

WQ-FL

Fluoride
ISE Sensor

User Manual



NEXSENS
technology

About NexSens

NexSens Technology, Inc. was founded in the late 1990s with a mission to advance the capabilities and simplify the development of environmental monitoring systems. The company specializes in environmental sensors, remote data acquisition and communications technology, easy-to-use computer software, and web based datacenters.

iChart Software 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 SDL500 (Submersible Data Logger) and iSIC (Intelligent Sensor Interface and Control) are state-of-the-art data loggers that simplify the collection of real-time data from environmental sensors and monitoring instruments. The data loggers support multi-vendor sensor connections and are specifically designed for environmental data monitoring.

WQData PRO is an enterprise class and business critical web-based software solution for environmental data management. It assists with collecting, storing, analyzing, interpreting, sharing, and publishing environmental data. The datacenter effectively manages a wide variety of biological, physical, and chemical parameters, along with many other environmental observations and project information.

WQSensors smart USB-based sensors include: Temperature, pH, ORP, Dissolved Oxygen, Ammonium, Bromide, Calcium, Chloride, Fluoride, and Nitrate. An integral USB connector on the sensor cable offers a simple, hassle-free connection to a computer without the need for a meter or batteries.

T-Node temperature systems, based on sensorBUS technology, provide a simple, yet effective, plug-and-play solution for developing multi-sensor networks and temperature strings. sensorBUS was developed to replace, expand, and enhance centralized parallel wiring for prevailing analog and digital signal transmissions. With integral 1-wire, SDI-12 and RS-485 interfaces, sensorBUS provides versatile sensor networking capability.

Monitoring Buoys are designed to support offshore monitoring systems. These buoys provide a robust floating platform for inland water monitoring projects.

NexSens products and systems simplify the setup and operation of environmental monitoring networks and help ensure quality data.

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Overview

WQSensors are water quality sensors with a direct USB interface, providing a connection without meters, batteries, or power supplies. WQSensor water quality measurement parameters include bromide, calcium, chloride, fluoride, ammonium, nitrate, dissolved oxygen, oxidation-reduction potential, pH, and temperature.

WQSensors such as the WQ-FL fluoride sensor that use ion selective electrodes incorporate a refillable double junction reference electrode with user replaceable sensing module. Each sensing module is composed of an ion-specific membrane. A measurement of the electric potential created across the membrane by specific ions is compared to the reference electrode, and a net charge is calculated. This net charge is directly proportional to the concentration of the specific ion.

WQSensors Software provides an interface to calibrate, log, and analyze data. Data for up to four sensors can be displayed in real-time, and reports that include graphical data representations and statistical summaries can be generated automatically. The software also includes a science library with an interactive periodic table, unit converter, and other useful science utilities.



Figure 1: WQ-FL fluoride ISE sensor

What's Included

The WQ-FL Fluoride ISE Sensor includes the following accessories and spares to get started and keep the unit operational:

- WQSensors software & science library CD
- Fluoride standard solution, 1000 ppm as F⁻, 30 mL bottle
- Fluoride ionic strength adjuster (ISA) solution, Total ionic strength adjustment buffer (TSIAB), 30 mL bottle
- Fluoride reference filling solution, 10% KNO₃, 30 mL bottle
- ISE sensor storage cap
- Quick start guide

Common Accessories

Table 1: Accessories commonly used with the WQ-FL fluoride sensor

Part Number	Description	Details
FL12	Fluoride ISE module	User replaceable threaded fluoride ISE electrode
WQ-A	Sensor arm	Used for hands-free measurements for up to five WQSensors
WQ-PLATE	Stir plate	Magnetic stir plate used to automatically stir samples during measurements
WQ-STIR	Micro-stirrer	Used with the WQ-PLATE to stir samples near the sensor
SDOFL2-500	Fluoride standard solution	Used for sensor calibrations, 1000 ppm, 500 mL
AJOFL1-125	Fluoride ionic	Used to ensure

	strength adjuster	samples and standards have a similar ionic strength, 125 mL
RFOFL1-125	Fluoride reference filling solution	Used to refill the WQ-FL reference module

Specifications

Table 2: NexSens WQ-FL fluoride sensor specifications

Length	6.1 in (155 mm)
Diameter (OD)	Body: 0.47 in (12 mm) Sensor Cap: 0.63 in (16 mm)
Cable Length	6'
Concentration Range	0.02 ppm (10^{-6} M) to saturation
Operating Temp Range	0 to 80°C
Operating pH Range	5 to 7 @ 10^{-6} M 5 to 11 @ 0.1 M
Reproducibility	±2%
Known Interferences	OH ⁻
Minimum Sample Size	5 mL in a 50 mL beaker

Getting Started

Each WQSensor ships assembled, tested, and calibrated to factory specifications. To get started, insert the WQSensor software CD included with the sensor into a computer and follow the wizard to download and install the software.

Preparing for Measurements

When preparing to take measurements with the WQ-FL, follow the procedure outlined below:

1. Remove the protective sensor cap must from the end of the sensor. **Do not touch the sensing module with bare hands.**

2. Make sure the reference fill solution level is above the reference fill line (see figure below).

NOTE

Reference fill solution can be added using the small nozzle on the reference fill solution bottle provided with the sensor or alternatively using a small syringe and needle.

To add reference solution, slide the fastfill cap sleeve down and add solution through the hole in the sleeve. Make sure that no air bubbles are trapped inside the sensor before closing the fastfill cap sleeve.

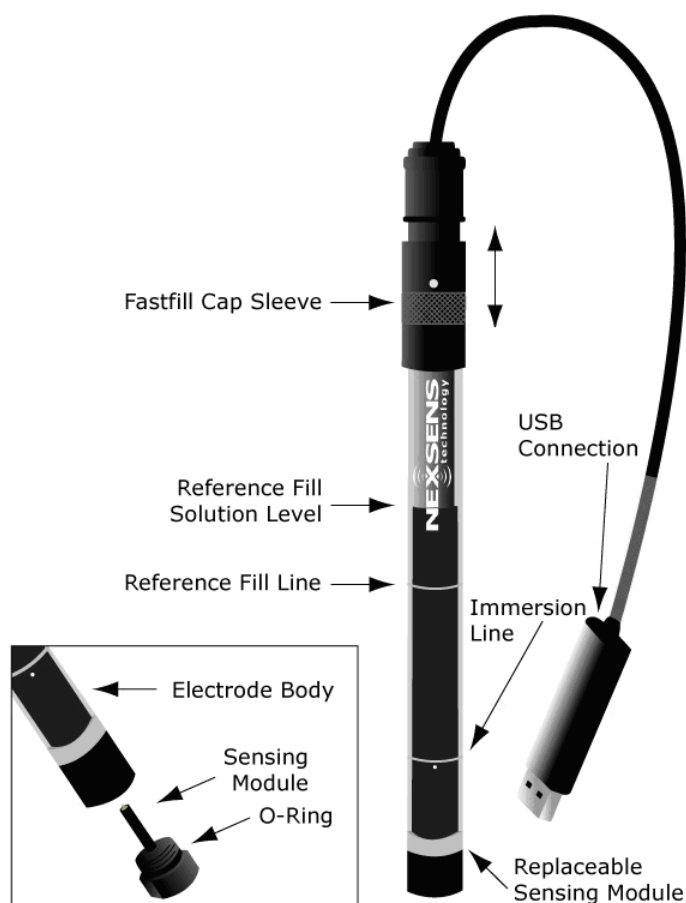


Figure 2: Typical ion selective electrode WQSensor

3. Rinse the electrode with distilled or deionized water and blot dry. **Do not rub the sensing module.**
4. Place the sensor tip in distilled or deionized water and stir for five minutes to ensure the electrode is completely clean.

Measurement Techniques

The quality of data collected depends heavily on measurement techniques applied. Adhere to the following guidelines for best results:

NOTE

Keeping atmospheric pressure on the reference fluid during measurements gives the most reproducible flow out of the junction.

- Calibrate and measure all samples at the same temperature. Recalibrate if the temperature of the probe's operating environment changes significantly.
- The fastfill sleeve should be open (down) during measurements (see Figure 3).
- The reference filling solution level should be higher than the sample level (see Figure 3).
- The sample level should be higher than the immersion line on the probe (see Figure 3).
- Do not allow air bubbles on the sensing module during measurements. Gently tap the sensor to remove bubbles if they exist.
- Always rinse electrodes with distilled or deionized water between measurements.
- Blot the sensor dry, never rub dry.
- Stir the sample whenever possible. Stirring decreases the amount of time for the sensor to equilibrate and readings to stabilize.
 - Stir thoroughly at a slow to moderate speed using either a magnetic stirrer or the probe as the stirring rod.
 - Stirring rate should be consistent among all samples and standards.
 - Magnetic stirrers may generate enough heat to change solution temperature. A piece of insulating material such as cork, cardboard, or Styrofoam can be placed between the stir plate and sample container to help minimize heat transfer.
- Add ionic strength adjuster to samples in a 1:1 ratio. For example, add 100 mL of ISA for each 100 mL sample. Adding ISA in a 1:1 ratio effectively masks interfering compounds or ions from the probe. Additionally the TISAB has an acetate buffer at pH 5.4, which helps adjust the sample pH to the appropriate range.

NOTE

Magnetic stirrers may generate enough heat to change solution temperature.

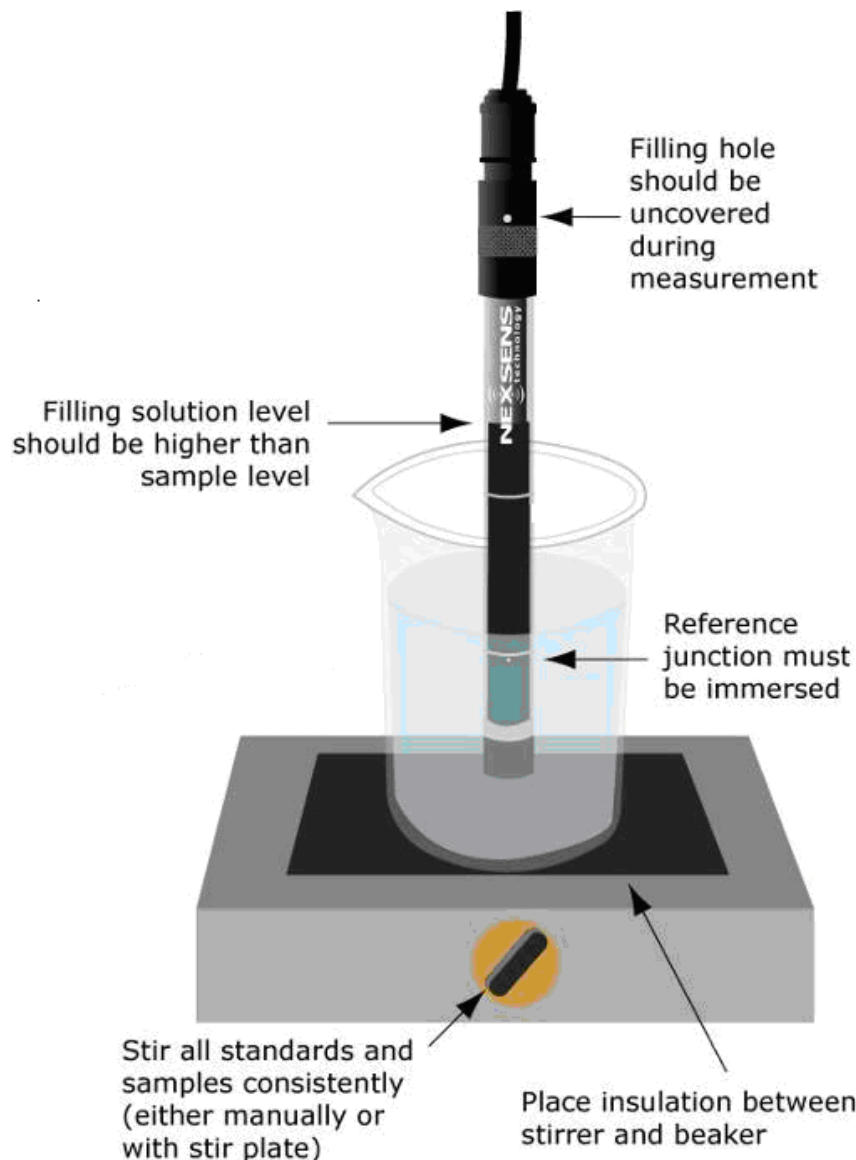


Figure 3: Visual summary of proper measurement techniques for ISE WQSensors

Computer Interface

WQSensor Software requires the following minimum system configuration:

- Pentium processor
- 64 MB RAM
- 100 MB hard drive
- 2 MB video card

- CD-ROM drive
- Adobe Flash
- Windows 2000 (SP1 or higher), Windows XP, Windows Vista, or Windows 7

Following the initial software installation, USB communication with WQSensors will be enabled. Plug a WQSensor into an available USB port. Windows will automatically recognize it and start the Found New Hardware wizard.

The device driver should download automatically. If the computer does not find the device driver and install it automatically, it can be installed manually from the following location:

"C:\Program Files\NexSens\WQSensor\Driver\wqsensor.inf"

If unable to get the WQSensor device driver installed, contact NexSens technical support.

Viewing Real-Time Data

To begin viewing live data, simply plug the sensor into an available USB port on a computer running WQSensors software and click the **Sensors** tab.

Data should be displayed on screen and updated once per second. The serial number of the connected sensor and the time of the last logged reading are displayed on the bottom of the screen.

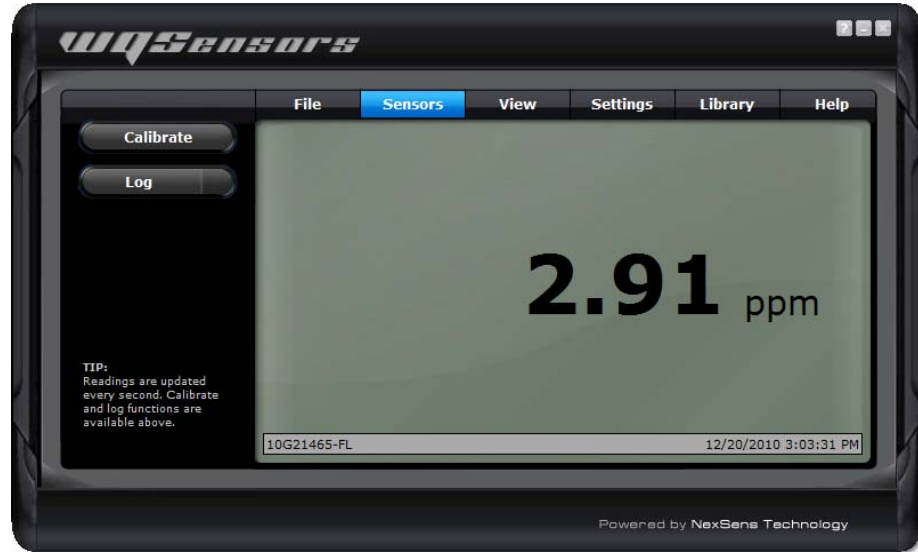


Figure 4: Click the **Sensors** tab to view live data; the connected sensor's serial number and time of last logged reading are displayed at the bottom of the screen

Up to four individual WQSensors can be viewed at one time through the **Sensors** tab of WQSensors software, provided each one is plugged into a separate USB port on the computer running the software.

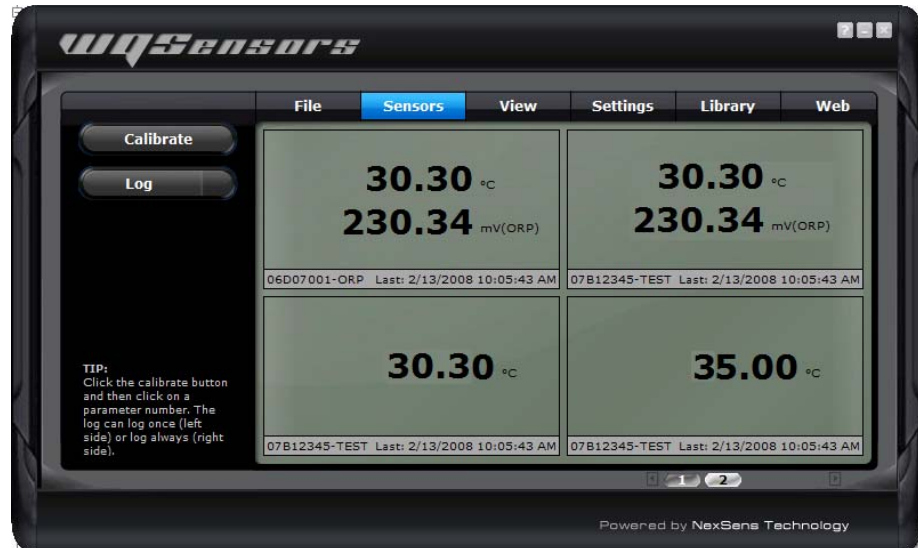


Figure 5: Four WQSensors connected to a computer showing live data, serial numbers, and time of last readings simultaneously

Logging Data

Data can be logged to the computer manually as single measurements or automatically at a user defined interval.

To log a single data point, click on the left hand side of the **Log** button. The left side of the button will turn blue and a short animation with the letter L will display on the bottom left hand corner of the screen.

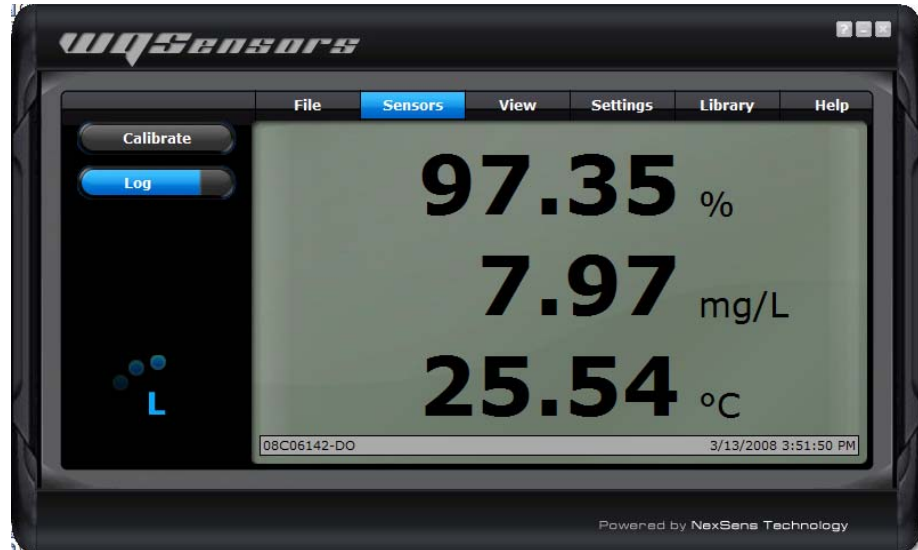


Figure 6: Click the left hand side of the **Log** button to manually log a single data point

For automatic data collection, a log interval must be specified. This interval can be set by clicking the **Interval** button in the **Settings** menu. Data can be logged as often as once per second.

NOTE
Data can be logged as often as once per second.

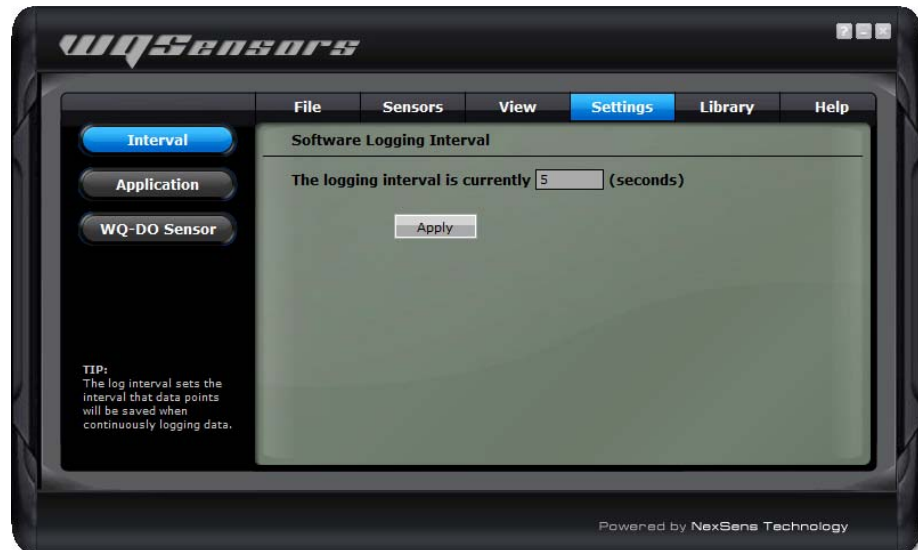


Figure 7: The log interval can be changed from the **Settings** menu by clicking the **Interval** button

To start logging continuous measurements automatically at the user defined interval, click on the right hand side of the **Log** button. The entire button will turn blue and a short animation with the letter L will display on the bottom left hand corner of the screen.

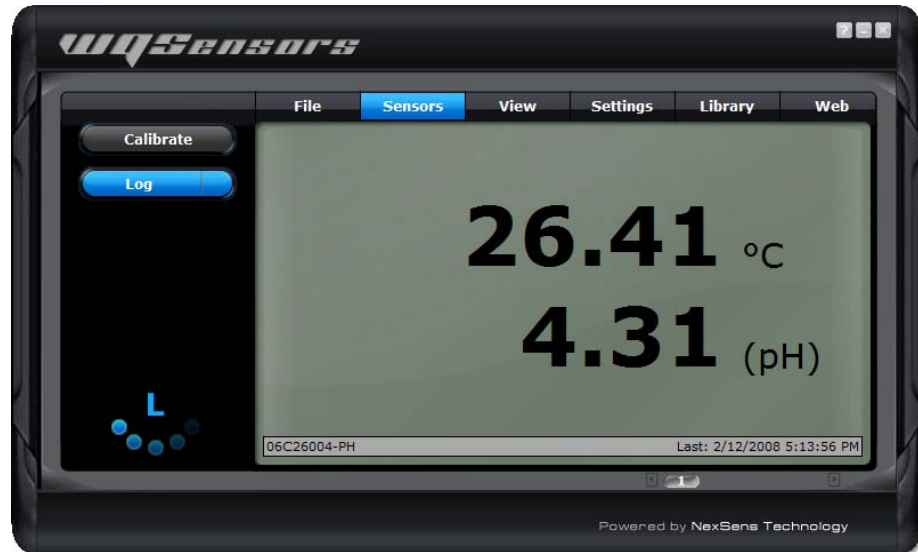


Figure 8: Click the right hand side of the **Log** button to automatically log data at the user defined interval

Reporting and Exporting Data

WQ Sensors software provides an interface to view data in raw or graphical form, automatically summarize data, compute statistical parameters, and export data.

Any data that is logged can be viewed or exported by generating a report. To generate a report, click the Report button in the View tab and then follow the procedure below:

1. Enter the desired range of time or check "Include all project data".
2. Select the sections to include in the report. Choose any or all of the following: "Summary", "Statistics", "Graph", and "Data". Fill in a Report Description and Author if desired.

NOTE

Data is exported in .csv (comma separated values) format for use with programs like Microsoft Excel.

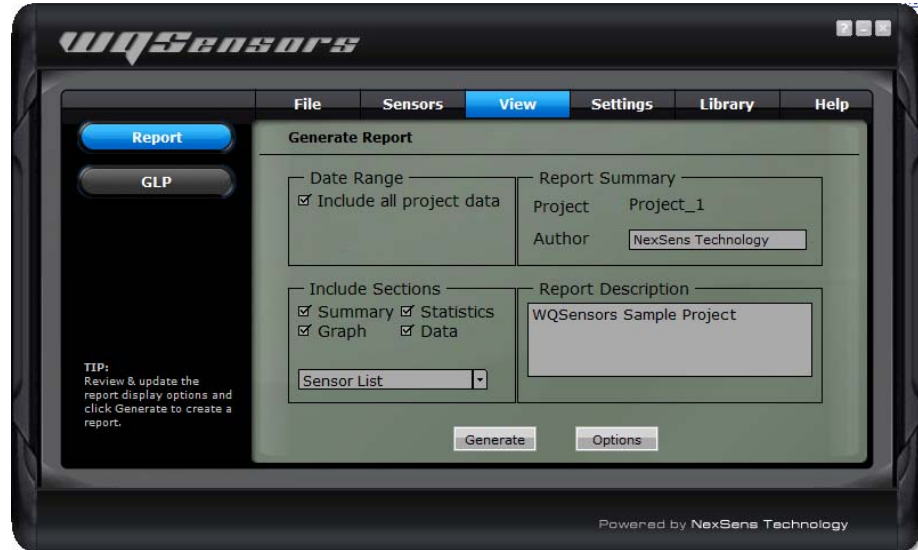


Figure 9: Select sections to include in the report and input a Report Description and/or Author

- Use the drop down **Sensor List** menu to place a check box next to each sensor that that should be included in the report.

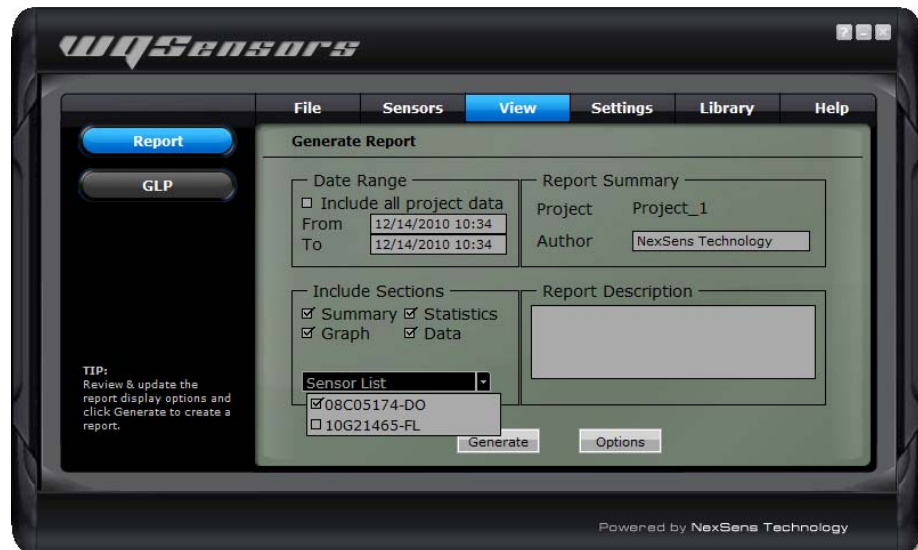


Figure 10: Select sensors from the **Sensor** list drop down menu

- Click the Options button to include additional notes about the project in the report, or to "Use time as X-axis".

NOTE
 If the "Use time as X-axis" box is left unchecked, data will be graphed with the sample # (i.e. 1st, 2nd, 3rd sample, etc) on the abscissa.



Figure 11: Additional report options menu including Report Notes and Graph Options

- Click Generate to create the report. Following creation, the report can be saved, printed, or exported to Microsoft Excel from the icon-based toolbar.

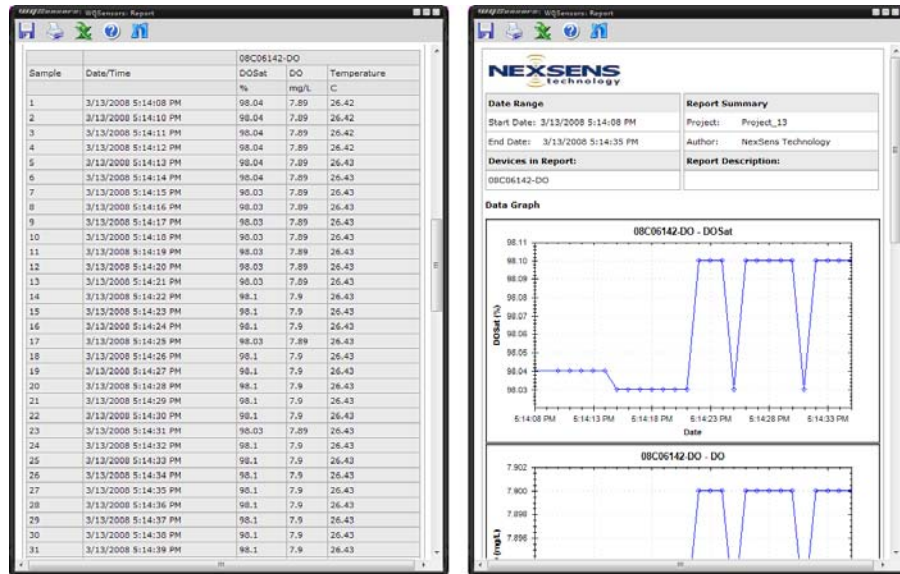


Figure 12: Sample report generated with WQ Sensors software; raw data collected is shown on left and graphical display is shown on right

Calibrating the Sensor

It is recommended that calibration is done on a daily basis, or at least prior to each use.

During calibration, observe the slope of the mV readings between the two points that are being used for calibration. Slope is defined as the change in voltage read by the sensor with a ten-fold change in concentration (mV/decade).

The slope of the WQ-FL sensor following a two-point calibration should be **58.2 ± 5 mV/decade at 25°C**. Every ±0.5°C change in temperature moves the mean value of the slope ±0.1 mV.

Follow the procedure outlined below to complete a calibration:

NOTE

Always use distilled or deionized water for diluting calibration standards.

1. Dilute the 1000 ppm fluoride standard solution as necessary to prepare two calibration standards that differ in concentration by a factor of 10 and bracket the expected sample range.
 - Consult the "Diluting Calibration Standards" technical note available on the NexSens Knowledge Base for a step-by-step guide to preparing calibration standards from a stock standard solution.
2. Make sure that the fluoride ionic strength adjuster (ISA) is added to each calibration standard in a 1:50 ratio. For example, 2 mL of ISA should be added for each 100 mL of diluted calibration standard. **ISA is not considered part of the dilution.**
3. Check that the sensor reference fill solution level is above the reference fill line.
4. Plug the sensor into an available USB port on a computer running WQSensors software. Click the **Settings** tab and then select "Show mV values?"



Figure 13: Click the **Settings** tab to enable showing mV values

5. Click the **Sensors** tab and data should be displayed on screen as shown.

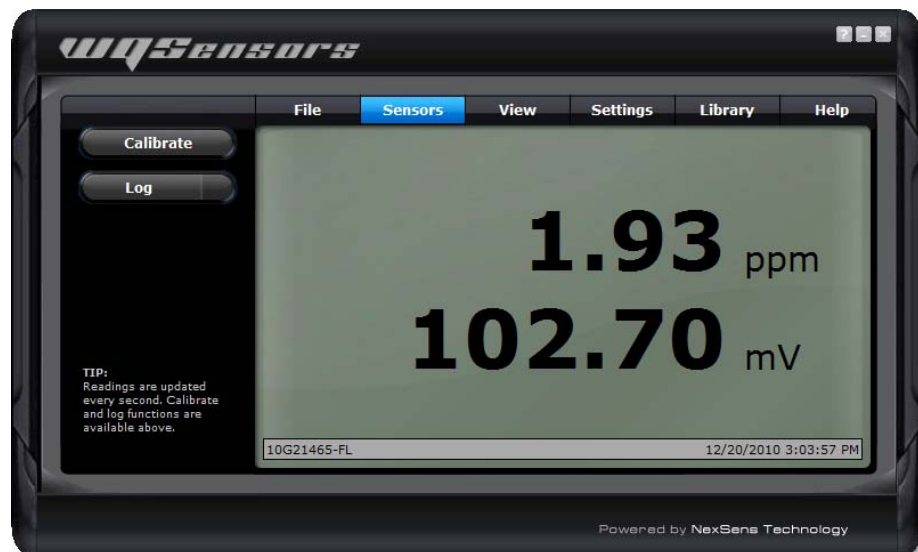


Figure 14: Click the **Sensors** tab to display ppm and mV data

6. Slide the fastfill sleeve on the sensor down, rinse the sensor tip in distilled or deionized water and blot dry. Keep the sensor vertical so that the reference fill solution does not spill out.
7. Place the sensor in the first standard and wait 1-2 minutes for readings to stabilize.

NOTE

Temperature and mV values cannot be calibrated.

- Click **Calibrate**, highlight the concentration reading in ppm, enter the concentration of the standard and press **Enter** or click the **Calibrate** button again. A short animation with the letter C will display on the bottom left hand corner of the screen.

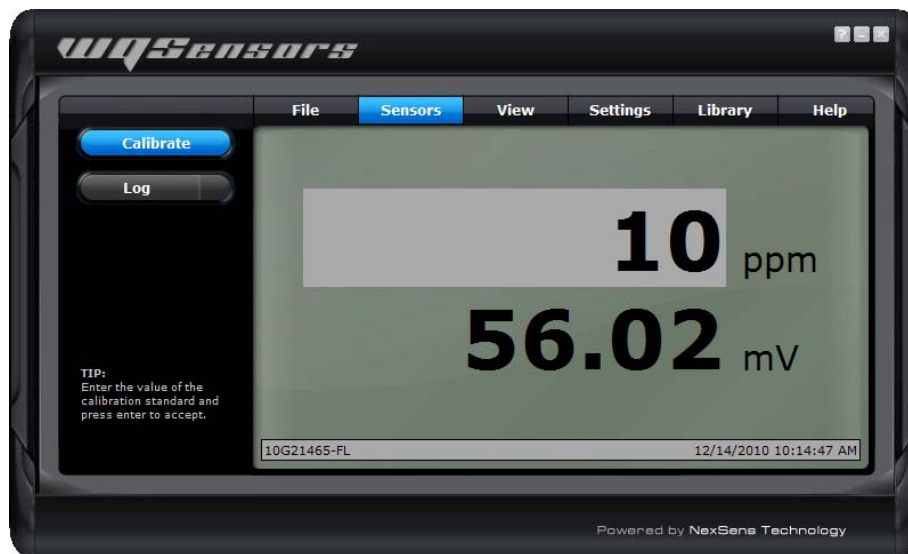


Figure 15: Enter the value of the first calibration standard and press **Enter** to accept

- Rinse the sensor and blot dry before placing it into the second calibration standard. Again wait 1-2 minutes for the reading to stabilize, enter the concentration of the standard in ppm, and press **Enter**.
- Rinse the sensor and blot dry. Close the fastfill sleeve and cover all calibrations standards tightly to prevent contamination. Calibration is complete.

Calibration should be done as often as every one to two hours for maximum accuracy. Calibration drift can be checked by immersing the probe in a standard with a known concentration and letting the reading stabilize.

Good Laboratory Practice Files

WQ Sensors software automatically records every calibration to a Good Laboratory Practice (GLP) file. The GLP file includes date & time, calibration values, and mV values for each calibration. This file is stored on the sensor and will carry over between computers. The GLP files can be

accessed for any sensor connected to the computer by clicking the **GLP** button in the **View** tab.

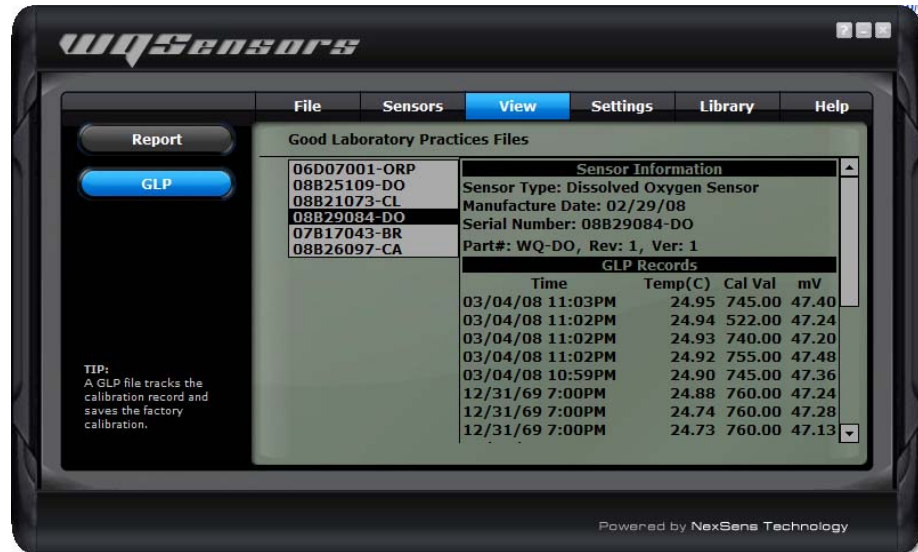


Figure 16: Click the **GLP** button in the **View** tab to access good laboratory practice files.

Project Files

Each project file contains information about every sensor that was connected to the computer while that file was open, as well as any data that was collected during that time.

When WQ Sensors software first runs, it defaults to Project_1. This is the default name for the first project file.



Figure 17: Default screen in the **File** tab showing the Existing Project Profile

To create a new project click the **New** button in the **File** tab and enter a project name. Click **OK** when finished.



Figure 18: Sample project created by clicking **New** in the **File** tab

To open a previously created project, click **Open** from the **File** menu. Select the project to open and click **OK**. WQ Sensors software will begin using that project file as the current project.

To rename the current project, select **Rename** from the **File** menu. Enter a new name and click **OK**. Only the current project can be renamed.

Optional Software Settings

Click the **Application** button in the **Settings** tab to toggle the Application Settings described below on or off as desired.



Figure 19: The Application Settings menu in the **Settings** tab in WQ Sensors software

“Show introduction animation?” - displays an introductory animation each time WQ Sensors software is started. Un-checking this box will disable animation.

“Remember last menu location?” - specifies whether the WQ Sensors software should reload the last menu opened each time WQ Sensors software is started. Un-checking this box will make the **Sensors** menu the default page. This feature is useful if a specific **Library** menu table or formula is used often.

“Convert Celsius to Fahrenheit?” - specifies whether to display temperature readings in Celsius or Fahrenheit. Un-checking this box will display all temperature readings in Fahrenheit.

“Show mV values” - displays mV readings from WQ Sensors in the **Sensors** tab. Un-checking this box will disable the display of mV values.

NOTE

mV readings are not required to take measurements but are useful in determining the quality of sensor calibrations.

Science Library

The WQ Sensor software **Library** menu is a desktop reference for water, wastewater, and environmental professionals. It's packed with tables, calculations, and many conversions. Among the science library's capabilities are the following:

- Converting units of measure
- Calculating flow over a weir
- Determining the inside diameter of PVC pipe
- Finding the ammonia tolerance level for rainbow trout
- Determining the atomic weight of bromine
- Finding the concentrations of elements in sea water

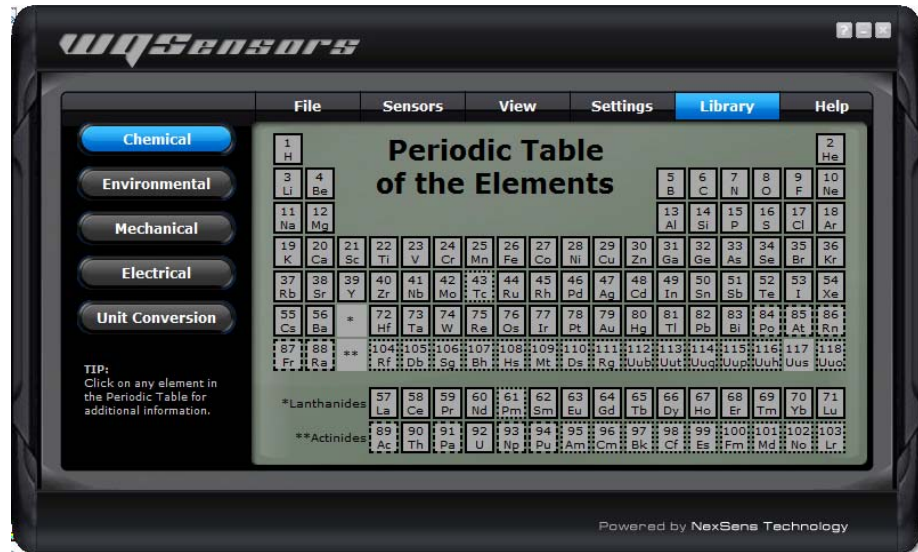


Figure 20: Interactive periodic table of elements included in the Science Library



Figure 21: Unit Conversion interface included in WQ Sensors software

Built-in Customer Support

WQSensors software integrates the internet into part of its functionality. Software updates, a technical support interface, WQSensor user manuals, and a WQSensor shopping interface can all be accessed through the **Help** tab.

NOTE

Be sure to include a name and email address when contacting NexSens technical support.

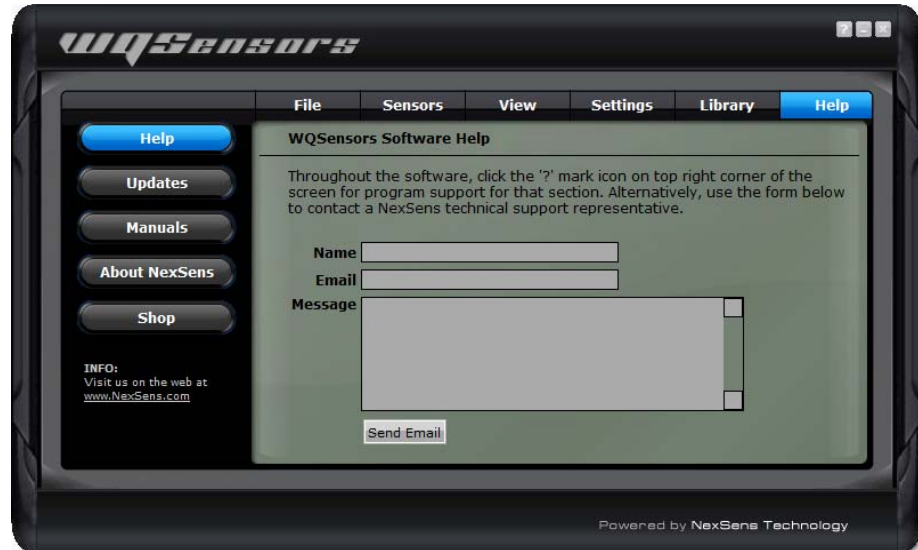


Figure 22: The default menu in the **Help** tab provides a form for contacting NexSens technical support (requires an internet connection)

If phone contact is preferable, include a note in the Message field of WQSensors Software Help suggesting a call back. Be sure to provide a phone number in this case.



Figure 23: Click the **Updates** button in the **Help** tab to display the current version of the software

Maintenance

If the response time and/or quality of data collected by a WQSensor decrease, try cleaning and reconditioning the probe. If these steps do not resolve the problem, consider replacing the sensing module to boost performance.

Cleaning

The sensor can be cleaned using distilled or deionized water. Rinse thoroughly as necessary but avoid using any detergent or other cleaning products.

Reconditioning

A good working ISE response stabilizes within one or two minutes. However, the ISE can become sluggish if the membrane becomes dirty from grease or particles in the sample.

Although the WQ-FL is a solid state ISE, it should not be polished in an attempt to recondition the electrode; it should only be rinsed thoroughly with water in an attempt to restore sensor performance.

Replacing the Sensing Module

NexSens recommends replacing the sensing module every six months for all ISE WQSensors to maximize measurement accuracy and sensor performance.

The sensing modules are user replaceable. Removal and installation is quick and easy and can be done in just a few minutes with no tools.

Follow the procedure outlined below to replace the sensing module:

1. Remove the existing sensor module by unthreading the connection between the module and the probe body. This can be done by hand, although a 7/16" wrench can be used to get started if necessary.
2. Screw the new module onto the probe body until it is hand tight. Do not over tighten the connection.

WARNING

Do not touch the sensing element with bare hands.

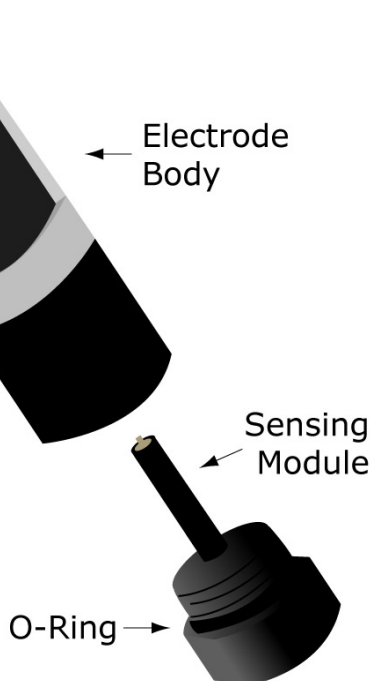


Figure 24: Exploded view of sensing module assembly

Storage

Short Term

For short term storage (1-3 days), rinse the electrode thoroughly with distilled or deionized water and then place the sensor tip in a solution of ISA and distilled or deionized water. ISA should be added to the water in a 1:50 ratio. For example, add 2 mL of ISA for each 100 mL of water.

Long Term

The sensor electrode should be stored completely dry for any amount of time longer than three days. Rinse the tip thoroughly with distilled or deionized water, blot dry, and allow to completely dry out. Then place the ISE sensor storage cap over the end of the probe.

During long term storage, make sure that the reference junction is not allowed to dry out. There must be adequate reference filling solution inside the probe at all times.

Salt deposits may form on the reference chamber during long term storage. These can be wiped dry or cleaned off with warm water.

NOTE

There must be adequate reference fill solution inside the probe at all times.

Troubleshooting

Follow the procedure below to isolate and resolve sensor problems

Table 3: Common problems and resolutions with WQ-FL fluoride sensors

Symptom	Possible Cause	Corrective Action
Out of range calibration	Considerable temperature gradient between standard solutions and reference fill solutions	Soak the electrode in the low range calibration standard for two hours and recalibrate
	Contamination of calibration standards, poor dilution accuracy or distilled water quality, mathematical error	Prepare new calibration standards
Sample data is erroneous	Sample pH is too high or low	Check that the pH solution of the sample is within the probe's operating range
	Extrapolated data	Make sure that the expected concentration of the sample is within the sensor's calibration range
	Samples contain interfering ions	Use appropriate complexing agents to negate the effects

If the issue persists, visit www.NexSens.com to search the Knowledge Base for FAQs and troubleshooting guides; otherwise please contact NexSens technical support.

Material Safety Data Sheets

Material Safety Data Sheets can be found at:
<http://www.nexsens.com/support/msds.htm>

Warranty and Service

NexSens Technology, Inc. warrants products against defects in materials or workmanship for a period of 6 months from the date of delivery to the original customer. This warranty is limited to the replacement or repair of such defects, without charge, when the product is returned to NexSens Technology, Inc. Damage due to accidents, misuse, tampering, lack of reasonable care, loss of parts, failure to perform prescribed maintenance, or accidents of nature are not covered. This warranty excludes all other warranties, express or implied, and is limited to a value not exceeding the purchase price of the instrument.

WARNING

NexSens Technology, Inc. products are not authorized for use as critical components in any life support system where failure of the product may affect its safety or effectiveness.

Limitation of Warranty

This warranty is not applicable to any NexSens Technology, Inc. product damage or failure caused by (i) failure to install, operate or use the product in accordance with NexSens Technology, Inc. written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with NexSens Technology, Inc. written instructions, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by NexSens Technology, Inc.

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