

Model 103 Thermistor Temperature Sensor

Temperature Range: -10 to +110°C

Do not place the thermistor tip in a flame!



Overview

The Model 103 Thermistor Temperature Probe utilizes a negative temperature coefficient (NTC) thermistor housed in a closed, stainless steel shaft to provide quick and accurate temperature readings.

The sealed, electrically isolated stainless steel enclosure provides fast response and allows temperature data to be recorded concurrently with pH, REDOX, conductivity, or other electrochemical measurements without affecting the sensor behavior.

Functional

The Model 103 Thermistor Temperature Probe, like all NTC thermistors, decreases in resistance as temperature increases. The MicroLab Interface measures this resistance by applying a precisely measured voltage, accurately measuring the returned current, and applying Ohm's Law ($R = V/I$) to calculate resistance. One can, if desired, use the formula tool to calculate and display this resistance to explore the temperature/resistance response of the sensor.

The Model 103 Thermistor Temperature Probe is designed to work with the Model 402, 507, 522, and 528 MicroLab Interfaces. MicroLab software utilizes the Steinhart-Hart equation to calculate the temperature of the thermistor, a technique used throughout industry and in research labs.

Since the Steinhart-Hart relationship is non-linear, the effective resolution of the temperature measurement increases with increasing temperature. At 0°C it is 0.01 °C, at 20 °C it is 0.006 °C, and at 70 °C it is 0.001 °C.

Because the MicroLab industrial thermistors are matched to +/- 0.2 °C over a 0-70 °C range in manufacture, one can use the provided calibration file for any of the MicroLab 103 family thermistors within this temperature range. If field calibrated with points near 0 °C and 100 °C, the thermistor will work well in the -10 to + 110 °C range.

Calibrating a Sensor

To calibrate a sensor, it is placed in a known condition and the current or voltage produced measured and recorded. By repeating this measurement several times with known standards, we can create a graph that relates the sensor output to a known measured value. If the graph forms a smooth line, MicroLab's software can develop an equation that relates sensor output to the measured value. By reading the resistance of the thermistor and solving this equation, MicroLab can calculate the temperature that corresponds to each measured resistance and can then display this value.

The *Calibration Page* of the *Add Sensor Wizard* will list the sensor being calibrated along with its label and units. The wizard will also display a calibration graph and the name of the calibration file for the sensor. The graph and file name are both be empty since this is a new sensor.

Specifications

Mechanical

Cable type: CAT-5
Length:
Overall 37"
Probe 5"

Electrical

Input power:
DAC Out, 1.60 volts

Sensor

Type: NTC Thermistor
10,000 ohms @ 25 °C

Functional

Temperature Range:
-10 to 110 °C
Accuracy: ±0.2 °C

MicroLab Input

Current input on CAT-5
Inputs A, B, or C.

Applications

- Temperature
- Thermistor Theory
- Heat of neutralization

Features

- Accurate
- Small thermal mass
- Fast response

Definitions

Ohm's Law:

$V=IR$ wherein:

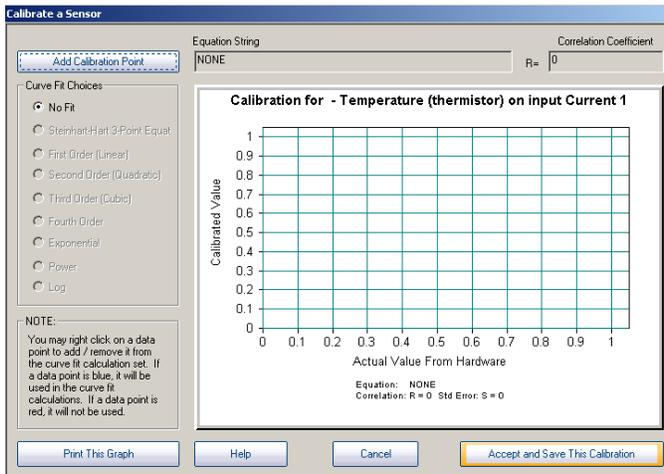
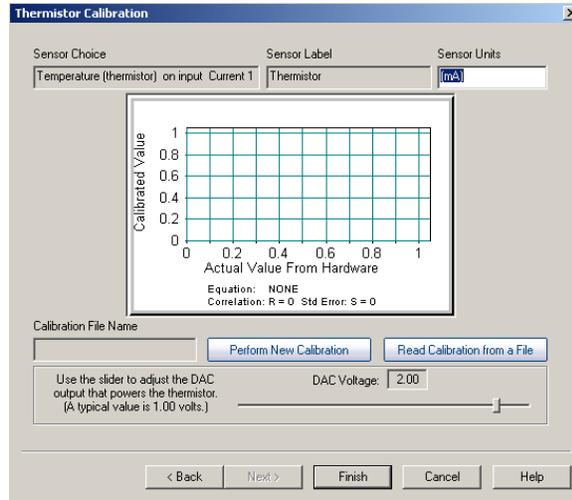
V = voltage
I = current
R = resistance

Sensor operates with MicroLab Interface Models 402, 507, 522 and 524

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To Calibrate a Sensor:

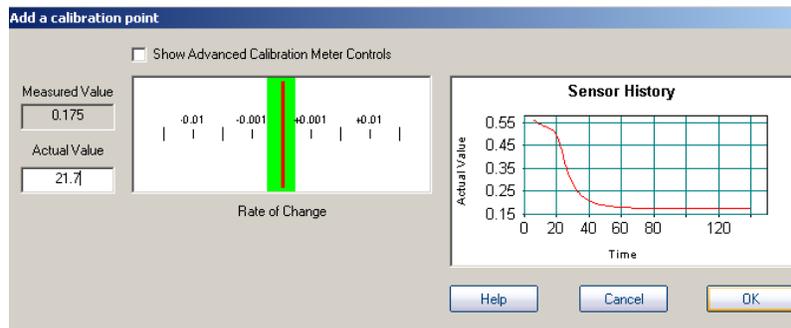
- Select the Sensor (Thermistor).
 - In the upper right "Sensor Units" block, enter (C) for Celsius.
 - Click **Perform New Calibration**
- The screen below will come up.



- Add a calibration point by clicking **Add Calibration Point** (upper left).

The **Calibration Module** before any calibration points have been added

The **Add a Calibration Point** display shows the sensor reading in the **Measured Value** edit box and the sensor's equilibrium with the standard with its rate of change and sensor history displays. The true value of the standard is entered into the **Actual Value** edit box with the keyboard.



The **Add Calibration Point** dialog

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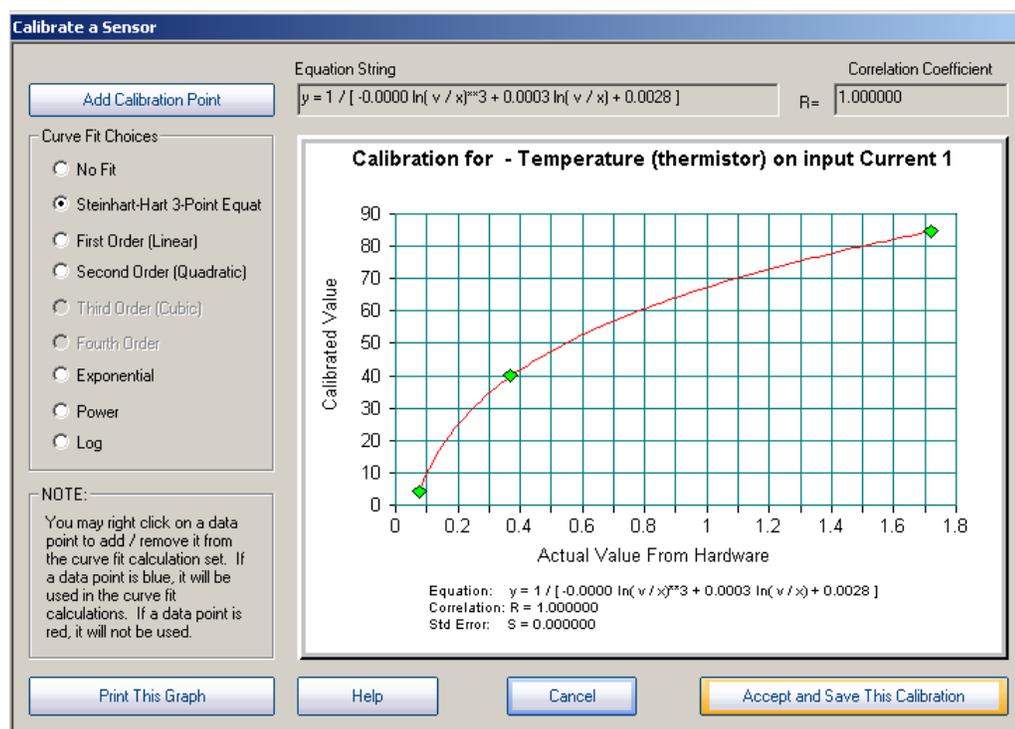
The red bar displayed in the **Rate-of-Change Meter** indicates how far the sensor reading is from equilibrium. If the sensor reading is increasing, the red bar will move to the right. If the sensor reading is decreasing, the red bar will move to the left.

The graph display shows the history of the sensor readings to help determine when the sensor has reached equilibrium.

When the **Calibration Meter** is stable within the green band and the history graph has flattened, the sensor has reached equilibrium. Enter the **Actual Value** with the keyboard and click **OK** to accept the reading.

Creating the Calibration Equation:

MicroLab will use the Steinhart-Hart curve fit for thermistors to generate an equation that relates sensor output to the measured temperature. Three calibration points are required for a Steinhart-Hart calibration.



The **Calibration Module**: A minimum of 3 calibration points are required to define a Steinhart-Hart curve fit. Note that the thermistor output changes value more rapidly at high temperatures than low temperatures. Resolution is about 0.01 °C at 0 °C and 0.001 °C at 100 °C.

After the three calibration points have been entered and the **Steinhart-Hart Equation** (applicable only to thermistor calibration) curve fit is selected, the calibration equation and the correlation coefficient will be calculated and presented above the graph. Click **Accept and Save Calibration**. Be sure to name the calibration file.

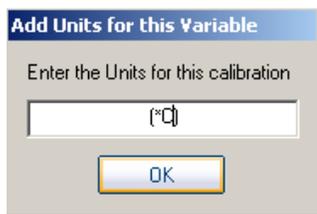
Note: For greatest accuracy with the **Steinhart-Hart Equation** it is recommended that the calibration points be taken at approximately equal intervals; for example, 0°C, 40°C, and 80°C.

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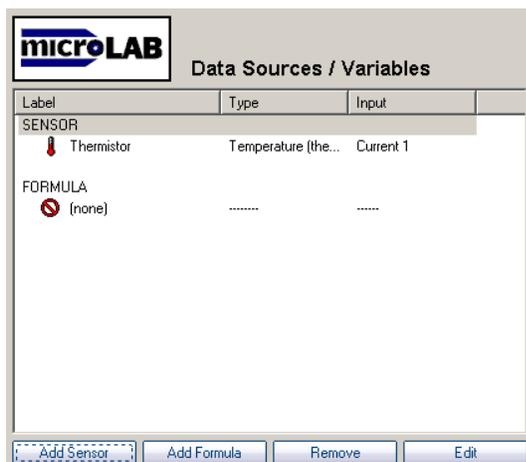
As you complete the calibration, **MicroLab** software will prompt you for the units of measurement. If you entered (C) at the initial calibration screen, this will appear in this box. Otherwise, enter the desired unit now.



MicroLab software will save the calibration information in a calibration file. **MicroLab** can reuse this calibration information in a future experiment.

MicroLab software will return to the **Calibration Page** of the **Add Sensor Wizard** after the calibration information has been saved. Notice that the calibration graph and the file name are now filled in and show the calibration information stored in the newly created file. Click **FINISH** to complete the **Add Sensor Wizard**.

When the wizard has finished, a new sensor will appear in the **Data Source / Variables View**. This is the sensor that we just calibrated.



To Measure Thermistor Resistance:

Using the *Add Sensor* button, Select DAC Output (Select A for Input A), and Current (Select A, for Input A). Then use the *Add Formula* tool to write the formula:

$$f(x) = \text{DAC Output}/\text{Current}$$

For Label, enter *Resistance*, and for Units, enter *K ohm*. Drag DAC Output (voltage), Current, and Resistance into the digital display for observation. Because the current reads in milliamperes, resistance will read in kilo ohms.



P.O Box 7358
Bozeman, MT 59771

Phn (888) 586-3274
Fax (406) 586-3582

Reach us at ...

www.microlabinfo.com

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