Conductivity Measurements

Calibration Notes

Measuring Conductivity

The ability of a solution to conduct electricity is determined by the concentration and mobility of ions in the solution and by the charges carried by those ions. Conductivity is a measure of the number of mobile ions per unit volume in a solution. Aqueous solutions can have a wide range of conductivity, spanning a factor of more than ten million from ultra pure water to concentrated ionic solutions.

You may have encountered conductivity in other classes, such as physics, but you likely saw it in terms of resistance rather than conductance. Both are a measure of a material's or solution's ability to transfer current. According to Ohm's Law, resistance, *R*, is the ratio of current, *I*, to voltage, *V*:

$$R = \frac{V}{I}$$

The **conductance, L,** of a material or a solution is just the inverse of resistance:

$$L = \frac{1}{R} = \frac{I}{V}$$

Because both resistance and conductance are intensive properties (depend on size and shape), these are converted to resistivity, **ρ,** or conductivity, **κ**:
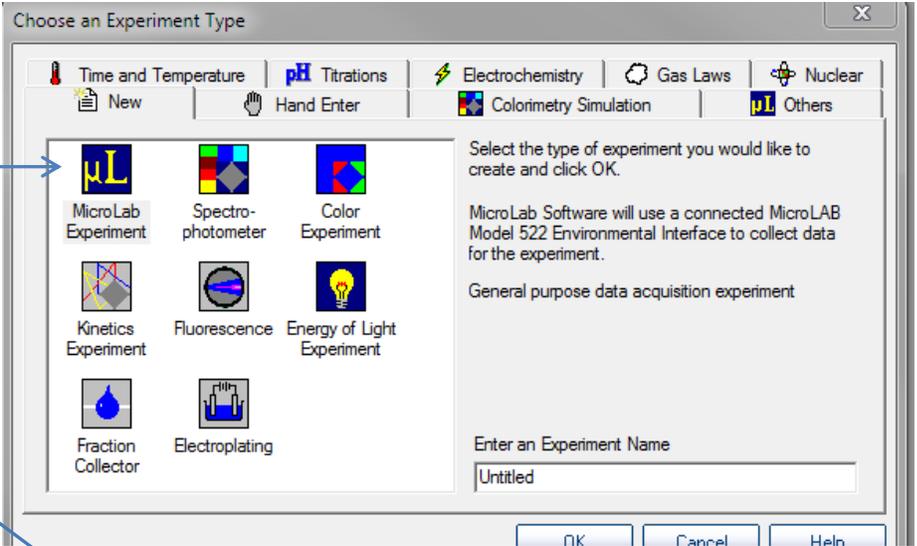
$$\rho = \frac{RA}{l} \qquad \kappa = \frac{1}{\rho} = \frac{l}{RA}$$

Where *A* is the area and *l* is the distance between where charge is being produced and being measured (for example, the length of wire or the gap between electrodes in solution).
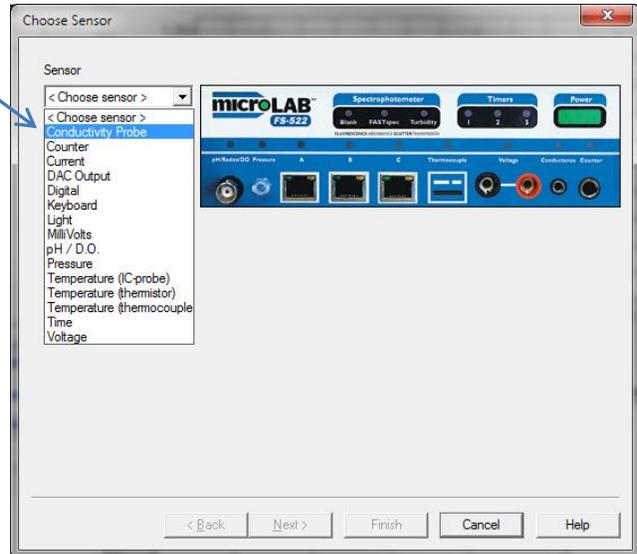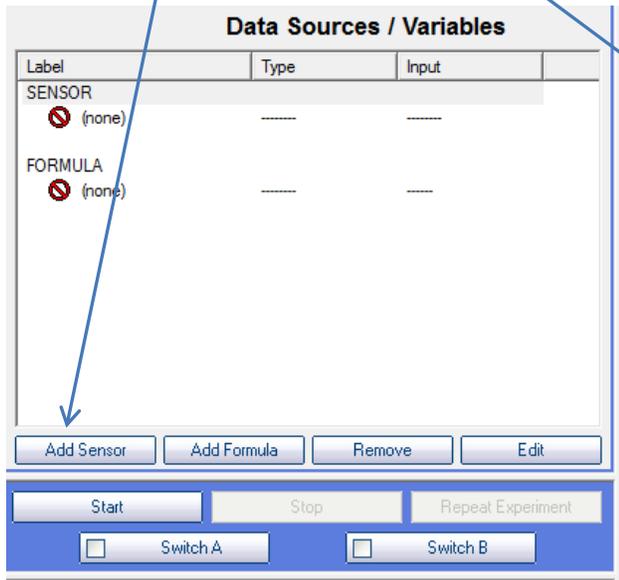
This document reviews how to calibrate conductivity probes using a MicroLAB FS-522 interface for conductivity measurments.
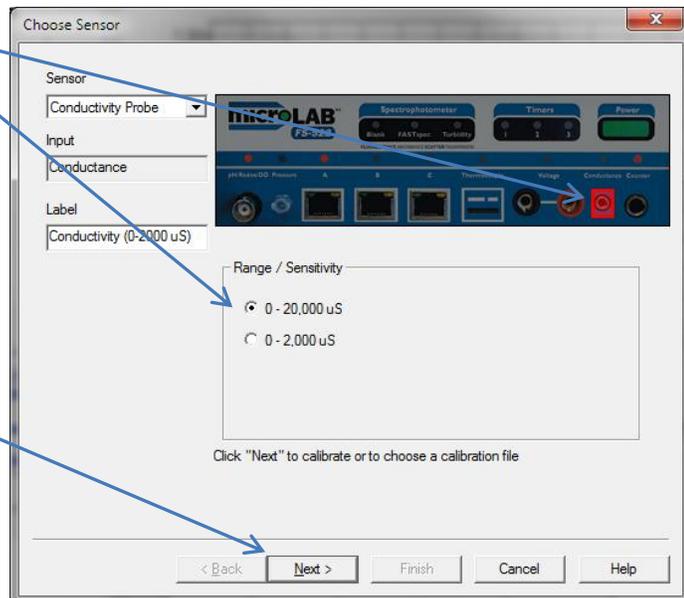
Calibration

Turn on your MicroLab FS-522 and start the software. Select the "MicroLab Experiment" icon.

Now click the "Add Sensor" button, and choose "Conductivity Probe".

Choose an Experiment Type

Time and Temperature | Titrations | Electrochemistry | Gas Laws | Nuclear
New | Hand Enter | Colorimetry Simulation | Others

Select the type of experiment you would like to create and click OK.

MicroLab Software will use a connected MicroLAB Model 522 Environmental Interface to collect data for the experiment.

General purpose data acquisition experiment

- MicroLab Experiment
- Spectro-photometer
- Color Experiment
- Kinetics Experiment
- Fluorescence
- Energy of Light Experiment
- Fraction Collector
- Electroplating

Enter an Experiment Name

Untitled

OK   Cancel   Help

Data Sources / Variables

Label	Type	Input
SENSOR		
(none)	--------	--------
FORMULA		
(none)	--------	------

Add Sensor | Add Formula | Remove | Edit

Start | Stop | Repeat Experiment
Switch A | Switch B

Choose Sensor

Sensor
< Choose sensor >
< Choose sensor >
Conductivity Probe
Counter
Current
DAC Output
Digital
Keyboard
Light
MilliVolts
pH / D.O.
Pressure
Temperature (IC-probe)
Temperature (thermistor)
Temperature (thermocouple)
Time
Voltage

< Back | Next > | Finish | Cancel | Help

Click on the conductance input, and then select either the "High Range" (0-20,000 uS) or the "Low Range" (0-2000 uS). Plug your conductance probe into the MicroLab FS-522.

Then click "Next" to get ready to calibrate the sensor.

Choose Sensor

Sensor
Conductivity Probe

Input
Conductance

Label
Conductivity (0-2000 uS)

Range / Sensitivity
- 0 - 20,000 uS
- 0 - 2,000 uS

Click "Next" to calibrate or to choose a calibration file

< Back | Next > | Finish | Cancel | Help

Now Click "Perform New Calibration". You are ready to start your calibration process.

Using the calibration solutions recipe below mix up several (at least three) standard solutions in your selected conductivity range. You can distribute this work around the lab, each group mixing up one calibration standard. You can also make "half-batches" with 500 mL of water and half the amount of salt.

Click "Add a Calibration Point" to prepare to calibrate your conductance electrode.
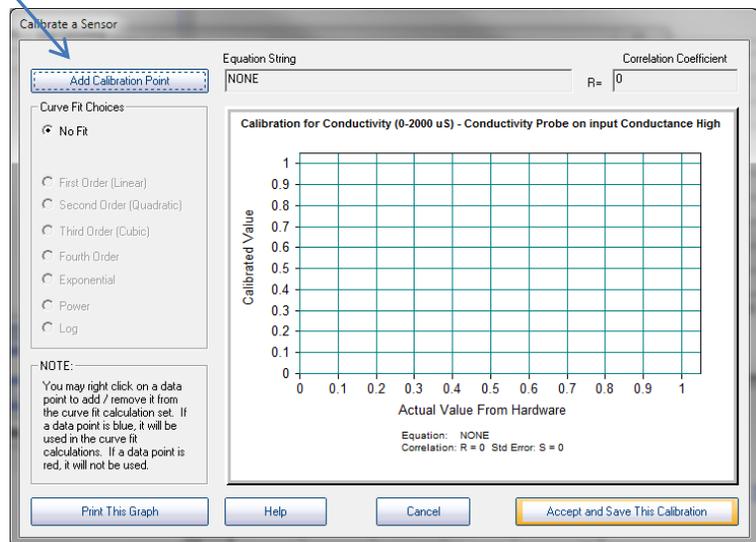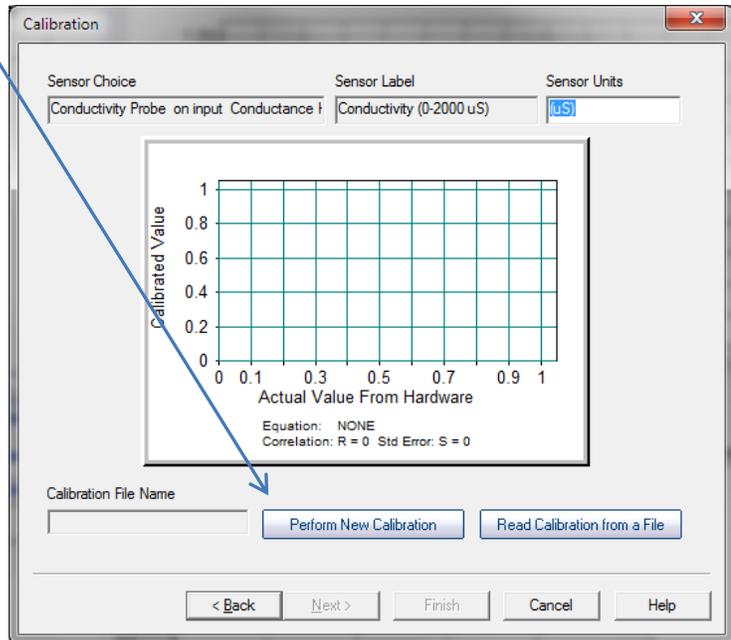
This screen will come up. The display with a green bar is a rate-of-change meter. It centers when the probe is in equilibrium and stable. The Sensor History graph shows a history of the calibration process.

If the red rate of change needle moves too fast, you can reduce the sensitivity by clicking the "Show Advanced Calibration Controls" box, and then adjusting the slider to an appropriate sensor sensitivity.
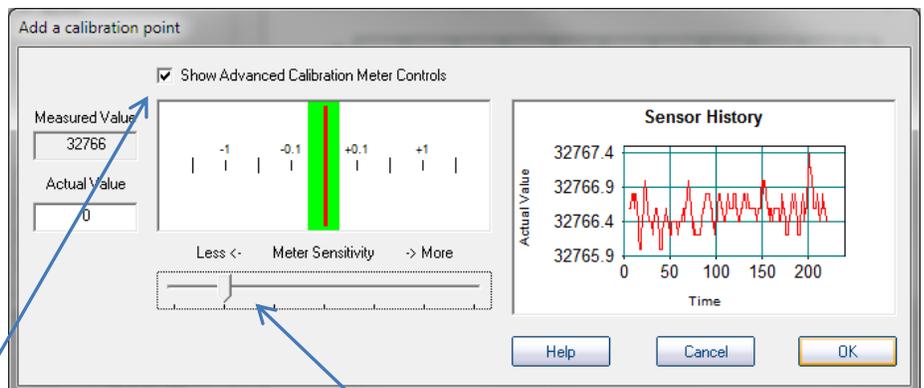
Enter the actual value of the standard in the "Actual Value" box. Place the conductance electrode in your conductivity standard, and wait for it to equilibrate. You can watch the history graph go up and stabilize. Stir with the electrode until this graph stabilizes and the needle settles in the green "equilibrium" bar on the rate of change meter. Then click "OK".
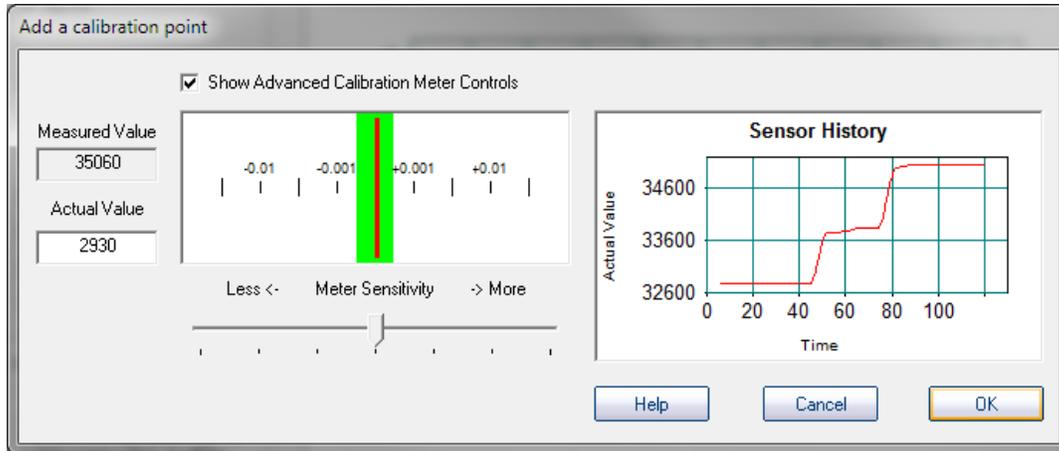
The calibration graph will come up, with one calibration point added:
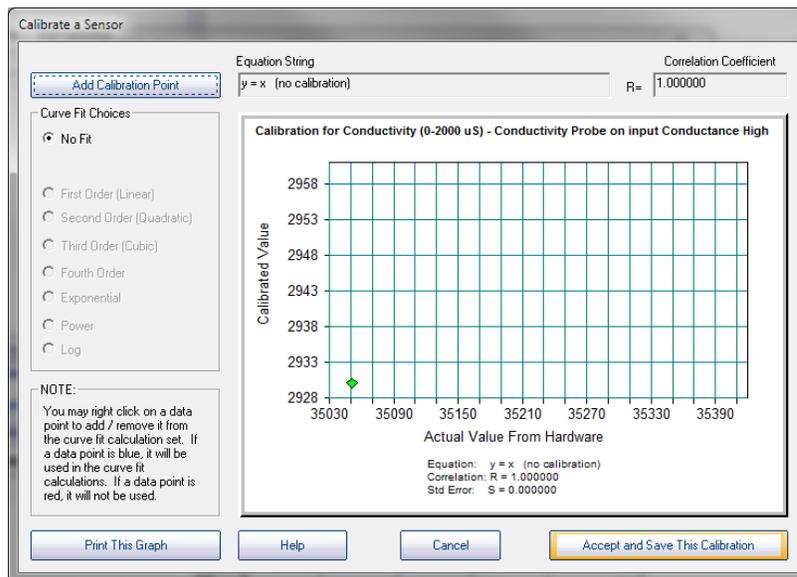
Repeat this process with at least two additional standards. You need at least one more standard than the order of the line fit you choose to use. If you do a linear fit, two points define the line and the third point proves that you are right if it is on the line. If you do a second-order polynomial fit, you need four points. Three will define the line, and the fourth will prove that you are right.

When you are done, click "Accept and Save this Calibration". You will have to save the file – it should default into the calibration folder in your MicroLab software folder. Make sure you know where it was saved.

Here is a sample calibration graph. This graph used a linear line fit, and produced a correlation coefficient of 0.999935 – Four 9's is very good. A perfect fit would produce a correlation coefficient of 1.0000.

Once the calibration graph is saved, you are ready to do your experiment. You can use this calibration with the same probe in a future experiment.

Calibration

Sensor Choice	Sensor Label	Sensor Units
Conductivity Probe on input Conductance H	Conductivity (0-2000 uS)	(uS)

Conductivity Calibration April 19, 2011.cft

Equation: y = 1.3396x - 44358.3383
Correlation: R = 0.999935
Std Error: S = 0

Calibration File Name

Conductivity Calibration April 19, | Perform New Calibration | Read Calibration from a File |

< Back   Next >   Finish   Cancel   Help

microLAB