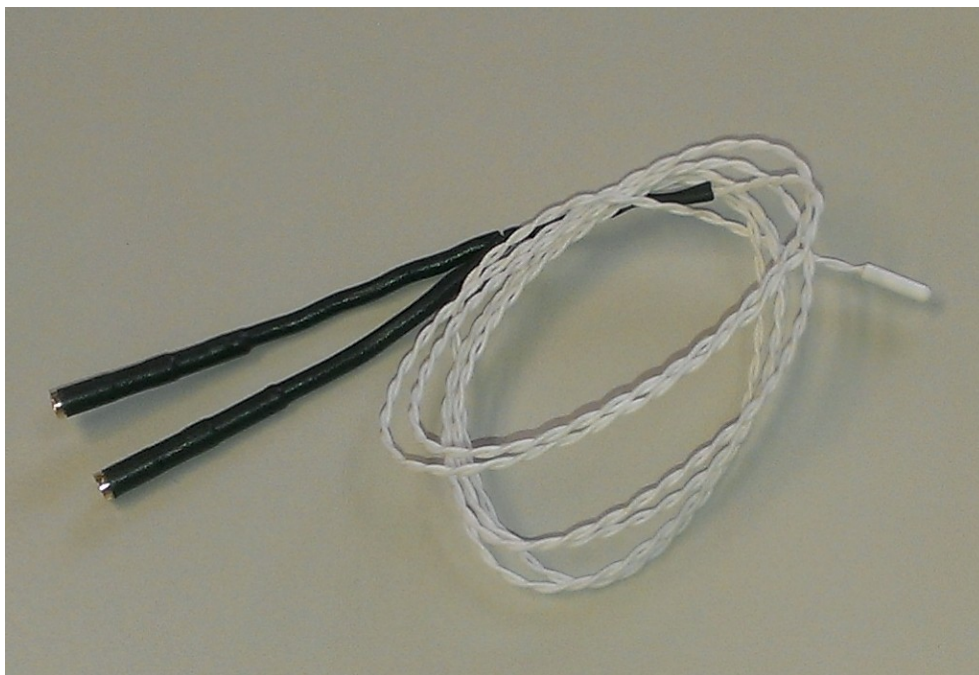


TM-BIO Temperature Sensor

Technical Note



TM-BIO

Overview

The TM-BIO Temperature Sensor is a sensor that can monitor temperatures between 0°C above and 50°C. The TM-BIO is capable of responding to changes in temperature within a few seconds because of its small size (1mm x 3mm) and mass. The TM-BIO is suitable for monitoring the temperature of nasal airflow, changes in skin temperature that indicate evaporative cooling, and changes in atmospheric temperature and temperature in environmental chambers. Since the sensor element is water-resistant, the tip of the TM-BIO can be immersed in aqueous solutions, including saline solutions, for a few hours.

How It Works

The sensor element in the TM-BIO that responds to temperature changes is a thermistor, which is a type of resistor that changes resistance with changes in temperature. The thermistor in the TM-BIO has a negative temperature coefficient (NTC) which means that the resistance of the thermistor decreases as the temperature goes up. Thermistors with positive temperature coefficients also exist. Table 1 at the end of this Technical Note shows the resistances of the thermistor in the TM-BIO over a range of temperatures from 0°C to 50°C.

How to Use the TM-BIO

Equipment Setup

- 1) Insert the safety connectors of the TM-BIO temperature sensor into the Safety inputs of the IX-Bxx recorders or the iWire-Bxx modules.



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Start the Software

- 1) Open LabScribe by clicking on the LabScribe desktop icon.
- 2) When the program opens, select **Preferences** from the **Edit** menu (or from the **LabScribe** menu on a Macintosh computer).
- 3) Select the **Channel** preferences dialog window. Name the channel to which the TM-BIO is connected. Set the **Mode/Function** for this channel to **TM-BIO ohm**. Also, set the sampling rate and display time. Click **OK**.

Calibration of the TM-BIO Temperature Sensor to ohms

- 4) Plug the **5kohm calibration resistor** in the safety connectors of the IX-Bxx recorder or the iWire-Bxx module .
- 5) Click the **Start** button on the **Main window** of the LabScribe software and begin recording. Type "**5k**" on the comment line to the right of the **Mark** button.
- 6) After about twenty seconds. Press the Enter key on the keyboard to mark the recording. Continue recording.
- 7) Plug the 10kohm calibration resistor in the safetyconnectors. Type "**10k**" on the comment line.
- 8) After about twenty seconds, the output of the TM-BIO temperature sensor displayed on the recording channel should reach a stable level. Press the Enter key on the keyboard to mark the recording. Click **Stop** to halt the recording.
- 9) Select **Save As** in the **File** menu, and type a name for the file. Choose a destination on the computer in which to save the file. Click on **Save** to save the file.
- 10) Compress the data from the calibration recording onto the same computer screen by clicking on the **Double Display Time** icon on the LabScribe toolbar. The output of the sensor at the two temperatures should be positioned on the same screen.
- 11) Click the **2-Cursor** icon and position the first cursor on the plateau of the first calibration (5k ohm) and the second cursor on the plateau of the second calibration (10 kohm).
- 12) Right-click in the recording window of the temperature channel. Select **Units** from the right-click menu and **Simple** from the **Units** submenu.
 - In the **Units Conversion** dialog window, select **2 point cal** from the pull-down menu in the upper-left corner of the window.
 - Put a check mark in the box next to **Apply Units to All Blocks**.
 - Notice that the voltages from the positions of the cursors are automatically entered into the value equations.
 - Enter 5000 in the corresponding box to the right of the voltage recorded when the 5Kohm resistor was plugged in. Enter 10000 in the corresponding box to the right of the voltage recorded when the 10 Kohm resistor was plugged in
 - Enter the name of the units, **ohm**, in the box below.



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- Click **OK** to activate the unit conversion.

Operating the TM-BIO Temperature Sensor

- Click on the Add Function icon on the TM-BIO Ohm channel and Choose **Linearize Sensor → TM-BIO**
- This will create a Calculated channel that will convert the resistance values to deg C.
- Once the TM-BIO temperature sensor is calibrated, it can be immersed in aqueous solutions, including saline solutions, for a few hours. **The TM-BIO is not designed for long-term immersion or chronic implantation.**
- The rugged Teflon jacket over the sensor can also be attached with tape or glue to a surface to be measured.

Do not attempt to measure temperatures above 50°C. Temperatures above this limit will damage the sensor.

Care of the TM-BIO Temperature Sensor

Since the jacket covering the element and the insulation on the wires are made of Teflon, they may be cleaned with just about any cleaner.



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Table 1: Resistances of the Thermistor Used in the TM-BIO Temperature Sensor at Different Temperatures

| Temp (°C) | Resistance (Ω) | Temp (°C) | Resistance (Ω) | Temp (°C) | Resistance (Ω) |
|-----------|----------------|-----------|----------------|-----------|----------------|
| 0 | 32650.5 | 17 | 14321.6 | 34 | 6808.36 |
| 1 | 31032.1 | 18 | 13679.8 | 35 | 6531.31 |
| 2 | 29499.9 | 19 | 13070.4 | 36 | 6265.75 |
| 3 | 28052.4 | 20 | 12491.6 | 37 | 6016.47 |
| 4 | 26684.6 | 21 | 11941.6 | 38 | 5776.05 |
| 5 | 25391.2 | 22 | 11418.9 | 39 | 5546.53 |
| 6 | 24168.2 | 23 | 10922.0 | 40 | 5327.34 |
| 7 | 23011.2 | 24 | 10449.5 | 41 | 5117.97 |
| 8 | 21916.3 | 25 | 10000.0 | 42 | 4917.94 |
| 9 | 20879.8 | 26 | 9572.32 | 43 | 4726.77 |
| 10 | 19898.3 | 27 | 9165.29 | 44 | 4543.91 |
| 11 | 18968.6 | 28 | 8777.79 | 45 | 4369.33 |
| 12 | 18087.6 | 29 | 8408.68 | 46 | 4200.84 |
| 13 | 17252.6 | 30 | 8057.31 | 47 | 4040.81 |
| 14 | 16460.9 | 31 | 7722.43 | 48 | 3889.51 |
| 15 | 15710.0 | 32 | 7403.29 | 49 | 3743.17 |
| 16 | 14997.7 | 33 | 7098.42 | 50 | 3603.10 |



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