

Quick Guide for Recording %O₂ and %CO₂ w/BIOPAC

(More detailed instructions attached)

Before continuing with this guide it is assumed that you have attended a peripheral equipment training session or have been shown directly by BIC staff how to operate both the BIOPAC and its pumps

Control Room

- Turn on the BIOPAC power strip, module pumps and booster pump
 - Power strip has neon orange label, modules have blue and brown tape, booster pump has a bright red light
- Check that all the connections to the O₂ and CO₂ modules and tubing are finger-tight and properly connected according to the tape on the tubing
- Open the default BIC Acqknowledge template (BIC Template.acq) on the eyetracking/data collecting PC desktop

Magnet Room

- Place a nasal cannula on your subject as per the instructions on the packaging and continue preparing your subject for your scan, which may or may not include recording other physiological data
- Firmly connect the tubing of the nasal canula to the tubing with the brass connector. It should be dangling on the hook next to the bed with a cap on the end
- Position your subject on the bed. Check to make sure your subject isn't pinching the cannula tube by verifying a good O₂ and CO₂ trace in Acqknowledge. You may have to adjust the nasal canula if the readings aren't accurate, so don't run the bed in just yet

Recording

- Hit the Start button (top left) to begin the recording in Acqknowledge
- Verify the %O₂ (blue waveform) and %CO₂ (pink waveform) along with any other data you're acquiring is being recorded
- There is a delay of approx. 33 seconds between the subject;s breath and sampling at the BIOPAC. Bear this delay in mind when deciding when to start and stop recording relative to your MRI acquisition
- When done recording hit Stop then File > Save and save as the appropriate file type

Shutting Down

- Turn off BIOPAC power strip, module pumps and booster pump
- Disconnect the nasal cannula from the brass connector and replace the cap
- If keeping the cannula for subsequent use, consider disinfecting or washing it, then storing it inside a plastic bag once it has dried.

How to record %O2 and %CO2 using BIOPAC and Aqknowledge

Utilizing the CO2100C and O2100C add-on modules, users can now record %O2 and %CO2 levels of their subjects while they are inside the magnet. The modules are already connected and ready to go so acquiring this alongside other physiological data at the BIC like pulse and respiration is easily possible.

Turning on BIOPAC and module pumps

Collecting %O2 and %CO2 requires the use of several pumps. By default they are left in the “OFF” position. Make sure to turn on the power strip (**Figure 1**) to power up the BIOPAC and modules. You must ALSO turn on the individual module pumps (**Figure 2**) and the additional booster pump (**Figure 3**). The O2 module takes a minute to warm up while the CO2 module can take approx. 15 minutes. Readings can be erratic if you don't wait, so plan ahead and turn the system on at the start of your session. The Gain settings should be set to 10%/V for CO2 and 20%/V for O2.

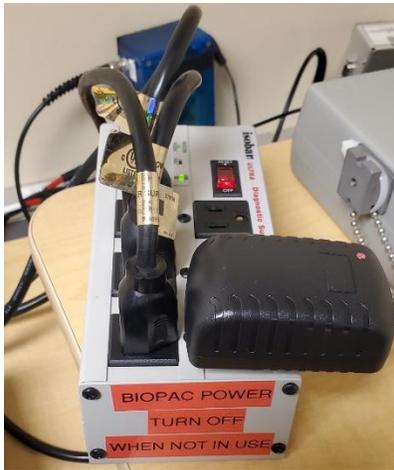


Figure 1 – BIOPAC Power Strip



Figure 2 – CO2 and O2 BIOPAC Module w/Pumps



Figure 3 – Booster Pump

No adjustments need to be made on the various BIOPAC switches. Figure 2 shows the default values for gain and pump speed and the filters attached. Verify these settings have not been changed before you start recording. Turn on the eye tracking/physio recording PC which is located behind the Siemens 3T control console.

Using the default BIC AcqKnowledge template

When collecting %O2 and %CO2 recordings, the main issue to be aware of with the Acqknowledge software is verifying that the modules are setup and recognized correctly.



Figure 4 – Volts means improperly setup modules. Want to see %O2 and %CO2

Thankfully the BIC default template (BIC Template.acq) located on the desktop of the Eyetracking PC has been adjusted and setup correctly already. Open the read-only file, save it as a .GTL (template file) under a different name, and stick it in your lab folder. The template includes all the modules currently available at the BIC. This can look rather cluttered on screen, but if you aren't collecting data from one module (say GSR) or don't need to constantly monitor one (TTL pulses) then simply hold down the Alt key and click on the corresponding channel on the top of the screen to toggle the display off. See Figure 5 below.



Figure 5 - List of channels for all available modules. Alt + left click to toggle off view

Assuming you're using a template setup like the one described above then the software is all set. If you would like more information on setting up your own .GTL file from scratch please contact me.

Connecting nasal cannula

Unlike our pulse ox or respirator belt, each subject must use their own nasal cannula. The BIC has some available or you could use your own if you'd prefer. There is a piece of plastic tubing hanging on the hook at the face of the magnet. Figure 6 shows the brass connector. Remove the cap (keep it close! You'll have to replace it when you're done) then push and twist the cannula connector at the same time to secure a tight fit. Attach the cannula to your subject following the instructions that came with it.



Figure 6 – Brass connector for nasal cannula

At this point it's best to head back into the control room and hit the "START" button on Acqknowledge to verify all signals are coming in. If you have connected up the pulse oximeter and respirator belt (and toggled off all other non-used channels) then the screen should look similar to the one below.

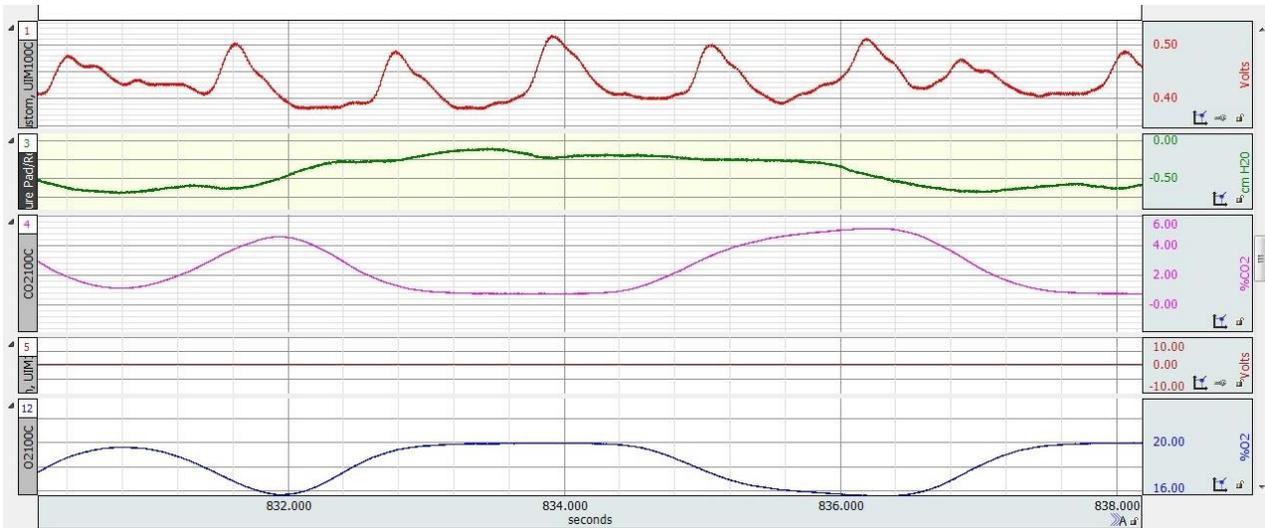


Figure 7- Acqknowledge with pulse, respiration, %CO2, and %O2. TTL channel shown but not being collected

Verify the signals are coming through BEFORE and AFTER moving your subject to isocenter, as some tubing and cables might shift or get pinched. Clear the channels, or open up a new graph template, and you're all set to start recording during your session. Save either as separate files after each scan or as one larger file for the whole session, whichever one works for you. The files can be saved in a variety of file types including .acq, .cvs, and .xls, though .xls will often return a file size error.

Clean up

When your session is over make sure to remove the nasal cannula, replace the cap on the tubing, and secure it on the hook on the front of the magnet. Shut down Acqknowledge (after saving!) and then flip the switch on the power strip to shut off the BIOPAC unit and pumps. If you are keeping the cannula for subsequent use, consider disinfecting or washing it, then placing inside of a plastic bag once it has fully dried.

Supplemental Information

I've included some supplemental information for those that are curious regarding some of the specifics of our setup.

- For a fixed pump speed, the total delay depends primarily on the length of tubing between the BIOPAC and the cannula. Preliminary tests show that this delay is around 33 seconds for the default BIC setup
- BIOPAC's manufacturer suggests the O2100C and CO2100C modules be calibrated before every session. Reading through their documentation, this seems to be due to barometric pressure and water vapor pressure (humidity). The former will affect the absolute level of gas flow, while the latter will affect the absorption of CO₂- and O₂-specific wavelengths. The sensors use an optical filter so presumably there could be overlap between the absorption spectrum of water, CO₂ and O₂ in some way. BIC staff will calibrate every week and monitor the measurements (occasionally asking the BIC community for input) to see just how much barometric pressure and humidity cause them to change or fluctuate. California weather patterns tend to shift slowly, so we may

not see anything substantial unless we get a rapid change in weather. If you are using the peak O₂ and CO₂ numbers to define end-tidal values then the calibration is probably not critical.

- Other than the nasal cannula, none of the tubing should be disconnected from the BIOPAC setup. IF anything gets detached, the tubing has been color coded to show the order in which they plug in to each other. (brown to brown, yellow to yellow, etc.)
- 5 micron filters are placed in-line on the face of each of the modules. BIC staff will be replacing these weekly.
- When collecting %O₂ and %CO₂ recordings, the main issue to be aware of with the Acqknowledge software is verifying that the modules are setup and recognized as modules rather than simply channels. This may seem like a minor detail, but improper setup results in the values for these readings being reported in volts rather than actual percentage of O₂ and CO₂. It's easy to see whether you are using the wrong setup by looking at the right side of the screen. If you see "Volts" rather than "%O₂" and "%CO₂" then you are using the wrong setup. The default BIC template is set up correctly, so always use a copy of that and it should work fine.
- Data sheets, including calibration procedures and technical specifications, for each module are available for those interested. Email me for more information