GA-300 Gas Analyzer

Technical Note

GA-300

Overview

The GA-300 CO_2 and O_2 Gas Analyzer is easy to use, robust, and adaptable to human, animal, and plant applications. The GA-300 has two analog outputs to allow recording and display of O_2 and CO_2 gas concentrations on an iWorx data acquisition system. In addition, the GA-300 incorporates an input for connection of a Polar® Heart Rate Receiver.

Front Panel

GA-300 Front Panel

On the front panel of the GA-300 are the analog CO_2 and O_2 outputs, an input and output for use with a Polar® Heart Rate Receiver, the fan and power switches, and the connector for the 5 VDC power adapter.

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Rear Panel

GA-300 Rear Panel

On the rear panel of the GA-300 Gas Analyzer are the inlet and outlet ports for the gas sampling tubing.

How to Use the GA-300 Gas Analyzer

Before the GA-300 Gas Analyzer is used, the following Two-Point Calibration procedure must be performed.

Calibration of the O_2 and CO_2 Channels

The outputs of the oxygen and carbon dioxide sensors of the GA-300 are voltages that are proportional to the concentrations of the gases being measured by the analyzer. To determine the volumes of oxygen consumed and carbon dioxide produced during metabolic testing, the voltage outputs of the sensors need to be converted, by the recording software, to the percentages of these gases in inhaled and exhaled air.

To make this conversion, samples of two different known concentrations of oxygen, and two different known concentrations of carbon dioxide, will need to be entered into the GA-300 gas analyzer as the voltage outputs of each sensor are recorded.

- One set of samples can be taken from room air, which contains 20.93% O_2 and 0.04% CO_2.
- The other set of samples can be taken from gas cylinders containing a combination of these two gases at different concentrations.
- Cylinders containing both oxygen and carbon dioxide are readily available from suppliers. Some of the most commonly used combinations contain:
  - 12% O_2 and 5% CO_2, with the balance being N_2
  - 16% O_2 and 4% CO_2

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Recording the Voltage Outputs of the Gas Sensors

Preparation:

1) Turn on the GA-300 for at least 15 minutes before performing a calibration.
2) Connect the CO_2 and O_2 outputs of the GA-300 to an iWorx data acquisition system. Using a BNC cable, connect the CO_2 output to a BNC input on the data acquisition unit. Use a DIN8 cable to connect the O_2 output to a DIN8 transducer input.
3) Double-click the desktop LabScribe icon to open LabScribe.
4) Configure LabScribe to show the O_2 and CO_2 channels.
5) Prepare the equipment that will deliver any gas samples, other than room air, to the GA-300:
   - Clamp and secure near the GA-300 Gas Analyzer any gas cylinders that will be used to provide gas samples.
   - Safely attach the regulator to the gas cylinder.
   - Attach a Luer-Lock connector to the outlet of the regulator that will allow the Calibration Kit for the GA-300 to be connected to the regulator of the gas cylinder.
   - Open the primary and secondary valves of the regulator for a few seconds to purge the air from the regulator.
   - Close the secondary valve on the regulator to stop the flow of gas. You will need the cylinder for the second sample of gas.
6) Attach a filter to the inlet port on the rear of the GA-300 analyzer. Attach the smooth end of the sampling tubing to the inlet of the filter.

Measure the voltage outputs of the oxygen and carbon dioxide sensors when measuring a sample of room air:

1) Move the gas sampling tubing away from the users to prevent the sampling of exhaled air. Allow room air to be pumped through the gas analyzer for 10 seconds before recording the outputs of the sensors.
2) Type **Output Voltage-Room Air** in the **Mark** text box to the right of the **Mark** button.
3) Click **Record**. The recording should scroll across the screen.
4) While recording, press the Enter key on the keyboard to mark the recording with information about the room air gas sample.
5) Record the outputs of the two gas sensors for about ten seconds. The recording should look like the data in the sample recording below.
6) Continue recording; do not stop recording until you have completed the following procedure.

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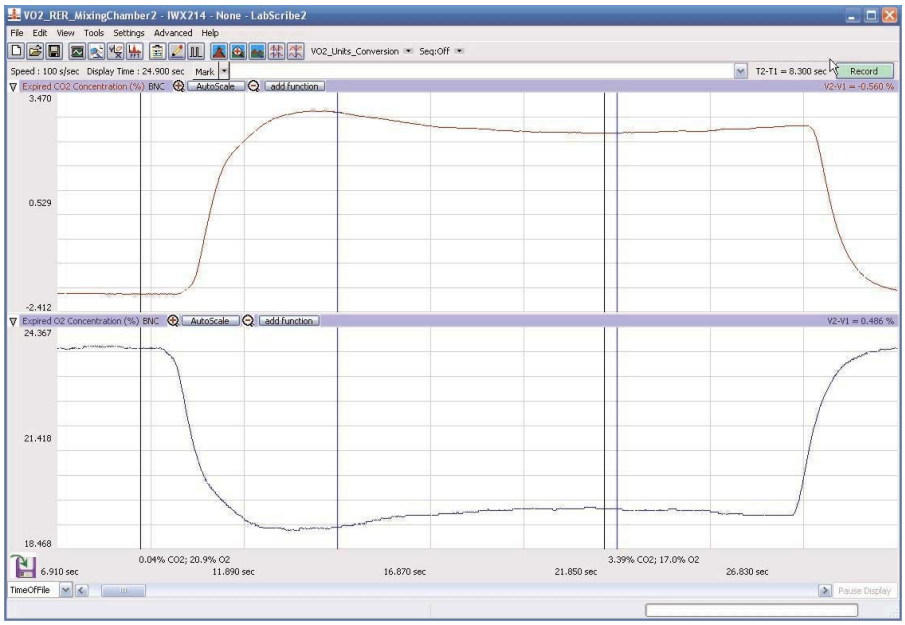

The voltage outputs of the two sensors in the GA-300 gas analyzer, carbon dioxide on the top and oxygen on the bottom.

Measure the voltage outputs of the oxygen and carbon dioxide sensors when measuring a second sample of a gas mixture containing known concentrations of oxygen and carbon dioxide:

1) Open the secondary valve on the regulator of the cylinder providing the second gas sample. Adjust the flow rate to LOW.
2) While the gas sample is flowing from the regulator, connect the gas sample tubing of the Calibration Kit (illustrated below) to the Luer-Lock connector on the output of the regulator.
   - Turn off the flow of gas from the cylinder.
   - Connect the outlet from the Calibration kit to the inlet filter port on the back of the GA-300. The GA-300 will pull the air in from the calibration tube.
   - Turn the regulator of the canister on LOW. The gas sample will automatically be pulled into the GA-300. Too high a flow rate may damage the CO_2 and O_2 sensors.

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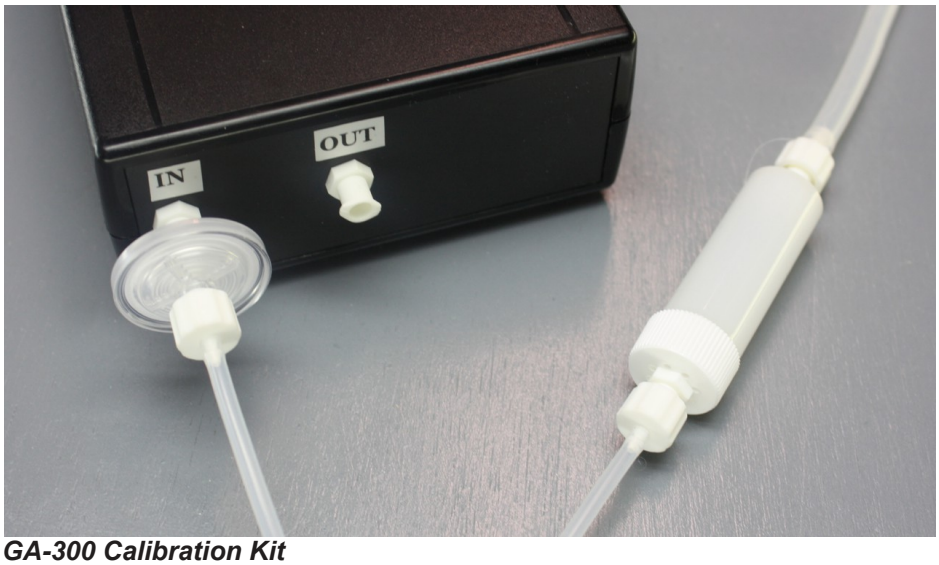

GA-300 Calibration Kit

3) Type **Output Voltage-Second Sample** in the **Mark** text box.
4) While continuing to record, press the Enter key on the keyboard to mark the recording with information about the second gas sample.
5) Once the recordings of the gas concentrations reach a steady level, record for another ten seconds. This can take up to two minutes.
6) Click **Stop**.
7) Select **Save As** in the **File** menu and name the file. Choose a destination on the computer in which to save the file. Designate the file type as *.iwxdata. Click **Save**.

Convert the Units on Gas Concentration Channels

1) Use the **Display Time** icons to adjust the **Display Time** of the **Main window** to show the complete calibration data on the **Main window**.
2) Place one cursor on the section of data recorded when the gas analyzer was collecting a sample of room air.
3) Place the second cursor on the section of data recorded when the second sample was collected.

Convert the voltages at the positions of the cursors to concentrations using the Advanced Units Conversion Dialog:

1) To convert the voltages on the **Expired CO_2 Concentration (%)** channel, click on the arrow to the left of the channel title to open the channel menu. Select **Units** from the channel menu, and select **Advanced** from the **Units** submenu.

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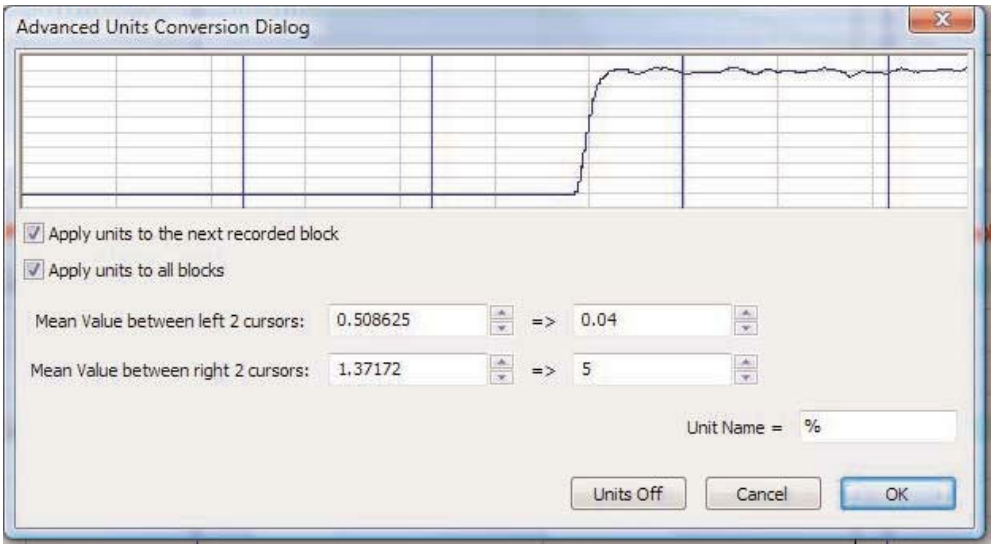
2) On the **Units Conversion** dialog, make sure **Apply units to the next recorded block** is selected
3) Put a checkmark in the box next to **Apply units to all blocks**.
4) Move the two left hand vertical cursors to the flat line area where the voltage of room air was recorded.
5) Move the two right hand vertical cursors to the flat area where the voltage of the gas cylinder (from the calibration tube) was recorded, as shown in the example below.



Advanced Units Conversion Dialog

6) Notice that the voltages from the positions of the cursors are automatically entered into the value equations. Enter the two concentrations of carbon dioxide measured from the two samples in the corresponding boxes on the right side of the conversion equations.
   - If using room air, the concentration of CO_2 = 0.04. The second gas concentration will be the one from the gas cylinder.
7) Enter the name of the units, %, in the box below the concentrations.
8) Click **OK** to activate the units conversion.
9) Repeat Steps 1 through 6 on the **Expired O_2 Concentration (%) channel**.
   - If using room air, the concentration of O_2 is 20.9 The second gas concentration will be the one from the gas cylinder.
10) Enter the name of the units, %, in box below the concentrations.
11) Click **OK** to activate the units conversion.
12) Click **Save.**

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Experiments

LabScribe experiments that can be performed using the GA-300 Gas Analyzer include:

- **Experiment HE-10: Aerobic Fitness Testing** (found in the **Human Exercise-GA300** category of the LabScribe **Settings** menu as **AerobicFitness-GA300**)
- **Experiment HE-9: Resting, Active, and Exercising Metabolic Rates** (found in the Human Exercise-GA300 category of the LabScribe Settings menu as **RestActExerMetabolism-GA300**)
- **Experiment HE-5: Resting Metabolic Rate (RMR)** (found in the **Human Exercise-GA300** category of the LabScribe **Settings** menu as **RMR-GA300**)
- **Experiment HE-4: Respiratory Exchange Ratio (RER)** (found in the **Human Exercise-GA300** category of the LabScribe **Settings** menu as **VO2-RER-GA300**)

Technical Data and Specifications

PERFORMANCE SPECIFICATIONS	
Ambient Temperature	5-40°C operation
Atmospheric Pressure	600 mmHg – 912 mmHg
Warm-up Time	15 minutes
Altitude	Two point calibration required
Humidity	10-95%, non-condensing
Range	1-25% O_2; 0-10% CO_2
Resolution	± 0.25% Oxygen ± 0.1% in 0-10% range
Flow with Pump	~250 ml/min
Response Time	15 s@ 250 ml/min flow

OTHER SPECIFICATIONS	
Power:	5 VDC, 2.5 A
Dimensions:	10.5 x 5 x 14 centimeters

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