

# PULSE OXIMETER PACKAGE

**CANL-425SV-A**

**USER'S MANUAL**



**DOC-095**  
**Rev. 1.6**

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## CHAPTER 1 | INTRODUCTION

Many scientists have realized an increased demand for non-invasive methods of obtaining cardiovascular measurements in laboratory animals, such as rats and mice. With this need in mind, MED Associates has developed a veterinary quality pulse oximeter that allows researchers to obtain measurements of percent arterial oxygen saturation (SpO<sub>2</sub>) and heart rate in anesthetized animals using a non-invasive transducer applied to the surface of well-perfused tissue such as the base of the tail, ear, tongue, or paw.

This stand-alone pulse oximeter features front-panel display that gives continuous read outs of heart rate and SpO<sub>2</sub>. There are also LED lights that indicate a sensor alarm, signal out of track, bad pulse signal, and sensor disconnect.

The pulse oximeter signal can be connected to the standard USB port on a computer. Software is available from MED Associates that provides a chart recorder-like display of the arterial pulse tracing as well as read outs for heart rate and SpO<sub>2</sub>. Data can also be stored as ASCII text files for importing into graphing or statistics programs.

For the purpose of data acquisition, the CANL-425SV-A is equipped with analog outputs (BNC-type connector) that can be used to acquire the pulse rate, raw plethysmograph, and SpO<sub>2</sub> using an analog-to-digital data acquisition system that may already be in place in a lab.

For labs that frequently perform surgeries, this pulse oximeter is the ideal tool for monitoring anesthesia levels during surgery.

Applications include monitoring arterial oxygen saturation during respiratory physiology studies on hypoxia.

### System Requirements

- Windows® XP, Vista (32-bit only) or Windows® 7 (32-bit only)
- Available USB port

### Device Specifications

Arterial Oxygen Saturation Range:	70 to 100 %
Pulse Rate Range:	18 to 450 pulses per minute
Operating Temperature:	0 °C to +50 °C
Non-operating (Storage) Temperature:	-20 °C to +70 °C
Operating Humidity:	10 to 90 % Non-Condensing
Non Operating (Storage) Humidity:	10 to 95 % Non-Condensing
Voltage / Amperage Input:	6 Volts DC / 500 mA – Center Pin (+)

## CHAPTER 2 | SYSTEM COMPONENTS

### Front Panel

The CANL-425SV-A (Figure 2.1) pulse oximeter features easy to read LED displays that show both heart rate (PULSE) and percent arterial oxygen saturation (SpO<sub>2</sub>). The CANL-425SV-A also features LEDs to indicate various operating conditions (refer to Chapter 5, Alarm Conditions for alarm troubleshooting):

- **SENSOR ALARM** – there is a problem with the sensor, or no signal is present.
- **OUT OF TRACK** – the pulsatile signal from the sensor is out of the range. This may be due to motion artifacts. To clear this alarm condition, ensure that the sensor is attached securely to the animal and that the animal is very still.
- **ARTIFACT** – a sudden change in the signal is observed, probably due to motion.
- **SENSOR DISCONNECT** – no sensor is attached to the PROBE INPUT port.
- **USB STATUS** – reserved for future USB port status annunciation.

*Figure 2.1 - Front Panel of CANL-425SV-A Pulse Oximeter*



## Back Panel

The CANL-425SV-A can be used either as a stand-alone pulse oximeter or connected to a computer using a USB cable and the SOF-425 software. The USB port is located on the back panel of the pulse oximeter unit, as shown in Figure 2.2 below.

The CANL-425SV-A pulse oximeter also provides analog data outputs for heart rate (PULSE RATE), SpO<sub>2</sub> and the raw pulsatile waveform from the pulse oximeter sensor (PLETHYSMOGRAPH).

These analog outputs can be interfaced into any existing data recording system such as a chart recorder, computer analog-to-digital system, or oscilloscope using BNC cables.

*Figure 2.2 - Back Panel of CANL-425SV-A Pulse Oximeter*



The analog output BNC connectors are all polarized with the Center (+) Positive and the Shell (-) Negative.

The PULSE RATE analog output is 10mV/beat with a range of 18 to 450 Beats Per Minute (+0.18 VDC to +4.5 VDC).

The PLETHYSMOGRAPH analog output is a raw pulsatile waveform representing the heartbeat detected at the sensor placement location. The period of the waveform will correspond to the heart rate, e.g. a period of 750mS will equal to 1.33 Beats per Second or 80 Beats per Minute and a period of 375mS will equate to 2.66 Beats per Second or 160 Beats per Minute.

The SpO<sub>2</sub> analog output is 20mV/Percent of arterial oxygen saturation with a range of 70 to 100% of oxygen saturation (+1.4 VDC to +2.0 VDC).

## Sensors

There are four types of sensors available for attachment to the CANL-425SV-A pulse oximeter:

- **TDR-43W** (Figure 2.3) – This sensor is attached to a flexible rubber strip that is most often wrapped around the tail of a rat or mouse. The light emitter is on one end of the sensor and the detector is on the other end. The emitter and the detector must be on opposite sides of the recording site. This sensor must be securely held in place using surgical tape or other means.

*Figure 2.3 - TDR-43W Wrap Sensor*



- **TDR-43T** (Figure 2.4) – This is a transreflectance sensor that incorporates the light emitter and detector on one surface. The light reflects off the tissue back onto the detector. This can be used on a flat tissue surface such as the abdomen or ear of a dog. Again, this sensor must be held securely in place using surgical tape or other means.

*Figure 2.4 - TDR-43T Transreflectance Sensor*



- **TDR-43C** (Figure 2.5) – Probably the most versatile sensor, it clips in place and can be used on the tongue of large animals (dogs, etc.), or placed on the upper thigh of a rodent (mouse or rat).

*Figure 2.5 - TDR-43C Clip Sensor*

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- **TD-43** (Figure 2.6) – This is a disposable sensor that is held in place using adhesive tape. This sensor can be reused several times before it is disposed.

*Figure 2.6 - TD-43 Disposable Sensor*

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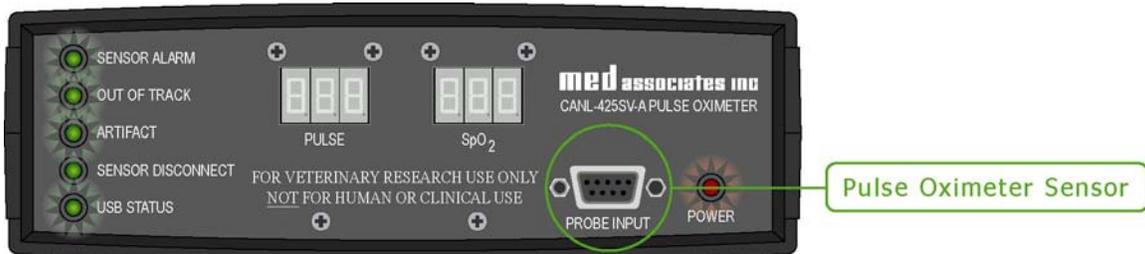
## CHAPTER 3 | USING THE PULSE OXIMETER HARDWARE

### Hardware Setup

- Using the +6 VDC Power Transformer (included with the pulse oximeter), connect the **DC POWER IN** jack to the connector on the power transformer cable. Then plug the power transformer into a standard wall outlet. The lights on the front panel should now turn on. The green LED Alarms will all be lit (ARTIFACT LED may be flashing).



- Connect the appropriate pulse oximeter sensor to the **PROBE INPUT** connector (Figure 2.1). Refer to the following sections in this chapter for notes on sensor placement and selection. The **SENSOR DISCONNECT** LED should turn off.



- Attach the sensor to the animal (see the Important Notes Regarding Sensor Positioning section of this manual). Once a stable recording site is obtained the alarm LEDs should all turn off. A heart rate reading will appear on the PULSE display and the percent arterial oxygen saturation (SpO<sub>2</sub>) will appear on the SpO<sub>2</sub> display.



- If the pulse oximeter is being used in conjunction with the SOF-425 software, refer to Chapter 5 for further instructions.

### Important Notes Regarding Sensor Positioning

All sensors must be positioned properly and attached securely to the animal. Sensor positioning is especially important for the TDR-43W and TD-43 sensors, where the light and detector portions of the sensor must be properly aligned on opposite sides of the recording site. If a bad signal is being obtained, try adjusting the sensor positioning.

Once a stable signal is acquired, use tape to ensure that the sensor remains fixed in place. In most cases anesthesia, or a restraint device, is required to keep the animal motionless. Anesthesia is preferable so that the animal is completely immobile and full access to multiple potential recording sites is possible.

### Pulse Oximetry in Rodents

We have found the best luck in rats and mice using the clip sensor (TDR-43C) positioned on the upper thigh muscle. Note that the fur from the recording site should be removed using a depilatory cream for best results. It is also possible to get a good signal from the tail using the TDR-43W Wrap Sensor, although, our experience has been that this signal is not as strong as the signal from the thigh muscle.

It is very important to have the animal motionless and have the sensor securely held in place. It may take some time to work out the best sensor positioning for the application. The best site is well vascularized and has a substantial tissue mass. Muscles, such as the thigh or upper part of the forelimbs, work well for this purpose.

### Pulse Oximetry in Larger Animals

In larger animals, such as dogs, the tongue provides a superb site for sensor attachment. Use the TDR-43C Clip Sensor for this application. The TDR-43T Transflectance Sensor may also be used on the ear lobe. It is advisable to remove any fur from the ear lobe using a depilatory cream prior to applying the sensor.

## CHAPTER 4 | INSTALLING THE SOFTWARE

### Driver and Software Installation

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**NOTE:** The pulse oximeter should not be connected to the USB Port on the computer until after this section is completed.

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If the computer being used was purchased as part of the Pulse Oximeter system from MED Associates, the driver and software installation was completed at the factory. If the computer was not purchased from MED Associates, follow the instructions to install the hardware drivers and software programs.

**Before beginning the installation, phone, fax or e-mail MED Associates with the registration information in order to receive the software installation password. This password will be necessary during the installation process.**

Insert the Pulse Oximeter Software CD into the CD-ROM drive. The screen shown in Figure 4.1 will appear. Click on **Install SPO2 Software** and the Begin Installation Screen shown in Figure 4.2 will appear.

*Figure 4.1 - SPO2 Software Main Screen*

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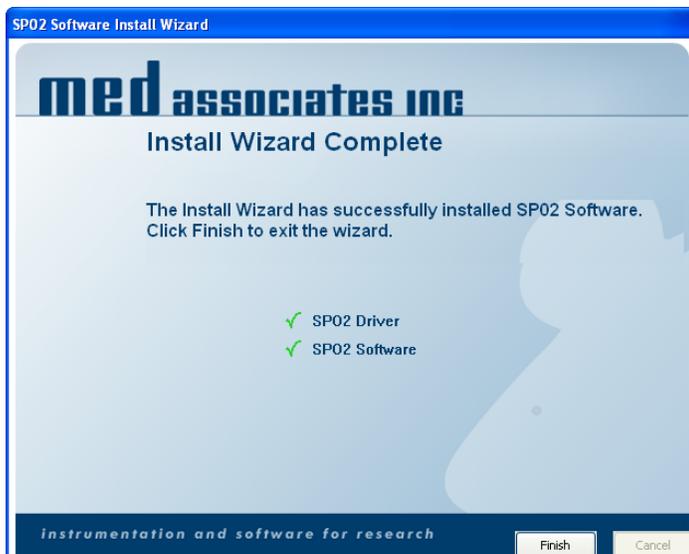
Begin installing the driver and software by clicking **Install**. Complete the steps to install the drivers and software, entering the desired User Name and Company as well as the password when prompted.

*Figure 4.2 - SPO2 Begin Installation Screen*



Successful installation of each item will be indicated by a green check mark, and a red X will indicate an unsuccessful installation. (See Figure 4.3). Click **Finish** to close this screen.

*Figure 4.3 – Install Wizard Complete Screen*



## Device Driver Installation

Begin by using the +6 VDC Power Transformer included with the pulse oximeter to connect the **DC POWER IN** jack on the back of the unit (Figure 2.2) to the connector on the power transformer cable. Then plug the power transformer into a standard wall outlet.

Next, use the included USB cable to connect the **USB PORT IN** connector on the back of the unit (Figure 2.2) to any available USB port on the computer. Note which USB port is used, as this is the port that should be used each time the software is run. If a different USB port is used, the driver installation will need to be completed again.

The Found New Hardware Wizard screen shown in Figure 4.4 will appear. Click the radio button for **Install the software automatically (Recommended)** then click the **Next** button.

Figure 4.4 - Found New Hardware Wizard Screen



After a few moments the screen shown in Figure 4.5 will appear. The device driver installation is now complete. Click **Finish** to close this window.

Figure 4.5 – Driver Installation Complete



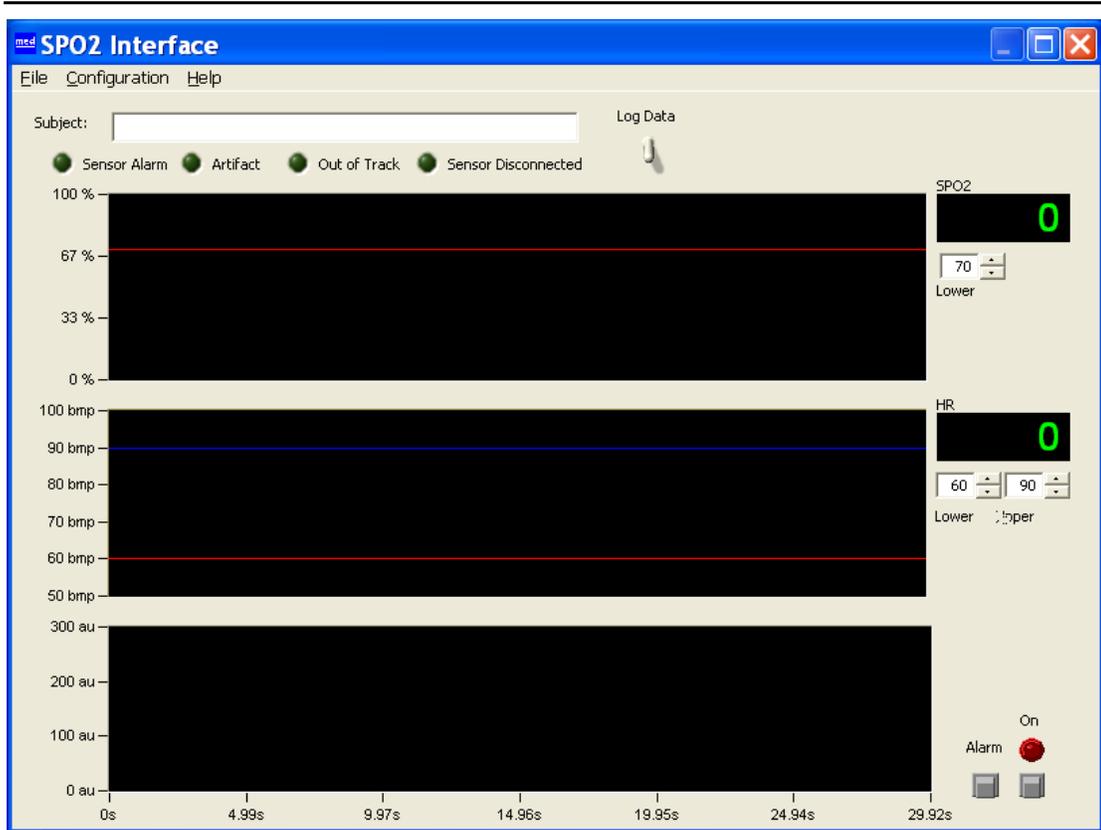
## CHAPTER 5 | USING THE PULSE OXIMETER SOFTWARE

Ensure that the pulse oximeter is connected to the same USB port that was used during driver installation (see Chapter 4) and that the power transformer cable is connected to the back of the pulse oximeter. Connect the appropriate sensor to the PROBE INPUT connector, and attach to the animal (refer to Chapter 3).

### Main Screen

To start the viewing/recording software, double-click the SPO2 program icon located on the desktop. The SPO2 Interface main screen will now be displayed (see Figure 5.1).

Figure 5.1 – SPO2 Interface Software Main Screen



## Configuring the USB Port

Once the software loads it needs to be configured to interface with the pulse oximeter. Select **Configuration | Communications Port**. When the Communications Port dialog box appears (see Figure 5.2), select **USB**, and be sure the correct USB port is displayed in the **Port** drop-down list. Click the **OK** button.

*Figure 5.2 - Selecting the USB Port*



## Acquiring Data

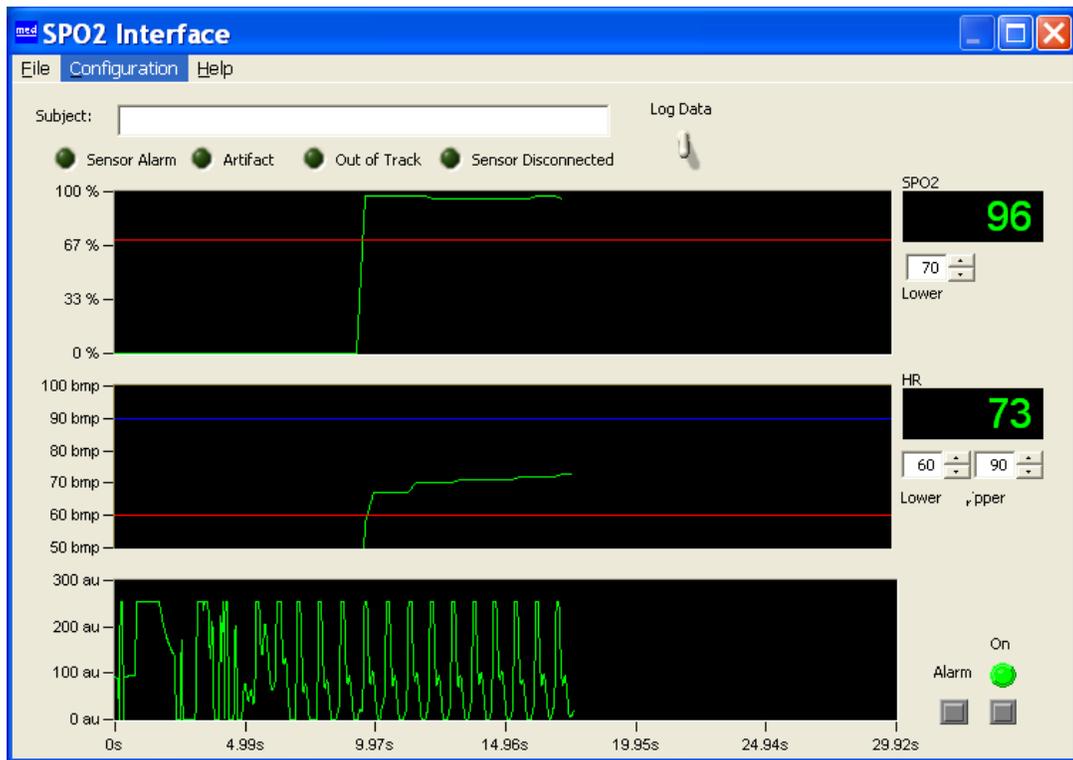
To begin displaying data from the pulse oximeter, click on the raised square button below the red **ON** LED in the lower right corner of the screen (refer to Figure 5.3). The LED will change to bright green, and signals will be displayed in the data windows.

If a good signal is being acquired the status LEDs (Sensor Alarm, Artifact, Out of Track, and Sensor Disconnect) will be off. The backgrounds of both the SPO2 and HR displays will be black.

Green traces for each signal will also appear in the scrolling displays (see Figure 5.3). The top scrolling display shows the arterial oxygen saturation (SpO<sub>2</sub>) on a default scale of 0 to 100%. The middle scrolling display shows the heart rate (bpm) on a default scale of 50 to 100 bpm. The lower scrolling display shows the plethysmogram, which is a pulsatile waveform corresponding to blood flow, on a scale of 0 to 300 arbitrary units (au).

The current SpO<sub>2</sub> and heart rate readings appear in windows next to each scrolling display, as shown in Figure 5.3.

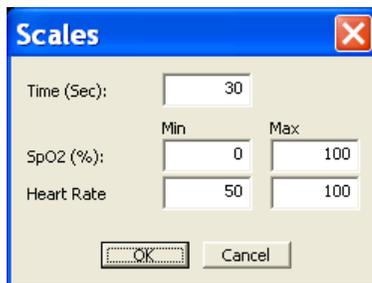
Figure 5.3 - Pulse Oximeter Data Being Displayed



### Adjusting the X- and Y-Axis Ranges

The range of the Y-axis values on both the SpO<sub>2</sub> and HR graphs, as well as the duration of time shown on the X-axis, can be changed by selecting **Configuration | Scales**. The Scales Configuration dialog box will appear (Figure 5.4).

Figure 5.4 - Configuring Scales



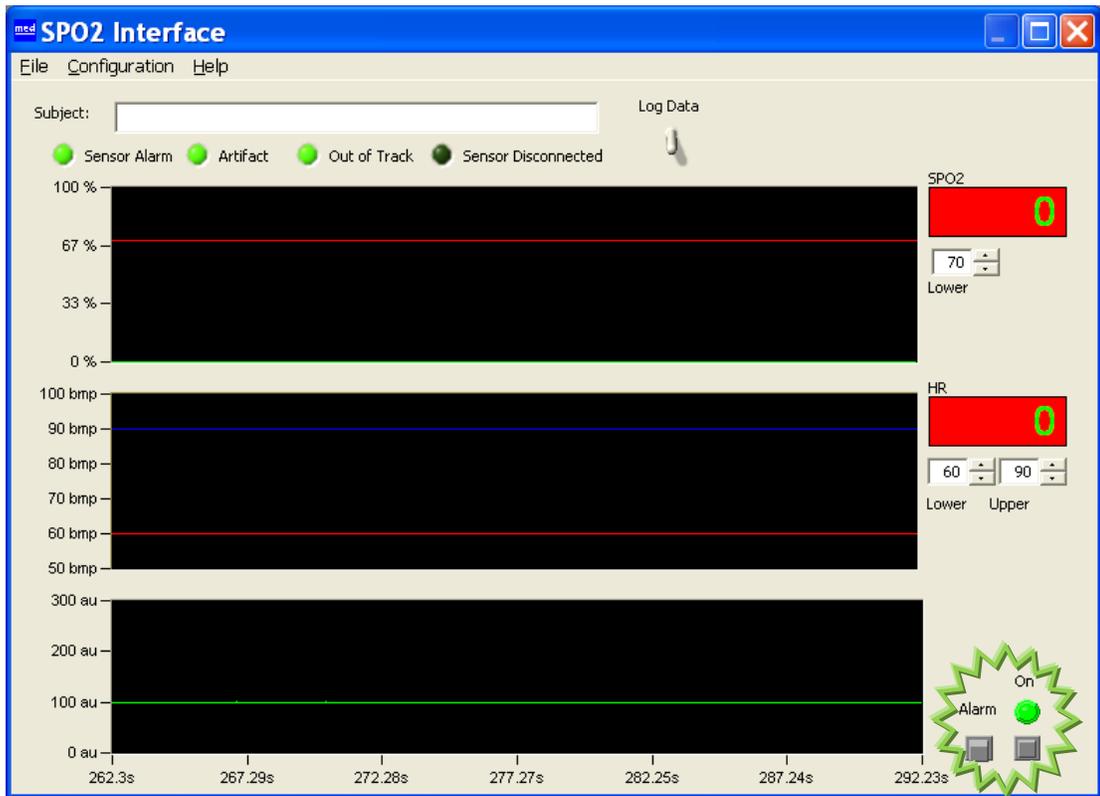
Input the Min and Max values to be displayed for both SpO<sub>2</sub> (%) and Heart Rate. The duration of time that graph is recorded for may also be changed by entering the desired duration in the Time (Sec) field. This is useful for compressing or expanding the view of the data.

### Audible Alarms

An alarm tone will occur if an alarm condition occurs and the corresponding green alarm LED will be lit on the screen. In addition the SpO<sub>2</sub> and heart rate (HR) displays will be red, as shown in Figure 5.5.

The audible alarm can be muted by clicking the raised square button below the **Alarm** label on the lower right corner of the screen. The visual alarms will remain (red background on the SpO<sub>2</sub> and HR displays and LEDs lit), but the alarm tone will be silenced.

Figure 5.5 - Example of Display During Alarm Condition



## Alarm Conditions

The following are definitions of alarm conditions and possible corrective actions:

Alarm	Description	Corrective Action
<b>Sensor Alarm</b>	Problem with sensor or sensor not connected	<ul style="list-style-type: none"> <li>• Verify that a sensor is connected to the PROBE INPUT port.</li> <li>• Check for proper sensor positioning; refer to the Important Notes Regarding Sensor Positioning section of this manual.</li> </ul>
<b>Artifact</b>	A sudden change in the signal is observed, possibly due to motion.	<ul style="list-style-type: none"> <li>• Ensure the animal is motionless.</li> <li>• Verify that the sensor is securely attached and positioned properly.</li> </ul>
<b>Out of Track</b>	The signal from the sensor is out of range.	<ul style="list-style-type: none"> <li>• Ensure the animal is motionless.</li> <li>• Verify that the sensor is securely attached and positioned properly.</li> <li>• Adjust the Alarm Thresholds, see instructions below.</li> </ul>
<b>Sensor Disconnect</b>	No sensor is attached to the PROBE INPUT port.	<ul style="list-style-type: none"> <li>• Verify that a sensor is connected to the PROBE INPUT port.</li> <li>• Replace the sensor.</li> </ul>

## Adjusting Alarm Thresholds

Both the upper and lower heart rate alarm thresholds can be adjusted, as well as the lower SpO<sub>2</sub> alarm threshold. The red line on the graph (refer to Figure 5.3) indicates the lower alarm threshold and the blue line indicates the upper heart rate threshold. These alarm thresholds may be adjusted using the numerical inputs below each data display window, or by clicking and dragging the threshold lines to the desired position.

An alarm condition will occur if the signals fall outside of the thresholds (above the upper threshold or below the lower threshold).

## Saving Data

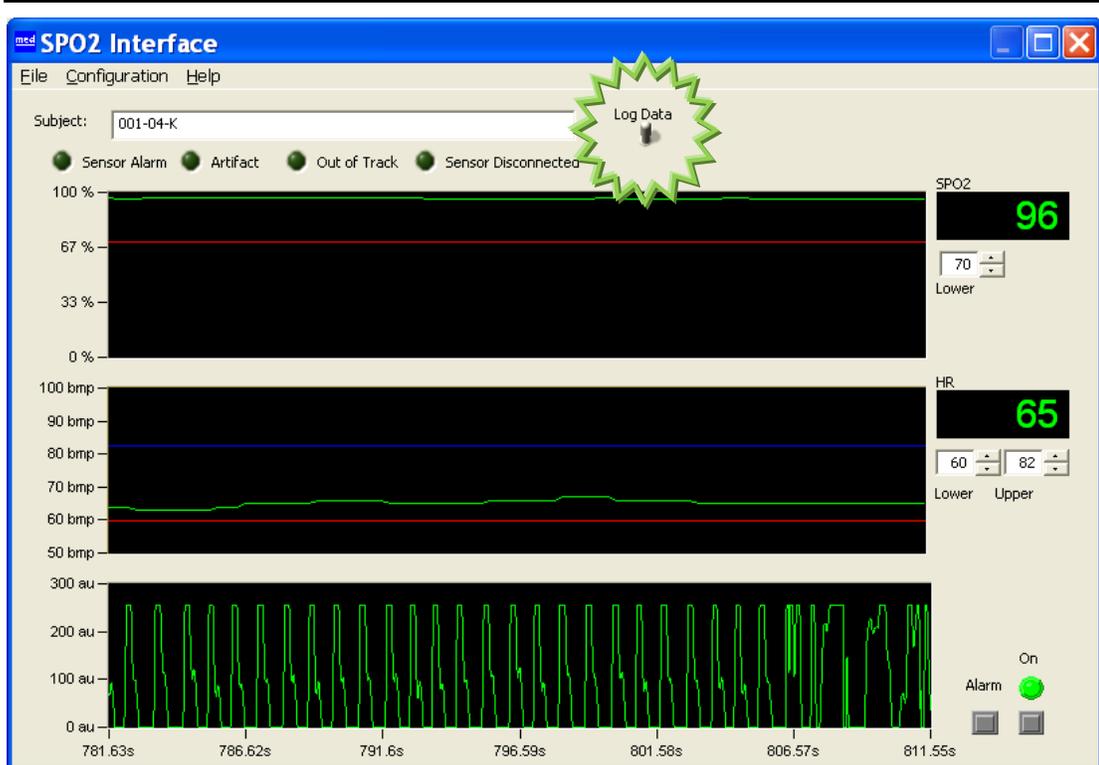
The pulse oximeter software can be used simply to monitor an animal or to save the pulse oximetry data in a text format (tab delimited ASCII).

To save data, enter a file name in the "Subject" field at the top of the pulse oximeter software screen (see Figure 5.6). This file name will be used as part of the name for all of the resulting data files.

To begin saving data, click on the **Log Data** switch located to the right of the Subject field (see Figure 5.6). The Log Data switch will move from downward pointing to upward pointing to indicate that data is now being saved.

When the measurements are complete, click on the **Log Data** switch again (it will move back to downward pointing). Data is no longer being saved.

Figure 5.6 - Saving Pulse Oximeter Data



All data files are saved in the directory in which the SpO<sub>2</sub> program was installed. The default directory is C:\Program Files\SPO2.

There are two files that are created each time the Log Data switch is activated. One file has a .RAW extension. This file is not readable. The other file has a .SO2 extension. The SO2 file contains the time-stamped data for SpO<sub>2</sub> (%) and heart rate (bpm) in a tab-delimited ASCII format. This data can be imported into any spreadsheet or graphing program, such as Excel®.

The data file names correspond to both the text entered into the **Subject** field and a time/date code. Figure 5.7 shows an example of a .SO2 file after it has been imported into Excel.

*Figure 5.7 - \*.SO2 File Imported into Excel*

	A	B	C
1	11/4/2004 1:07		
2	Subject: 001-04-K		
3			
4	Time	HR	SPO2
5	155.511	114	82
6	155.844	114	83
7	156.177	114	83
8	156.51	114	83
9	156.843	114	83
10	157.176	114	83
11	157.509	115	84
12	157.842	115	84
13	158.175	115	83
14	158.508	115	82
15	158.841	115	82
16	159.174	115	82
17	159.507	115	81
18	159.84	115	81
19	160.173	115	81
20	160.506	115	81
21	160.839	114	81
22	161.172	114	81
23	161.505	114	81
24	161.838	114	81
25	162.171	114	82
26	162.504	114	82
27	162.837	114	82
28	163.17	113	82
29	163.503	113	82
30	163.836	114	83
31	164.169	114	83
32	164.502	114	82
33	164.835	114	81
34	165.168	114	81
35	165.501	113	81
36	165.834	113	82

The ASCII file contains the time/date the file was recorded, the subject name, and three columns of data. The first column is the time stamp. Data are saved at a sample rate of 3 samples per second. The second column is HR for Heart Rate (bpm), and the third column is SpO<sub>2</sub> (%).

### **Contact Information**

Please contact MED Associates, Inc. with any questions.

Visit our website at [www.med-associates.com](http://www.med-associates.com) for contact information.

For technical questions, email [support@med-associates.com](mailto:support@med-associates.com).