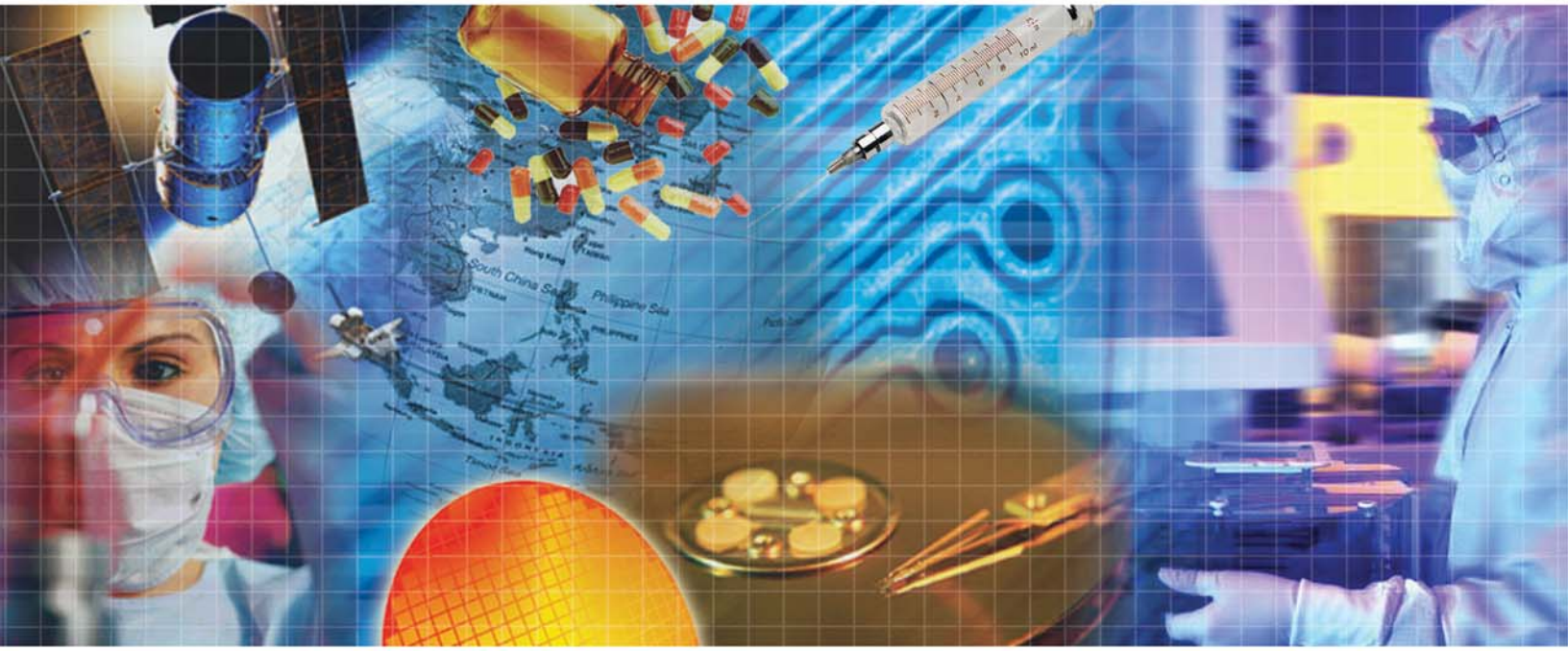


LIGHTHOUSE
WORLDWIDE SOLUTIONS
Technology That Counts!

NanoCount 30+
Liquid Particle Counter

Operating Manual

Lighthouse Worldwide Solutions

NanoCount 30+ Liquid Particle Counter

Operating Manual

Manufactured by:

Lighthouse Worldwide Solutions

1221 Disk Drive

Medford, Oregon 97501

LWS Part Number: 248083427-1 Rev 4

LIGHTHOUSE
WORLDWIDE SOLUTIONS

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: Liquid Particle Counter
Model Number(s): NanoCount 30+

Conforms to the following Product Specifications:

SAFETY	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
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	Electrical Equipment for Measurement, Control and Laboratory Use EMC Requirements Part 1: General Requirements Includes Amendment A1:1998; IEC 61326:1997 + A1:1998

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. October2, 2012

William Shade - V.P. Engineering

Table of Contents

About this Manual

Chapter 1 General Safety

Chapter 2 Introduction

Chapter 3 Getting Started

Chapter 4 Communications

Chapter 5 Operating the NC30+

Chapter 6 Programming with MODBUS Protocol

Appendix A NC30+ MODBUS Register Map v1.45

Appendix B Maintenance

Appendix C Limited Warranty

Index

About this Manual

This manual describes the operation and use of the Lighthouse NanoCount 30+ (***NC30+***).

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 warns that doing something incorrectly could result in personal injury, damage to the instrument or loss of data.***

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

Hexadecimal numbers are shown with the word “hex with a small “h” following the digits. For example:

```
hex 0D
0Dh
```

Additional Help

For more information about the Lighthouse NanoCount 30+ Liquid Particle Counter, contact Lighthouse Worldwide Solutions.

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

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 1-800-945-5905 (USA Toll Free), 1-541-770-5905 (Outside of USA).

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

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

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

Figure 1-1 NC30+ **Power Input Connector**

Electrostatic Safety Information

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

2 *Introduction*

Overview

This operating manual introduces you to the Lighthouse NanoCount 30+ Liquid Particle Counter. Included in this manual are instructions for installation, operation, communications and maintenance.

Interchangeable Terms

Throughout this document, the NanoCount 30+ may be referred to as the ***NanoCount 30+, NC30+, NanoCount, particle counter*** or ***instrument***. For simplicity, these terms are interchangeable and mean the same thing.

Description

The NanoCount 30+ features channel sizes of 30, 50, 80 and 100nm and supplies continuous data collection using the RS-485 MODBUS, Ethernet MODBUS/TCP and 4-channel 4-20mA protocols.

With a user-controlled flow rate of 80 ml/min., ± 5%, the NanoCount 30+ is designed to accurately measure up to 4 channels of simultaneous particle counts in deionized water. See Figure 2-1.

Figure 2-1 The NanoCount 30+ Liquid Particle Counter

The instrument uses a laser diode light source and laser beam shaping optics to illuminate a cross section of the liquid flow path. As particles move through the flow cell, they enter the laser beam and scatter light. The scattered light is collected by the optical system and imaged onto a photodiode. The photodiode converts the light into current which is converted to voltage and amplified by the electronics.

The result is a voltage pulse each time a particle crosses the laser beam. The width of the pulse is proportional to the time it takes the particle to cross the laser beam and the pulse's amplitude is proportional to the size of the particle.

The voltage pulses created by the particles are processed by additional electronics to quantify the pulses by the size of each particle. The quantities of the various sized particles are processed and stored in the sensor's buffers or transferred via MODBUS.

The ***NC30+*** counters were created for continuous, 24 hours per day, 7 days per week operation. The instrument provides versatile mounting options allowing installation where space is at a premium. The ***NC30+*** integrates seamlessly with many large facility monitoring or management systems and transfers up to 4 channels of simultaneous particle count data using the RS-485 MODBUS output.

Accessories

You can order several accessories to tailor the instrument to your needs. Contact your distributor or sales representative at 1-510-438-0500 for additional information and datasheets.

NanoCount 30+ Specifications

Table 2-1 NanoCount 30+ Specifications

Size Range	30nm - 100nm
Channel Thresholds	Standard: 30, 50, 80, 100 nm
Flow Rate	80 ml/min, ± 5%, User-controlled
Laser Source	Solid State Diode
Calibration	NIST Traceable
Data Storage	3000 Samples
Communication Modes	Ethernet MODBUS TCP/IP, RS-232 via RJ45 to PC, RS-485 MODBUS
Display	TFT
Supporting Software	Lighthouse Monitoring System, LMS Net XChange, LMS Express and LMS Express RT
Concentration Limit	1,000,000 counts/ml @ 5% Coincidence Error
Power Input Requirements	100-240VAC
Enclosure	Stainless Steel
Sample Inlet/Outlet Connection	1/4” Flare
Sample Temperature	32 - 122°F (0 - 50°C)
Sample Pressure	75 PSI max
Wetted Surface Materials	Quartz, PFA, Kel-F, Kalrez, Ryton, Epoxy, Glass, Sapphire, SS316L
Communication Protocol	Ethernet, RS-485 MODBUS, four 4-20mA Analog Outputs
Dimensions	15.0"(W) x 12.0"(h) x 25"(D) [38.1 x 30.48 x 63.5cm]
Weight	71 lbs. (32.2 kg)
Operating Temp/RH	50° F to 95° F (10° C to 35° C) / 20% to 95% non-condensing
Storage Temp/RH	14° F to 122° F (-10° C to 50° C) / Up to 98% non-condensing

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

NanoCount 30+ Chemical Compatibility

The NanoCount 30+ with integrated flow control is designed for particle detection in deionized water. Contact Lighthouse Technical Support before attempting to sample other liquids. ***Failure to heed this restriction may result in damage to the instrument's flow control and void the warranty.***

Warrantied Operation

The NanoCount 25+ and NanoCount 30+ are designed with the highest levels of sensitivity for detection of ultrafine contamination in pressurized ultrapure water (UPW) systems. This sensitivity also makes these sensors extremely vulnerable to background reflection spikes caused by air gaps in the UPW supply line.

On more than one occasion, air gaps greater than 0.25 inches in length passing through the NanoCount's flow cell have triggered very high background levels from which the units were unable to recover on their own. These faults required RMA servicing for complete realignments (minimum 10 business days not including transit time to and from Lighthouse).

To avoid this fault (and consequential downtime) from occurring with your NanoCount unit, we require the following parameters of their use:

1. These units must only be used on pressurized ultrapure water systems, filtered down to 20nm (10nm preferred). Please refer to Figure 2-1 for pressure limitations.
2. Before powering on the unit, an uninterrupted stream of sample liquid must first be flowing continuously through its sensor. It is strongly recommended that an overnight flush be done (with the unit's power off) at maximum flow each time the unit is first connected to a new supply line.
3. The unit must be powered off before shutting off its sample flow.
4. Trained personnel must always be present and ready to shut off power while the NanoCount is operating, just in case the presence of bubbles is detected.

Without the expressed written consent from Lighthouse Worldwide Solutions' Engineering Department and Service Department, operating your unit outside of these parameters will void its warranty.

For more information on warrantied NanoCount operation, or if you have specific requests for test applications on your NanoCount unit, please contact the Engineering Department at 1-510-438-0500.

3 Getting Started

Initial Inspection

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

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

If the case is not damaged, keep it for reshipping the instrument for its annual factory calibration. ***RETAIN THE INLET AND OUTLET SHIPPING CAPS!***

Annual Calibration

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

Shipping Instructions

Should it become necessary to return the unit to the factory for any reason, be sure to contact Customer Service and obtain a Return Material Authorization (RMA) number. Reference this number on all shipping documentation and purchase orders. After receipt of the RMA, follow the instructions below:

WARNING: ***If the sensor must be returned for service or when it is returned for calibration, the Flow Cell must be flushed with deionized water or reagent grade isopropyl alcohol and blown dry with clean air and the nozzles capped. Any chemicals present in the sensor at the time of shipping require specific hazardous materials warnings on the shipping container. A Material Safety Data Sheet (MSDS) must be included for every chemical inside the sensor at the time of its shipment. If the Flow Cell is not clean and dry prior to shipping, it may be damaged (freeze-fracture, dried contaminants) and require replacement during servicing or calibration.***

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

1. Use the original case, nozzle caps and packing materials whenever possible. Refer to www.golighthouse.com/rma for detailed instructions. Remove any attachments and package to prevent physical and ESD damage.
2. If the original case 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 may result in additional repairs being billed to customer. 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.

Cable Build

The NanoCount 30+ is not designed for use in a daisy chain configuration. It is designed to communicate through a single RJ45 connector and must be used in a star (connected to a hub) or a single-point (i.e., connected to a single PC) configuration where the *NC30+* is always the terminating device on the data cable to which it is attached.

Defeating this design by using its data connector as a parallel connection to more than one instrument or as part of a daisy chain network of instruments may result in damage to the NanoCount 30+, which may void its warranty.

The specialized connector required to connect to the NanoCount may be supplied with the instrument in kit form. The end of the network cable that attaches to the instrument should use this connector in order to function properly. This section of the manual will illustrate the connector installation. This cable should be duplicated and labeled as the network for which it is built. Ethernet and RS-485 wiring are basically the same physical wiring but different in wire assignments.

If the instrument will only be used for one network (Ethernet or RS-485), the other connector should be blocked off to prevent accidental use. If network use may change periodically, the connectors should be labeled, attached to the ***NC30+*** and the other end of the cable disconnected when not in use.

Requirements

The following tools and materials are required to build/attach the sealed industrial RJ45 connection used on the ***NC30+*** and focus on RS-485 usage. Ethernet differs in network hardware.

- Category 5e Unshielded Twisted-Pair 24AWG wire (CAT5e UTP), minimum
- CAT5e UTP plenum wire may be required for installation in ceiling plenum area
- Industrial RJ45 plug kit
- Wire strippers
- RJ45 crimp tool
- RS-485 hub or switch (preferred)

Site Preparation

WARNING: ***Both ends of the cable must be wired the same. References are made throughout this section to the EIA/TIA-568B standard for ethernet/RJ45 wiring that must be followed.***

Failure to wire both ends to this standard will cause failure of the instrument and may damage the instrument, the hub or both and void the respective warranties.

When all needed tools and materials are ready, proceed through the following steps:

1. Check with local regulatory agencies to determine installation restrictions and cable requirements for the application before starting cable runs.

2. Make the necessary cable “runs” and leave about two to three feet at each end as a “service loop”. When pulling CAT5e cable, do NOT allow it to kink or the cable may break internally and cause failures. Typical installations use Unshielded Twisted Pair (UTP) but Shielded Twisted Pair (STP) may be required in areas of high electrical noise equipment, such as generators, fans and fluorescent lights. When cable has to be installed in the false ceilings or air space above a work area (plenum), plenum cable may be required.

3. Even though the RJ45 connectors used to build ethernet cables are typically the same for either end, the connector supplied in the kit should be used on the instrument end.

4. If STP wire is needed, the RJ45 required for wire termination is metal-jacketed. This special RJ45 provides a grounding point for the cable's shield. Only one end of the each cable should be grounded. This provides the shield to block electrical noise from entering the wire. Because RS-485 hub have grounded connector housings, the hub end should be used for this ground connection.

Procedure

Figure 3-1 displays the parts to build the Industrial RJ45 cable.

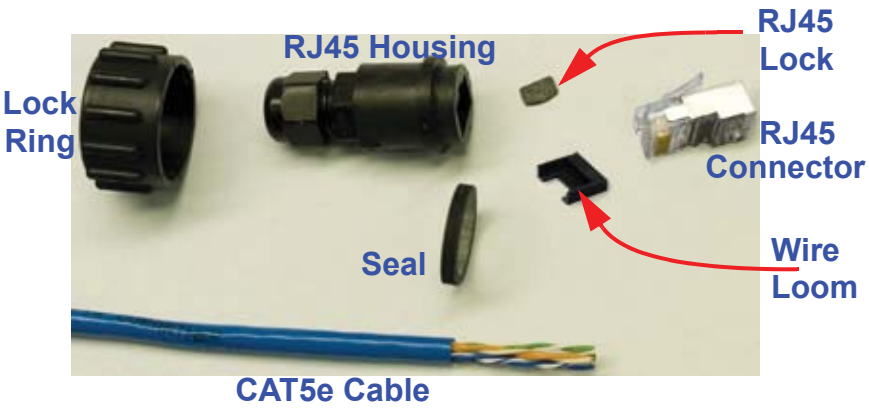


Figure 3-1 Industrial RJ45 Cable Parts

1. Strip 1-1/2-inch to two-inches of insulation from the end of the cable, taking extreme care to not nick or cut the individual wires. Do NOT strip the individual wires.

2. Remove the contents of the Industrial RJ45 connector from the package - do NOT dispose of or lose any pieces. Compare the contents with Figure 3-1. Contact Lighthouse Support if it appears that something is missing from the package or replacements are needed.

3. Remove the large lock ring from the housing if they are mated.

4. Loosen the smaller sealing nut to allow the CAT5e cable through.

5. On the instrument end of the cable, push the stripped end of the cable through the large Lock Ring and RJ45 housing as illustrated in Figure 3-2. Make sure the ring is oriented as shown. If it is reversed, the cable may have to be cut, the RJ45 connector discarded and a new connector installed.

Figure 3-2 Housing with Cable Inserted

6. Separate the pairs of wires down to the cable's insulation. There will be an orange, a green, a blue and a brown pair of wires. Each pair will have a solid color wire and one striped wire of the pair color. Do not get them confused - the orange and brown pair may look alike in plenum cable and "swapping" these two pairs will cause failure of the cable.

7. Carefully untwist each pair and straighten the wire. The individual wires will be inserted into the Wire Loom shown in Figure 3-1 and Figure 3-3. Note the Loom's flat tray shape. Insert the wires into the loom based on the EIA/TIA-568B standard as shown in Figure 3-4.

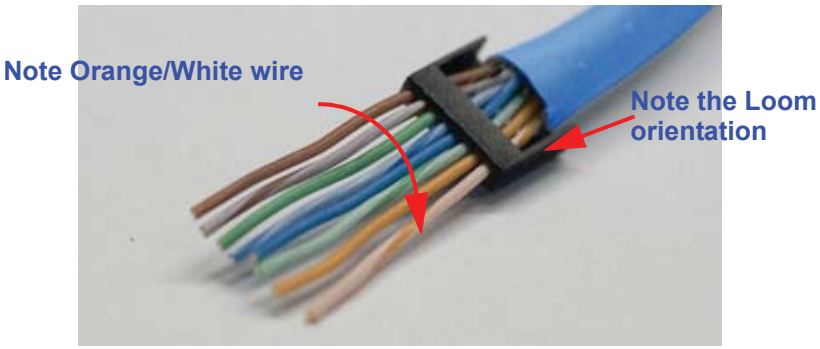
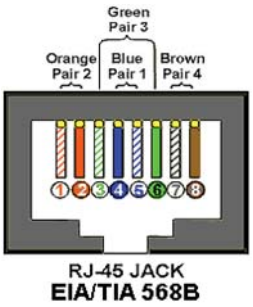


Figure 3-3 Close-up of Wire Loom

8. Note that the green pair is split up and the blue pair is out of sequence (solid color then striped) and between the green-pair wires. When all of the wires are in the correct holes, push the loom onto the wires as far as it will go and verify that at least one-quarter-

inch of each wire extends beyond the edge of the loom. This allows for trimming the wires in a straight line parallel to the loom edge. One-eighth-inch is required for crimping into the RJ45 connector so, in step 9, do not trim shorter than one-eighth-inch. Review the photos in Figure 3-4 to ensure accuracy.



View is from RJ45 opening

View is tab facing reader

Figure 3-4 EIA/TIA-568B Color Code Example

Note: *The "pairing" of wires in the loom changes at positions 4 through 6.*

9. Continue to push the cable into the loom and trim the ends of the wires in a straight line to one-eighth-inch as illustrated in the center panel of Figure 3-4.

10. Insert the wires/loom into the RJ45 connector (lock tab facing down) as shown in Figure 3-5 and push inward until the wire ends fully butt against the ends of the wire channels. The loom helps to keep the wires positioned so they will go into the correct channels for crimping.

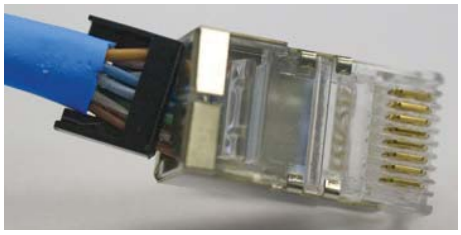


Figure 3-5 Loomed Wires Being Inserted into RJ45

11. Insert the RJ45 connector into a crimp tool similar to that shown in Figure 3-6. Maintain inward pressure while crimping the wires into their channels.

Figure 3-6 Typical RJ45 Crimp Tool

12. Check the cable wire ends in the RJ45 to make sure they have been crimped properly. Removing the connector at this point is a lot easier than after everything is installed and communication with the instrument is failing due to a poor crimp. Review Figure 3-7 for an illustration of how tightly the wire ends should be against the ends of each channel.

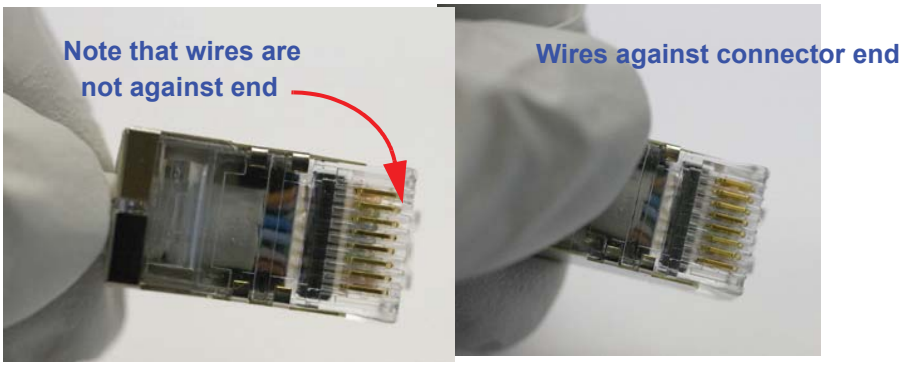


Figure 3-7 Close-up of RJ45 Wire Detail

13. Pull on the cable to bring the RJ45 into the connector housing. Make sure to squeeze the latch tab to allow it to enter the slot in the housing as shown in Figure 3-8).

Figure 3-8 Close-up of RJ45 Latch

14. Push the RJ45 connector fully into the housing and insert the Lock Clip, round edge out, as illustrated in Figure 3-9.

Figure 3-9 Lock Clip Installation

15. Hand tighten the housing cable clamping nut until snug. See Figure 3-10.

Figure 3-10 Tighten Cable Clamp Nut

16. Install the sealing ring onto the front of the connector housing. This seal is held in place when the connector is locked onto the instrument. See Figure 3-11.

Figure 3-11 Install Connector Seal

17. Slide the large lock ring down the cable and over the cable housing body. It may need a twisting action to fully position it against its retainer ring. Verify that its larger opening is facing outward, away from the cable. See Figure 3-12.

Figure 3-12 Cable Connector Completed

18. The hub end of the cable run can now be terminated. The wire should be checked with an ethernet 100baseT cable tester (not just a continuity tester) to ensure that the signals, power and ground will be reliable. Steps 6 through 12 can be used as a reference for termination of the hub end.

19. Make sure the hub power is OFF or the hub end of the cable is disconnected from the hub before connecting the cable to the instrument.

Instrument Overview

NC30+ Front Connections

Inlet and Outlet Nozzles

The Inlet and Outlet Nozzles on the front of the instrument use ¼" flare tubing and allow the liquid sample to flow to and from the system being sampled. See Figure 3-13.

Figure 3-13 NC30+ Front Connections

NC30+ Flow Control and Meter

The Flow Control includes a digital flow indicator to enable adjusting the liquid flow to 100 ml/min. With tubing connected to the instrument, turn the flow control valve fully counter-clockwise to purge air from the ***NC30***+. This prevents erroneous counts. See Figure 3-14.

Figure 3-14 NC30+ Flow Control

Adjust the flow to 80 ml/min while viewing the screen as shown in Figure 3-15.

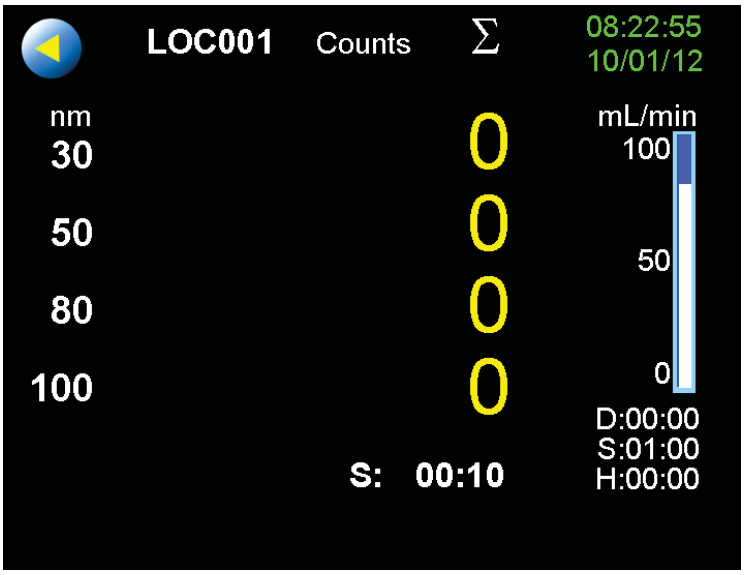


Figure 3-15 Flow meter set to 80 ml/min

NC30+ Rear Panel Connections

Figure 3-16 shows the rear panel connections.

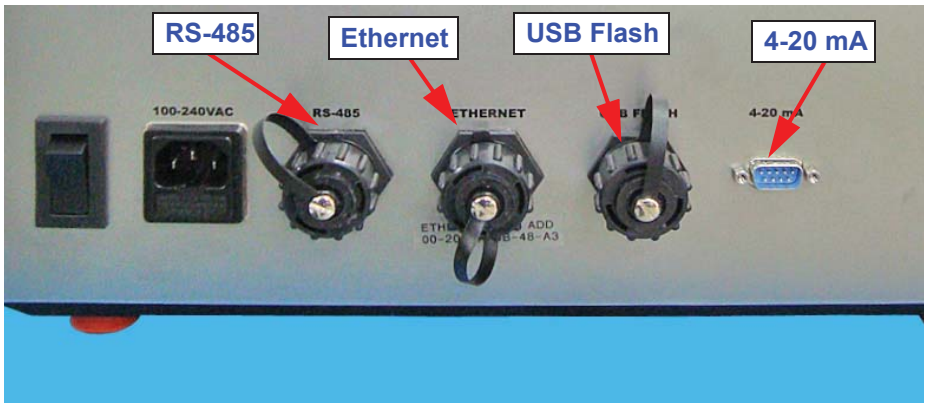


Figure 3-16 NC30+ Rear Panel Connections

Communication Ports

WARNING: ***Do NOT attempt to use both the Ethernet and RS-485 ports at the same time - data loss on both networks may occur in addition to damage to the instrument or network hardware.***

RS-485

- This port works with RS-485 only and allows gathering of data and full control of the unit through software such as LMS Express and LMS Net.
- Reprogramming the unit functions is possible through this interface.

Ethernet

- This port works with Ethernet LANs and allows data gathering via programs such as LMS Express and Facility Monitoring System.
- Simple "Start/Stop" commands may be issued to the ***NC30+*** via Ethernet and the afore-mentioned software. Reprogramming the unit is not fully possible.

USB Flash

- A standard Flash Drive can be attached to the USB-A port. The data can be downloaded via the Data Output screen in either a *CSV or *LSD format.

4-20mA

- This standard industry interface allows only simple data gathering functions.

WARNING: ***The NC30+ is not designed for daisy-chaining. Doing so may damage the sensor and void your warranty.***

The RS-485 protocol is provided as a default protocol for industrial applications with multiple devices on the same bus and requires an adapter when used with a PC. The Communication Port connector allows easy connection using standard CAT 5 patch cables commonly used for office LANs. Connecting the counter to a PC via RS-485 requires an RS-485 to RS-232 converter, cables, connectors and terminator; please contact your Lighthouse Sales Representative for the LWS RS-485 converter kit.

For more information, please see Chapter 4, "Communications".

Device Address

The RS-485 address of the instrument is preset at the factory to '1' and changes are made via the touch screen.

Power

The NanoCount 30+ uses an IEC power cord for 100-240 VAC power.

Attaching the Sensor Lines

This section provides instructions on how to attach the liquid source and drain lines to the Inlet and Outlet nozzles on the sensor. Refer to previous sections of this chapter for electrical connection information.

WARNING: ***Please follow the standard precautions for working with liquids around electronic components.***

Use of safety measures when working with liquids around electronics cannot be stressed enough. Make sure the NC30+ is physically secure before connecting any tubing or electrical cables. Use Personal Protection Equipment, such as face shields, protective garments and gloves, whenever working around hazardous liquids.

1. Make sure that there is no flow of liquid in the system and power is removed from the ***NC30+***.

Note: *When connecting flare fittings to the NC30+, do **NOT** use a wrench or other tool to tighten the flare nut! Doing so will damage the instrument, tubing or nut. The connections **MUST** be **finger-tight** only.*

2. Connect the liquid source to the ***NC30+***'s Inlet nozzle using the provided ¼" flare tubing. Make sure the tubing is inserted firmly onto the nozzle and the knurled nut is finger tight only.

3. Connect the liquid drain to the ***NC30+***'s Outlet nozzle using the provided ¼" flare tubing. Make sure the tubing is inserted securely onto the nozzle and the knurled nut is finger tight only.

4. Turn the liquid system on and allow liquid to flow through the ***NC30+***, making sure that there are no leaks at the sensor's inlet or outlet or any other connections.

WARNING: ***If a leak occurs anywhere within the system, immediately stop the flow of liquid and repair the leak!***

5. If leaks occur, immediately stop the flow of liquid. Disconnect and clear the flare fittings and connectors of debris or burrs. Repair any other leak(s) and return to Step 1 of this section.

6. If no leaks occur, connect power to the ***NC30+***.

7. Make sure the sample liquid is bubble-free - bubbles will be counted as particles and in large amounts may cause sensor errors.

8. Allow liquid to flow through the sensor for 10 minutes or until there are no bubbles and the Service LED is OFF. If the Service LED comes on and remains on, the flow cell should be cleaned (see *Appendix B, "Maintenance"* for cleaning instructions).

9. If there are no leaks and the service LED is off, the instrument is ready to configure the communications - refer to *Chapter 4, "Communications"*.

10. Adding devices or additional connections between the sample source and the sensor will increase the chances for leaks and bubbles - keep connections to a minimum.

Inlet Connection to Sample Source

Note: ***The user is responsible for maintaining a nominal flow rate of 80 ml/min. ± 5% through the sensor.***

The sample source is connected to the instrument using ¼" flare tubing attached to the Inlet Nozzle. The user is responsible for maintaining a nominal flow rate of 80 ml/min. ± 5% through the sensor to ensure the accuracy of the data. See Figure 3-17.

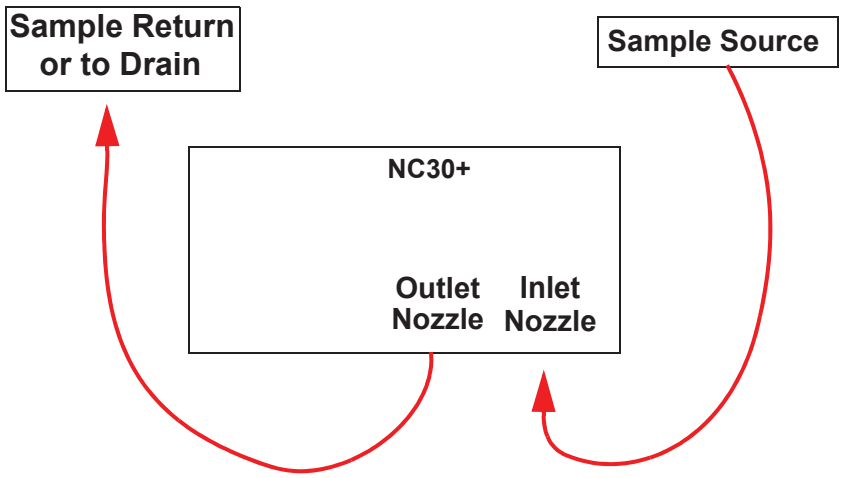


Figure 3-17 Example of an *NC30+* Installation

If there are any questions or problems during system setup, please contact Lighthouse Worldwide Solutions' Technical Support at 800-945-5905 (USA Toll Free), 541-770-5905 (Outside of USA) or techsupport@golighthouse.com.

4 Communications

This chapter describes how to set up and program the ***NC30+***.

Communications

Rear Data Ports

Figure 4-1 shows the ***NC30+*** communication ports, power connector and power switch located on the rear panel of the ***NC30+***.

WARNING: ***The NC30+ is not designed for daisy-chaining. Doing so may damage the sensor and void its warranty.***

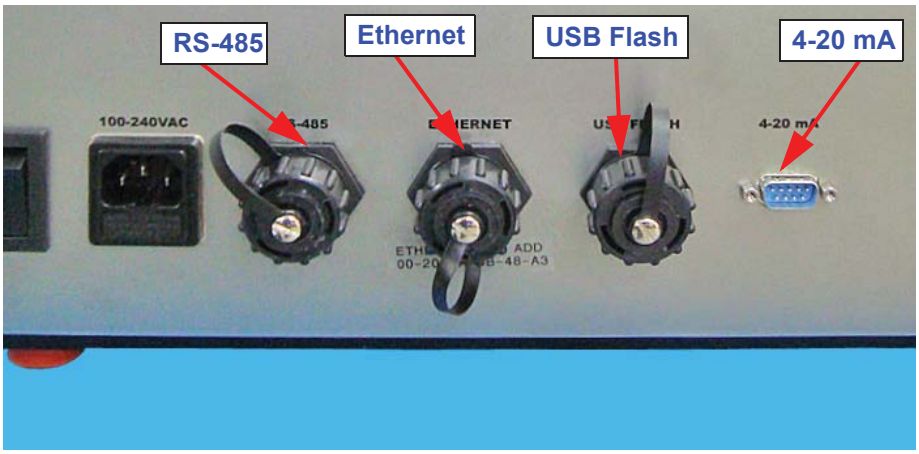
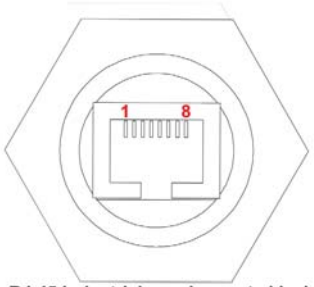


Figure 4-1 NC30+ Rear Panel Connections

Industrial RS-485 RJ45

The RS-485 RJ45 data connector (Figure 4-2) can be used to connect the unit to a COM port of a desktop or laptop PC and RS-485 signals. Its primary purpose is to connect to an RS-485 network and is sealed to prevent liquid or gas infiltration into the NEMA style enclosure.



RJ-45 industrial panel mounted jack

Pin / Wire Color		Signal
1	White/Orange	RS232 - TX
2	Orange	RS232 - RX
3	White/Green	Reserved
4	Blue	RS485 - B
5	White/Blue	RS485 - A
6	Green	Reserved
7	White/Brown	Reserved
8	Brown	GND

Figure 4-2 RS-485 Port Pin Assignments

RS-232 Communications

The instrument can use RS-232 as a communication mode by using the optional USB to RS-232 Converter cable. The cable is connected to the RS-232/RS-485 COM port on the NanoCount and to any USB port on a PC.

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

Identify the computer port that has been added to the PC by using the "Properties" of My Computer and examining the COM ports. USB ports are generally added to the bottom of the list and named "USB COM port 'x'. Refer to Figure 4-3 for screen examples (Windows XP).

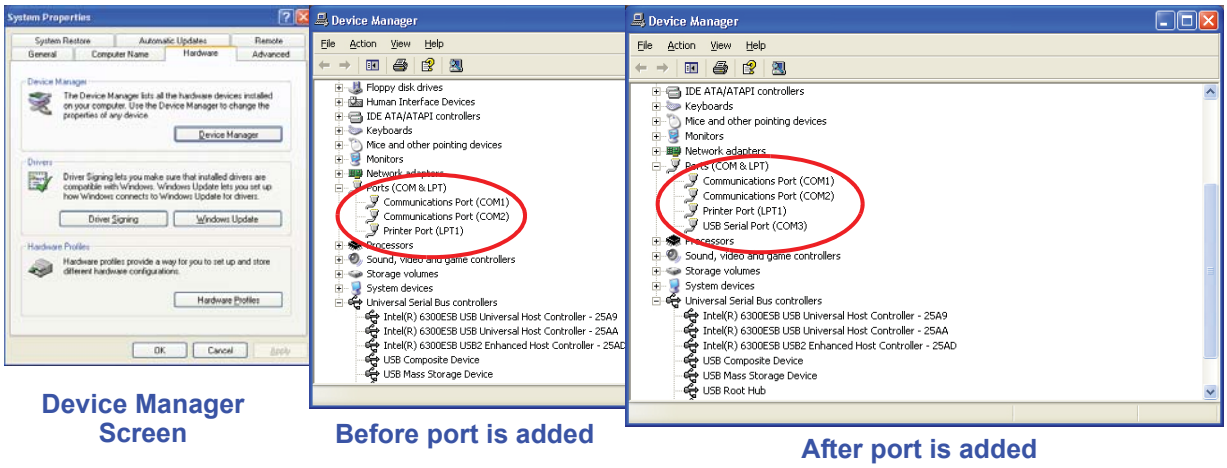


Figure 4-3 Example Device Manager Screens

Use LMS XChange or LMS Express/Express RT to connect to the instrument and retrieve data from it. Use the port assignment determined in Device Manager.

WARNING: ***The NC30+ is not designed for daisy-chaining. Doing so may damage the sensor and void its warranty.***

RS-485 Communications

The instrument utilizes RS-485 as its primary communication, which is especially beneficial when the distance to the computer is more than 50 feet and when the instrument is used in a multi-point network configuration.

For connecting the instrument to a large-scale RS-485 network refer to "Cable Build" on page 3-2 for instructions on building the Industrial RJ45 cable.

If the RS-485 protocol will be used with a computer COM port, then an RS-485 converter must be used in the 2-wire configuration with ChB+ wired to the Cat5 cable pin 4, and ChA- wired to pin 5. Please contact your Lighthouse Sales Representative for an RS-485 converter kit that includes the cables, connectors and terminals.

Connecting to a PC

Refer to Figure 4-4 illustrating the LWS RS-485 Converter Kit.

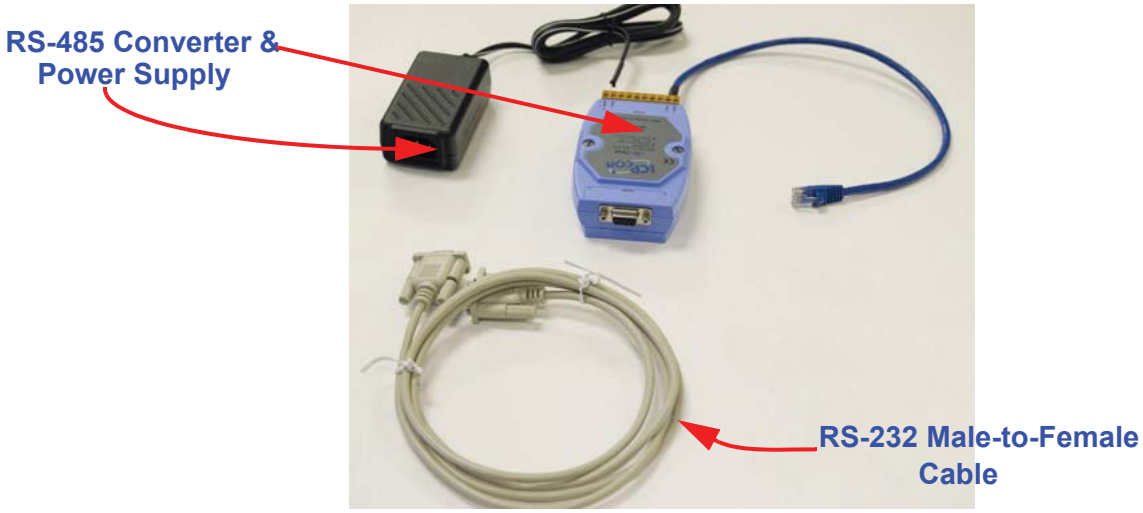


Figure 4-4 LWS RS-485 Converter Kit Example

1. Disconnect power from the instrument.
2. Connect one end of a standard Cat5 cable to an LWS RS-485 converter.
3. Connect the other end of the Cat5 cable to the Communication port on the instrument.
4. Connect the RS-232, DB9 side of the RS-485 converter to a DB9 Male to DB9 Female straight through cable. Connect the female DB9 to any available COM port on the computer.
5. Power on the instrument.

Connecting to an RS-485 Network

To connect a PC to multiple units or RS-485 network, use a Cat5 cable and RS-485 adapter to attach the computer to an RS-485 hub. Connect the instrument to the hub using the Industrial RJ45 cable referred to starting in “Cable Build” on page 3-2.

Make sure that each ***NC30+*** or other RS-485 instrument has a unique address (non-zero) or a conflict will result and data will be lost.

The ***NC30+*** complies with EIA's RS-485 standards as shown in Table 4-1for distances and number of devices.

Refer to "Programming with MODBUS Protocol" on page 6-1 for specific information on using MODBUS to program and communicate with the instrument.

Table 4-1 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 RS85 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)	10Mb/s - 100Kb/s
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

Ethernet Communications

WARNING: ***Connect the Ethernet port ONLY to an Ethernet LAN.***

The Ethernet RJ45 connector provides Ethernet connectivity using the TCP/IP communication protocol. Communicating with the instrument on an Ethernet LAN requires a PC or server running a MODBUS communication package such as LMS Express, Express RT or LMSNet connected to the same LAN. Both must be configured to use the same IP address range, subnet and default gateway. It is strongly advised that the instrument be assigned a static IP so its address does not change and software programs monitoring its data will not lose contact with it due to a DHCP change. Contact the local IT or Network Admin staff for clarification and IP assignment or Lighthouse Technical Support at 1-800-945-5905 (USA Toll Free), 1-541-770-5905 (Outside of USA) for more information.

The instrument can be connected directly to a PC computer Ethernet port by using a crossover cable and coupler for testing and configuration purposes. The Industrial RJ45 build uses 'standard' straight-through cable to attach to an Ethernet hub or switch.

The ***NC30+*** Ethernet interface can connect to an existing or new Ethernet network and uses MODBUS over TCP/IP as its communication protocol. Standard Ethernet hubs, switches, routers and wiring can all be used with the ***NC30+***. However, the cable used for connecting the instrument must be built according to the instructions provided in this manual.

Ethernet RJ45

The Ethernet RJ45 data connector provides standard Ethernet connectivity and is sealed to prevent liquid or gas infiltration into the NEMA style enclosure. Refer to "Cable Build" on page 3-2 for instructions on building the Industrial RJ45 cable.

Ethernet Configuration

The ***NC30+*** comes pre-configured to use DHCP and receive an IP address automatically. This is not a desired configuration - use this section to change these settings.

If you do not understand these terms or the possible impact of changing the NC30+'s settings, do NOT proceed without contacting your facility's IT personnel.

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

The Lighthouse Worldwide Solutions NC30+ family of instruments incorporate MODBUS TCP/IP communication over Ethernet. Connecting a NC30+ particle counter directly to an Ethernet network should only be done with the permission and guidance of the network administrator.

The primary advantage of using the NC30+ on an Ethernet network is that a separate network does not have to be installed just for the instruments. Using the NC30+ Ethernet Port allows the instrument to co-exist with computers, printers and servers on a LAN that is already in place, thereby reducing installation costs.

This section explains how to program the Ethernet port through its TCP/IP or RS-232 interface. It will also list typical equipment required and provide some troubleshooting information. The end of the document includes examples of TIA T568A and T568B wiring diagrams for straight-through and cross-over cables.

Ethernet Setup

Use Lantronix DeviceInstaller to make configuration changes to IP Address and subnet with the NC30+.

1. Start the Lantronix DeviceInstaller program. DeviceInstaller will automatically begin searching for attached devices. The **Hardware Address (MAC Address)** for the NC30+ will be displayed as shown in Figure 4-5.

   - Confirm the device by verifying that the hardware address displayed in DeviceInstaller matches the address below the Ethernet RJ45 connector on the back of the NC30+.

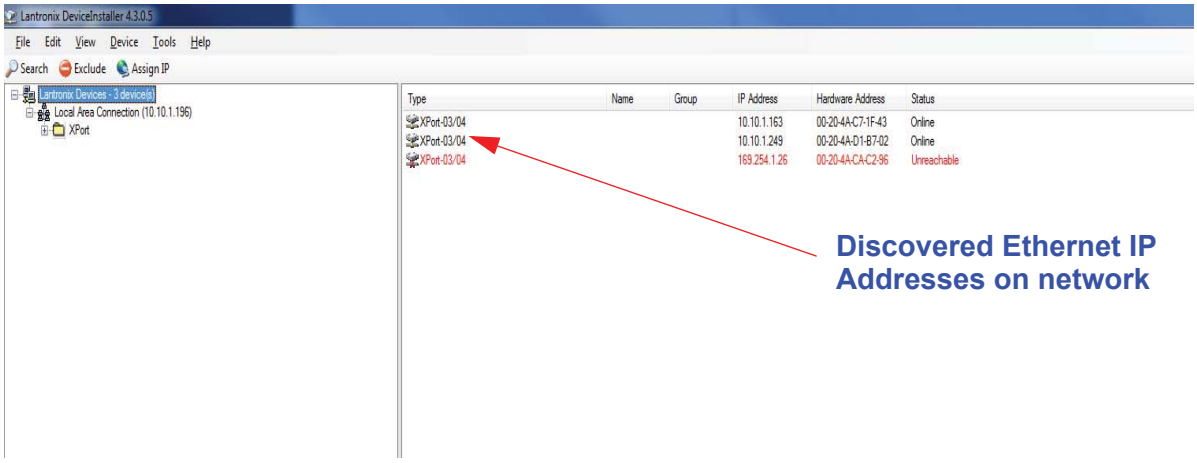


Figure 4-5 Detecting Attached Devices

2. Select and double-click the XPort for the NC30+ to open the Device Details tab. See Figure 4-6.

   - Select the **Web Configuration** tab and then press the green arrow.
   - The Windows Security Login window will open. Select **OK** without entering a username or password.

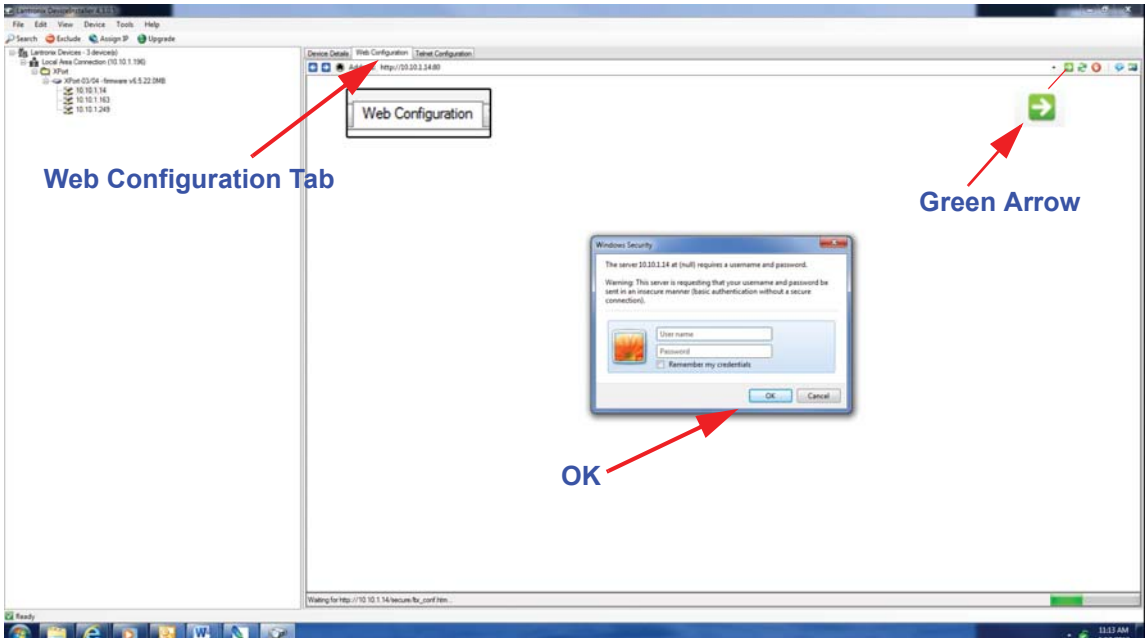


Figure 4-6 Web Configuration Tab

3. The **Device Server Configuration Manager** will open as shown in Figure 4-7.

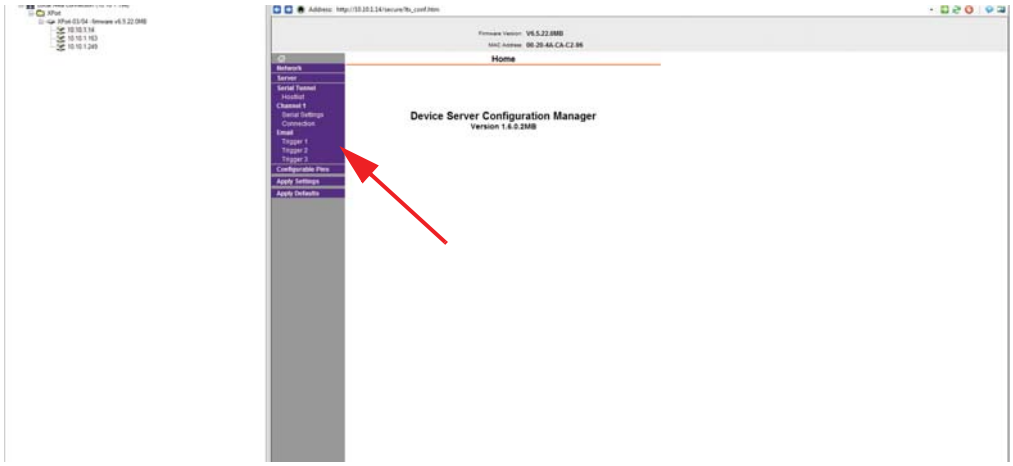


Figure 4-7 Device Server Configuration Manager

4. Select **Network Settings.** See Figure 4-8.

- Choose the "**Use the following IP configuration:**" radio button.
- Enter the IP Address *"XXX.XX.X.XX"* and the Subnet Mask *"255.255.255.0"* in the appropriate fields.
- Leave the Default Gateway field blank unless the IT department indicates one is needed. If a gateway is needed, the IT department will provide one.
- Press the **OK** button to save the settings. Network Setting will display **Done!**

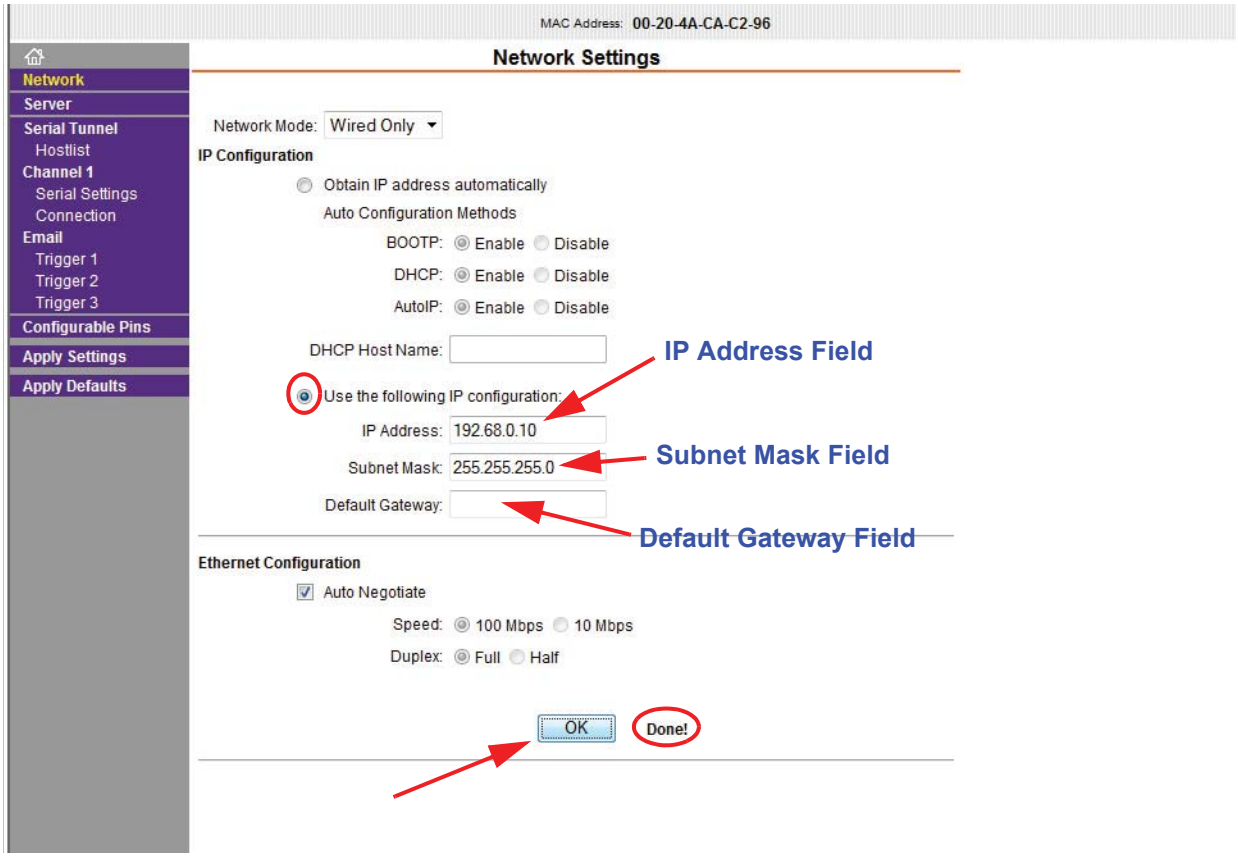


Figure 4-8 Network Settings

Note: *These settings should be the default settings and may not need to be changed.*

5. Select **Serial Settings** under **Channel 1**. See Figure 4-9. Verify that the Port Settings are set to the following:

   - **Protocol: "***RS-485 - 2 wire"*
   - **Flow Control:** *"None"*
   - **BaudRate:** *"19200"*
   - **Data Bits:** *"8"*
   - **Parity:** *"None"*
   - **Stop Bits:** *"1"*
   - Press the **OK** button to save the settings. Serial Settings will display **Done!**

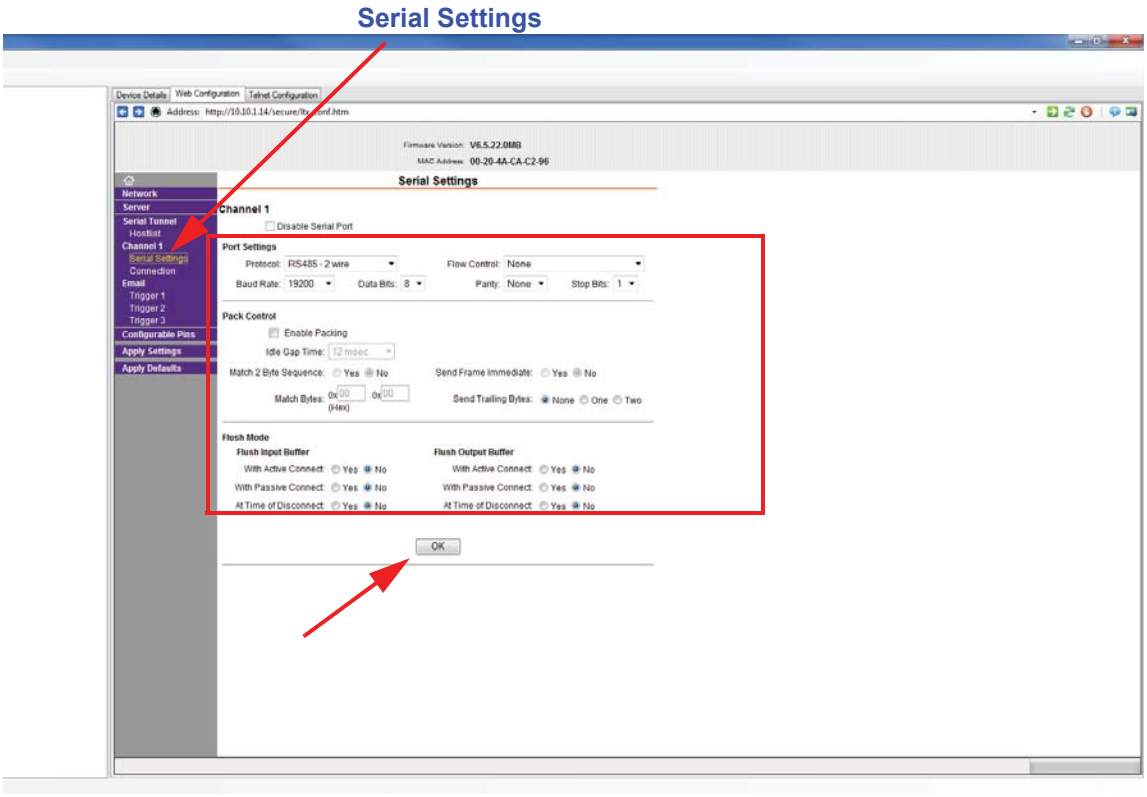


Figure 4-9 Serial Settings

6. Select **Connections** as shown in Figure 4-10 and verify that **Connect Protocol** and **Connection** settings are set to the following:

   - **Protocol:** *"Modbus"*
   - **Local Port:** *"502"*
   - **Accept Incoming:** *"Yes"*
   - Under **Modbus Mode**, set the **Message Timeout to** *"1000"* **ms** if not already set.
   - press the **OK** button. Connections Settings will display **Done!**

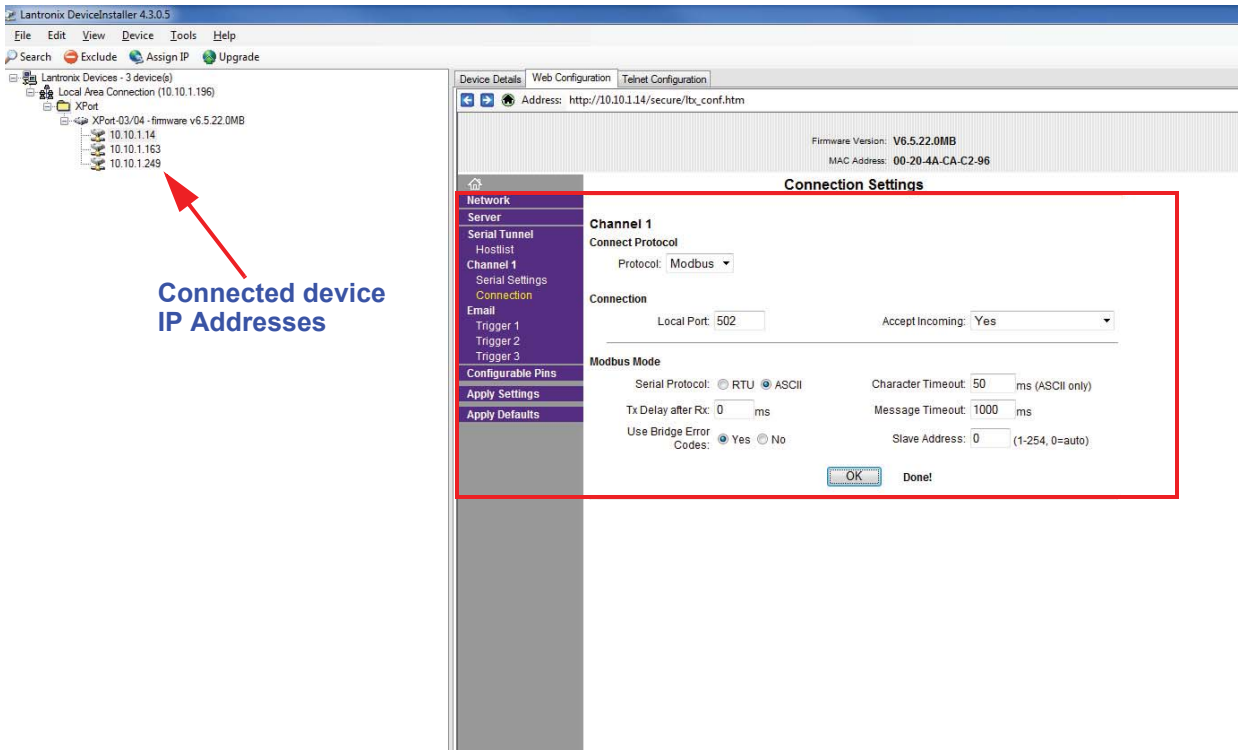


Figure 4-10 Connections

7. Select Apply Settings link to save the setting to the NC30+ as shown in Figure 4-11.

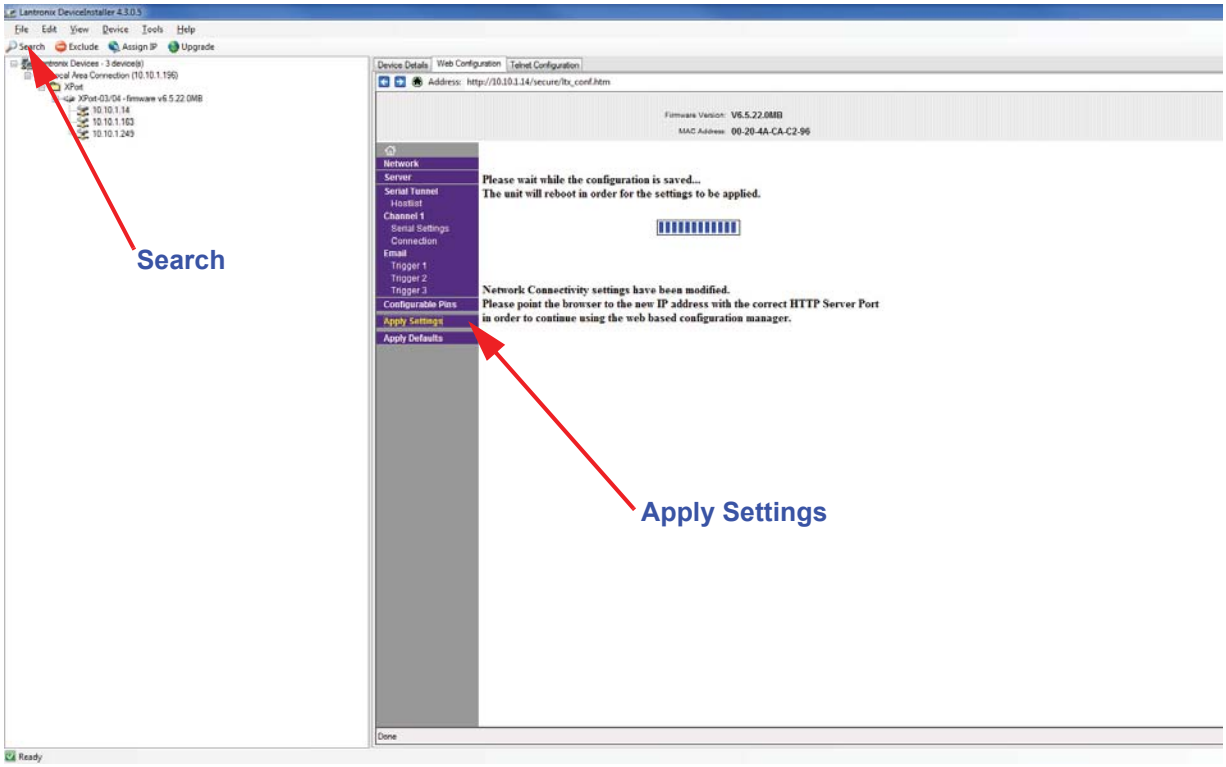


Figure 4-11 Apply Settings

Select the **Search** icon to refresh the attached devices and verify that the IP Address for the NC30+ has been changed.

Definitions of Terms Used

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

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

Preparing for Network Installation

Note: *The network where the instruments will operate must have an available IP address for each instrument. The IP scheme, or subnet, must match that of the PC that will be used to retrieve the data from the instruments. Contact Lighthouse Technical Support for additional information.*

Equipment Required:

- Network enabled Personal Computer (IBM-compatible)
- NC30+

Use either of the following:

- Small 5-port hub or switch and two 3-foot long straight-through Cat5 Ethernet cables
- Or one 3-foot cross-over Cat5 Ethernet cable

Software Required:

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

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

Note: *All values in screen shots are examples only. Use only the values provided by the Network Administrator.*

Additional Requirements:

1. Contact the network administrator and obtain administrator rights on the PC to be used for this procedure.

2. For each unit to be attached, obtain an unused static IP address, Gateway IP address and the appropriate Netmask for the LAN in which they will be installed.

3. Create a list and record the MAC address(es) for all NC30+s to be configured. It is suggested that the IP address that will be used for each NC30+ be written next to the MAC address. This list can be provided to the network administrator for future reference.

4. The PC being used to program the NC30+ must be using the same subnet that the adapter will use. Contact the network administrator for assistance.

5. The PC that will monitor or retrieve data from the instrument(s) must be using the same subnet and gateway programmed on the NanoCount's network interface.

Configure Device

Ethernet Port Configuration

This section is organized based on the cable used to perform the NC30+ programming.

Straight-through Cat5 requires a hub or switch and two straight-through Cat5 cables. Cross-over Cat5 connects the PC directly to the NC30+ with no hub. Each will be explained separately. If troubleshooting is required, the cross-over cable technique is easier to use in the field because it requires fewer devices.

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

For troubleshooting outside of the LAN, it is suggested that the PC's IP address be used as the Default Gateway for both the PC and the NC30+.

Frequently, it is necessary to change the NC30+ Ethernet parameters to allow for easier troubleshooting. When this is needed, verify the instrument is reprogrammed to its previous network settings before reattaching to the LAN. Contact Lighthouse Technical Support at 800-945-5905 (USA Toll Free), 541-770-5905 (Outside of USA) or the network administrator for additional information.

Straight-through Cat5 Setup:

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

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

1. Connect one end of a straight-through Cat5 cable to the NC30+'s Ethernet Port.
2. The other end of the Cat5 cable should plug into one port on the hub or switch.
3. Attach another straight-through cable to the PC's RJ45 receptacle and an open port on the hub or switch.
4. Proceed to "Windows Telnet Programming:" on page 4-17.

Cross-over Cat5 Setup:

1. Attach one end of the cross-over cable to the RJ45 receptacle on the PC.
2. Attach the other end of the cable to the NC30+ Ethernet Port.
3. Apply power to the NC30+. Apply power to the PC if it is not already running. Observe the LEDs on the hub/switch RJ45 connector - blinking indicates network activity. Observe the network LEDs on the instrument's RJ45 receptacle - they should blink indicating activity. Proceed to next section.

Program the Interface

Windows Telnet Programming:

Use Telnet to program the NC30+ for Ethernet communications if DeviceInstaller is not available.

1. Start Windows.
2. On the Taskbar, click on **Start**.

WARNING: ***Perform only the steps or commands as provided in this guide. Failure to heed this warning can result in damage to equipment, personal injury or data loss and may void the equipment warranties.***

3. Select **Run as shown in** Figure 4-12.

Figure 4-12 RUN Screen

4. In the Run window, type CMD and click OK. See Figure 4-13.

Note: *Typing commands in the command console requires a space between the instruction and the command variables. For example,'arp' is followed by a space, then '-d' and another space, then the *.*

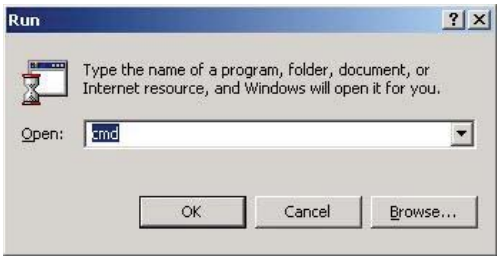


Figure 4-13 Starting the Command Console

5. A command prompt window will open. Clear the ARP Cache by typing arp -d * at the command line and press Enter. Ignore any error messages that indicate the address table doesn't exist or has no entries. See Figure 4-14.

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

Figure 4-14 Clear Address Table Command

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

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

8. Type arp –s xxx.xxx.xxx.xxx nn-nn-nn-nn-nn-nn and press Enter. Replace the x's with the desired IP address, such as 192.168.0.10 or 10.10.0.15, and the n's with the desired MAC address, such as 00-20-4a-8a-26-31. The IP address will be four segments total with up to 3 digits per segment, each segment separated by a period. Note that the MAC address segments are separated by dashes (-), not periods. See Figure 4-15.

```
C:\Documents and Settings\Administrator>arp -s 10.10.0.18 00-20-4a-8a-26-31
```

Figure 4-15 ARP Command to Add New IP

9. Activate the NC30+'s Ethernet interface by typing, telnet xx.xx.xx.xx 1 (replace x's with the IP address to be used for the instrument) and press Enter. This command will cause a connect error but is required to establish communications. See Figure 4-16.

```
C:\Documents and Settings\Administrator>arp -s 10.10.0.18 00-20-4a-8a-26-31
C:\Documents and Settings\Administrator>telnet 10.10.0.18 1_
```

Figure 4-16 Command - Send "Telnet 1"

10. Type telnet xx.xx.xx.xx 9999 and press Enter. This command accesses the telnet port of the instrument. The expected error message from Step 9 is shown in Figure 4-17.

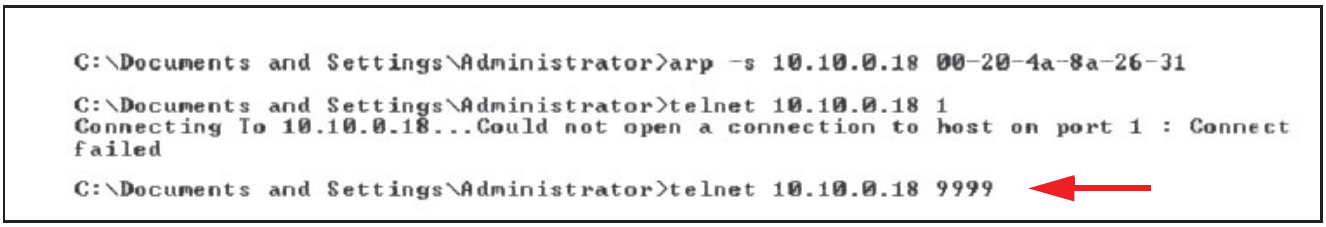


Figure 4-17 Command - Send "Telnet 9999"

You will have 4 seconds to respond in the next step. If you respond too slowly, you'll have to repeat step 10.

11. Press Enter to start the instrument Ethernet interface setup program. Figure 4-18 displays some of the default settings - make no changes to these settings except as instructed.

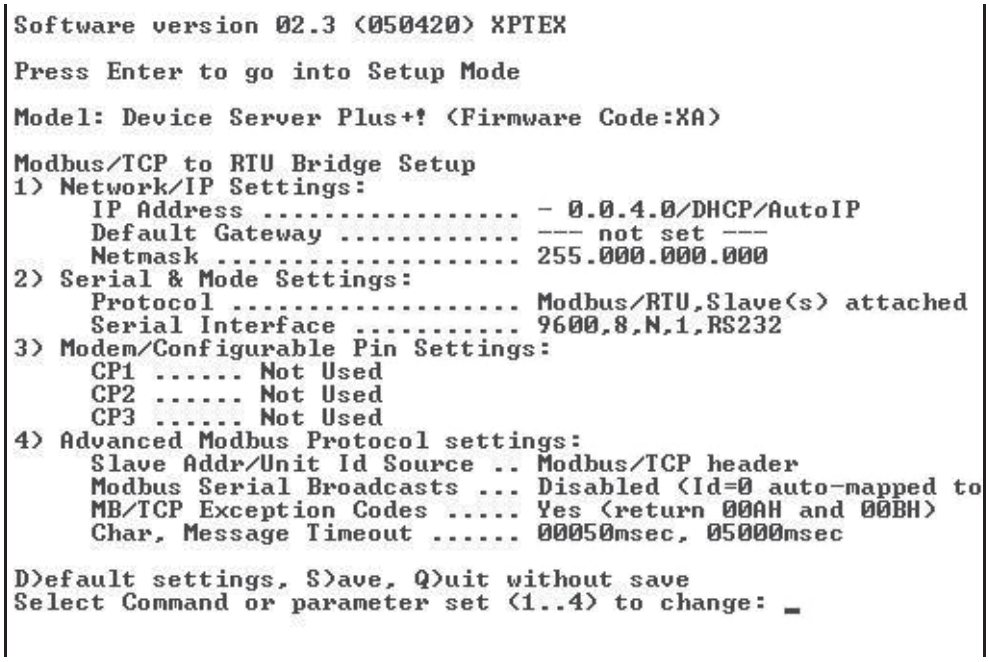


Figure 4-18 Starting the Set Up Program

12. Type **1** to set the IP address. Type the desired IP address and press Enter. See Figure 4-19.

Figure 4-19 Assigning IP Address

13. Type Y to set the Gateway IP address. Type the Gateway IP address and press Enter. See Figure 4-20.

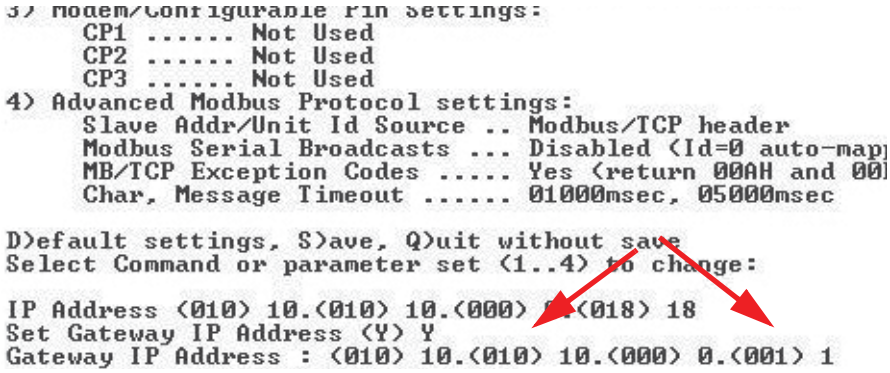


Figure 4-20 Assigning Gateway IP Address

14. Type Y to set the Netmask. type the desired Netmask value and press Enter. See Figure 4-21.

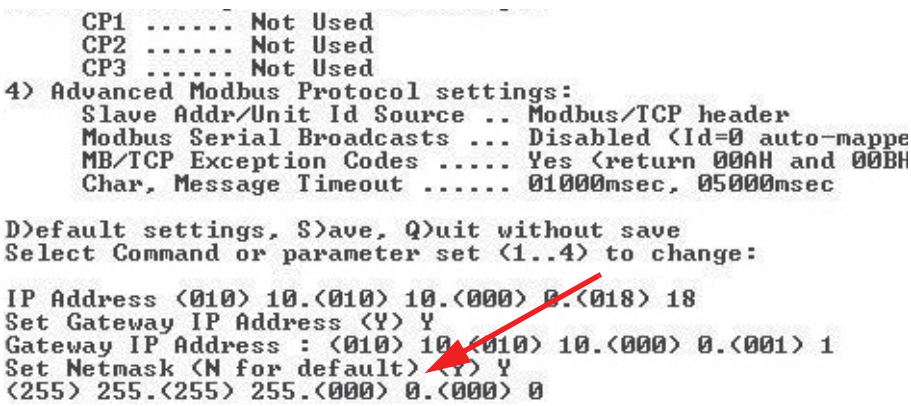


Figure 4-21 Assigning Netmask

15. Type **N** in response to "Change telnet config password". The instrument is shipped without a password. Changing the telnet password or providing one is discouraged, except for absolute security requirements. If a password is applied and forgotten, the instrument must be returned to Lighthouse to clear the password. See Figure 4-22.

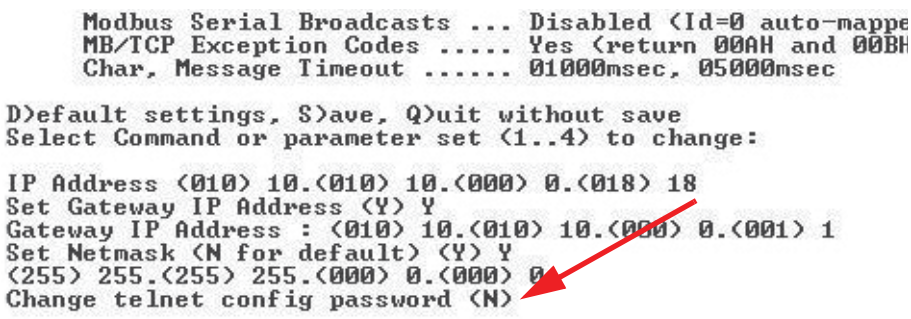


Figure 4-22 Telnet Config Password Screen

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

16. Type S to Save and restart and press Enter to save the changes. See Figure 4-23.

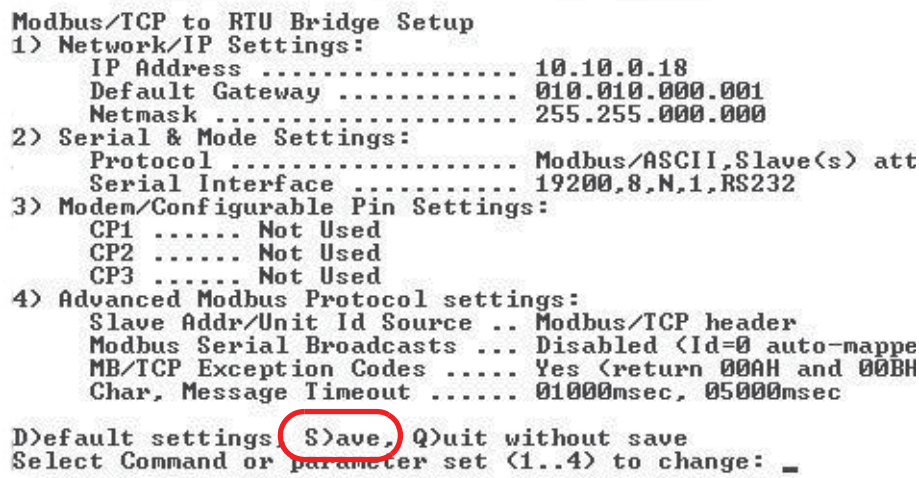


Figure 4-23 Saving the Settings

17. Perform Step 7 though Step 16 for each ***NC30+***.

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

18. Clear the ARP Cache by type arp –d * and press Enter. ***If this is not done before quitting this process, the PC may create "ghost IPs" on the LAN and cause serious problems with the network.***

19. Type **Exit** to quit the command console.

USB Flash Communications

USB-A Port

The USB-A port allows data to be downloaded from the NC30+ via the Data Output button on the Menu screen. The data can be downloaded as either a *CSV or *LSD file.

4-20mA Communications

4-20mA DB9

The 4-20mA DB9 provides 4-channel 4-20mA communications and is sealed to help prevent liquid or gas infiltration into the NEMA style enclosure. Table 4-2 illustrates the DB9 pinouts.

Table 4-2 DB9 Pinouts

DB9 Pin #	Signal Assigned
1	CH1 +
2	GND
3	CH2 +
4	GND
5	CH3 +
6	GND
7	GND
8	CH4 +
9	GND

5 Operating the NC30+

Using the Instrument for the First Time

This chapter describes how to use the NanoCount 30+ (***NC30+***). The ***NC30+*** is ready to use out of the box.

Warrantied Operation

The NanoCount 25+ and NanoCount 30+ are designed with the highest levels of sensitivity for detection of ultrafine contamination in pressurized ultrapure water (UPW) systems. This sensitivity also makes these sensors extremely vulnerable to background reflection spikes caused by air gaps in the UPW supply line.

On more than one occasion, air gaps greater than 0.25 inches in length passing through the NanoCount's flow cell have triggered very high background levels from which the units were unable to recover on their own. These faults required RMA servicing for complete realignments (minimum 10 business days not including transit time to and from Lighthouse).

To avoid this fault (and consequential downtime) from occurring with your NanoCount unit, we require the following parameters of their use:

1. These units must only be used on pressurized ultrapure water systems, filtered down to 20nm (10nm preferred). Please refer to Table 2-1 for pressure limitations.
2. Before powering on the unit, an uninterrupted stream of sample liquid must first be flowing continuously through its sensor. It is strongly recommended that an overnight flush be done (with the unit's power off) at maximum flow each time the unit is first connected to a new supply line.
3. The unit must be powered off before shutting off its sample flow.
4. Trained personnel must always be present and ready to shut off power while the NanoCount is operating, just in case the presence of bubbles is detected.

Without the expressed written consent from Lighthouse Worldwide Solutions' Engineering Department and Service Department, operating your unit outside of these parameters will void its warranty.

For more information on warrantied NanoCount operation, or if you have specific requests for test applications on your NanoCount unit, please contact the Engineering Department at 1-510-438-0500.

To start using the instrument, proceed as follows:

1. Position the instrument in the environment to be measured.
2. Attach instruments to sample lines as outlined in *Chapter 3*.
3. Attach instrument to AC power.
4. Set the power switch on the rear panel to ON.
5. While booting, the unit displays a startup screen.
6. The MAIN screen displays as shown in Figure 5-1.

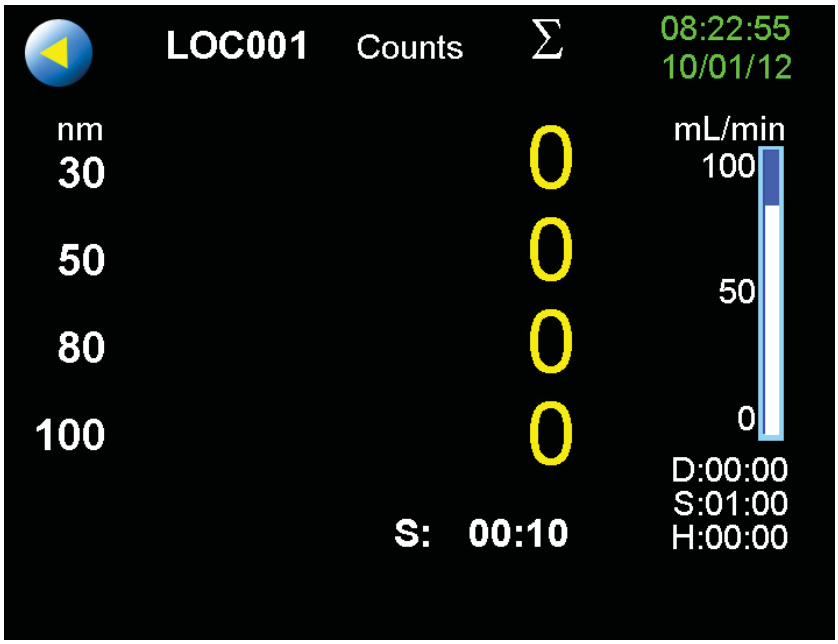


Figure 5-1 NC30+ MAIN Screen

7. Use the instrument Flow Adjustment knob to adjust the flow to 80 ml/min.
8. All instrument functions are controlled through MODBUS - there is no Start/Stop button available on the touch screen. “Programming with MODBUS Protocol” on page 6-1 provides details on the use of MODBUS.

9. When the instrument starts counting, the letter ’S’ appears on the display and indicates the elapsed sample time. Particle counts are grouped and displayed according to the size of each particle.

10. If the instrument is HOLDING, the letter ’H’ is displayed with the hold elapsed time.

11. If the instrument is being delayed, the letter ’D’ and the elapsed time are displayed.

Touch Screen Overview

The ***NC30+*** instrument incorporates a unique touch screen interface to control and configure the instrument. This interface allows the user to easily view and configure the instrument for their specific needs and applications.

Pressing the Back Button from any screen where it is available will place the user at the MAIN Menu screen shown in Figure 5-2.

MAIN Menu

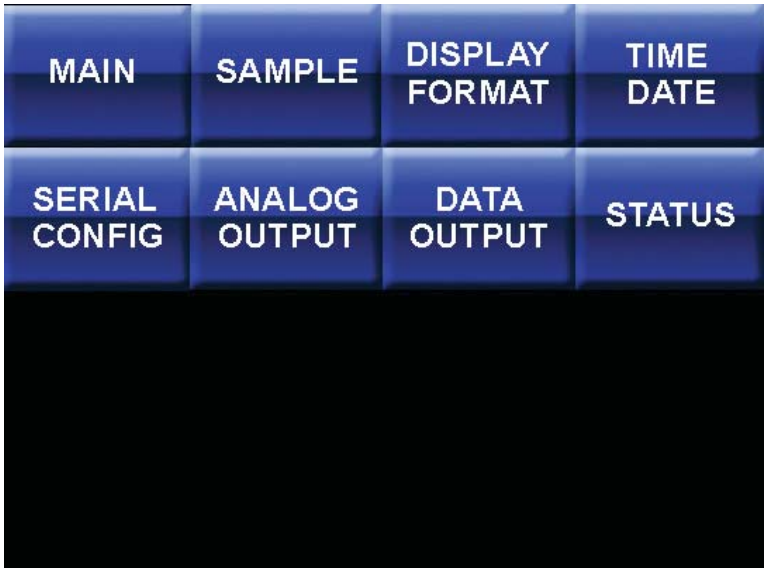


Figure 5-2 MAIN Menu

- Allows the user to quickly select the screen desired.

MAIN

Figure 5-3 shows the Main NC30+ display screen.

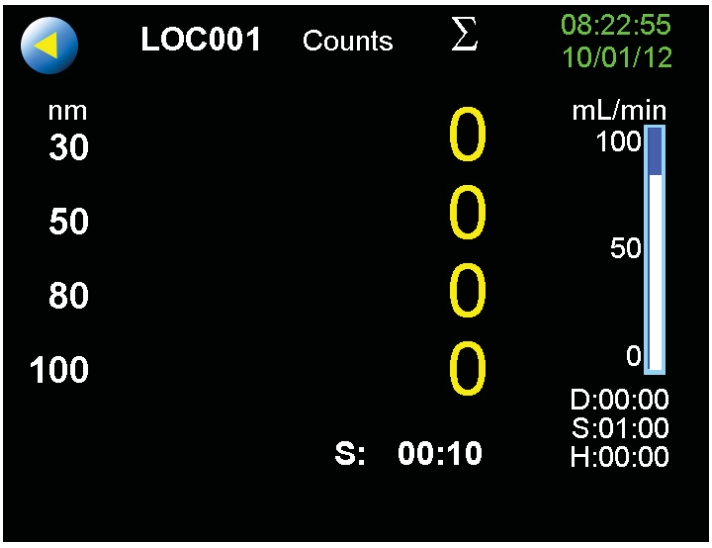


Figure 5-3 Main Screen

- Shows counts and ***NC30+*** count mode, flow rate.

SAMPLE

The Sample setup screen is shown in Figure 5-4.

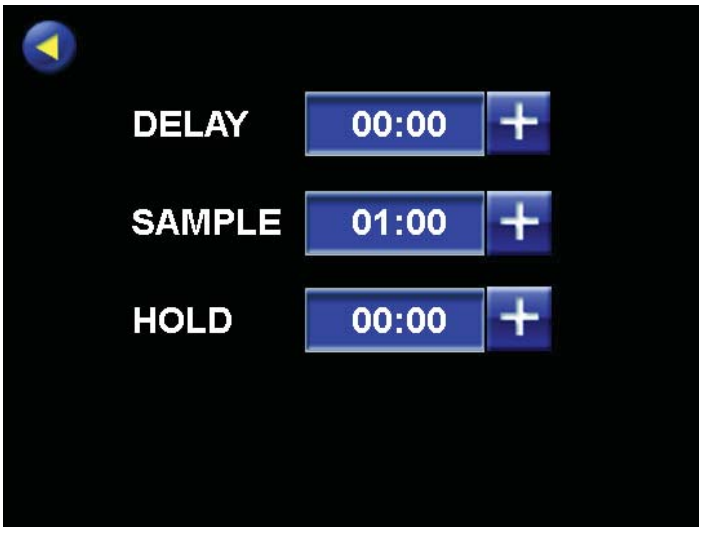


Figure 5-4 Sample Settings

- Sample set up screen for Sample time, Delay and Hold times. When the '**+**' button is pressed, the screen switches to the Data

Entry screen.

DATA ENTRY

The Data Entry screen is shown in Figure 5-5.

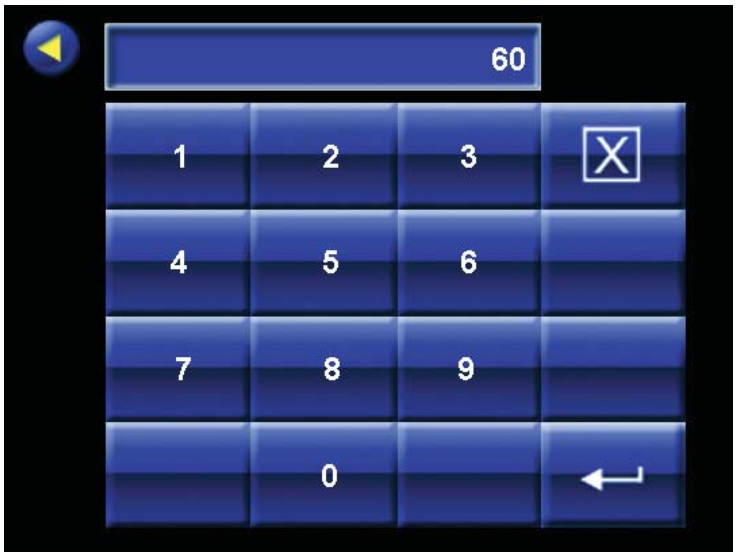


Figure 5-5 Data Entry

- Press the number buttons to enter the desired value.

- Use the ***Delete*** button to erase the last entered value (similar to a backspace key).

- Use the ***Return*** button to accept the values and return to the previous screen.

- To return to the MAIN Menu, use the ***Back*** button.

DISPLAY FORMAT

Figure 5-6 shows the Display Format settings screen.

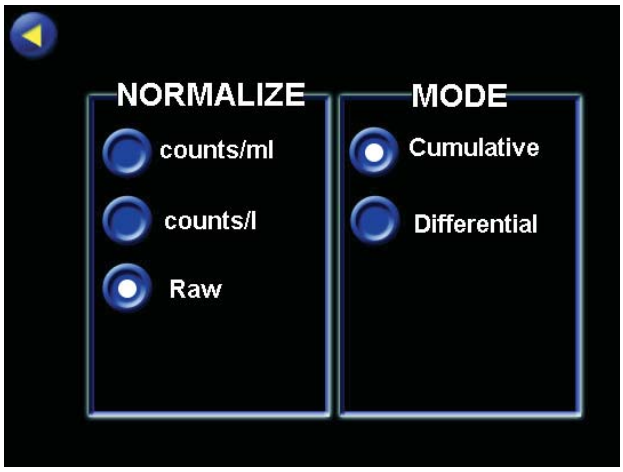


Figure 5-6 Display Format Settings Screen

- Choose ***Normalized counts/ml, counts/l*** or ***Raw*** in either ***Cumulative*** or ***Differential*** Modes.

TIME DATE

The Time/Date setup screen is shown in Figure 5-7.

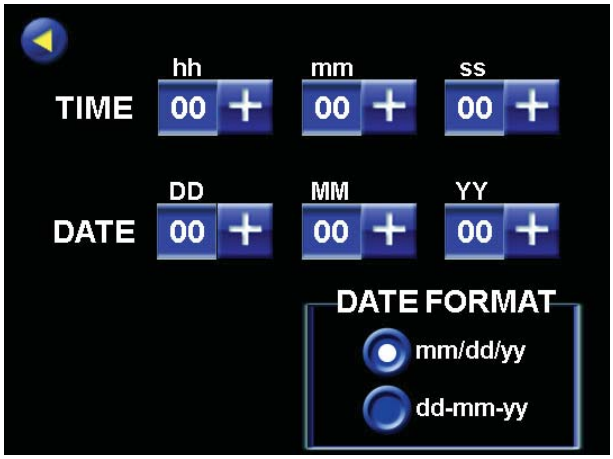


Figure 5-7 Time Date Settings Screen

- Provides a date entry screen for setting the Time and Date.

- When the '**+**' button is pressed, the Data Entry screen is displayed in Figure 5-5.

- The ***Back*** button exits this screen with no further action.

SERIAL CONFIG

The Serial Address configuration screen is shown in Figure 5-8.

Figure 5-8 Serial Address Setting Screen

- Enables user to set the ***NC30+*** COMM address.
- The ***Back*** button exits and the '**+**' enters Data Entry screen.

ANALOG OUTPUT

Figure 5-9 shows the Analog Output setup screen.

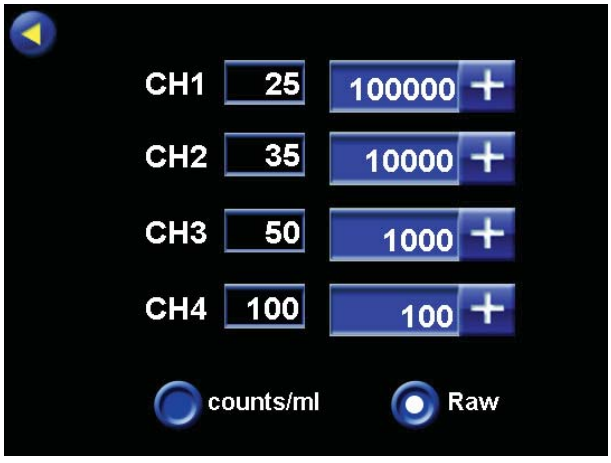


Figure 5-9 Analog Output Setting Screen

- Sets the analog (4-20mA) upper thresholds equivalent to 20mA for each channel size. Zero counts will be 4mA and anything

between 0 and value falls proportionately between 4 and 20mA.

- The output can be ***counts/ml*** or ***Raw***.
- ***Back*** button exits and the '**+**' enters Data Entry screen.
- Table 5-1 shows the pinouts that may be used to measure the signal for each channel.

Table 5-1 DB-9 Pinouts

DB-9 Pin #	Signal Assigned
1	CH1 +
2	GND
3	CH2 +
4	GND
5	CH3 +
6	GND
7	GND
8	CH4 +
9	GND

DATA OUTPUT

The Data Output screen is shown in Figure 5-10.

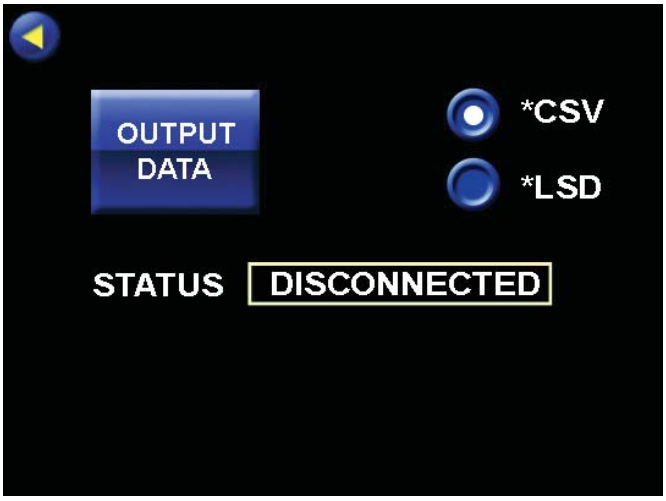


Figure 5-10 Data Output

- Selecting the **Data Output** button from the Menu screen will open the **Data Output** screen.
- When a flash drive is connected to the USB port the software automatically detects the drive as shown in Figure 5-11.

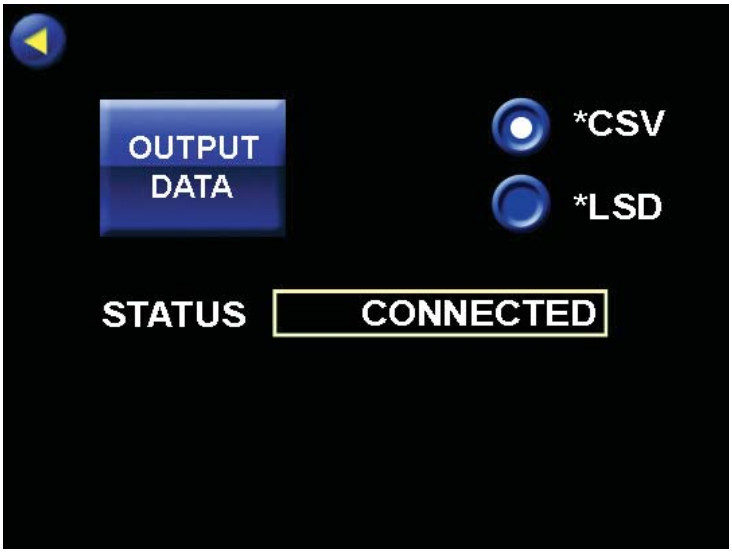


Figure 5-11 Flash Drive - Connected

- Select the format for download. Data can be downloaded by ***CSV** or ***LSD** file.
- Select the **Output Data** button to download the data. See Figure 5-12.

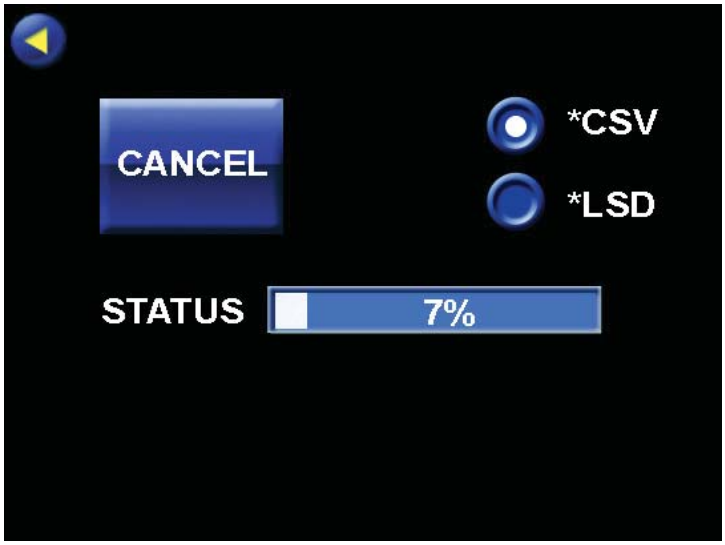


Figure 5-12 Downloading Data

- Remove the flash drive from the USB port.

STATUS

The Status screen is shown in Figure 5-13.

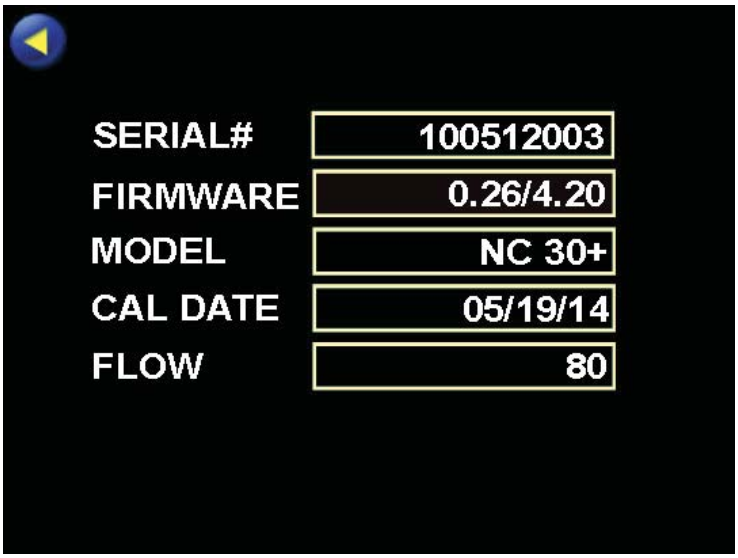


Figure 5-13 Status Screen

- Displays the instrument serial number, Firmware revisions, model and calibration due date.

6 Programming with MODBUS Protocol

The ***NC30+*** can be programmed using the MODBUS Protocol. The full protocol is detailed in “NC30+ MODBUS Register Map v1.45” on page A-1.

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

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 the instrument is powered up the instrument it will begin sampling using the default configuration:

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

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 **10 or 12** to command register 40002.

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

Running the Instrument Using MODBUS

The applicable action commands are provided 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.
9	Manual Start. The instrument samples continuously until it receives a Manual Stop command. Ignores local timing parameters. Sets Sample Time for data record to equal the time interval between the Manual Start and Manual Stop command.
10	Manual Stop. Stops sampling. Records counts since Manual Start.
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, the most current 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

MANUAL Counting Mode

In Manual counting mode, the computer starts the sample and the instrument continues counting until a stop command is given. At that point, the sample time is listed at whatever the time interval was between the start command and the stop command.

Write these commands to the Command register (40002):

9 Start Instrument; to start recording.

10 Stop Instrument; to stop recording after desired sample time.

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	signed 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	signed 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, 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.

Table 6-3 Data Set Registers

Register	Data Type	Description
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).

Changing the Default Instrument Parameters

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

The Location 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 (32767 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** Specifies location of Particle Counter.
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 at what location a sample was recorded.

Hold Time (Registers 40031, 40032)

The Hold Time is used for pausing in between samples for multiple cycles. If Hold Time is greater than 1 minute, the pump will turn off.

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)

WARNING: ***Do NOT set the Sample Time value to less than 30 seconds.***

The Sample Time specifies the time period of each sample, specified in seconds. The maximum value is 86,399 seconds (high word: 1, low word: 20863) which is 23 hours, 59 minutes, 59 seconds. The instrument is programmed at the factory with a default value of 60 seconds. Do NOT set this value to less than 30 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).

A NC30+ MODBUS Register Map v1.45

COMM Settings

Lighthouse particle counters with MODBUS have the following communications settings:

Table A-1 MODBUS Communications Settings

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

The MODBUS slave address is set on the particle counter. Valid addresses are 1-63. Address 0 is the broadcast address.

Supported MODBUS Commands

Table A-2 MODBUS Registers

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

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

Register Map Sensor Settings Registers

Instrument settings are stored in holding registers (the 4xxxx series), which are mostly read/writable. Not all holding registers are writable. Table 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, v1.35 = 135d = 0087h.
40002	unsigned integer	Command register. Makes the counter execute a command. See the description of this register in the table below.
40003	unsigned integer	Device Status. [bit 0=RUNNING, bit 1=SAMPLING, bit 2=NEW DATA, bit 3=DEVICE ERROR]
40004	unsigned integer	Firmware version. Major version digits are hundreds. Minor version digits are tens and ones. For example, 210 = v2.10.
40005	unsigned integer	Serial Number [high]
40006	unsigned integer	Serial Number [low]
40007	ASCII string	Product Name char[0], char [1] (NULL terminated string)
40008	ASCII string	Product Name char[2], char [3]
40009	ASCII string	Product Name char[4], char [5]
40010	ASCII string	Product Name char[6], char [7]
40011	ASCII string	Product Name char[8], char [9]
40012	ASCII string	Product Name char[10], char [11]
40013	ASCII string	Product Name char[12], char [13]
40014	ASCII string	Product Name char[14], char [15]
40015	ASCII string	Model Name char[0], char [1] (NULL terminated string)
40016	ASCII string	Model Name char[2], char [3]
40017	ASCII string	Model Name char[4], char [5]
40018	ASCII string	Model Name char[6], char [7]
40019	ASCII string	Model Name char[8], char [9]

Table A-3 Sensor Settings Registers

Register	Data Type	Description
40020	ASCII string	Model Name char[10], char [11]
40021	ASCII string	Model Name char[12], char [13]
40022	ASCII string	Model Name char[14], char [15]
40023	unsigned integer	Flow Rate. Divide by 100 to get rate in CFM. For example, 100 = 1CFM.
40024	signed integer	Record Count. Total number of records stored in the counter.
40025	signed integer	Record Index. Zero based index to data in 30xxx register series. Must be lower than the record count (register 40024). Set this index to expose a counter's record in the 30xxx registers. Set to -1 to retrieve last record stored in the counter.
40026	unsigned integer	Location number. Particle Counters: Specifies location of Particle Counter. Must be 1 to 200 (maps to location names associated with registers 40200 - 40999). Manifold Controller: Specifies Manifold position. Values 1-32 for the Universal Manifold and values 1-6 for the MiniManifold Controller moves the arm to that position on the manifold. Value 0 moves arm to Home position.
40027	signed integer	Real Time Clock (RTC) [high]. Updates instrument's real-time clock. Works in conjunction with 40028. Displays date and time, in number of seconds since midnight, 1/1/1970. Can be generated by ANSI C/C++ time() function.
40028	signed integer	Real Time Clock [low]
40029	unsigned integer	Initial Delay [high]. Works in conjunction with 40030. Number of seconds to wait before starting the first sample. Max value is 359,999, which equals 99h 59m 59s.
40030	unsigned integer	Initial Delay [low]
40031	unsigned integer	Hold Time [high]. Works in conjunction with 40032. Number of seconds to wait between sample periods. Max value is 359,999, which equals 99h 59m 59s.
40032	unsigned integer	Hold Time [low]
40033	unsigned integer	Sample Time [high]. Works in conjunction with 40034. Number of seconds to sample. Max value is 86,399, which equals 23h 59m 59s.

Table A-3 Sensor Settings Registers

Register	Data Type	Description
40034	unsigned integer	Sample Time [low]
40035	unsigned integer	Data Set [high]. Works in conjunction with 40036. Data entered here is applied to the device through the command register.
40036	unsigned integer	Data Set [low]
40037	unsigned integer	Alarm Mode. Type of alarming performed
40038	unsigned integer	Alarm Parameter. Control parameter for given alarm mode.
40039	unsigned integer	Laser Reference Voltage (millivolts)
40040	unsigned integer	View Volume. Divide by 100 to get percentage. For example: 6550d = 65.50%
40041	ASCII string	Flow Unit. Defines unit as cfm, lpm, mlpm.
40042	ASCII string	Flow Unit. char[2], char[3]
40043	unsigned integer	Calibration Reference Voltage (millivolts)
40047	signed integer	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].
...		
40199	unsigned integer	Number of available alphanumeric location names (0 means alphanumeric names are not supported).
40200	ASCII string	Location_1_char[0], char[1] (NULL terminated string)
40201	ASCII string	Location_1_char[2], char[3]
40202	ASCII string	Location_1_char[4], char[5]
40203	ASCII string	Location_1_char[6], char[7]
...		
40996	ASCII string	Location_200_char[0], char[1] (NULL terminated string)
40997	ASCII string	Location_200_char[2], char[3]
40998	ASCII string	Location_200_char[4], char[5]
40999	ASCII string	Location_200_char[6], char[7]

Registers 40200-40999 are reserved for eight character names

associated with location index values. Thus the name for location =3 would be located at registers 40208-40211. Up to two hundred locations can be specified.

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

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

Alarm Parameter (40038) defines additional parameters that may be needed in defining an alarm mode.

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

Device Status

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

Table A-4 Device Status

Bit	Description
0	**RUNNING:** Set when a start command is executed remotely via Command 9 (manual start) or Command 11 (instrument start) or through the user interface. The flag will 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.
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 collected. An example of a device error could be a positioning error on a manifold device.

Command Register

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

Table A-5 Command Register

Value	Action
1	Saves all writable 4xxxx register values to the device's 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, and Initial Delay.
5	Enable Remote Control. Locks out the instrument's user interface. Can only change instrument parameters via MODBUS.
6	Enable Local Control. Unlocks the instrument's user interface. Instrument changes can be made at the device itself or through MODBUS.
7	Turns local pump on, if applicable. Flow is regulated by an internal setpoint.
8	Stop pump, if applicable.
9	Manual Start. The instrument samples continuously until it receives a Manual Stop command. Ignores local timing parameters. Sets Sample Time for data record to equal the time interval between the Manual Start and Manual Stop command. If applicable to device, does not start pump.
10	Manual Stop. Stops sampling. Records count since Manual Start.
11	Instrument Start (Automatic Counting). Particle Counters: Uses defined Initial Delay, Hold Time, Sample Interval and counting mode. Instrument executes samples and holds until an Instrument Stop command is issued. For instruments with pumps, this command will start the pump. Manifold Controller: Uses defined Manifold Sequence. Stops counting and changing positions when an Instrument Stop command is issued.

Table A-5 Command Register

Value	Action
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.

Data Registers

Data Registers

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

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

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

Table A-6 Enable/Disable Bits

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

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

Data Registers

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

Example:

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

Analog data is little-endian. Thus, analog data items are formed by placing the low bytes in front of the high bytes.

Example:

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

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

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

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

Table A-7 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	Device Status [high]
30008	unsigned integer	Device Status [low]
30009	unsigned integer	Particle Channel 1 [high]

Table A-7 Data Registers

Register	Data Type	Description
30010	unsigned integer	Particle Channel 1 [low]
30011	unsigned integer	Particle Channel 2 [high]
30012	unsigned integer	Particle Channel 2 [low]
30013	unsigned integer	Particle Channel 3 [high]
30014	unsigned integer	Particle Channel 3 [low]
30015	unsigned integer	Particle Channel 4 [high]
30016	unsigned integer	Particle Channel 4 [low]
30017	unsigned integer	Particle Channel 5 [high]
30018	unsigned integer	Particle Channel 5 [low]
30019	unsigned integer	Particle Channel 6 [high]
30020	unsigned integer	Particle Channel 6 [low]
...		
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]
...		
30073	unsigned int	Valid analog channels [bit0=ch 1, ..., bit15=ch16]
30074	unsigned int	Valid particle channels
30075	unsigned int	Alarm Flags - Analog Channels (bit 0 = channel 1 ...)
30076	unsigned int	Alarm Flags - Particle Channels

Note: *Particle data is always 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 (30007 - 30008)

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

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

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

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-8 Device Status Word

Bit	Description
0	Laser Alert Status 0 = Laser is OK 1 = Laser Alert
1	Flow Alert Status 0 = Flow Rate is OK 1 = Flow Rate Alert
2	Particle Overflow Status 0 = No overflow 1 = Overflow occurred
3	Instrument Service Status 0 = Working correctly 1 = Instrument malfunction detected.
4	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

Bits 7 to 31 are currently unused.

Valid Data in Channels (30073 - 30076)

Register 30073 represents the flag bits corresponding to valid data present in the analog register range. The mapping is such that bit 0 set to TRUE (=1) would correspond to valid data present in Analog Channel 1.

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

Register 30075 represents the flag bits corresponding to analog channels that have exceeded the threshold [Threshold High Registers (45xxx series)] based on alarm mode.

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

Data Type Registers

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

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

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

Table A-9 Data Types

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

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

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

Table A-10 Examples of Particle Data Items

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

Data Units Registers

The 42xxx register series identifies the units used by data items in the

30xxx series. These registers run in parallel with the Data Registers. For example, Data Register 30010's Units Register is 42010.

Note: *Not all data types have units.*

LWS Particle Counters may use units not on the table.

Units are stored as 4 character ASCII strings across 2 registers. If the Units string contains less than 4 characters or no characters at all, the rest of the string is padded with NULLs.

The table below shows units that may be sent by the device. Some of these units are not currently used but are reserved for future use.

Table A-11 Data Units

Units	Description	Units	Description
#	Count (For Particles)	ft/m	Feet per minute
%	Percent	m/s	Meters per second
s	Seconds	“H2O	Inches of water
min	Minutes	“Hg	Inches of mercury
hour	Hours	mmWa	Millimeters of water
F	Fahrenheit	mmHg	Millimeters of mercury
C	Celsius	cmHg	Centimeters of mercury
K	Kelvin	Pa	Pascals
ft	Feet	kPa	Kilopascals
m	Meters	Bar	Bar
ft^2	Square feet	mBar	Milli-bar
m^2	Square meters	V	Volts
ft^3	Cubic feet	mV	Milli-volts
m^3	Cubic meters	A	Amperes
L	Liters	mA	Milli-amps
CFM	Cubic feet per minute	Ohm	Ohms
CMM	Cubic meters per minute	mOhm	Milli-ohm
L/m	Liters per minute	p/f3	Particles per cubic foot
p/m3	Particles per cubic meter		

NOTE: This register bank is obsolete and is maintained for backward compatibility.

B Maintenance

Flow Cell Cleaning

The flow cell is an integral part of the ***NC30+*** sensor and must be cleaned periodically to maintain the accuracy of the sensor.

The sensor will detect when its flow cell needs cleaning and indicate this by turning on the service LED. Refer to, *Chapter 3, 'Getting Started",* for LED details.

WARNING: ***Cleaning and maintenance should only be performed by an authorized LWS Service Representative.***

Removal of the top cover by unauthorized personnel may result in damage to the unit and will void the warranty.

If the unit needs to be cleaned due to a service light, please call an LWS Service and Support at 800-945-5905 (USA Toll Free), 541-770-5905 (Outside of USA).

C 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 one year 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 one 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 one 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 COMMERCIALLY REASONABLE TIME AFTER RECEIVING SUCH EQUIPMENT. BUYER SPECIFICALLY ACKNOWLEDGES THAT SELLER'S PRICE FOR THE EQUIPMENT IS BASED UPON THE LIMITATIONS OF LWS'S LIABILITY AS SET FORTH IN THIS CONTRACT.

Warrantied Operation

The NanoCount 25+ and NanoCount 30+ are designed with the highest levels of sensitivity for detection of ultrafine contamination in pressurized ultrapure water (UPW) systems. This sensitivity also makes these sensors extremely vulnerable to background reflection spikes caused by air gaps in the UPW supply line.

On more than one occasion, air gaps greater than 0.25 inches in length passing through the NanoCount's flow cell have triggered very high background levels from which the units were unable to recover on their own. These faults required RMA servicing for complete realignments (minimum 10 business days not including transit time to and from Lighthouse).

To avoid this fault (and consequential downtime) from occurring with your NanoCount unit, we require the following parameters of their use:

1. These units must only be used on pressurized ultrapure water systems, filtered down to 20nm

(10nm preferred). Please refer to Table 2-1 for pressure limitations.
2. Before powering on the unit, an uninterrupted stream of sample liquid must first be flowing continuously through its sensor. It is strongly recommended that an overnight flush be done (with the unit's power off) at maximum flow each time the unit is first connected to a new supply line.
3. The unit must be powered off before shutting off its sample flow.
4. Trained personnel must always be present and ready to shut off power while the NanoCount is operating, just in case the presence of bubbles is detected.

Without the expressed written consent from Lighthouse Worldwide Solutions' Engineering Department and Service Department, operating your unit outside of these parameters will void its warranty.

For more information on warrantied NanoCount operation, or if you have specific requests for test applications on your NanoCount unit, please contact the Engineering Department at 1-510-438-0500.

Warranty Of Repairs After Initial One (1) Year Warranty:

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

B. Other than as stated 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 THEIR OWN EXPENSE.

Index

Numerics

A

B

C

D

E

F

G

H

I

L

M

N

O

P

R

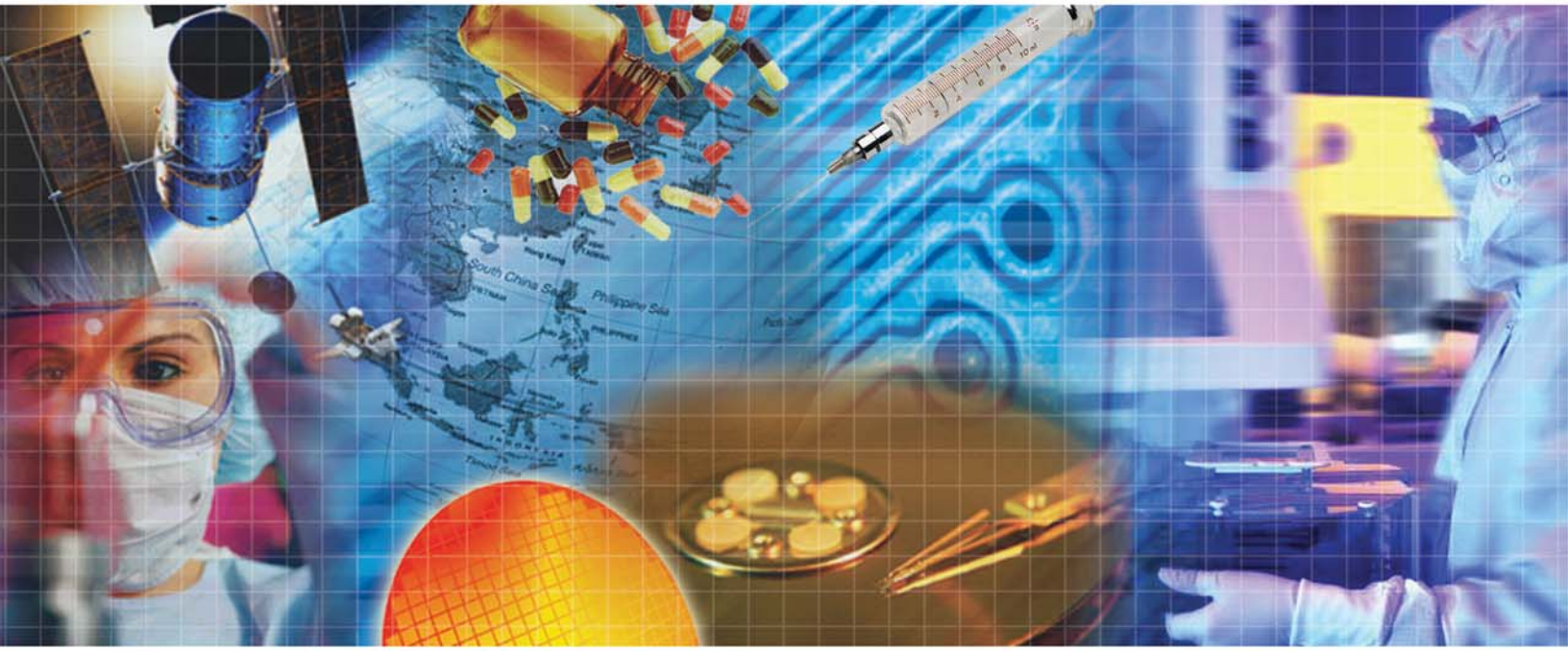
S

T

U

V

W



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