

iWorx Pulse Oximeters and Sensors

Technical Note

Overview

Pulse oximeters measure the amount of oxygen in blood by determining the oxygen saturation level (SpO₂) of the hemoglobin in blood. Hemoglobin exists in the blood in two different forms, oxygenated (oxyhemoglobin) and deoxygenated (deoxyhemoglobin). Oxygenated hemoglobin absorbs more infrared light and allows more red light to pass; whereas, deoxygenated hemoglobin absorbs more red light and allows more infrared light to pass. Therefore, the absorbance of each wavelength of light depends on the saturation or desaturation of hemoglobin, and can be used to determine the oxygen saturation level of the hemoglobin.

iWorx offers a variety of easy-to-use pulse oximeters and sensors.



PO2-100D

The **PO2-100D Pulse Oximeter and Plethysmograph Sensor** measures blood oxygen saturation (SpO₂) and pulse pressure (plethysmography) using a dual-wavelength light transmittance based finger clip.

The PO2-100D is intended for use with non-iWire iWorx data recorders with DIN8 transducer inputs. It has a DIN-8 connector for recording SpO₂ and a BNC connector for recording plethysmography data.



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The PO2-100D is designed for educational use and includes well documented and illustrated lab exercises. (Note: the PO2-100D is not to be used for medical diagnostics.)

The sensor of the PO2-100D emits wavelengths of light at 600nm (red) and 925nm (infrared), and then detects the absorbance of those wavelengths by the hemoglobin in the blood. Through the programming built into the PO2-100D, the absorbance of light at each wavelength is used to determine the ratio between the concentrations of oxygenated and deoxygenated hemoglobin in the blood. After conversion of the output of the PO2-100D to the proper units, the level of oxygen in the blood is expressed as the percentage of oxygen saturation. Normally, the oxygen saturation level of blood is between 95 and 100%.

iWire PO2-100

The **iWire-PO2-100** is the iWire model of the PO2-100D and is intended for use with iWire-equipped iWorx data acquisition systems. It has an iWire connector for recording SpO2 and a BNC connector for recording plethysmography data.

The iWire-PO2-100 Pulse Oximeter and Plethysmograph Sensor measures blood oxygen saturation (SpO2) and pulse pressure (plethysmography) using an included dual-wavelength light transmittance based finger clip.

The iWire-PO2-100 is designed for educational use and includes well documented and illustrated lab exercises. (Note: the iWire-PO2-100 is not to be used for medical diagnostics.)



PO2-200D



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The **PO2-200D Pulse Oximeter** measures blood oxygen saturation (SpO₂) in humans using a finger (Nonin 8000AA) or ear clip (Nonin 8000Q2) sensor that connects via a DB-9 connector. It has a DIN8 connector for recording SpO₂ and a BNC connector for recording plethysmography data.

iWire PO2-200

The **iWire-PO2-200 Pulse Oximeter** is the iWire model of the PO2-200D and is intended for use with iWire-equipped iWorx data acquisition systems. It has an iWire connector for recording SpO₂ and a BNC connector for recording plethysmography data.

The iWire-PO2-200 Pulse Oximeter measures blood oxygen saturation (SpO₂) in humans using a finger (Nonin 8000AA) or ear clip (Nonin 8000Q2) sensor that attaches via a DB-9 connector.



PO2-300D

The **PO2-300D** is a pulse oximeter for small animal testing. It requires either an A-PO2-AWS Wrap Sensor, or an A-PO2-ALC Lingual Clip Sensor. It has a DIN8 connector for recording SpO₂ and a BNC connector for recording plethysmography data.



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A-PO2-AWS

Animal wrap sensor for use with the PO2-300D.

A-PO2-ALC (not pictured)

Lingual clip sensor for use with the PO2-300D.

How to Use iWorx Pulse Oximeters

Equipment Setup

- 1) If you are using the PO2-200D, iWire-PO2-200, or PO2-300D, connect the sensor to the pulse oximeter's DB-9 sensor connector.
- 2) If you are using the PO2-100D, PO2-200D, or PO2-300D, plug one end of the DIN8 cable into the DIN8 connector of the oximeter. Plug the other end of the same cable into a transducer input of an iWorx data acquisition system.
- 3) If you are using the iWire-PO2-100 or the iWire-PO2-200, connect the iWire connector to an iWire port of an iWire-compatible iWorx data acquisition unit.
- 4) Connect one end of a BNC-BNC cable to the BNC output of the PO2-100D and the other end of the BNC-BNC cable to a BNC input of an iWorx data acquisition system.
- 5) If using one of the human pulse oximeters, clip the sensor over the end of the subject's middle or ring finger. An embossed diagram on the sensor indicates the position of the finger within the clip. If using the PO2-300D, affix the animal wrap or lingual sensor to the animal. The status light on the pulse oximeter will stop blinking in a few seconds when the sensor is positioned and working properly.

Warnings

The finger sensor will not work properly when placed over fingernails coated with any shade of nail polish, or over artificial nails. Also, make sure the center of the nail is aligned under the light-emitting diode of the sensor when the clip is placed on the finger or toe.



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Unit Conversions

The output of the pulse oximeter is a voltage that can be converted to a percentage. If the output is recorded using an iWorx data acquisition unit and LabScribe software, the output can be converted from voltage to the percentage of oxygen saturation in the blood using the following steps:

- 1) Make sure the sensor is placed on the subject correctly. The indicator light of the pulse oximeter will stop blinking after a few seconds when the unit is working properly.
- 2) Click on the **Record** button in the upper right corner of the LabScribe **Main window**. Record from the subject for about ten seconds. Click on the **Stop** button. Two blue cursors should appear on the **Main window**.
- 3) Right-click on the recording area of the **Oxygen Saturation** channel to open that channel's right-click menu. Select **Units** from the menu and **Simple** from the submenu to open the **Units Conversion** dialog window.
- 4) Pull down the menu in the upper left corner of the **Units Conversion** dialog window and select **slope & offset**. Set the **slope** equal to **10**, the **offset** equal to **80**, and the **Name** of the units for the Y-axis equal to **%O2 Sat**. Put a check in the box next to **Apply units to all blocks**. Click on the **OK** button.

Heart Rate Measurements

Since the sensor also functions as a pulse plethysmograph, the pulse signal can be used to determine the subject's heart rate. If the pulse oximeter is used with an iWorx data acquisition unit and LabScribe software, the pulse signal can be used to compute and display the subject's heart rate on another channel:

- 1) On the LabScribe **Main window**, open the **Edit** menu and select **Preferences** from the menu. The **Preferences** dialog window will open onto the **Channels** page.
- 2) Click on the title of an unused channel, and title the channel **Heart Rate**. Click the **OK** button at the bottom of the window to return to the **Main window**.
- 3) Right-click on the recording area of the new **Heart Rate** channel to open the channel's right-click menu. Select **Periodic** from the menu and **Rate** from the submenu.
- 4) Right-click on the recording area of the **Heart Rate** channel to open the channel's right-click menu, for a second time. Select **Set Raw Ch** from the menu and the **Pulse** channel from the submenu.
- 5) While recording the pulse, heart rate, and oxygen saturation data, click on the **AutoScale** button for the **Pulse** channel; and then click on the **AutoScale** button for the **Heart Rate** channel to display the subject's heart rate.



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Experiments

LabScribe experiments using an iWorx pulse oximeter include:

- **Experiment HE-3: Exercise, Blood Pressure, and Oxygen Saturation Levels** (found in the **Human Exercise** category of the **Settings** menu as **O2Saturation-Exercise**)
- **Experiment HC-5: Effects of Temperature on Peripheral Oxygen Saturation Levels** (found in the **Human Circulation** category of the LabScribe **Settings** menu as **ECG-PulseOx**)

Specifications and Accuracy

Oxygen saturation range is 80% to 100% +/- 2%. Oxygen saturation (SpO₂) data is valid across a pulse rate range from 18 to 300 beats per minute (18 to 450 bpm for the PO2-300D). Pulse accuracy is +/- 2-3 bpm. SpO₂ data is reported on a beat-to-beat basis with a maximum update rate of three data points per second.

Operation and Storage Environment

The device is designed to operate in a 0°C to 50°C environment with 10 to 90% non-condensing humidity. The device may be stored in an environment from -30°C to 50°C with 10 to 95% noncondensing humidity.

Safety

The sensor on the PO2-100D meets the IEC 60601-1 Dielectric Withstand specification.



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