

# Using PhysLogger to Model the Response of a Thermistor

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## Scope

PhysLogger is a versatile homegrown data acquisition and control device that allows users to measure, control, and analyze quantities around them. In this experiment, PhysLogger, in connection with two sensing PhysInstruments, will be used to simultaneously record temperature and resistance readings of a thermistor. These readings will be analyzed to quantify the behavior of thermistor with changing temperature.

## Procedure

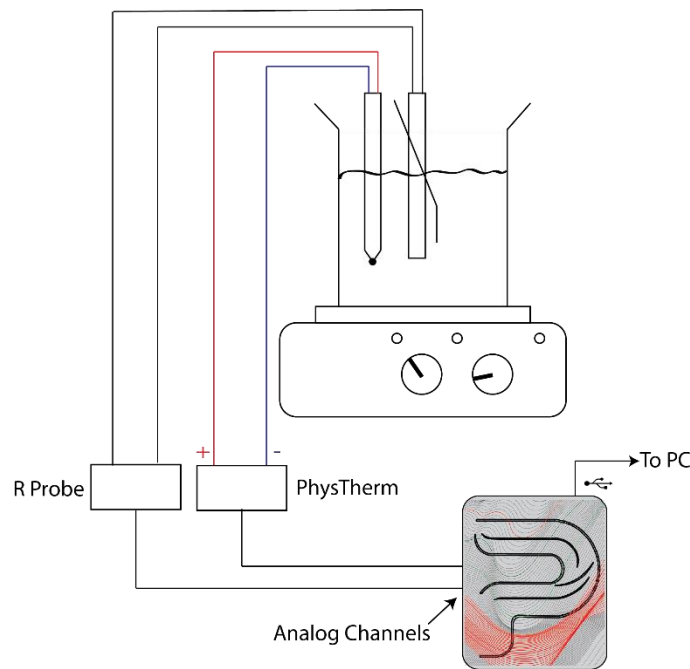


Figure 1: Experimental Setup for studying the response of a thermistor with respect to a changing temperature. Thermistor connected to R-Probe and thermocouple connected to PhysTherm are immersed in water that is heated by a hot plate and stirred by a magnetic stirrer (ensuring uniform temperature distribution). R-Probe and PhysTherm are connected to PhysLogger that acquires and live plot temperature and resistance measurements.

1. Place a beaker filled with water on a hotplate with magnetic stirrer. Immerse a thermocouple and thermistor in water.
2. Connect PhysLogger to your PC by inserting the provided USB cable to the USB (•⇄) port of PhysLogger.
3. Using a fork spade connector, connect the thermocouple to PhysTherm. PhysTherm, a member of the PhysInstruments suite, is a sensor with automatic cold junction temperature compensation used to precisely and rapidly measure temperature over a wide range.

- Note:** Ensure correct polarity when connecting thermocouple wires to PhysTherm.
4. Connect thermistor to R-Probe, i.e., a PhysInstrument sensor that can measure resistance accurately up to 10 k $\Omega$  and offers both banana and fork spade plug adaptability.
  5. Connect the PhysTherm and R-Probe to two of the analog channels (~A, ~B, ~C or ~D) of PhysLogger.
  6. Locate and open PhysLogger2 application on your PC.
  7. To configure PhysTherm and record temperature, click on Measure > Temperature. Select the channel to which your PhysTherm is connected to and set the input temperature range to [-260 °C, 200 °C] with < 1 °C resolution.
  8. To configure R-Probe and record resistance of thermistor, click on Measure > Resistance and select the channel to which the R-Probe is connected to.
  9. Once both PhysTherm and R-Probe are configured (see Figure 2), click on Proceed. A live plot with both temperature and resistance values will appear.

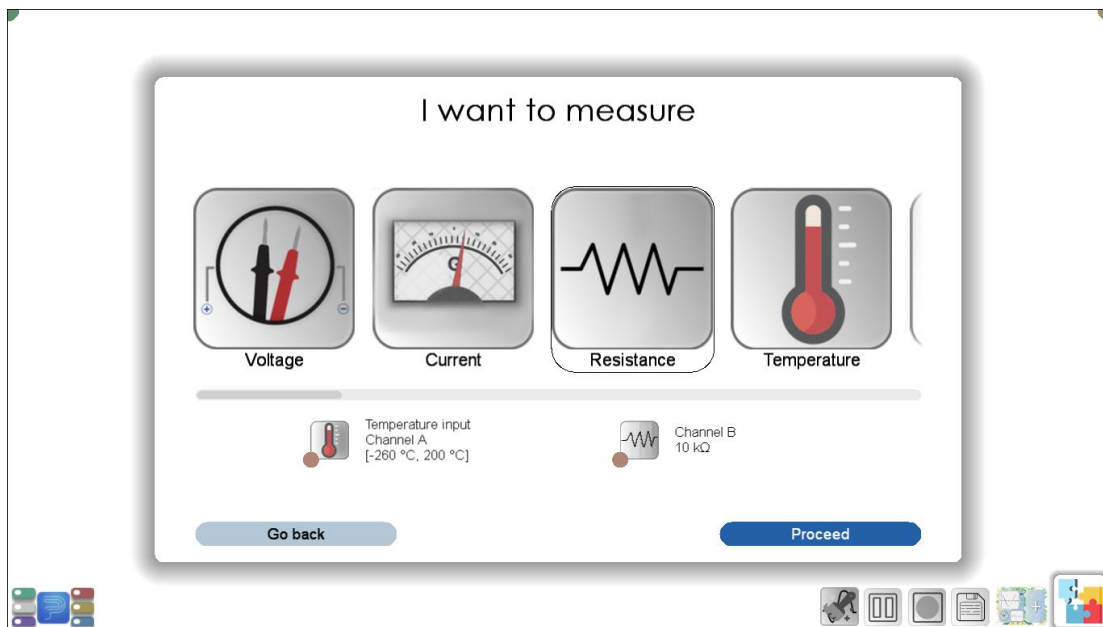
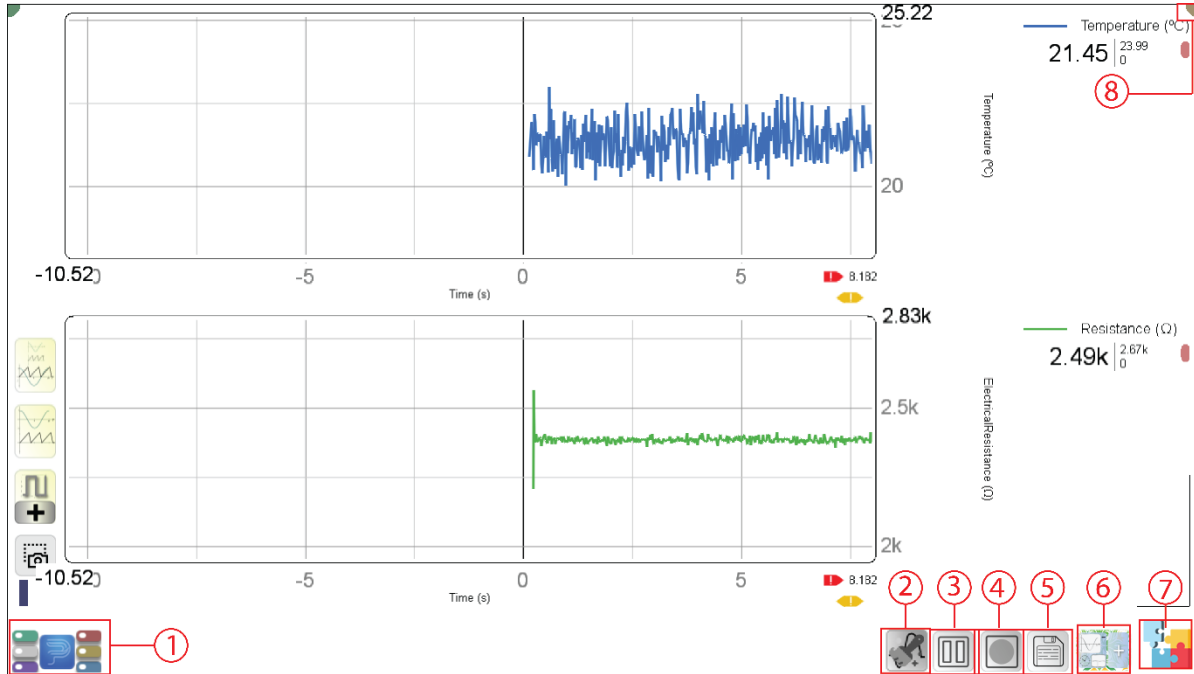


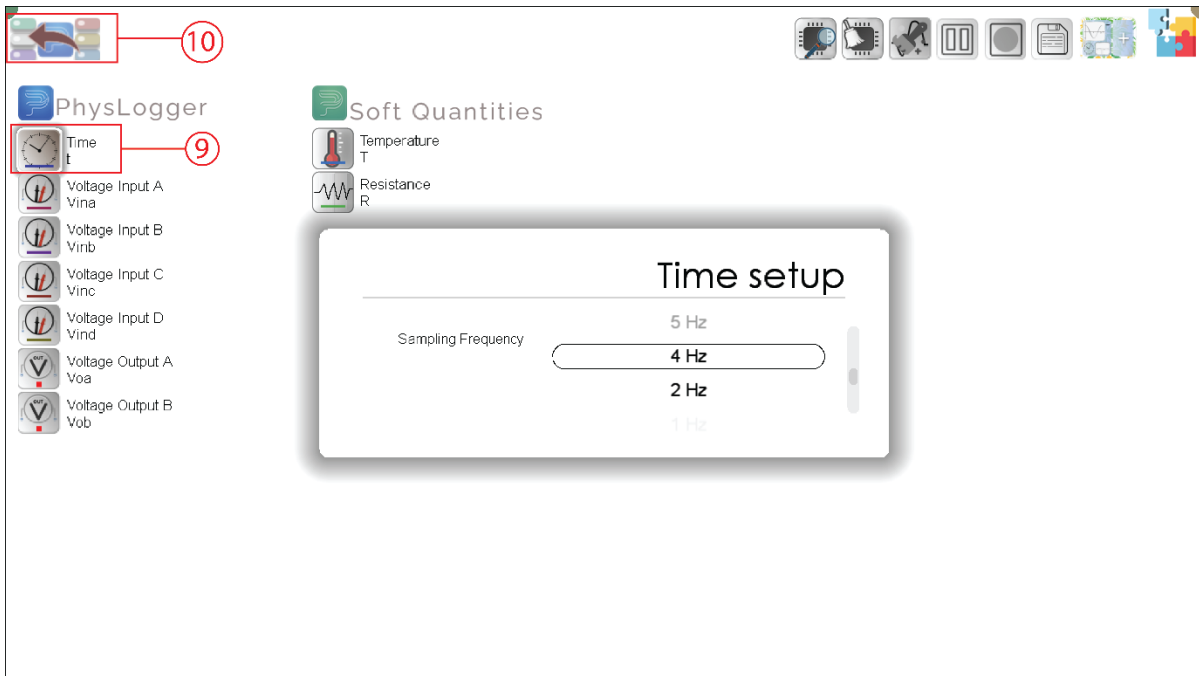
Figure 2: Select the respective channels of PhysLogger to which PhysTherm and R-Probe are connected to and configure both quantities in PhysLogger Desktop App.

10. Sampling frequency is recommended to be set to a lower value, e.g., 2 to 4 Hz (see Figure 3 for a description of common workspace icons of PhysLogger).
11. Before you start the experiment, ensure that the default save location for all data and screenshots is set to a directory you have access to. This location can be changed by clicking on Options.
12. Switch on the hot plate and enable stirring.
13. As water is uniformly heated, the temperature of thermistor is observed to increase.
14. Observe how the resistance of thermistor changes with this change in temperature.

15. Once the desired data has been collected, Save the resistance and temperature readings.
16. Students are expected to analyze the collected readings, extract the useful range of data, plot resistance readings against temperature readings, fit the recorded data to a suitable mathematical equation, and compare their experimental readings with Steinhart data.



- (a) Workspace of PhysLogger showing the icons for (1) Quantities Panel, (2) Clear Workspace, (3) Pause measuring and plotting (4) Record readings for a limited time, (5) Save data, (6) Add Pages, (7) Extensions (widgets such as additional live plots with different quantities can be accessed from here), (8) Options (allows the user to close the App, and adjust preferences, such as changing the saving location of data and screenshots).



- (b) On pressing the Quantities Panel icon, this screen appears where all configured quantities are displayed. This screen allows the user to adjust Sampling Frequency by clicking on (9) Time and return to the live plot by clicking on the (10) Quantities Panel icon. If desired, any quantity can be dragged from this panel and plotted on live plot.

Figure 3: Screenshot showing the common icons of the PhysLogger workspace.