

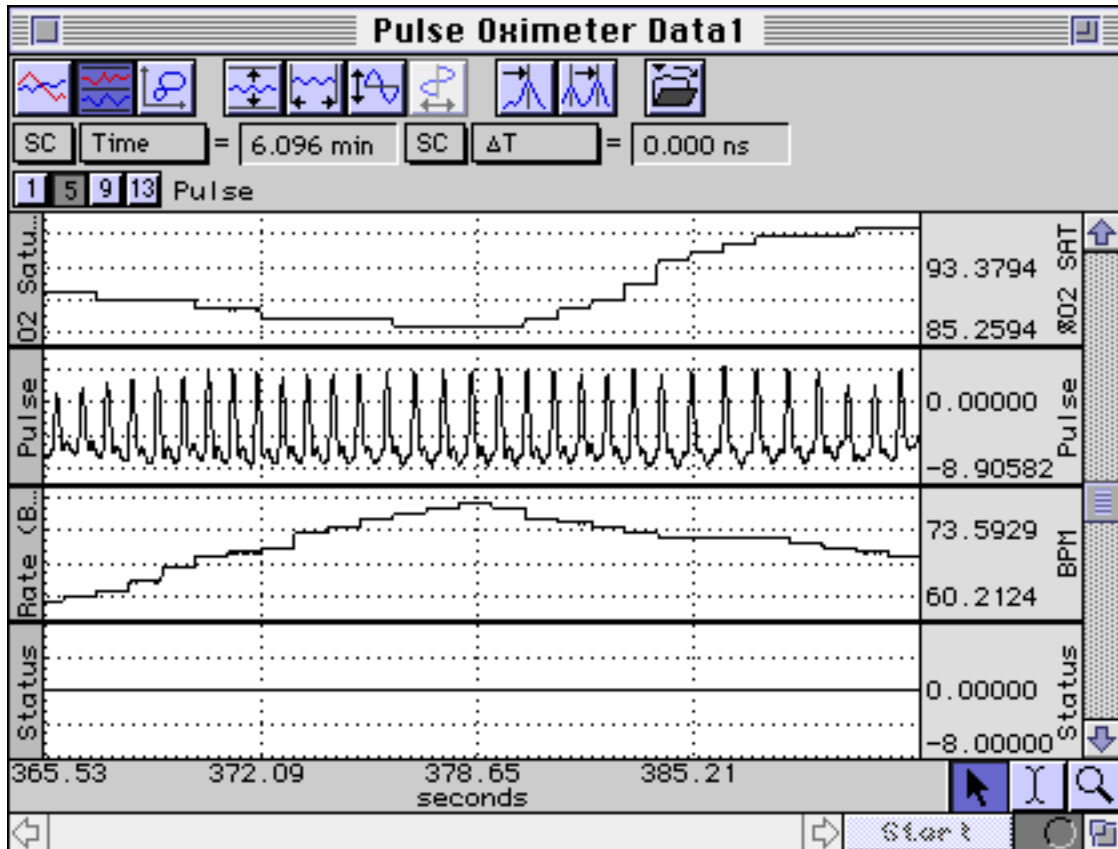


BIOPAC Systems, Inc.

42 Aero Camino
Goleta, CA 93117
Ph (805) 685-0066
Fax (805) 685-0067
www.biopac.com
info@biopac.com

#AH125 - Pulse Oximeter Module Operation

Updated 1/14/03



The **Pulse Oximeter Module (OXY100C)** is primarily used to measure the blood oxygen saturation level in a non-invasive fashion. The OXY100C transmits two wavelengths of light (660 and 940 nanometers) via LEDs, through a pulsating vascular bed (typically a finger or earlobe), to a receiving photodiode. Oxygen saturated blood absorbs different fractions of light at different wavelengths compared to unsaturated blood. Accordingly, the ratio of light absorbed can be used to calculate the ratio of oxygenated hemoglobin to total hemoglobin. This ratio is expressed as the O₂ Saturation Level and will vary between 0% and 100%.

The OXY100C outputs four signals simultaneously:

OXY100C output signals

O ₂ Saturation	Pulse Waveform	Pulse Rate	Module Status
---------------------------	----------------	------------	---------------

These signals can be optionally directed to a number of different MP100 or MP150 unit inputs. The user can choose to sample all, some or none of these signals.

The OXY100C updates the O₂ Saturation and Pulse Rate signals in real time on a beat-by-beat basis. The Pulse Waveform signal is output continuously. The Status signal will change states when module operation changes and can indicate module or transducer malfunction or transducer misplacement.

The *AcqKnowledge* graph above illustrates a typical O₂ Saturation (channel 1) and Pulse Rate (channel 9) recording. The actual Pulse Waveform is displayed in channel 5 and the module status is displayed in channel 13.

HARDWARE SETUP

The Pulse Oximeter Module connects directly to the MP unit via the UIM100. Up to four OXY100C modules can be used with a single MP System. The Pulse Oximeter Transducer (TSD123) connects to the OXY100C via a 3 meter extension cable included with the OXY100C.

To use the OXY100C with an MP System, first snap the OXY100C into the left side of the UIM100, then connect the Analog and Digital cables directly from the MP unit to the respective OXY100C mating connectors. When the cable connections are secure, the MP unit can be powered up.

CALIBRATION

The OXY100C includes calibration features which permit easy scaling of all these signals when using the OXY100C with an MP unit and *AcqKnowledge*.

It's best to calibrate the OXY100C once, then save the respective scale values in a data file for subsequent use. The following sequence of steps are recommended for proper scale setting of the OXY100C when using *AcqKnowledge*.

1. On the OXY100C module slide the four position Calibration switch to

the OFF location (bottom position).

2. Set all the Signal Channel Enables to ON (top position).
 - There is one Signal Channel Enable two position switch for each signal output by the OXY100C. When any Signal Channel Enable switch is OFF (bottom position), then that corresponding MP unit input channel can be used by another input device.
3. Place the four position Bank Select switch to the first bank (top position). In this position the OXY100C output signals will be directed as follows:

Output	Channel
O ₂ Saturation	1
Pulse Waveform	5
Pulse Rate	9
Module Status	13

If multiple OXY100C modules are used with a single MP unit, then be sure to place additional OXY100C modules on unique banks. Furthermore, please check that any OXY100C output does not reside on the same channel used by any other amplifier module.

4. To properly sample the signals from the OXY100C, determine the highest frequency component of all the waveforms sampled.
 - The sample rate of the MP unit (as set in the *AcqKnowledge* Setup Acquisition dialog) will need to be double the rate of the highest frequency component resident in the input data. Normally, if just using the OXY100C, the maximum sampling rate would be 50Hz or less.
 - If not sampling the Pulse Waveform signal, the maximum sampling rate drops to double what the expected pulse rate maximum would be.
 - The fastest pulse rate detectable by the OXY100C is 250 BPM, so the safe minimum sampling rate would be:
 $2 \times [250 \text{ BPM}] / [60 \text{ sec/min}]$ or 8.33 Hz.
5. Using the Setup Channels option in *AcqKnowledge*, label the OXY100C signal outputs as shown:

Input Channels setup				
Acquire	Plot	Values	Channel	Label
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	A1	O2 Saturation
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A2	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A3	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A4	Analog input
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	A5	Pulse
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A6	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A7	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A8	Analog input
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	A9	Rate (BPM)
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A10	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A11	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A12	Analog input
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	A13	Status
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A14	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A15	Analog input
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A16	Analog input

6. For **O₂ Saturation** (Channel 1) scaling:
- In *AcqKnowledge*, place the scale selection dot adjacent to Channel 1.
 - Slide the OXY100C Calibration switch on the OXY100C module to the CAL LO position.
 - Click on the Cal2 button in the Channel A1 scaling dialog box.
 - Slide the OXY100C Calibration switch to the CAL HI position.
 - Click on the Cal1 button in the Channel A1 scaling dialog box.
 - Type in the corresponding Map values.
Cal1 Map value is 100.00.
Cal2 Map value is 0.00.
 - Type in the proper units as %O₂ SAT.

Channel A1 scaling:		
	Input volts	Map value
Cal1	3.2035	100.0000
Cal2	0.0064	0.0000
Units label:	%O ₂ SAT	
Cancel		Ok

Ideally, the nominal Cal1/Input volts value should be exactly 3.200. The nominal Cal2/Input volts value should be exactly 0.00. In practice, there will be very slight deviations from these expected values.

The minimum O₂ Saturation level detectable by the OXY100C is 0.00% The maximum O₂ Saturation level detectable is 100%. In the range from 80% to 100% the O₂ Saturation level is $\pm 2\%$ accurate. From 0% to 79%, the accuracy of the O₂ Saturation level is not specified.

7. For **Pulse Waveform** (Channel 5) scaling:

- a. In *AcqKnowledge*, place the scale selection dot adjacent to Channel 5.
- b. Slide the OXY100C Calibration switch on the OXY100C module to the CAL LO position.
- c. Click on the Cal2 button in the Channel A5 scaling dialog box.
- d. Slide the OXY100C Calibration switch to the CAL HI position.
- e. Click on the Cal1 button in the Channel A5 scaling dialog box.
- f. Type in the corresponding Map values.
Cal1 Map value is 10.00
The Cal2 Map value is -10.00.
- g. Type in the proper units as Pulse.

The screenshot shows a dialog box titled "Channel A5 scaling:". Inside the dialog, there are two columns: "Input volts" and "Map value". The "Cal1" row shows an input of 4.0604 and a map value of 10.0000. The "Cal2" row shows an input of 0.0073 and a map value of -10.0000. Below these, the "Units label:" is set to "Pulse". At the bottom of the dialog are "Cancel" and "Ok" buttons.

	Input volts	Map value
Cal1	4.0604	10.0000
Cal2	0.0073	-10.0000
Units label:	Pulse	

Ideally, the nominal Cal1/Input volts value should be exactly 4.064. The nominal Cal2/Input volts value should be exactly 0.00. In practice, there will be very slight deviations from these expected values.

The Pulse Waveform output from the OXY100C is functionally equivalent to a standard plethysmographic waveform, such as obtained with the PPG100C and TSD100.

8. For **Pulse Rate** (Channel 9) scaling:
 - a. In *AcqKnowledge*, place the scale selection dot adjacent to Channel 9.
 - b. Slide the OXY100C Calibration switch on the OXY100C module to the CAL LO position.
 - c. Click on the Cal2 button in the Channel A9 scaling dialog box.
 - d. Slide the OXY100C Calibration switch to the CAL HI position.
 - e. Click on the Cal1 button in the Channel A9 scaling dialog box.
 - f. Type in the corresponding Map values.
Cal1 Map value is 250.00.
Cal2 Map value is 0.00.
 - g. Type in the proper units as BPM.

	Input volts	Map value
Cal1	3.9902	250.0000
Cal2	0.0027	0.0000

Units label: **BPM**

Cancel Ok

Ideally, the nominal Cal1/Input volts value should be exactly 4.00. The nominal Cal2/Input volts value should be exactly 0.00. In practice, there will be very slight deviations from these expected values.

The minimum BPM detectable by the OXY100C is 30. The maximum BPM detectable is 250. The BPM accuracy in the range of 30-250 BPM is $\pm 1\%$. The BPM settles to $\pm 1\%$ of the final reading less than 15 seconds after the sensor is properly applied.

9. For **Module Status** (Channel 13) scaling:
 - a. In *AcqKnowledge*, place the scale selection dot adjacent to Channel 13.

- b. Slide the OXY100C Calibration switch on the OXY100C module to the CAL LO position.
- c. Click on the Cal2 button in the Channel A13 scaling dialog box.
- d. Slide the OXY100C Calibration switch to the CAL HI position.
- e. Click on the Cal1 button in the Channel A13 scaling dialog box.
- f. Type in the corresponding Map values.
Cal1 Map value is 16.00.
Cal2 Map value is 0.00.
- g. Type in the proper units as Status.

Channel A13 scaling:	
Input volts	Map value
Cal1 2.0438	16.0000
Cal2 0.0021	0.0000
Units label:	Status
Cancel	Ok

Ideally, the nominal Cal1/Input volts value should be exactly 2.048. The nominal Cal2/Input volts value should be exactly 0.00. In practice, there will be very slight deviations from these expected values.

When using the OXY100C, the Module Status levels are:

Status	Module Status Value
Normal operation	0.0
Probe off finger	1.0
Probe disconnected from OXY100C	10

10. After you have calibrated the required channels, slide the OXY100C Calibration switch on the OXY100C module to the CAL ON position.

[Return To Application Note Menu](#)