

InVue™ NX148 Liquid Chemical Concentration Monitor

User Guide



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SAFETY

Before assembling, installing or running InVue™ NX148 liquid chemical concentration monitor, heed the following:

CAUTION! NX148 is a sensitive electronic device. Rough handling may cause damage. Do not drop.

WARNING!

- Touching live electrical parts can cause fatal shocks and severe burns. Incorrectly installed or improperly grounded equipment is a hazard.
- Do not touch live electrical parts.
- Contact Entegris representative for training before cleaning.
- Keep all panels and covers securely in place.
- Properly ground the system before use. Plug the power supply into a properly wired receptacle.
- Follow local electrical codes and the guidelines in the manual when installing the NX148 concentration monitor. Failure to do so may create an electrical shock hazard. Shock hazards can exist even when equipment is properly installed. The operator should be properly trained and follow established safety practices.

SAFE DISPOSAL

When disposing of any component of the NX148 concentration monitor, observe the local and national requirements for the disposal of electrical and electronic equipment.

Additional technical information is posted on www.entegrisfluidhandling.com

INSTALLATION WORKFLOW

Prepare	Unpack
	Install software
Install	Determine best location
	Mount sensor, attach fluid lines
	Connect electrical wiring
Initialize	Rezero to DI water or other baseline reference chemical
	Determine the Temperature Compensation Coefficient (TCC)
	Calibrate to the process chemical (optional)
Run	Use 148-connect software to view and log data
	Connect to 4–20 mA DAQ for analog measurement
	Digital communication is available via Modbus®
Troubleshoot	Software messages/hardware issues

USER-SUPPLIED TOOLS AND EQUIPMENT

These supplies are also required for completing the installation and calibration:

Computer	MS Windows® 98 or higher 128+MB RAM
DI water or other reference index chemical	Used for initial DI water rezero
Fluid lines and installation tools and fittings to attach lines to NX148 fittings	Fine thread flare, PrimeLock® or Super 300 Type Pillar® standard end connections

Optional:

<ul style="list-style-type: none"> • 4-20 mA Analog Measurement Device • Basic wiring tools 	The most common installation is wiring NX148 concentration monitor to an analog device and setting parameters to control a manufacturing process
Site-specific installation tools, mounts	See <i>Installing NX148 Concentration Monitor In-line</i> for help assessing the tools and equipment needed for the installation

INSTALLING THE 148-CONNECT SOFTWARE

SOFTWARE INSTALLATION INSTRUCTIONS

Steps

1. Run the Entegris 148-connect installation program found on the entegrisfluidhandling.com website.
<http://www.entegrisfluidhandling.com/Product.aspx?G=2094>



Prior to downloading the software for the first time, a user profile needs to be completed and approved.

The installer program outputs an icon for 148-connect on the desktop and creates a default data storage location on your computer's hard drive.

2. Launch the program by double clicking on the **Entegris Connect** icon on the desktop..



INSTALLING NX148 CONCENTRATION MONITOR IN-LINE

CHOOSING A LOCATION

Environmental Requirements

Process chemical temperature	16° to 50°C (60° to 122°F)
Ambient temperature	25° ±5° (77° ±9°F)

Fluid Flow Requirements

Fluid flow/direction	Bidirectional
Line pressure	0 to 5.5 bar (0 to 80 psig)
Location relative to pump/bellows	Upstream of pump/bellows
Location relative to pressure-regulating device	Downstream of pressure-regulating device

OTHER FLOW CONSIDERATIONS

For accuracy, the in-line location must:

- Provide flow representative of the bulk fluid.
- Maintain adequate flow so that sediment and bubbles do not collect on the sensor.
- Provide minimal flow pulses. Strong pressure pulses in the fluid stream may cause erratic readings.

NOTE: A pressure-regulating device can improve sensor operation and performance.

MOUNTING NX148 CONCENTRATION MONITOR

The sensor is mounted in-line with the process fluid stream using the end connections on either side of the body.

Orientation (Front View)

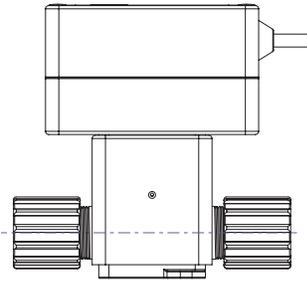


Figure 3. Recommended orientation for normal mounting

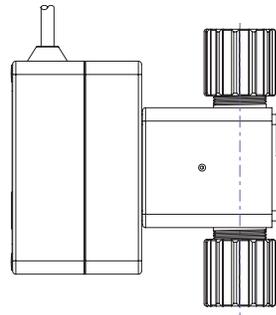


Figure 4. Alternate orientation for minimal bubble rejection mounting

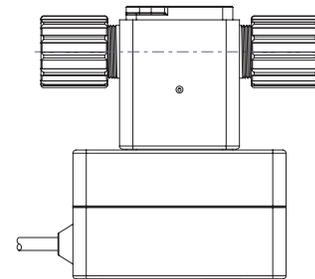


Figure 5. Alternate orientation for maximum bubble rejection mounting

ATTACHING FLUID LINES

NOTE: Lines must be dry. Do not use any DI water or process fluids.

Attach tubes using standard procedure for Teflon® connections.

Standard end connections	Fine thread flare
	PrimeLock
	Super 300 Type Pillar
Custom connection	Site dependent

WIRING NX148 CONCENTRATION MONITOR

NOTE: NX148 can be implemented using the computer as the sole monitoring and logging device.

OPTIONS	ACTION
Installation using only the RS-485 communication	Connect the USB RS-485 cable to NX148 and to your computer
Attach NX148 to separate digital device	Proceed with wiring (see Connecting Interconnect cable with an Analog Device)

ELECTRICAL CONNECTIONS

Use the NX148 Cable Pinout and the USB-RS485 Wiring Diagram to connect the interconnection cable with an analog device.

NX148 Cable Pinout

COLOR	CONNECTION	FUNCTION
Red	24V+	24V power input
Black	24V-	GND power supply
Yellow	RS-485 A	RS-485 COMM
Brown	RS-485 B	RS-485 COMM
Orange	RS-485 ground	RS-485 COMM
Pink	4–20 mA Channel A	Concentration output
Gray	4–20 mA Channel B	Temperature output
Tan	4–20 mA Channel C	Refractive index output
Green	4–20 mA Ground	4–20 mA ground

USB-RS485 WIRING DIAGRAM



Figure 1. Power connection

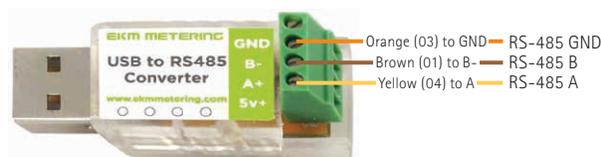


Figure 2. Digital communication connection between NX148 and computer

CONNECTING NX148 CONCENTRATION MONITOR TO 148-CONNECT SOFTWARE

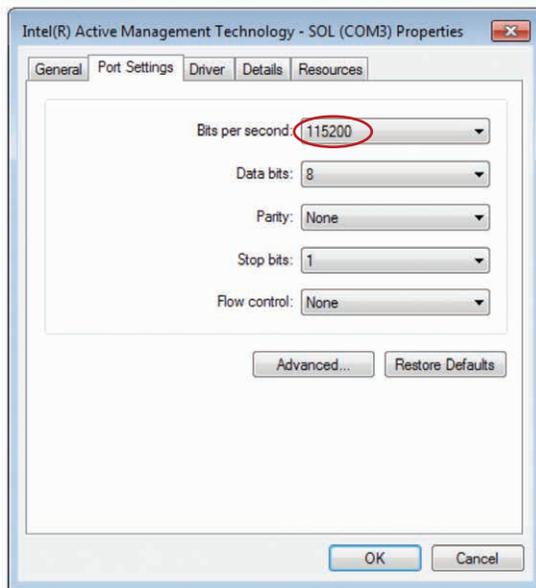
To establish communication between a new sensor and the software:

Steps

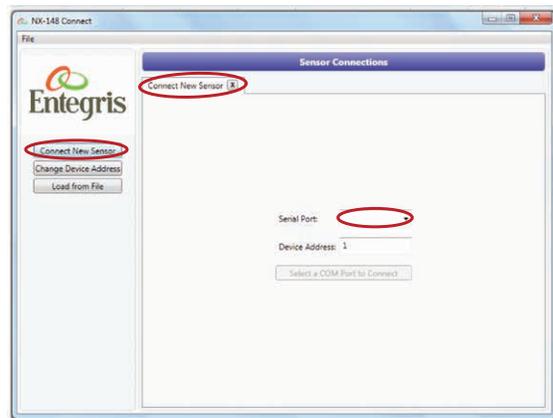
1. To connect the NX148 sensor to the computer, plug the RS-485 USB adapter into the selected USB port.
2. Wait for Windows to download and install the appropriate driver from the Internet. Sometimes it takes up to 30 seconds for this process to complete.

NOTE, Internet access is required for automatic or manual download.

3. Using Windows Menu, set baud rate for RS-485 COM Cable Device Manager-> Right Click COM port appropriate for USB RS485 Cable-> Properties-> Port Settings-> Change Bits Per Second to: either **9600** or **115200**.
4. Power cycle the NX148 sensor.
5. Launch 148-connect by double clicking on the 148-connect icon on the desktop.



6. Select the Connect New Sensor tab.



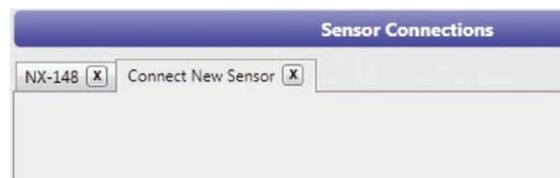
7. Select the serial port from the pull-down menu.
8. Click Connect New Sensor to establish the connection. While the USB to 485 converter is communicating, it will flash while sending messages. If you have trouble establishing communication, power cycle the NX148 to reestablish communication. If you still have trouble establishing communication, download the converter driver from the driver manufacturer's website at: <http://www.ekmmetering.com/ekm-blink-rs-485-to-usb-converterter.html>

INITIALIZING NX148 CONCENTRATION MONITOR IN AIR

This section explains how to initialize NX148 in air. Initialization configures the optical components and removes background and electrical noise.

Steps

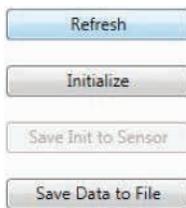
1. Ensure all parts are clean and dry.
2. Open and run 148-connect software.
3. Select the **NX148** tab from the opening screen.



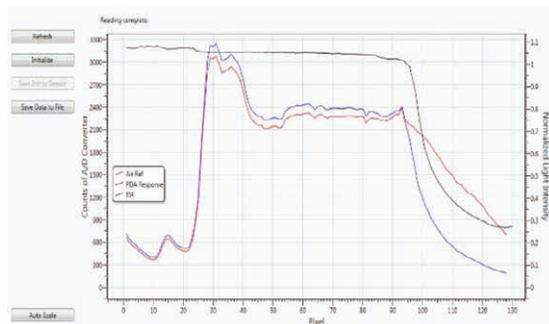
4. Select the **Initialization** tab
5. Click **Initialize Sensor**.
 - a. Initialization tab displays counts of A/D Converter on the left axis.
 - b. Pixel on the bottom axis.
 - c. **Normalized Light Intensity** on the right axis.
 - d. The **Auto Scale** button would put the graph axis back to normal after zooming in or out.
6. The software displays a confirmation screen.

NOTE: To prevent malfunction, reconfirm that the NX148 window is clean and dry before clicking "Yes". See General Troubleshooting.

7. If Initialization passes, click **Save Init to Sensor**, then proceed to **Rezero**.



8. If Initialization fails, confirm sensor window is clean and dry and perform **Initialization** steps again. See *General Troubleshooting*. If failure persists, contact *Technical Support*. See *Technical Support*.



- a. **Clear Graph** removes data and gives graphing tab a new start.
- b. **Auto Scale** returns the view back to default view after zooming in on parts of the data graph.

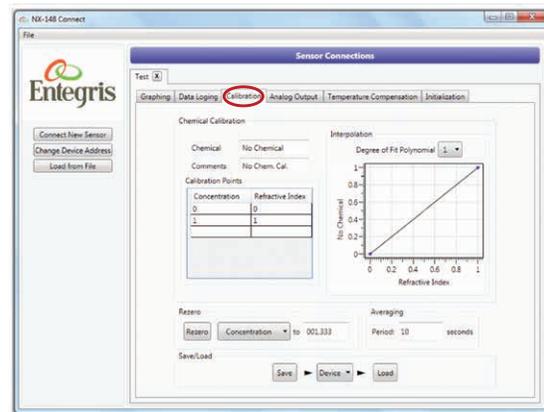
REZERO

The rezero function calibrates the refractive index measurement to a known baseline.

The typical baseline is DI water (IoR = 1.333000). Process lines that cannot be run with water may use another reference chemical of a known concentration or Index of Refraction.

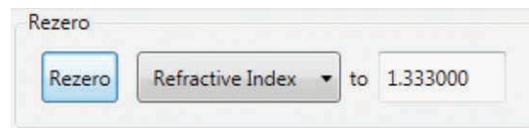
Steps

1. Wet the sensor by running DI water or other preferred reference chemical, e.g., hydrogen peroxide, through process lines.
2. In 148-connect, select the **Calibration** tab.



3. At the Rezero frame on the bottom, set the parameters:

- a. To rezero to DI water, set the Refractive Index to 1.333000.



- b. To rezero the concentration value, select **Concentration** from the dropdown menu and enter the concentration.
- c. Titrate chemical blend to acquire concentration value, and enter value in box next to concentration tab, (e.g., 0.100000).



4. Click **Rezero**. A pop-up window appears for confirmation.
 - a. Select **Yes** to save the concentration to NX148.
 - b. Select **No** to re-enter the concentration.

CALCULATING THE TEMPERATURE COMPENSATION COEFFICIENT

TEMPERATURE COMPENSATION

NX148 actively monitors and compensates for changes in the Refractive Index based on fluid temperature changes.

NX148 applies a linear temperature compensation model as determined by the Temperature Compensation Coefficient, or TCC.

The default is set for H₂O at -4×10^{-5} . For other chemistries or processes, new TCC coefficients need to be calculated.

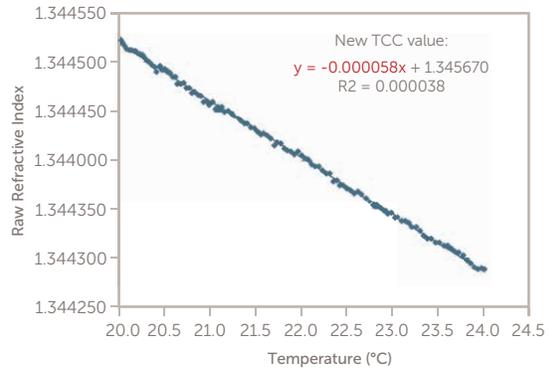
CALCULATING THE TCC

Steps

1. Collect data using the NX148 software collect data that is representative of the process being measured. Examples include:
 - Greater than 3 batches of chemical exchange
 - Greater than 3 days for a continuous process
 - Greater than 3 wafer pods

NOTE: The concentration should not change during the collection time
2. Open the data in Excel or similar spreadsheet program.
3. Highlight the Fluid Temp column data and the Raw Refractive Index column data.
4. Go to the insert tab in Excel.
 - a. Click on **scatter graph** option.
 - b. Select the “scatter with only markers option”.
 - c. Right click data and select **add trend line**.
 - d. Click **display equation** on chart and **R² value** on chart.
5. Slope value from the $y = mx + b$ is the new TCC.

NOTE: TCC is always negative and should generally range between -4×10^{-5} and 1.5×10^{-4} .

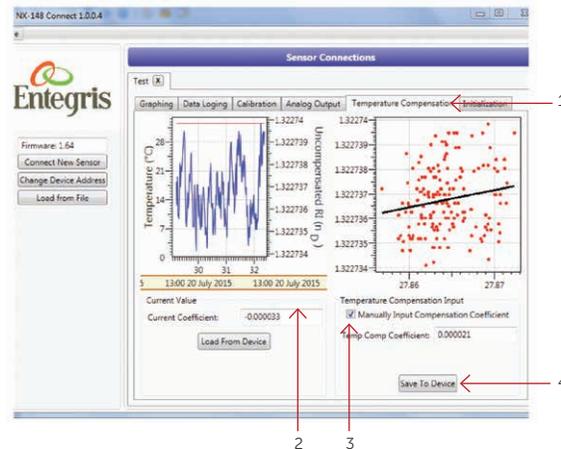


IMPLEMENT THE CALCULATED TCC

Steps

1. Click on the **Temperature Compensation** tab.
2. Click the manually input compensation coefficient check box.
3. Click on current coefficient box and change TCC to calculated value.
4. Click **save** to device.
5. Rezero Refractive Index or Concentration (See rezero section, p. 9).

Contact your Entegris Technical Representative for additional assistance in determining the TCC.



CALIBRATING

Calibrating sets NX148 to measure the process chemical.

OPTIONS	SEE
Create a new calibration table	Creating and Saving Calibration Table Initial calibration
Load calibration points from a file	Loading an Existing Calibration

DETERMINING CALIBRATION TABLE INTERVALS

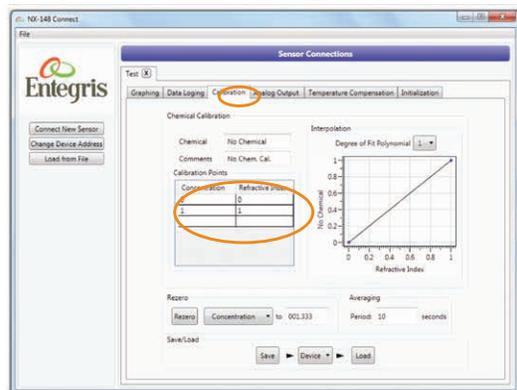
The recommended interval for the calibration table is:

- NX148 has a maximum of five calibration points
- Select calibration points above and below the target process concentration range, with the target concentration as the midpoint
- Concentration steps should be in increments of 0.1%

CREATING AND SAVING CALIBRATION TABLE

Steps

1. Begin with NX148 wetted with the baseline chemical, at the temperature, pressure and flow characteristic of the manufacturing process being monitored.
2. In 148-connect, select the **Calibration** tab.



3. Enter the name of the chemical being calibrated and any comments.
4. Add the chemical to the liquid at the known low-end concentration calibration point.

5. Observe the data graph. When the chemical is homogenized, the reading will reach steady state. Record the Index of Refraction.
6. Type the percent of concentration and the refractive index and press Enter.

Another data entry box appears.

NOTE: To edit data, use the arrow keys to move to a field and edit as needed.

7. Increase the concentration to the next increment.
8. Continue entering calibration points until the range of interest is covered at five points.
9. Save the calibration points to the device:



SAVING THE CHEMICAL CALIBRATION TO A FILE

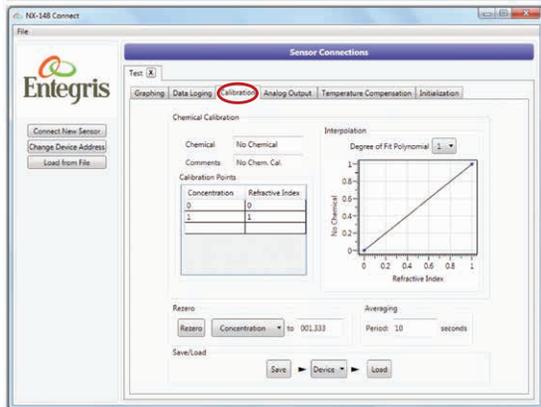
OPTIONS	ACTION
Save calibration points to a file	<ol style="list-style-type: none"> 1. Select File from the dropdown menu 2. Click Save 3. Enter a file name. The file type is .csv <p>NOTE: This does not load the settings onto NX148</p>
Load the shown calibration points onto NX148	<ol style="list-style-type: none"> 1. Select Device from the dropdown menu 2. Click Load

LOADING AN EXISTING CALIBRATION

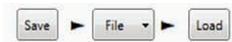
To load an existing set of calibration points onto NX148 from a saved file:

Steps

1. In 148-connect, select the Calibration tab.



2. Select File from the dropdown menu. You are prompted to select a file.



3. Click Load. The display shows the calibration points from the selected file.

4–20 MA ANALOG OUTPUT SETUP

This section explains how to set a 4–20 mA analog device to accurately interpret NX148 signals for:

- Concentration
- Refractive index
- Temperature

Steps

1. Select the Analog Output tab.



2. Configure the NX148 sensor's analog settings to match the user's 4–20 mA settings.
3. Use the Override Analog to test the maximum and minimum settings:

OPTIONS	ACTION
Accept analog settings as shown	Click Save Analog Calibration to Device
Override the shown settings	<ol style="list-style-type: none"> 1. Edit the settings 2. Click Override Analog Outputs 3. Click Save Analog Calibration to Device
Read 4–20 mA setting from the device	Click Load Analog Calibration from Device

NOTE: NX148 uses the following formula to interpret sensor data between the high and low units of measure:

$$Reading = \frac{high - low}{16} \cdot (current = 4) + low$$

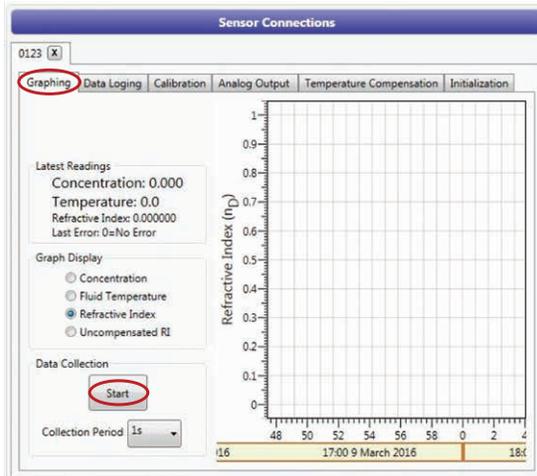
where *Reading* = % concentration, temperature of fluid, or refractive index.

LOGGING DATA

Before starting the data logging process:

Steps

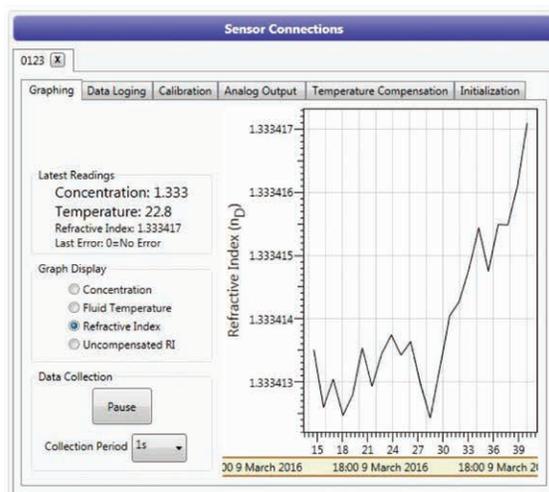
1. Click the Graphing tab.



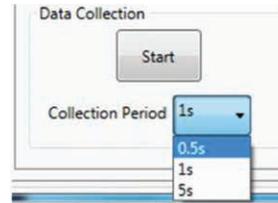
2. Click Start.

3. The graph will display information on selected data. Allow a few seconds for the graph to display selected data.

NOTE: It is important to click the Start button; if you do not click the Start button and start the data logger, no data will log. Data graph will look like the graph below.

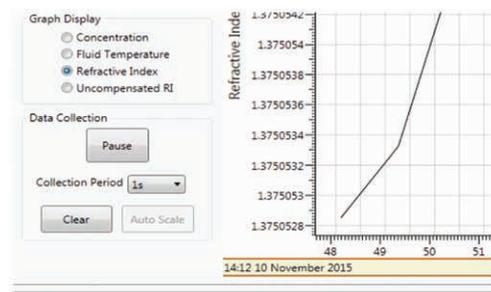


4. Select data point Collection Period to select how quickly you want the data logged.



5. The Graphing tab also has Clear Graph and Auto Scale buttons.

6. Auto Scale puts the graph back to normal after zooming in or out.



To log data to files:

Steps

1. Select the Data Logging tab



2. Enter the path name where the files will be stored.

NOTE: File names are created automatically.

3. Using the pull-down menu, select how often to create a new file.

NOTE: The file size depends on the number of data points being collected during the period of time selected.

4. You can overwrite the earlier file or begin a new data set.

OPTIONS	ACTION
To start data collection with the data already queued in the Data Graph	Check the box Save previously collected data
To start data collection without any queued data	Uncheck the box Save previously collected data

5. You can start or stop logging at any time.

OPTIONS	ACTION
To start logging immediately	Click Start Logging
To stop logging immediately	Click Stop Logging

GENERAL TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
“Sensor In Air” when chemical is flowing	Bubble trapped in flow cell	Turn the sensor upside down to release the bubbles. Mounting in this position may prevent future occurrences.
	Optical window fouling has obscured the signal	Inspect the TIR curve on the Diagnostics tab for a non-linear curve in a 'mountain' pattern. Clean window with a DI water flush and rezero.
	Sensor malfunction	Inspect sensor for cracks or delamination. If found, replace sensor.
Excessive noise (signal drifts more than 0.04% in stable chemical)	Optical window fouling	Clean window with a DI water flush. Initialize and rezero.
	Bad calibration	Verify chemical calibration is representative of the current chemical. If necessary, recalibrate the sensor per “Create a New Chemical Calibration Table” .
Small, rapid concentration or Index of Refraction changes	Pressure pulsations from the system pump	Relocate the sensor to an upstream position from the pump.
Software cannot communicate with sensor	Baud rate not changed to 115,200	Open device manager and select ports. Go to NX148 assigned port and change.
	Power not connected	Confirm the power supply is wired to NX148 unit and connected to power outlet.
	Software	Reopen NX148 software.
	USB to serial converter error	Confirm sensor is wired correctly to RS-485 connector. Ensure the USB driver is installed and operating normally.
No device was found; Ensure power is connected and powered displayed when connecting to sensor	Wrong port selected	Select correct port.
	No power to the NX148 unit	Connect power supply.
	Baud rate not changed	Change baud rate to 115,200.
	RS-485 wired incorrectly	Confirm wiring is wired correctly to the RS-485 connector.

GENERAL TROUBLESHOOTING (CONTINUED)

SYMPTOM	PROBABLE CAUSE	REMEDY
Concentration reading changes incorrectly when temperature changes	Improper temperature compensation	Change the temperature compensation coefficient.
	Variable heating and cooling temperature rates	Expose sensor to similar heating and cooling rates. Adjust the temperature compensation coefficient as needed.
	Rapid temperature change	Dampen any heating and cooling rates above 5°C/min.
Concentrations are incorrect by a small constant offset	Sensor needs to be rezeroed	Rezero sensor according to rezero process.
	Concentration needs re-titration	Re-titrate sensor as per rezero Step 3 on page 9.
Concentrations scale incorrectly (fine at low concentrations but increasingly incorrect at higher ones)	Chemical calibration is incorrect	Select the correct chemical on the Sensor Calibration/Chemical Calibration tab. For custom chemicals, rebuild the chemical calibration table.

For technical support or further assistance, please contact your authorized Entegris representative.

TECHNICAL SUPPORT

For technical support, contact Entegris at +1 800-394-4084.

For product information or quote request, email webrequest@entegris.com.

LIMITED WARRANTY

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