have been completed, they are ready for connecting the REMOTE-2 PN Series to AC power and data-gathering equipment. Proceed as follows:

Connections

The top of the instrument has the inlet line, which supplies sample air to the sensor. Using the compression fittings is required to allow wipe-down of the instrument.



Figure 3-4 Instrument Top Connections

The photo below shows the bottom connectors for the REMOTE-2 PN Series.

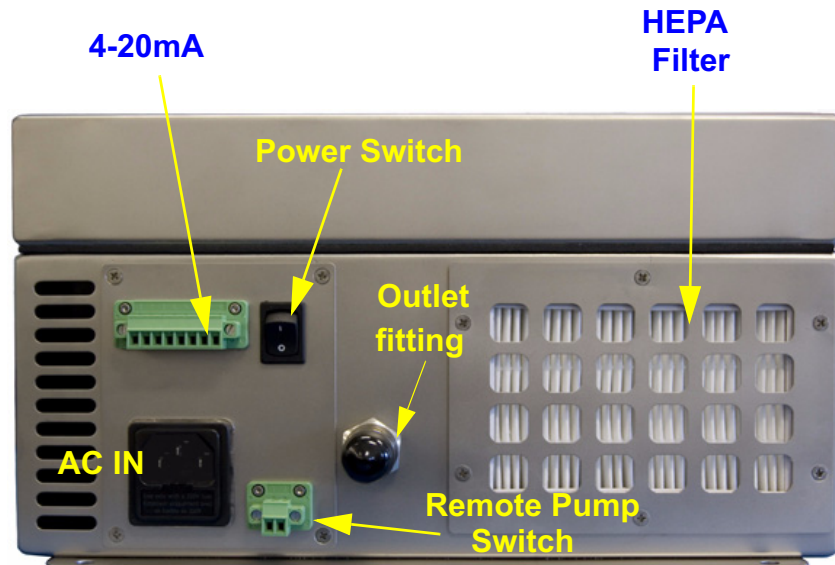


Figure 3-5 Instrument Bottom Connections

Communication Port

The communication port uses 4-20mA protocol. To connect the counter to a PC requires an RS-232 adapter kit. Please contact your Lighthouse Sales Representative for this kit.

1. For information on how to use the Program Port to change the instrument settings, please refer to “Programming” on page 4-1.

Data Cable Install

WARNING: *Make sure the data cable is NOT attached to the monitoring device before it is connected to the REMOTE-2 PN. Power to the REMOTE should be ON when connecting to the device.*

Best practices dictate that power to equipment on both ends of the data cable should be OFF before a cable is attached. This may not always be practical, especially if a Lighthouse SIU or other equipment is monitoring devices around the clock and service cannot be interrupted.

If the Rxxx2PN is involved in a new installation, power should be OFF at both ends, cables installed and power applied to the Rxxx2PN then the monitoring device. If power cannot be removed from the monitoring end, make sure the Rxxx2PN is powered ON before connecting the data cable.

Energize Connections

1. Connect the signal cable to the hub or data-gathering equipment.
2. Connect the 'PN' AC Power cord to the AC source.
3. Apply AC power using the switch on the bottom left side.
4. Power should be applied to the instrument, indicated by the Rxxx2 Power LED illuminating. If the pump jumper wire is installed prior to power ON, the pump should start running; otherwise, turn ON the pump remote switch. After approximately twenty seconds, data will be supplied by the REMOTE-2 PN to data monitoring equipment or network.

Operation

Note: *The Rxxx2PN incorporates a pump protection circuit that turns the pump OFF if the Inlet air supply is blocked. To restore the instrument to normal operation, clear the obstruction, open the cover, turn the switch OFF, wait a few seconds and turn the switch ON. The pump should start.*

Understanding the LEDs

The front-panel LEDs have specific meanings when illuminated. The figure below shows location of the LEDs and gives a brief description of their meaning.



Figure 3-6 Example of Front Panel LEDs

- The green POWER LED turns on when the instrument is powered on.
- The red SERVICE LED will turn on and remain steady if Laser power is out of range, the sensor optics are dirty or the view volume contains foreign objects. A flashing LED indicates an alarm condition, such as particle counts exceeding set limits.
- If the internal pump stops running, the Inlet air supply may be obstructed and the pump protection circuit has turned the pump OFF. To restore normal pump operation, find and clear the obstruction and turn the power switch OFF. Wait a few seconds and turn the switch ON. The pump should start running. Contact Lighthouse Technical Support if this fails to restore normal pump operation.

4

Programming

General

The REMOTE-2 PN Series instrument can be programmed by connecting an ASCII terminal to the instrument to change the unit's Sample Time, Range, Service High, Service Low, Alarm Threshold and Suppress Alarm Count.

This chapter contains the information needed to configure the instrument to meet your needs.

Note: *References are made to the REMOTE-2 PN Series, which includes the NEMA enclosure, and the Rxxx2, which is only the particle counter inside the NEMA enclosure. The Rxxx2 cannot be replaced by a "standard" REMOTE xxx2. The REMOTE enclosed was designed specifically for this application.*

Connecting Instrument to a Terminal

The RJ45 connector on the Rxxx2 (labeled as "**Programming Port**" in Figure 4-1) is used to connect the instrument to a COM port on a desktop or laptop PC. When connected and operating as an ASCII terminal, the PC can be used to program or monitor the instrument output.

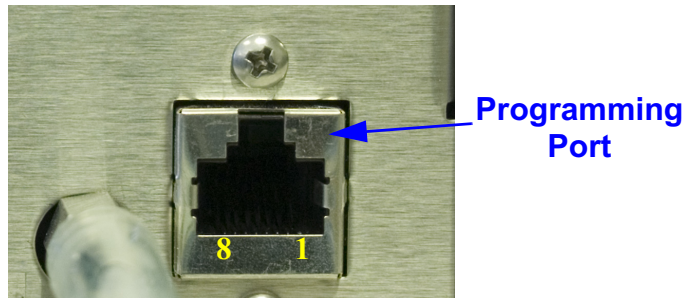


Figure 4-1 The Programming Port Pin Positions

The cover must be opened to gain access to the Programming Port and the REMOTE-2 PN Series system must be power-cycled before any changes made will take effect.

A modular adapter, RJ45 to DB-9, is available from Lighthouse. The pinouts of the adapter are shown in Table 4-1.

RJ45 Pin	Signal Name	DB-9 Pin
1	TX	2
2	RX	3
8	Ground	5

Table 4-1 RJ45 to DB-9 Connections

To connect the instrument to a computer:

1. Open the NEMA cover by turning the cover lock with a thin coin or other suitable device.
2. Turn the Power switch OFF to remove power from the instrument.
3. Connect the RJ45 end of the adapter cable to the Programming Port of the Rxxx2.
4. Connect the DB-9 end of the cable to a COM (Serial) Port on your computer.

5. Start Hyperterminal on your computer and configure the COM Port settings as shown in Figure 4-2. Any available COM Port may be used, not just the one shown.

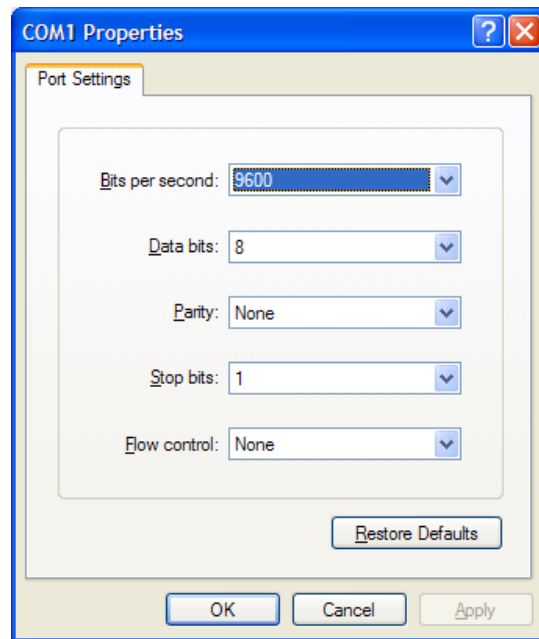


Figure 4-2 COM Port Properties

6. Configure the ASCII settings as shown in Figure 4-3:

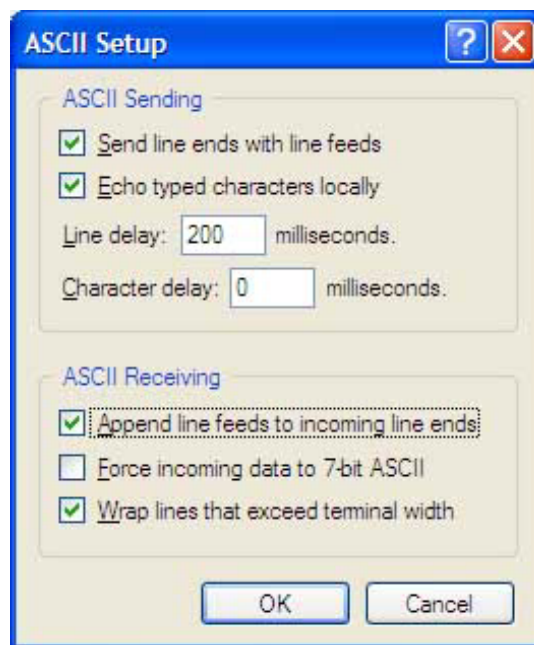


Figure 4-3 ASCII Settings

Power Up

Turn the Power switch ON. The REMOTE-2 PN Series waits for valid programming commands during the first 20 seconds after POWER ON. If no valid commands are received within that time, the instrument recalls its last stored parameters (or default settings) and starts counting.

If a programming command is received within the first 20 seconds, the command is examined and, if valid, the associated parameters are set and stored in non-volatile memory, overwriting the previous values.

The instrument waits another 20 seconds for the next command and the process repeats for each command that is sent. When no more valid commands are received, the timer times out and the instrument loads the stored parameters and uses them to begin counting. Old parameters are used if they were not modified during the program session.

Lighthouse recommends that, before powering up the instrument, a list be made of the commands to be used and parameters to change. This avoids unnecessary time outs.

Sample Session

Hyperterminal should be running BEFORE applying power to the REMOTE-2 PN Series.

1. Apply power to the instrument. The Rxxx2 "program mode" prompt is sent by the unit.
2. The next commands must be performed before the instrument "times out" or the startup steps will have to be repeated.
3. Type: **<v>**-- *this is Verbose mode. This must be the first command sent if you wish to see responses from the instrument*
4. Type: **<?>** -- *the unit's current settings are displayed.*

Note: *The commands discussed require the < (shifted comma) and > (shifted period) characters; they mark the start and end of the commands.*

Note: *The flow rate displayed will be according to the model - 0.1 cfm for the R3012PN and R5012PN or 1.0 cfm for the R3102PN and R5102PN.*

```
<?>
Flow Rate = 1.0 cfm or 0.1 cfm
Sample Time = 5 secs
Range1= 10000.
Range2= 1000.
Service High = 3000 mV
Service Low = 145 mV
Alarm Channel = 1
Alarm Threshold = 1000 counts
Suppress Alarms = 2
Channel 1 = 0.3
Channel 2 = 0.5
```


5. Type: **<m1>** -- *the unit's menu is displayed to show commands to use to change parameters.*

```

<m1>
*** User Menu ***

<?> Display Parameters
<V> Verbose Mode
<sa> Start Counting
<sb> Stop Counting
<gv> Get Version Number
<ra#> Set Range 1 (counts)
<rb#> Set Range 2 (counts)
<ta#> Set Sample Seconds
<aa#> Set Alarm Channel #
<ab#> Set Alarm Threshold (# of counts)
<ae#> Set Alarm Suppression #

```

6. The instrument waits 20 seconds after the last command is received, validated and performed, then begins sampling

ASCII Programming Syntax

The REMOTE 5012PN, 5102PN instrument can be programmed by an ASCII terminal (i.e. Hyperterminal) using the ASCII protocol. The command format is a *start character* followed by a *command* followed by a *terminating character*. Any characters before the *start character*, or after the *terminating character* are ignored. White spaces between *command character* and *command parameter* are ignored.

Command Structure

The commands are defined as single case-sensitive ASCII characters. Format is defined as:

```
<x [yyyy]>
```

where:

< = Start Character

x = Command Character

yyyy = Optional Command Parameter

> = Terminating Character

Note: *The < and > characters are part of the command and must be typed. The brackets [and] are field delimiters and are not typed.*

Note: *All command characters are lower case, except for the V (verbose).*

Handshake

Upon execution of the command, and assuming you have typed **<V>** for Verbose, the REMOTE instrument will send a response based on the value of the counts, suppress alarms, and alarm status. Examples of responses are listed below:

<ERR> = Error in Command String.

-or-

Sample: ch1-2: 0, 0 Range1= 5000, Range2= 2500.

When the unit is powered up, it sets up the counters and timers, and starts reporting data. The data will be similar to this example:

Sample: ch1-2: 0, 0 Range1= 5000, Range2= 2500.

Sample: ch1-2: 0, 0 Range1= 5000, Range2= 2500.

Protocol

Protocol is defined through an RS-232 interface. The hardware protocol is defined as:

Baud Rate: 9600

Data Bits: 8

Stop Bits: 1

Parity: None

Flow Control: None

List of Available Commands

VERBOSE MODE

<V> (the shifted **'**, followed by uppercase **'V'** followed by the shifted **'**.)

By default, VERBOSE MODE is off and the instrument responds with **<OK>** after each command is received and correctly implemented.

Turning on VERBOSE MODE tells the instrument to echo the information to the screen.

VERBOSE MODE is required to program the Rxxx2 but not to run it.

GET CURRENT SETTINGS

<?>

Shows current parameter settings.

Type:

<?>

Response:

Note: *The flow rate displayed will be according to the model - 0.1 cfm for the R3012PN and R5012PN or 1.0 cfm for the R3102PN and R5102PN.*

```
<?>
Flow Rate = 1.0 cfm or 0.1 cfm
Sample Time = 5 secs
Range1= 10000.
Range2= 1000.
Service High = 3000 mV
Service Low = 145 mV
Alarm Channel = 1
Alarm Threshold = 1000 counts
Suppress Alarms = 2
Channel 1 = 0.3
Channel 2 = 0.5
```

DISPLAY MENU OF COMMANDS

<m1>

Shows menu of commands.

Type:

<m1>

Response:

```
<m1>
*** User Menu ***

<?> Display Parameters
<V> Verbose Mode
<sa> Start Counting
<sb> Stop Counting
<gv> Get Version Number
<ra#> Set Range 1 (counts)
<rb#> Set Range 2 (counts)
<ta#> Set Sample Seconds
```

<aa#> Set Alarm Channel #
<ab#> Set Alarm Threshold (# of counts)
<ae#> Set Alarm Suppression #

START/STOP COUNTING MODE

START Counting

<sa>

This will start the device's counting mode. When implemented, the unit will wait until the sample time passes before displaying the sample data.

Type:

<sa>

Response:

```
<sa>START  
Sample: ch1-2: 0, 0 Range1= 10000, Range2= 5000.  
Sample: ch1-2: 0, 0 Range1= 10000, Range2= 5000.
```

STOP Counting

<sb>

This will stop the device's counting mode.

Type:

<sb>

Response:

```
<sb>STOP
```

GET CURRENT VERSION NUMBER

<gv>

Shows current version number of the device firmware.

Type:

<gv>

Response:

<gv> Version: 010

SET CHANNEL RANGES

Note: Range 1 should always be greater than or equal to Range 2; Range 2 should never be greater than Range 1.

<ra#> -- sets upper range of channel 1 where # is the range value

<rb#> -- sets upper range of channel 2 where # is the range value

Sets upper limit to counting range. The upper limit will be equal to 20mA, and the lower range will always be 0 counts = 4 mA. If the counts exceed range limit, the counts will be set to the range limit. The maximum range is 10,000,000.

Type:

<ra10000>

Response:

<ra10000>Range1= 10000.

Type:

<rb7500>

Response:

<rb7500>Range2= 7500.

SET SAMPLE TIME (seconds)

Note: Sample times ≤ 5 seconds are not recommended.

<ta#>

Sets sample time in # seconds, where $\# \geq 1$ and $nnnn \leq 3600$.

Type:

<ta30>

Response:

<ta30>Sample Time = 30 secs

SET ALARM CHANNEL

<aa#>

Sets the alarm channel to channel 1 or 2.

Type:

<aa1>

Response:

<aa1>Alarm Channel= 1

SET ALARM THRESHOLD

<ab#>

Sets Alarm High count threshold for the configured alarm channel. Value # must be less than range in order to set the threshold. Set the value to 0 (zero) to disable alarm.

If the count for the configured alarm channel exceeds the threshold then:

- The red SERVICE indicator on the instrument blinks.
- The EXTERNAL ALARM relay, described below, is set.
- The alarm alert will be seen on the ASCII terminal as illustrated next:

Type:

<ab1000>

Response:

<ab1000>Alarm Threshold= 1000 counts

Alarm Alert without Alarm Suppression Example:

Note: *The field bk= 429 in this example is the "backlight" function which is a measurement of scattered light in the instrument. See SET_SERVICE_HIGH and SET_SERVICE_LOW*

In this example, the Alarm Suppress is disabled (0).

```
secs=1: ch1-2: 285, 48 , bk= 429
secs=2: ch1-2: 487, 89 , bk= 429
secs=3: ch1-2: 1699, 1033 , bk= 1049
secs=4: ch1-2: 2572, 1320 , bk= 434
secs=5: ch1-2: 3337, 1575 , bk= 429
```

```
Sample: ch1-2: 3337, 1575 Range1= 10000, Range2= 5000.
Alarms: Threshold= 1000, Channel= 1, # in a row=1
```

```
secs=1: ch1-2: 615, 228 , bk= 434, alarm alert.
```

```
secs=2: ch1-2: 1115, 382 , bk= 429, alarm alert.
secs=3: ch1-2: 1595, 502 , bk= 429, alarm alert.
secs=4: ch1-2: 2029, 637 , bk= 429, alarm alert.
secs=5: ch1-2: 2381, 738 , bk= 429, alarm alert.
```

```
Sample: ch1-2: 2381, 738 Range1= 10000, Range2= 5000.
Alarms: Threshold= 1000, Channel= 1, # in a row=2
```

SET ALARM SUPPRESSION

<ae#>

Sets the alarm suppression for the configured alarm channel. The number of alarm conditions have to be greater than # in order to turn on the Alarm Relay.

For example, if Alarm Suppress is set to 2, then the device won't report an alarm condition via the external alarm output or the flashing service light until the 3rd consecutive alarm condition.

Type:

<ae2>

Response:

```
<ae2>Suppress Alarms = 2
```

Alarm Alert with Alarm Suppression Example:

In this example, the Alarm Suppress is set to 2.

```
<ae2>Suppress Alarms = 2
```

```
secs=1: ch1-2: 0, 0 , bk= 429
secs=2: ch1-2: 681, 430 , bk= 2558
secs=3: ch1-2: 1629, 886 , bk= 444
```

```
Sample: ch1-2: 1629, 886 Range1= 10000, Range2= 5000.
Alarms: Threshold= 1000, Channel= 1, # in a row=1
```

```
secs=1: ch1-2: 828, 517 , bk= 1640
secs=2: ch1-2: 1861, 1230 , bk= 434
secs=3: ch1-2: 3149, 2177 , bk= 449
```

```
Sample: ch1-2: 3149, 2177 Range1= 10000, Range2= 5000.
Alarms: Threshold= 1000, Channel= 1, # in a row=2
```

```
secs=1: ch1-2: 450, 126 , bk= 434
secs=2: ch1-2: 1279, 530 , bk= 444
secs=3: ch1-2: 1875, 678 , bk= 439
```

Note: *The first line starting with "Alarms" (in boldface) shows what the current alarm threshold is, which channel is set for alarming and how many alarm conditions in a row have occurred.*

```
Sample: ch1-2: 1875, 678 Range1= 10000, Range2= 5000.  
Alarms: Threshold= 1000, Channel= 1, # in a row=3
```

Note: *The "alarm alert" (in boldface) doesn't display until after the 3rd consecutive alarm condition; the external alarm light goes on at this point as well.*

```
secs=1: ch1-2: 697, 131 , bk= 439, alarm alert.  
secs=2: ch1-2: 1215, 227 , bk= 434, alarm alert.  
secs=3: ch1-2: 1505, 302 , bk= 439, alarm alert.
```

```
Sample: ch1-2: 1505, 302 Range1= 10000, Range2= 5000.  
Alarms: Threshold= 1000, Channel= 1, # in a row=4
```

Service High and Service Low

Service High and Service Low are the voltage levels at which the Service Light will go on. Those levels are compared to the "Backlight" measurement (seen as the bk= 1455 field) in every sample period. If the Backlight measurement is greater than Service High or less than Service Low, then:

Note: *The "normal" levels seen in these "bk" fields are examples only and are not necessarily what you will see with your instrument.*

- the service alert appears as seen in the following Hyperterminal Service Alert example:
- J10 pins 1 and 2 (Chans 1 and 2) = 2mA
- the Service Light is turned on

The default Service High threshold is 3500.

Service Alert Example:

```
secs=1: ch1-2: 667, 214 , bk= 463  
secs=2: ch1-2: 2262, 1395 , bk= 449  
secs=3: ch1-2: 2890, 1608 , bk= 434  
secs=4: ch1-2: 4719, 2983 , bk= 4995, service alert.  
secs=5: ch1-2: 4719, 2983 , bk= 4995, service alert.
```

```
Sample: ch1-2: 4719, 2983 Range1= 10000, Range2= 5000.  
Alarms: Threshold= 1000, Channel= 1, # in a row=1
```

Service Menu

The Service Menu is available by typing **<ms>**.

Type:

```
<ms>
```

Response:

```
<ms>  
*** Service Menu ***  
<ia> Don't show 1 sec data  
<ib> Show 1 sec data  
<gb> Get Bkgnd
```


DON'T SHOW 1 SEC DATA**<ia>**

Turns OFF 1 second data display.

Type:

<ia>

Response:

`<ia>Don't show 1 sec data.`

After starting the counter with <sa>, the device will wait until the sample time interval passes before displaying the first sample.

SHOW 1 SEC DATA**<ib>**

Turns ON 1 second data display.

Type:

<ib>

Response:

`<ib>Show 1 sec data.`

After starting the counter with <sa>, the device will show the samples collecting every second.

```
secs=1: ch1-2: 0, 0. , bk= 424
secs=2: ch1-2: 0, 0. , bk= 424
secs=3: ch1-2: 0, 0. , bk= 424
secs=4: ch1-2: 0, 0. , bk= 424
secs=5: ch1-2: 1, 0. , bk= 424
```

This mode can be used to view the data on a second-by-second basis for troubleshooting.

GET BACKGROUND LIGHT VALUE**<gb>**

Displays the current background value in milli-volts (mV).

5

Technical Data

Introduction

This chapter describes the operation and programming of the instrument.

Control Design

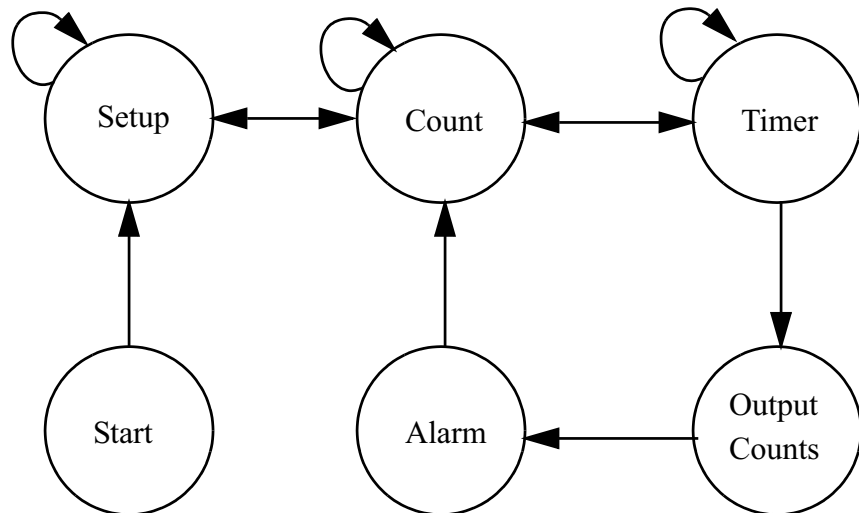


Figure 5-1 States for the REMOTE-2 PN Series Particle Counter

START

- Starts microprocessor, and initializes hardware.

SETUP

- The REMOTE-2 PN Series ships in Program Mode:

During the first 20 seconds, the unit waits for programming commands. If any programming commands are received within the first 20 seconds, those commands will be examined and executed. If the commands are valid, the parameters will be set. If no

commands are received or an invalid command is received, the instrument will recall its last stored parameters (or default settings) and continue to use them.

Startup Example:

Lighthouse Remote Instrument (4-20mA) :

```
Sample Time = 60 secs
Range1= 10000.
Range2= 1000.
Alarm Threshold = 750 counts
Suppress Alarms = 2
Service High = 3500 mV
Service Low = 125 mV
```

COUNT

The instrument uses setup parameters to run, collect data, and output count and alarm data. Zero particle counts will be represented by 4mA, and counts equal to the upper range will be 20mA. The current output will have a direct linear relationship to the range.

- $I_{out} = 16mA(\text{counts}/\text{range}) + 4mA$
- $V_{out} = I_{out}(R\text{-load})$
- If a Service Alert occurs, both channels are set to 2mA.

TIMER

Keeps track of time relative to sample seconds, and outputs sample data every SampleSecs.

OUTPUT

- Outputs counts on CH1 and CH2 lines in 4-20 mA output currents.
- When counts are greater than the alarm threshold, after a "suppress" # of consecutive alarm conditions, the Alarm Relay is turned on.

ALARM

If the CH1 or CH2 count exceeds the programmed ALARM threshold then:

- The red SERVICE indicator on the instrument blinks.
- The EXTERNAL ALARM relay, described below, is set.

SERVICE ALERT

If the service/background light voltage is greater than the Service High, or less than Service Low limits, then:

- CH1 and CH2 outputs are set to 2mA.
- The red SERVICE indicator on the instrument is turned on steady.
- If STATUS = 4 mA ==> No Alarms and No Service Alerts.

EXTERNAL ALARM

An ALARM condition, as described above, also closes a relay inside the instrument. Contacts of that relay are connected to the DATA connector, pins 8 (-) and 9 (+). The user may use an external power supply and a buzzer or light stick to provide local indication of an alarm condition. The contacts are rated at 40VDC, 1A maximum.

6

Maintenance Procedures

This Chapter provides procedures to perform to maintain the REMOTE 'PN' instruments.

Safety

Before performing any of the maintenance tasks described in this chapter, review the safety warnings supplied throughout this manual.

Calibration

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

Exterior Cleaning

This procedure may be superceded by customer requirements; however, not not under any circumstances apply Acetone to the REMOTE 'PN' instrument.

1. To keep the interior of the laser sensor clean, remove the isokinetic probe or tubing from the air inlet, as needed, and install the protective plastic cap supplied with the instrument.
2. Moisten a lint-free cloth with isopropyl alcohol. The cloth should be moist, not wet.
3. Wipe down the exterior surfaces of the instrument.

Purge Test

1. Connect the Purge filter to the sample inlet. The purge filter should be a 0.1 micron 0.1 CFM, 1.0 CFM or 2.0 CFM filter, as appropriate for the instrument. ***Using a filter that does not match the instrument rated flow may damage the filter, the instrument or both.***
2. Apply power to the instrument.
3. Configure the unit via the user interface 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 via the user interface to sample for 5 minutes and set a 10 second hold.
6. Set Cycles to 10 so the instrument will take 10 five-minute samples.
7. If an average of more than one count per five minute sample is reported, reset the instrument to sample for 30 minutes again to purge it, then repeat the Purge Test again.
8. After the instrument has met the requirement of the Purge test, return the instrument to its normal location and operating status.
9. If the instrument still fails the Purge Test, contact Lighthouse Tech Support for assistance.

A 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.
- C. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER REPRESENTATIONS, WARRANTIES AND COVENANTS, EXPRESS OR IMPLIED WITH RESPECT TO THE EQUIPMENT AND ANY DEFECTS THEREIN OF ANY NATURE WHATEVER, INCLUDING AND WITHOUT LIMITATION WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. LWS SHALL NOT BE LIABLE FOR, AND BUYER ASSUMES ALL RISK OF, ANY ADVICE OR FAILURE TO PROVIDE ADVICE BY LWS TO BUYER REGARDING THE EQUIPMENT OR BUYERS USE OF THE SAME. UNDER NO CIRCUMSTANCES SHALL LWS BE LIABLE TO BUYER UNDER ANY TORT, NEGLIGENCE,

STRICT LIABILITY, OR PRODUCT LIABILITY CLAIM AND BUYER AGREES TO WAIVE SUCH CLAIMS. LWS's SOLE AND EXCLUSIVE LIABILITY AND BUYERS SOLE AND EXCLUSIVE REMEDY, FOR ANY NONCONFORMITY OR DEFECT IN THE PRODUCTS OR ANYTHING DONE IN CONNECTION WITH THIS CONTRACT, IN TORT, (INCLUDING NEGLIGENCE), CONTRACT, OR OTHERWISE, SHALL BE AS SET FORTH IN THE SUBSECTION A HEREOF AS LIMITED BY SUBSECTION B HEREOF. THIS EXCLUSIVE REMEDY SHALL NOT HAVE FAILED OF ITS ESSENTIAL PURPOSE (AS THAT TERM IS USED IN THE UNIFORM COMMERCIAL CODE) PROVIDED THAT THE SELLER REMAINS WILLING TO REPAIR OR REPLACE DEFECTIVE EQUIPMENT (AS DEFINED IN SUBSECTION A) WITH A COMMERCIALY REASONABLE TIME AFTER RECEIVING SUCH EQUIPMENT. BUYER SPECIFICALLY ACKNOWLEDGES THAT SELLER'S PRICE FOR THE EQUIPMENT IS BASED UPON THE LIMITATIONS OF LWS'S LIABILITY AS SET FORTH IN THIS CONTRACT.

Warranty Of Repairs After Initial Two (2) Year Warranty:

- A. Upon expiration of the initial two-year warranty, all parts and repairs completed by an authorized Lighthouse repair technician are subject to a six (6) month warranty.
- B. Other than the above, LWS makes no warranty of any kind, expressed or implied, except that the products manufactured and sold by LWS shall be free from defects in materials and workmanship and shall conform to LWS's specifications; Buyer assumes all risk and liability resulting from use of the products whether used singly or in combination with other products. If instrument is modified or in any way altered without the explicit written consent of LWS, then the warranty is null and void.
- C. WARRANTY REPAIRS SHALL BE COMPLETED AT THE FACTORY, BY AN AUTHORIZED SERVICE LOCATION, BY AN AUTHORIZED SERVICE TECHNICIAN, OR ON SITE AT BUYER'S FACILITY BY A LIGHTHOUSE AUTHORIZED EMPLOYEE. BUYER PAYS FREIGHT TO FACTORY; SELLER WILL PAY STANDARD RETURN FREIGHT DURING THE WARRANTY PERIOD. BUYER MAY SELECT A FASTER METHOD OF SHIPMENT AT ITS OWN EXPENSE.

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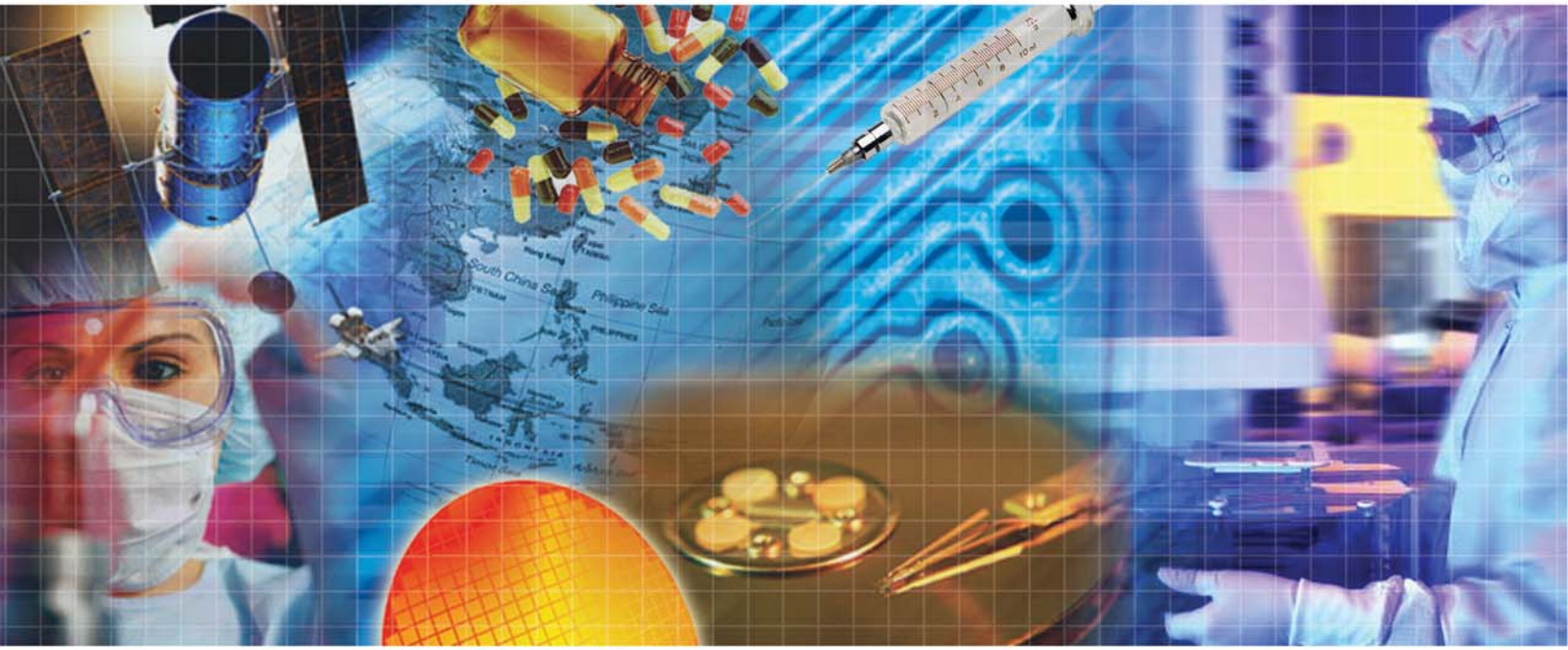
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