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NexSens N510
Sensor Interface Manual
Revision 07.10.15

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About NexSens Technology, Inc.

NexSens software and real-time data logging systems are designed to simplify the setup and operation of environmental monitoring networks. NexSens products automate much of the tedious programming, data collection, and manual data processing common with other systems.

iChart is an easy-to-learn, easy-to-use Windows-based software program designed to interface with the industry's most popular environmental monitoring sensors and systems. A large multi-vendor instrument library makes setup quick and easy. iChart automates much of the tedious programming, data collection and manual data processing common with other environmental data collection systems.

The NexSens iSIC (Intelligent Sensor Interface and Control) is a state-of-the-art line of data loggers that simplify the collection of real-time data from environmental sensors and monitoring instruments. The iSIC data logger supports multi-vendor sensor connections and is designed for environmental data monitoring with NexSens communication equipment and software.

How to Use This Manual

This manual is designed to provide you with detailed instructions for interfacing specific sensors to the NexSens iSIC data logger.

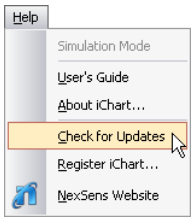
This manual provides you with all the information needed to interface your sensor with the iSIC data logger. For advanced system and sensor reference material:

- Review the material in the iSIC operations manual:
  - http://www.nexsens.com/support/manuals.htm
- Review the sensor manufacturer's operations manual. This information should have been provided with the purchase of the sensor. This material can also typically be found at the instrument manufacturer's website. If you are still having difficulty, email your technical support question to:

  support@nexsens.com

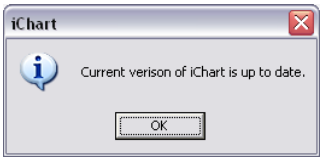
Keeping iChart Up to Date

NexSens periodically releases new versions of iChart software and iSIC firmware to be downloaded free of charge. The updated versions typically add new features, improve existing features, and/or add more reliability to the system. It is important that iChart is updated to the latest version before connecting a new sensor to your iSIC data logger. Your computer will require internet access to update automatically.

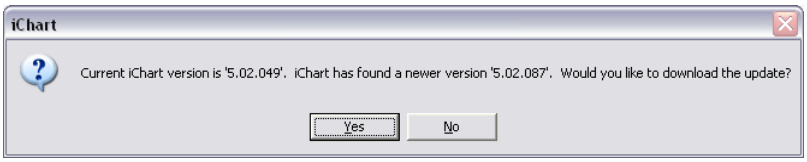


To obtain the latest version of iChart software, open the program on your computer. In the **Help** menu, select **Check for Updates.**

If your software is up to date, iChart will confirm that your computer is running the current software release.

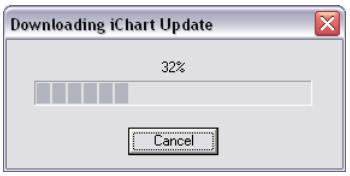


If a newer version of iChart is available, a dialog box will appear asking if you would like to upgrade to download the update.



Click **Yes**. iChart will begin downloading the update.

Note: Depending on your connection speed, this update may take a few minutes. You can continue running other applications on your computer while the download is progressing.



When the update has finished the downloading process, click **OK** and close iChart.

Reopen iChart. When the program opens, iChart will automatically begin the installation process. Follow the step-by-step installation windows to complete the iChart software update.

Note: If an internet connection is unavailable on the computer, iChart can be downloaded onto another computer and then moved to the computer where it needs installed. The latest version of iChart can be downloaded here:

http://www.nexsens.com/support/downloads.htm

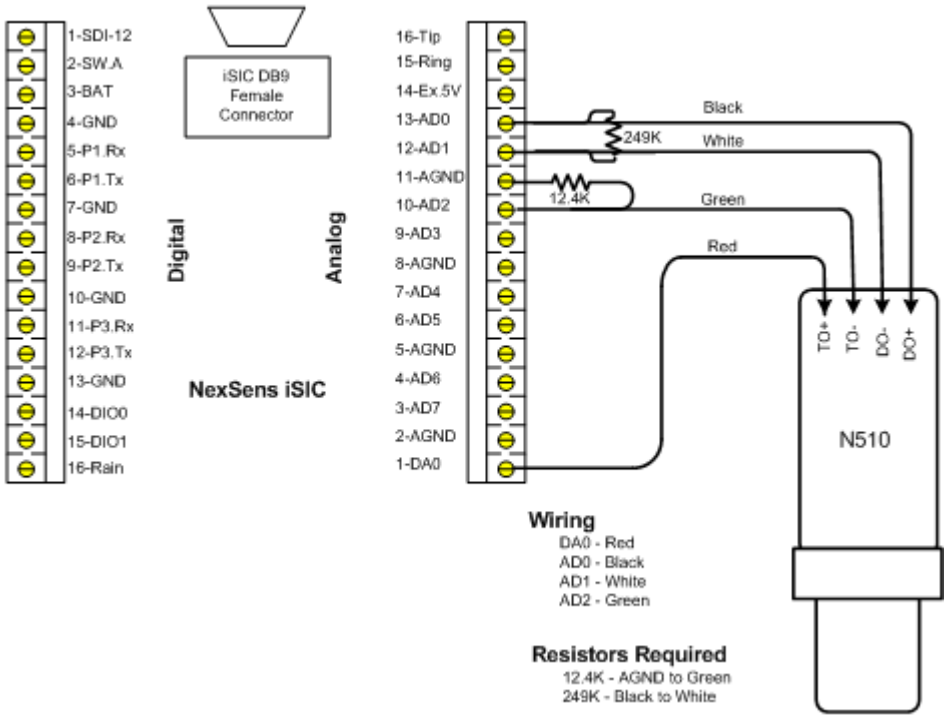
Technical

Connection	Instrument cable 25, 50 or 100 feet standard Analog interface
Temperature	
Operating Temperature	-80°C to +120°C
Measuring Range	-80°C to +75°C for stability
Time Constant	1 Second Maximum in Oil Bath 10 Second Maximum in Still Air
Sensor Type	10k +/- 0.56% Epoxy Encapsulated Precision Thermistor
Dissolved Oxygen	
Operating Temperature	0°C to 50°C
Measuring Range	0-350% Saturation typical
Accuracy	+/- 0.2 mg/L
Response Time	90% in 180 seconds
Membrane Type	5 mil
Output Signal	Current Source
mV Conversion Resistor	*249K

*Required to interface to an iSIC

Wiring

Up to (2) N510 can be connected to a standard iSIC data logger at a time. With a dissolved oxygen expansion up to (4) more can be connected.



The NexSens N510 sensor has four wires to measure temperature and dissolved oxygen.

The red and the green wires are used to measure temperature. The red wire should be wired to DA0 and a 12.4K resistor should be placed between the AD channel the green wire is connected to and AGND.

The black and white wires are used to measure dissolved oxygen. The black wire should go to the higher AD channel in an AD channel pair (ie. AD0, AD2, AD4, or AD6) and the white wire should go to the lower channel in the pair (ie. AD1 if black is going to AD0). A 249K resistor should be placed between the black and white wires.

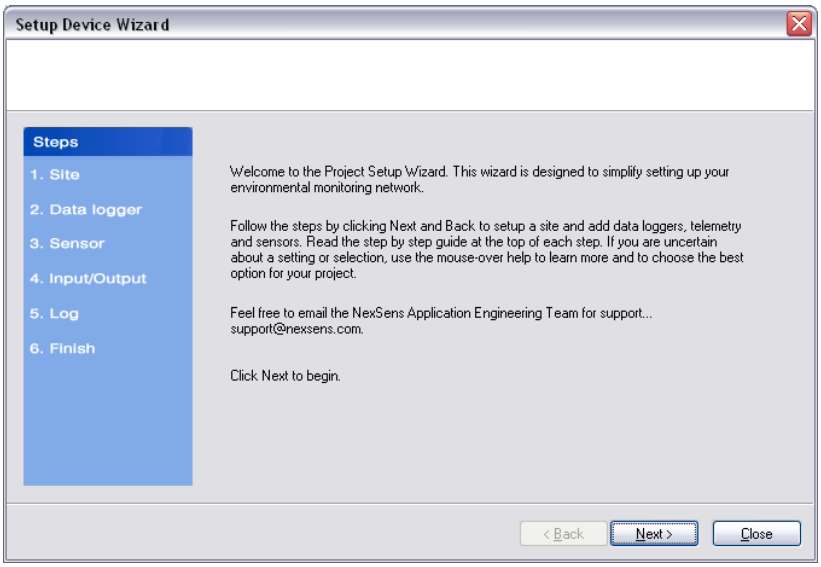
Note: Do not wire more than one wire to each ADx pin (multiple wires can go to AGND and DA0 pins when using multiple sensors).

Adding to iChart

Once all wiring is completed, the device is ready to be added to an iChart database. To add the device to an existing database, select **Instrument | Add Device**. To create a new database, select **File | New Project.**

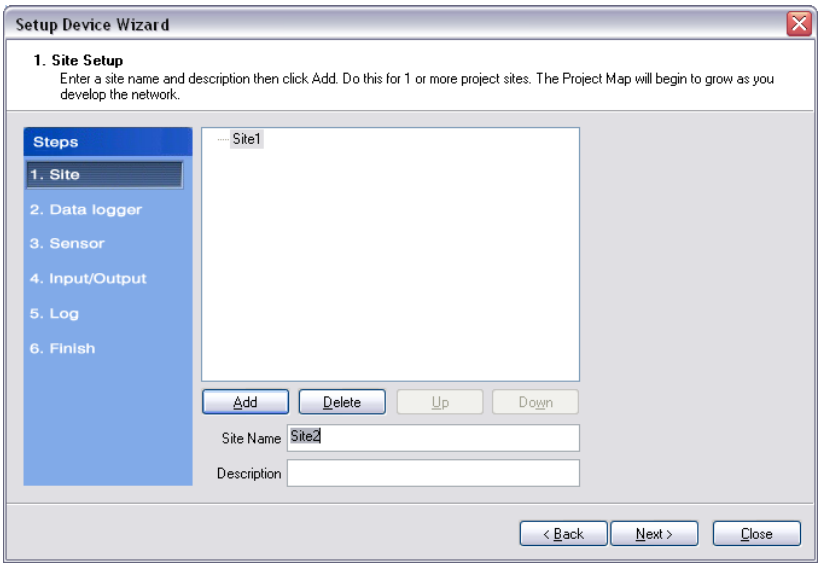
Setup Device Wizard

The Setup Device Wizard will begin. Click **Next** to continue.



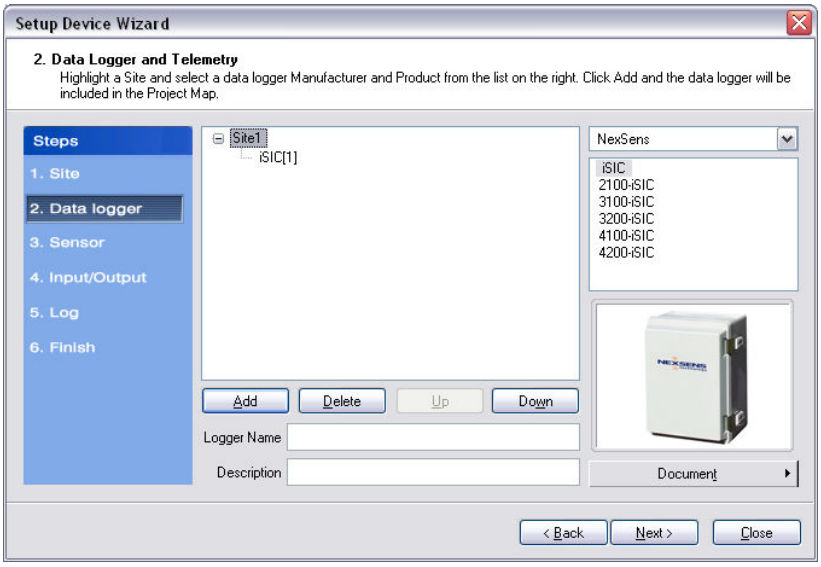
Step 1 – Site Setup

The first step is to create a site for data loggers and sensors to be located in. If this is an existing project, sites may already exist. Enter a **Site Name** and click **Add**.



Step 2 – Data Logger & Telemetry

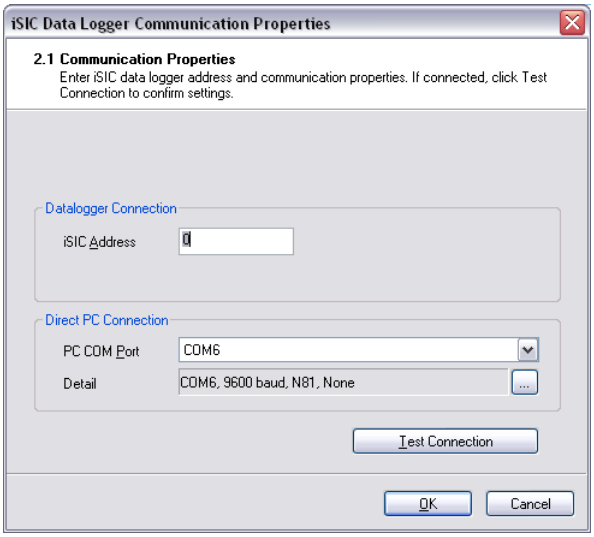
The next step is to add the data logger(s) to the sites created in the previous step. Select a site to add a data logger to. Then select the data logger model number from the list at right and click **Add**.



The **iSIC Data Logger Communication Properties** dialog box will appear. Enter the required iSIC data logger connection information (see below for model-specific instructions) to finish adding the data logger to the selected site. When complete, click **OK**.

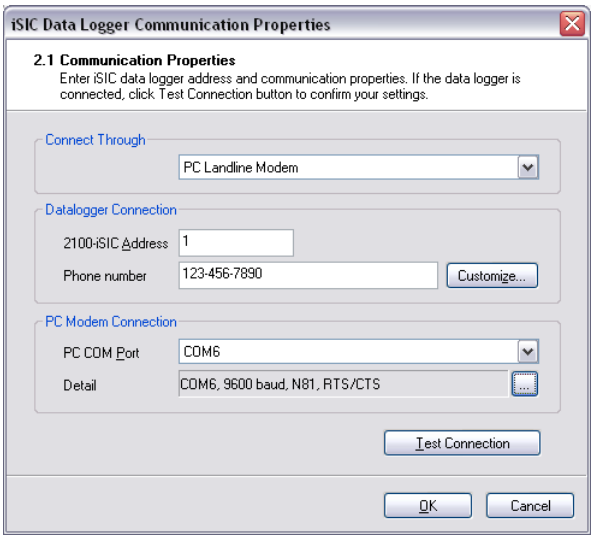
For an **iSIC** data logger, enter the iSIC address and select the PC COM Port that the data logger is connected to.

- The iSIC address is typically '1'. If unknown, enter '0' and click **Test Connection** to determine the address.
- The PC COM Port drop-down menu is the list of available COM ports iChart detected on the computer.



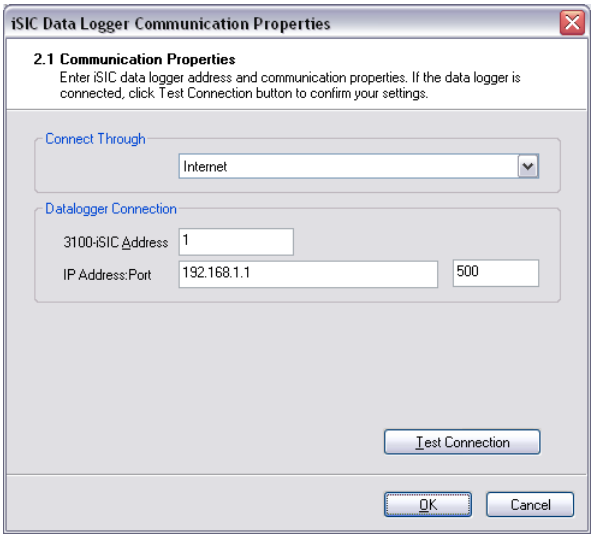
For a **2100-iSIC**, enter the 2100-iSIC address, phone number, and PC COM Port that the computer phone modem is connected to.

- The 2100-iSIC address is typically '1'. If unknown, enter '0' and click **Test Connection** to determine the address.
- The PC COM Port drop-down menu is the list of available COM ports iChart detected on the computer. Internal PC phone modems are typically set to COM3.



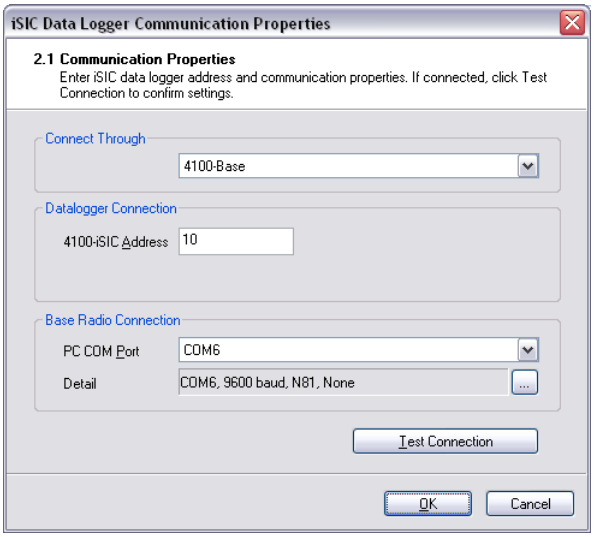
For a **3100-iSIC**, enter the 3100-iSIC address and the IP address of the data logger.

- The 3100-iSIC address is typically '1'. If unknown, enter '0' and click **Test Connection** to determine the address.
- The IP address is provided by the cellular service provider in which your cellular data account is setup. The port is set to 500 by default.



For a **4100-iSIC**, select the method in which the 4100-iSIC is connected to your PC and enter the 4100-iSIC address.

- A 4100-iSIC can connect to a PC through a 4100-BASE or a 4200-iSIC.
  - A 4100-BASE system connects to a PC via RS-232 cable.
  - A 4200-iSIC connects to a PC via landline telephone.
- The 4100-iSIC address is '1' by default.
  - If there is more than one 4100-iSIC in use, each 4100-iSIC should be programmed with different addresses (See the *4100-iSIC | iSIC Addressing* section in the iSIC manual).



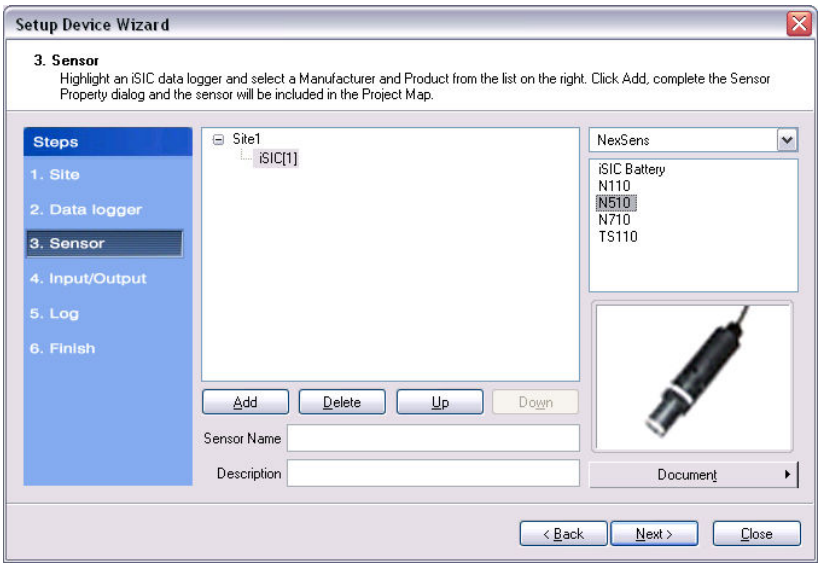
For a **4200-iSIC**, enter the iSIC address and PC COM port the data logger is connected to.

- The 4200-iSIC address is typically 250. When communicating with a 4200-iSIC, any communication using the 4200-iSIC address will be sent to the 4200-iSIC data logger.
  - Communications using any other address will be broadcast to any 4100-iSIC(s) in your radio network.

    Note: Do not use address '0' when communicating to a 4200-iSIC.
- The drop down menu of PC COM Port's is the list of available COM ports iChart detected on the computer. Internal phone modems are typically set to COM3.

Step 3 – Sensor

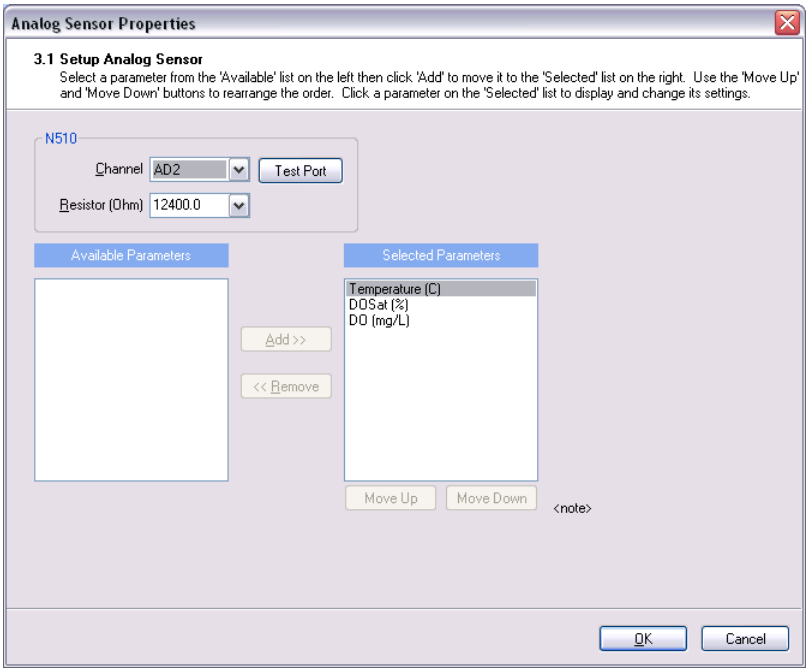
After selecting a data logger, click **Next** and select **NexSens** from the drop-down list of manufacturers. Then select the **N510** model number associated with your device and click **Add**.



The **Sensor Properties** dialog box will come on the screen.

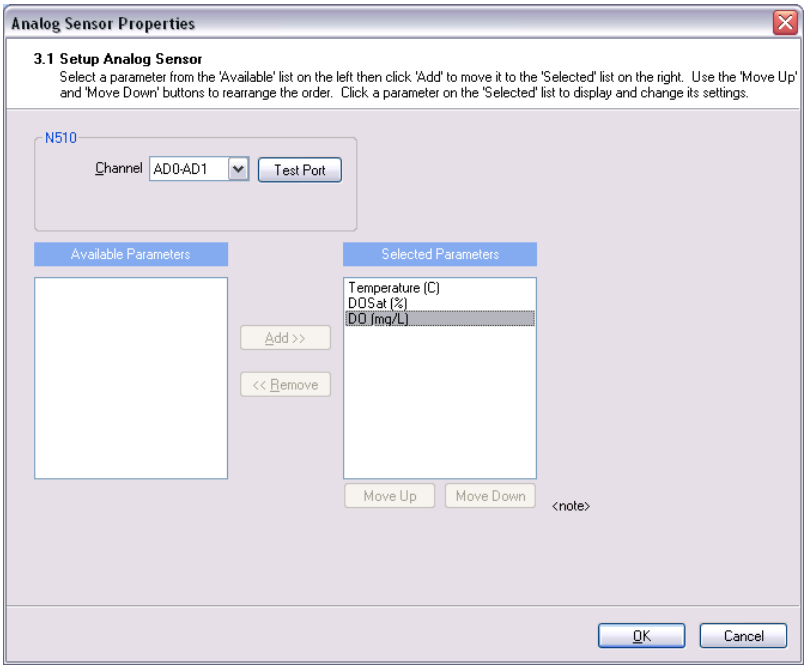
First, make sure **Temperature (C)** is selected in the **Selected Parameters** list. Then select the **Channel** and **Resistor** value that was used in the thermistor N510 wiring.

"AD2" and "12400.0" were used in the wiring section at the beginning of this manual.

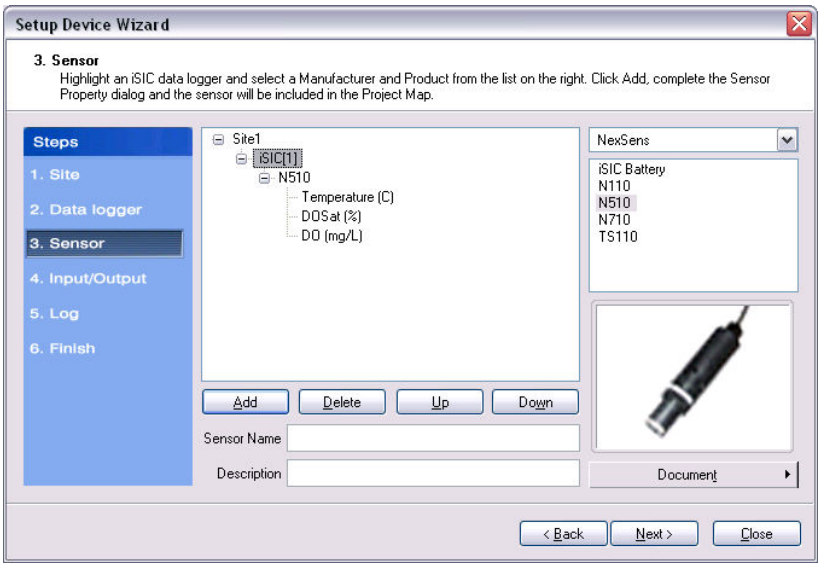


Next, select **DO (mg/L)** from the drop down menu. Select the differential analog pair that was used in the DO N510 wiring.

"AD0-AD1" was used in the wiring section at the beginning of this manual.

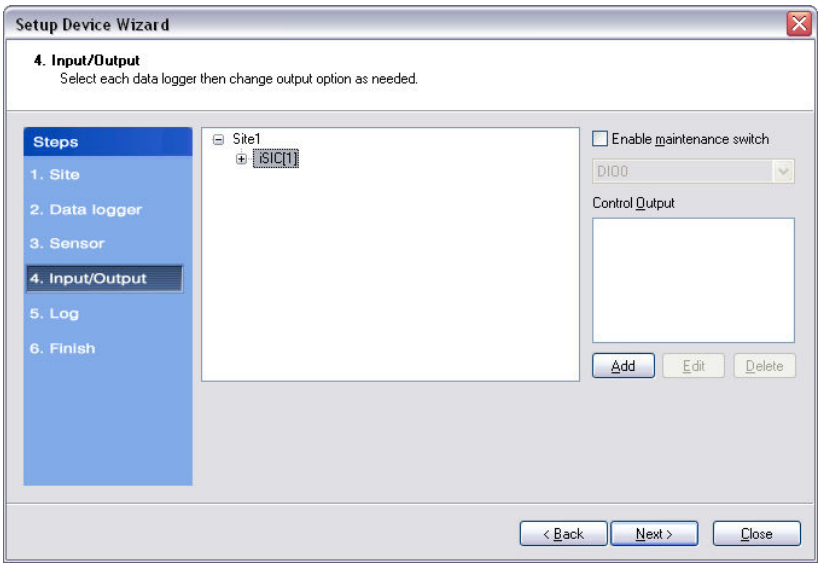


Click **OK** and the sensor will be added to the selected data logger. More sensors can be added at this time by selecting the sensor manufacturer and then sensor model number from the drop down menu on the right. Click **Next** when finished adding sensors.



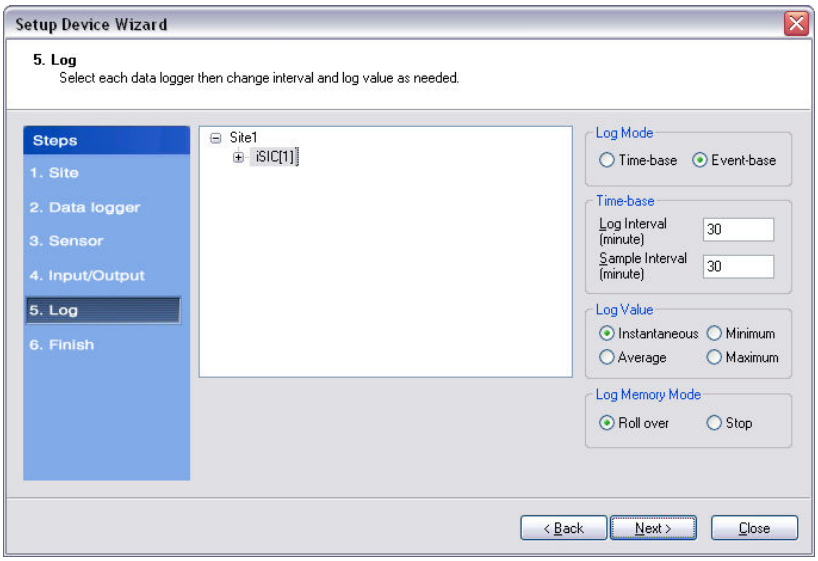
Step 4 – Input/Output

Enable any output and control features of the data logger. See the iSIC manual, section ***4.4.2 iSIC Controls*** for more information on this functionality.



Step 5 – Log

Select each data logger from the site list and enter the desired **Log Interval** and **Sample Interval** for the data logger in the **Interval** section. In the **Log Value** section, select how the data logger should log data points.



Log Mode

The Log Mode controls when data is logged by an iSIC. In **Time-base** (the default and most common), data is logged at a specified interval, controlled in the **Time-base** section. In **Event-base** log mode, data is only logged when a ground pulse is sent to the Rain input pin on the iSIC digital terminal strip (such as from the contact closure of a tipping bucket rain gauge).

Log Value

By default, the **Sample Interval** and **Log Interval** are equal. When a sampling interval is different than the log interval, all the sampled measurements for the iSIC are used to calculate the average, minimum, or maximum of that logging interval (based on the log type selected, only one can be selected at a time). The individual data points that comprise the samples are not saved; only the final, average, minimum or maximum data point is saved at the specified log interval.

Log Memory Mode

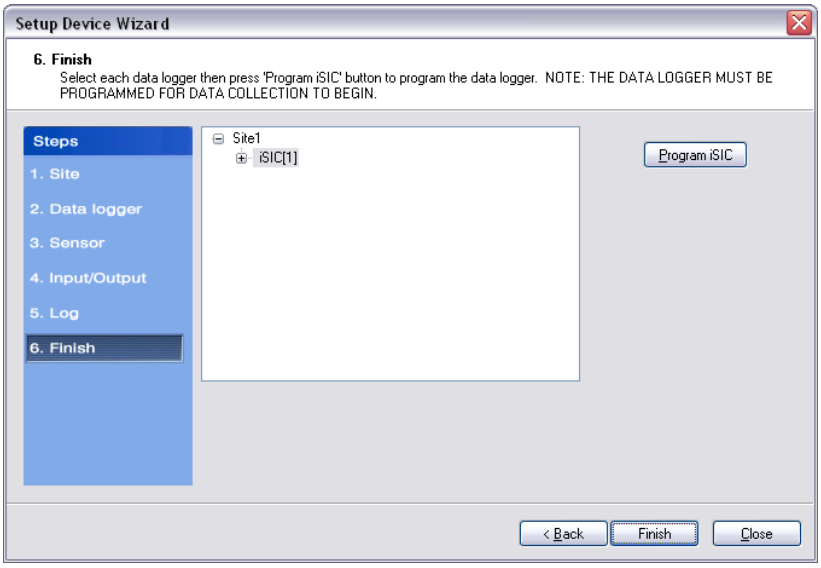
The default memory mode is **Roll over**, and is the recommended operating mode. In this mode, the last ~150K readings (when using 512K flash) will be stored in iSIC memory. When the iSIC memory has filled with readings it will "roll over" the original readings and keep logging. This is ideal for real time applications, where data is being uploaded to a PC as

In **Stop** memory mode, the first ~150K readings (when using 512K flash) will be stored in the iSIC memory. When the iSIC memory has filled with readings, it will stop logging until memory is cleared. When operating in this mode, it is recommended that memory is cleared every time data is uploaded.

Step 6 – Finish

All data loggers and sensors must be programmed before data collection can begin.

- Select an iSIC data logger and click the '**Program iSIC**' button. Before programming an iSIC:
  - The iSIC must be powered and connected to the computer.
  - The 2100-iSIC must be powered and connected to a phone line.
  - The 3100-iSIC must be powered and have a cellular data account.
  - The 4100-iSIC must be powered and be able to communicate to the computer through a 4100-base or 4200-iSIC
  - The 5100-iSIC must be powered and be able to communicate to the computer over Ethernet.
- Click **Finish** when programming is complete.



This wizard can always be revisited by selecting **Project | Setup Device Wizard** if you would like to program an iSIC at a later time or need to setup other sites, data loggers, and sensors.

Step 7 – Retrieve an Initial Data Set and Use the Instrument Within iChart

After your sensor has been added to the database, the main instrument control screen will appear.

Important: All parameters are initially displayed with blank values until after the first log interval has passed and data has been interrogated. Once data has been retrieved from the iSIC, these fields will show the most recent data set recorded by the instrument. By default, iChart will automatically interrogate devices five minutes after every hour.

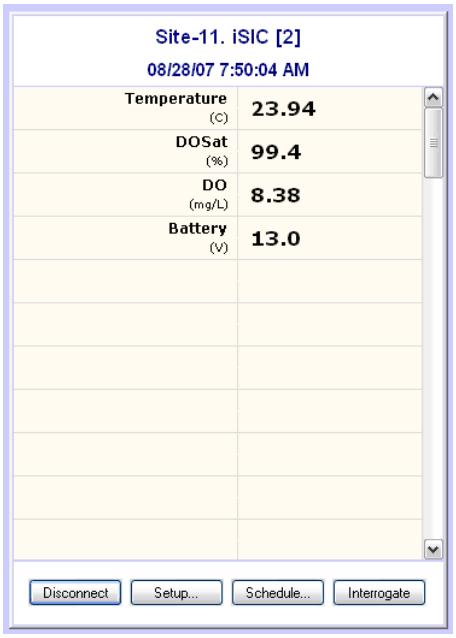
Calibration

Once the sensor has been setup, you can proceed to calibrate the instrument. This will need to be done before you can obtain accurate readings from your device. There are two types of calibrations offered with the N510: **in-situ** and **in-air**.

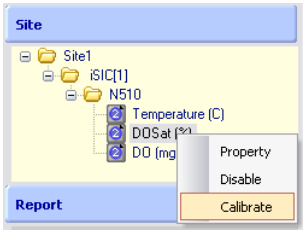
In-Situ Calibration

We suggest an mg/L in-situ calibration of the sensor. To complete the calibration you will need to take a dissolved oxygen reading with a dependable handheld meter. First, make sure that the N510 has stabilized (15 minutes or more). Then verify that the handheld meter is calibrated and functioning properly. Take a reading as close to the N510 sensor as possible with the handheld meter.

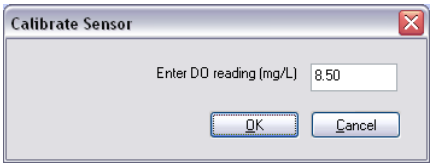
Click **Connect** and wait until the DO readings have stabilized to 0.1 mg/L.



Then right click on the **DO mg/L** parameter in the **Navigation Panel** and select **Calibrate**.



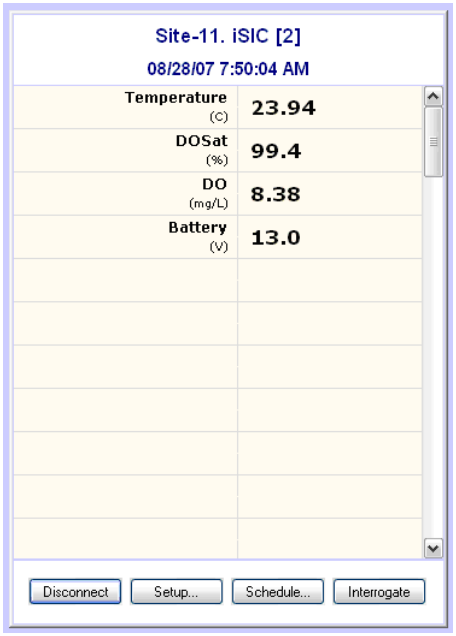
Enter the handheld meter mg/L value into the **DO (mg/L)** field of and click the **OK**.



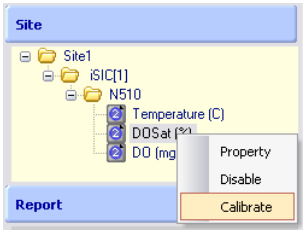
The oxygen readings in the **Current Readings** section should update to the calibrated value (You can check this by clicking **Connect** again).

In-Air Calibration

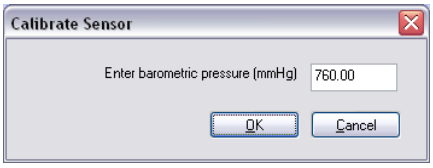
A saturated air calibration can be used as an alternate to the mg/L calibration described above. To complete a saturated air calibration, first place the probe in a moist air environment. This can be created by wrapping a moist towel around the sensor. Try to avoid pressing the towel against the membrane; just loosely wrap the towel to create a pocket of humid air. After the probe has stabilized (15 minutes or more) click **Connect** and wait until the DO readings have stabilized to 0.1 mg/L.



Then right click on the **DOSat (%)** parameter in the **Navigation Panel** and select **Calibrate**.



Enter the barometric pressure (in mm of mercury) into the **(mmHg)** field and click the **OK**.



The oxygen readings in the **Current Readings** section should update to around 100%. Note that the actual % value will vary based on the barometric pressure entered. (You can check this by clicking **Connect** again).

Calibration Considerations

As with any dissolved oxygen sensor, you need to carefully prepare and properly calibrate the instruments to achieve reliable readings.

Most importantly, the probe must be filled with the correct type of electrolyte and have a good membrane. See the probe maintenance section of this manual for the procedure to change a membrane and add electrolyte.

For the first time set-up, or after a membrane change, the probe must equilibrate to the calibrating environment. We suggest at least 15 minutes of acclimation, not only with the probe in the environment, but also with the probe powered and taking readings.

When calibrating in mg/L mode, you must realize that the probe has a slow reaction time due to its thick 5 mil membrane. The best calibrating environment has a stable DO content and has ample exchange to compensate for the probes stirring dependence. If you are calibrating in a quickly changing environment (unstable DO) it will be difficult to get a reliable reading with your secondary meter. In unstable environments it may be wise to calibrate using the moist air barometric pressure calibration.

Basic Probe Maintenance

Regular maintenance is required to maintain reliable readings with your N510. Regular maintenance will include cleaning the probe and any deployment apparatus associated with the probe. Occasional maintenance will include changing the sensor membrane and replacing the probes electrolyte. Even less frequently you may need to replace the lead electrode contained within the sensor module.

A power point presentation of probe reconditioning can be found here:

http://www.nexsens.com/download/reconditioning_ati_do_probe.ppt

Cleaning

We suggest cleaning your N510 every week. Cleaning can be accomplished by simply spraying off the sensor face and membrane with a spray bottle using water. For heavy fouling use a soft, moist sponge to gently clean the area. This is also a convenient time to visually inspect the membrane for any tears or holes. Any damage to the membrane warrants a membrane change. In high fouling environments cleaning may be required more frequently, and low fouling environments may require less frequent cleaning. A one-week interval is a good starting point to observe probe performance and state of fouling.

Membrane change and electrolyte replacement

Beyond basic cleaning maintenance, you will need to replace your membrane and electrolyte occasionally. Expected membrane life can range from 2 to 6 months, depending on the sampling environment. You should change your membrane and electrolyte if you visually detect membrane damage, or your probe performance decreases (response time increases, will not calibrate to a known-good handheld meter, data starts to drift shortly after cleaning or calibration).

To change a membrane, do the following:

Remove the small plastic "bleed" screw on the side of the sensor module. Be sure to not lose the screw and small o-ring.

Next you will need to unscrew the electrolyte cup assembly on the end of the DN510. Do not just remove the silver cap that holds the membrane in place, remove the whole cup assembly that screws up onto the sensor unit. The cup assembly is fairly smooth with fine horizontal ridges. The sensor module itself is distinguishable by its deeper vertical grooves. Once the cup assembly is removed you should see the electrode within the sensor unit, and have the electrolyte cup and membrane separated from the probe.

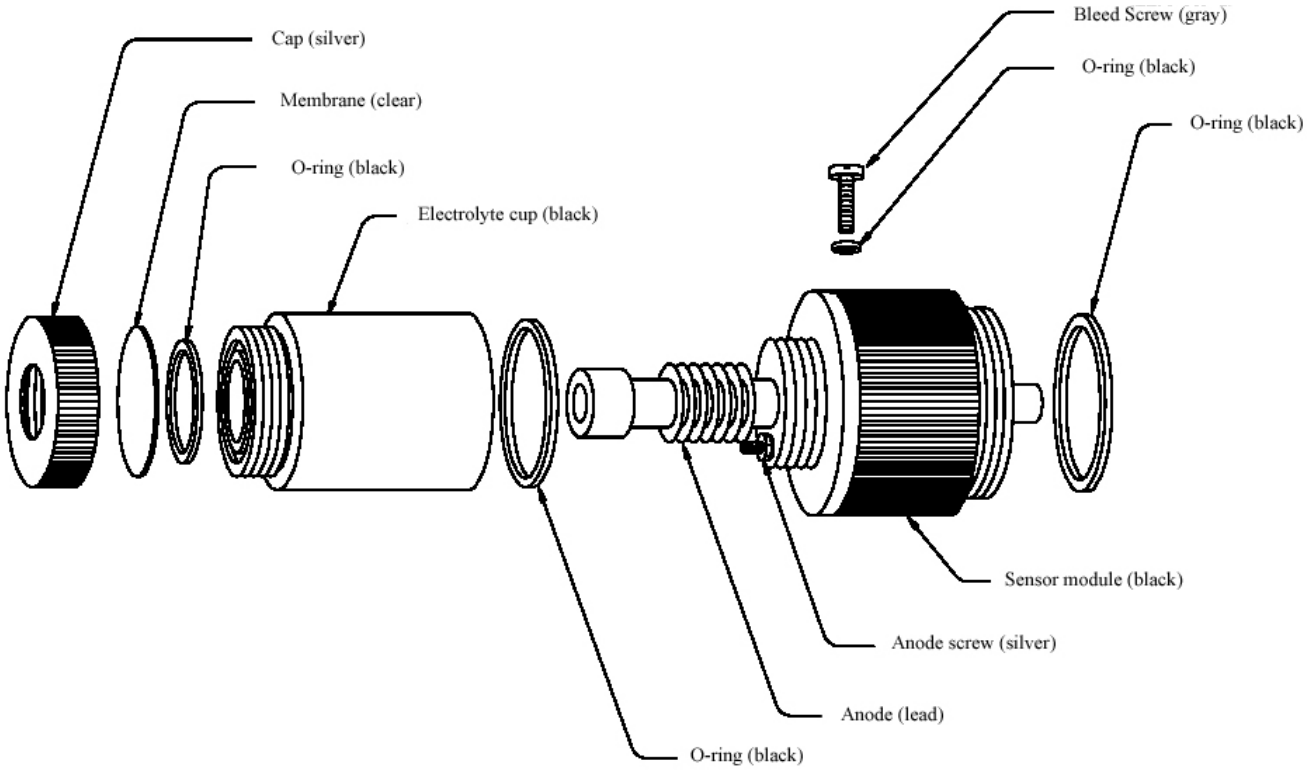
You should then remove the silver metal "cap" that holds the membrane against the electrolyte cup. You can then remove and discard the old membrane.

Place a new membrane inside of the silver metal cap. Make sure that you put a clear 5-mil Teflon membrane in the cap, not one of the blue paper inserts that separates the membranes. Now you can screw the silver cap (with the membrane) back onto the electrolyte cup.

Next, fill the electrolyte cup with fresh electrolyte. Fill the cup to just below the internal threads.

While holding the sensor module in one hand, screw the electrolyte cup back up onto the sensor module. If you filled the cup with enough electrolyte you should have some spillage of excess electrolyte out of the bleed screw hole.

Finally, carefully replace the plastic bleed screw. Excessive over-tightening could cause the plastic screw to break. You are now ready to re-calibrate following the instructions from the Calibration section of this manual.



Anode Replacement

Every few years it may be necessary to replace the lead anode in the dissolved oxygen sensor module. If cleaning, membrane and electrolyte replacement, and calibration do not bring back sensor performance you should replace the lead anode. Contact NexSens to order replacement anodes for your N510.

Troubleshooting

iChart fails to interrogate my device after it has been running in the field for some time.

The iSIC battery may not have enough voltage. The iSIC needs at least 10.7V to operate, and the battery may have over time dropped below that value. Check the battery voltage with a Multimeter, it may need to be charged. Also, NexSens recommends that the battery be replaced every 18-24 months, as over time batteries fail and can no longer be charged.

The iChart report says that the dissolved oxygen AND temperature readings are all zero.

The sensor may have failed or the connection between the iSIC and the sensor may be become interrupted. Verify that the wires from the sensor to the iSIC are secure in the terminal strip. If they are, make sure that the cable has not been cut or damaged.

The iChart report is showing values for dissolved oxygen OR temperature readings that extremely out of range.

The sensor may have failed. First, verify the wiring as in the above problem. If the wiring is not the problem, make sure that there is solution in the electrolyte cup and that the membrane is undamaged. See the 'Basic Probe Maintenance' section of this document for instructions on replacing the electrolyte and membrane.

If these troubleshooting procedures have not resolved your problem, please contact our support team at NexSens Technology, Inc:

Accessories and Spare Parts

A501	Membranes, 5-mil Teflon, 10 ea.
A502	Dissolved oxygen electrolyte, 4 oz.
A503	Anode, lead
A504	Bleed screw, plastic
A505	O-ring, for plastic bleed screw
A506	O-ring, for sensor module
A507	O-ring, for electrolyte cup assembly
A508	DN510 float kit