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The O2100A Module for the MP100 System

Technical Use Notes

Snap the O2100A module together with the UIM100A (or other BIOPAC modules). Be sure to select an unused channel on the channel selector switch on top of the module. If two or more BIOPAC modules are set to the same channel, the outputs will conflict resulting in erroneous readings.

Turn on the MP100A unit and start up the AcqKnowledge software. Please consult your AcqKnowledge manual for more information about running AcqKnowledge.

The O2100A module is supplied with a 12 VDC @ 1 amp wall adapter. Plug the adapter into the main power supply and insert the adapter plug into the back of the O2100A module.

Note: Do not use other wall adapters with the O2100A module.

The green POWER LED should light up, if not, check the adapter mains power and the connection to the O2100A module. If all looks OK, then check the FUSE on the back of the O2100A module. The FUSE rating are: Instrumentation Type, Fast Blow @ 2 amps.

If the green POWER LED comes on, check for pump operation by turning the PUMP switch ON. You should hear a humming from the box, indicating that the pump is working. You generally will never have to adjust the PUMP SPEED control.

The PUMP will start fast, then slow down and stabilize on a speed after a few seconds. This is a perfectly normal process, designed to overcome the pump's initial mechanical hysteresis.

If the pump does not come on or comes on for a brief period and then shuts off, the PUMP SPEED control is set to a very low value (i.e., zero speed). To change the pump speed, use a small straight blade screwdriver to turn the recessed potentiometer in the PUMP SPEED control.

- To increase PUMP speed: Turn trim POT clockwise.
- To decrease PUMP speed: Turn trim POT counter-clockwise.

Keep the PUMP switch in the ON position as you change the PUMP SPEED control.

If everything is OK so far, adjust the GAIN switch on the front of the O2100A module. Set the GAIN for the range desired. Generally, it is usually best to place the GAIN at the maximum setting of 10% oxygen per volt (bottom position).

The GAIN ranges imply the following:

100% / V - One volt output equals 100% oxygen concentration

- Voltage output range is from 0 to 1 volt

50% / V - One volt output equals 50% oxygen concentration

- Voltage output range is from 0 to 2 volts

20% / V - One volt output equals 20% oxygen concentration

- Voltage output range is from 0 to 5 volts

10% / V - One volt output equals 10% oxygen concentration

- Voltage output range is from 0 to 10 volts

For example, if the 10% / V setting is used, then 16% oxygen (approximate concentration in expired breath) will be output as: 1.60

volts or 1600 mV.

Gas Sampling Setup

Note: Prior to actual sampling any gas, it's very important to stabilize your measurement setup. Pump speed, filters and sampling lines all affect the oxygen measurement of the O2100A module. Everything should be stable prior to attempting an O2100A module calibration.

The sample input port is a male Luer fitting on the front of the O2100A module. Be sure to attach a 5 micron filter (or better) on the sample input port prior to sampling any gases. The O2100A module incorporates an internal particulate filter, however the addition of this external filter will extend the life of the internal filter and otherwise improve the long-term performance of the O2100A module.

Adjacent to the sample input port (on the right, facing the front panel of the module) is the sample output port. The sample output port is a bulkhead fitting with a 10/32 internal thread. To vent away undesirable gases from the site of the O2100A module, simply screw a 10/32 Luer adapter into the bulkhead fitting and attach the venting line to the Luer adapter.

Always use a 5 micron hydrophobic sampling filter (or better) at the sampling input of the O2100A module. One is included with each O2100A module and each Gas Sampling Interface Kit (AFT20). The 5 micron hydrophobic filter will help to protect the O2100A module from air borne particulate matter and other contaminants.

Important: Sample only dry gases. All water vapor needs to be removed from the sampling stream prior to being monitored by the O2100A module. Water vapor permeable tubing (i.e. NAFION®) is recommended to dry the sampling stream. The AFT20 Gas Sampling Interface Kit includes all the items necessary (including NAFION® tubing) to efficiently connect the O2100A module to the sampling chamber.

Calibration of the O2100A Module

The O2100A module is factory calibrated, but only to ± 1% oxygen concentration accuracy. Furthermore, if you need to run at increased flow rates, the calibration will veer further from ±1% accuracy. Generally, you should perform a gas calibration prior to all exacting measurements. This is also true if you are running at increased pump speeds and thus flow rate.

> **Note: Initial (Factory) oxygen accuracy calibration is usually inadequate for varying setup protocols. Proper calibration of the O2100A module should be performed after the specific measurement setup is in place.**

Exact calibration is typically performed in AcqKnowledge, using the Scaling function, under Setup Channels, on the MP100 menu once the measurement setup is in place. Setup your measurement so all gas sampling lines are in place between the O2100A module and the sampling chamber. Adjust the PUMP SPEED control (if required) on the O2100A module. When running the O2100A module, click on the CAL1 button when your first calibration gas is introduced into the sampling chamber. Then click on CAL2 when the second calibration gas is introduced into the sampling chamber. The calibration gases should be chosen to bracket your expected measurements.

For example, for performing VO2 measurements, you can use normal air as the first calibration gas because you know the oxygen concentration is 20.93%. However, a second calibration gas will need to be introduced into the chamber. In this latter case, it might be best to use a calibration gas of 16% oxygen and 84% nitrogen. In this case, your measurements will be dialed in for the range of 16% to 20.93% oxygen.

> **Note: Do not change the pump speed, the sampling filter or the sampling line length or configuration during or after a calibration. Changing any of these elements will affect an accurate calibration.**

Pump Speed Control

The pump speed is factory preset to result in a sampling rate of approximately 100 ml/min, when used with the AFT20 Gas Sampling Interface Kit. The time delay between change of oxygen concentration

at the sampling end of the Gas sampling Interface Kit (AFT20) to measurement at the O2100A module is approximately 2.4 seconds. This is because the pump will move 100 ml/min and the internal volume of the Gas Sampling Interface Kit is about 4.0 ml.

The Gas Sampling Interface Kit volume is calculated using:

PVC Sample Line: 72" long at 0.060" ID Volume = 3.336 ml

NAFION® Dryer: 12" long at 0.050" ID Volume = 0.386 ml

Misc Tubing/Junctions: 6" long at 0.060: ID Volume = 0.278 ml

Volume in ml is defined as: (Pi) • (radius in cm)2 • (length in cm)

If the sample rate is 100 ml/min, then the pump will pull 4 ml in 2.4 seconds:

(60 min/sec) • (4 ml) / (100 ml/min) = 2.4 seconds

To check the flow rate, breathe at the free end of the sampling line at the moment you mark the recording using the marker function in AcqKnowledge. You should see no change in the oxygen concentration level until after 2.4 seconds. Please note that you can change the pump speed to a relatively fast level. It's quite possible to exceed the maximum acceptable flow rate to the module, depending on the sampling line type and conditions. You won't harm the module by setting a fast flow rate, but an erroneous reading may occur.

To achieve the best results, run the pump speed so the flow rate to the module does not exceed 200 ml/min. The O2100A module output will be relatively insensitive to flow changes between 50 and 150 ml/min. However, above 150 ml/min, the O2100A module output will become increasingly sensitive to flow rate. As flow is increased up to 200 ml/min, the module output signal may also increase. Past a flow rate of 200 ml/min, the module output signal may start to oscillate, begin to decrease, or otherwise behave very erratically.

Run at flow rates between 150 and 200 ml/min when you wish to improve the response time of the O2100A module. Response times can

often be improved at least 50% over the nominal response times of 500ms at 100 ml/min.

Specifications

Range: 0-100% O2

Repeatability: 0.2%

Resolution: 0.1%

Linearity: 0.4%

Zero Stability: 0.01% O2 / Hour

Response Time: 160 msec (T10 - T 90) @ 200 ml/min

260 msec (T10 - T 90) @ 150 ml/min

500 msec (T10 - T 90) @ 100 ml/min

Flow Range: 50- 200 ml/min

Temp Range: 5-50°C

Zero Drift: 0.1% O2 / °C

Span Drift: 0.5% O2 / °C

Gas sampled must be free of liquids or any condensable vapors.

Gas sampled should be filtered to 5 microns or better.

The module measures the partial pressure of O2 and thus the module output is proportional to the partial pressure of O2 in the sample cell.

For example, the partial pressure of 21% concentration of O2 at sea

level (760 torr) is:

760 torr * 0.21 = 159.60 torr.

So at 700 torr and 21% O2, the module output will be:

(700 torr / 760 torr) * 159.6 torr = 147 torr

Accordingly, when operating at an ambient pressure of 700 torr, the module scaling needs to multipled by a factor of (700/760) or 0.921* (original scaling).

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