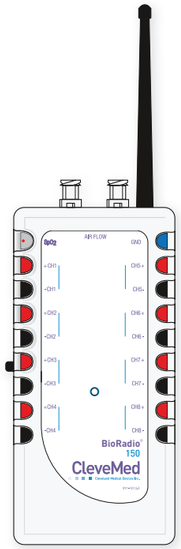
GREAT LAKES NEUROTECHNOLOGIES

Quick Notes

BioCapture™ : Acquiring Respiratory Effort data

Respiratory effort, or plethysmography, is the measurement of rhythmic fluctuation of the chest and/or abdomen. There are only a few primary methods of measuring these changes. This Quick Note will demonstrate a basic respiratory effort recording using respiratory inductance plethysmography (RIP) belts.

What you will need

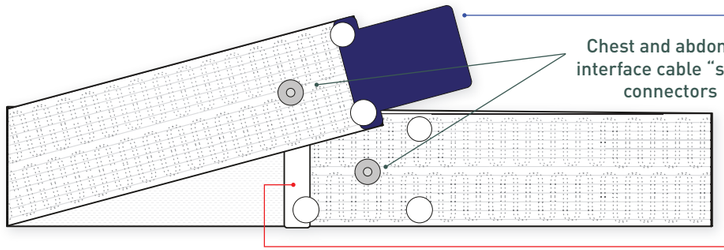


2.4 GHz BioRadio 150 User Unit

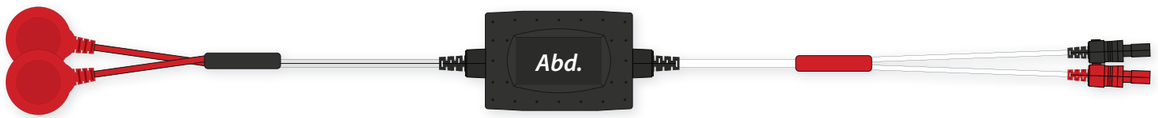
2.4 GHz USB Receiver

Need to order supplies?
Contact your local Sales Representative, call 1-855-GLNeuro (855-456-3876) or e-mail sales@glneurotech.com.

RIP Belt Warranty*
RIP belts are guaranteed to be free from defects for **60 days** from purchase date. Interface cables are guaranteed for **one year** from purchase date.



RIP belt P/N 501-0192 (pkg of 2, part number and colors will vary by size)



Interface cable
P/N 501-0194 (Abdominal)
P/N 501-0195 (Chest)

Set up

While putting on the belt(s), it is important to insure that the correct interface cable is connected to the correct belt. Abdominal measurements require an abdominal interface cable and chest or thoracic measurements require a chest interface cable. **Using two interface cables of the same kind will interfere with one another.**

**Great Lakes NeuroTechnologies will replace any nonworking belt or interface cable under warranty. Call 1-855-GLNeuro (855-456-3876) or e-mail support@glneurotech.com with any performance issues.*

RIP belts come in a variety of sizes, from an adult 2XL to a newborn infant. Please contact your local Sales Representative to inquire about sizes.

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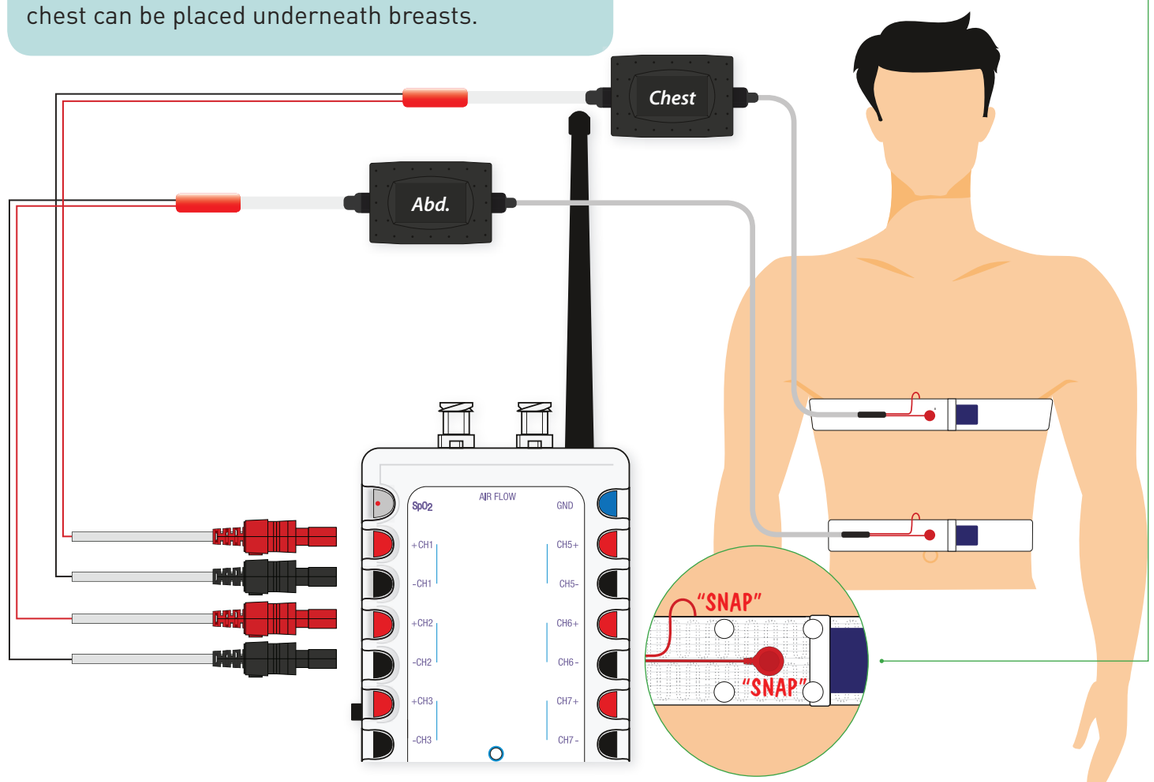
With you or a participant sitting, or preferably standing, and relaxed, connect the RIP belt(s) and interface cable(s) in the manner below:

- Put on the chest belt above the chest or nipple line. Secure the belt in place with the white square end of the belt. Cover the square end of the belt with the rounded colored Velcro'd end. Both interface cable snap connectors, near each end, should face outward.
- Place the abdominal belt above the belly button and secure in the same manner as the chest belt.
- Connect the abdominal and/or chest interface cables to the RIP belt(s) by fastening the button snap electrodes of the interface cable to the interface cable's silver snap connectors.

2-Channel Respiratory Effort hook up

RIP belts can be worn over clothing, and should fit snugly (but not too tight) around the chest and abdomen. For women, RIP belts positioned on the chest can be placed underneath breasts.



Connecting interface cables to BioRadio 150 User Unit

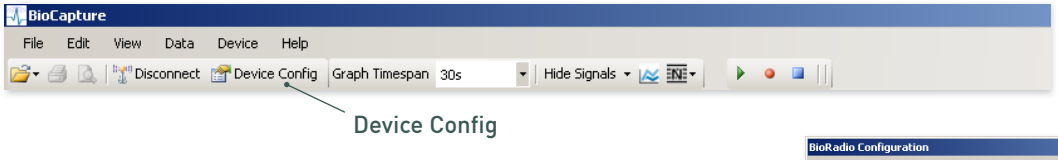
Connect the interface electrode cables to the BioRadio 150 User Unit in the following manner:

- Chest red input → + CH1
- Chest blk input → - CH1
- Abdom red input → + CH2
- Abdom blk input → - CH2

To reduce signal noise, twist or bundle together any dangling cables, or tape any dangling cables to the skin with medical tape.

Configuring your BioCapture system

With your BioRadio 150 User Unit powered on and your USB Receiver connected and ready for use, launch the BioCapture software and click Device Config, from the tool bar to configure your BioCapture system.



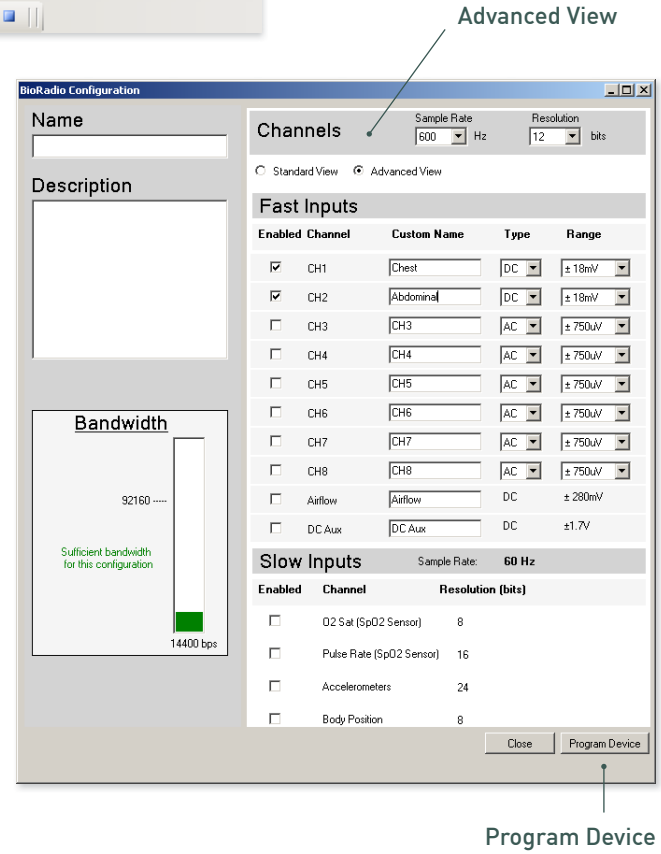
From the Standard View, enable Channel 1 (CH1) and Channel 2 (CH2), type in Chest and Abdominal, respectively.

Click on Advance View. Under Type select DC and set Range to ± 18 mV.

Sample Rate and Resolution can remain unchanged.

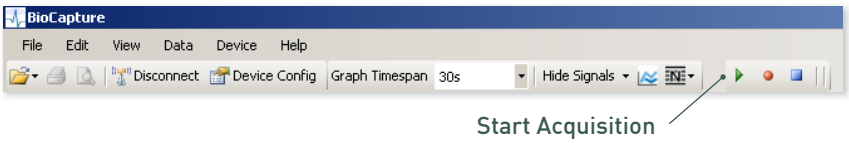
i For further reading on Sampling Rate, Resolution, Type and Range please refer to the BioCapture User's Guide.

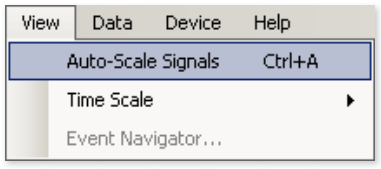
Click Program Device to program your BioCapture system.



Acquiring Respiratory Effort data

Your BioCapture system should now be ready to collect two channels of respiratory effort. With you or a participant relaxed and breathing normally, press Start Acquisition from the tool bar to begin acquiring data. Two small data traces will appear.

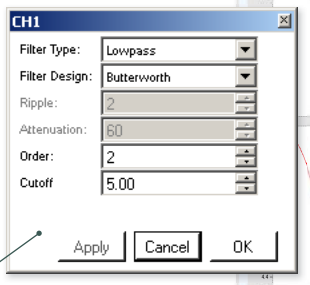


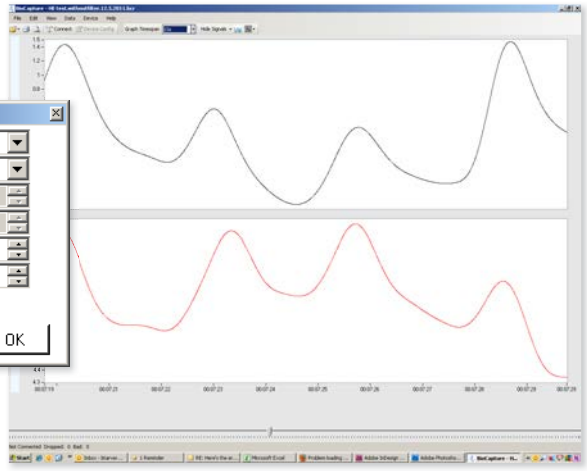


▲ Auto-Scale Signals

You may need to access the Y-Axis Set Max/Min option for a more interpretable RIP signal display. The hardware configuration, as shown on the previous page, sets a display range of ± 18 mV (millivolts). You can also auto-scale all signals by pressing Ctrl + A or by selecting View > Auto-Scale Signals.

For a smooth signal display, Great Lakes NeuroTechnologies suggests adding a Lowpass Butterworth 2nd order filter, with a 5.00 Hz cutoff.





▲ RIP belt signal display of the chest and abdomen, with Auto-Scale on and custom low pass filters—Butterworth, 2nd order, 5 Hz cutoff

HOW DOES IT WORK??

RIP belts: An introduction to electricity and magnetism

RIP belts rely on the principle of electricity and magnetism: an electrical current passing through a loop or coil of wire generates a magnetic field. The ability to store power within a magnetic field is called inductance, hence the term respiratory inductance plethysmography or RIP for short. As can be seen on the RIP belt, the zigzagging coiled wires sewn into a RIP belt function as electric silos or inductors. The interface cable sends current through the RIP belt, creating a magnetic field. During every breath changes to the cross-sectional area of the patient's body changes the power—or presence—of the belt's magnetic field. Therefore, RIP belts indirectly measure the changes in the magnetic field over time. The power within a magnetic

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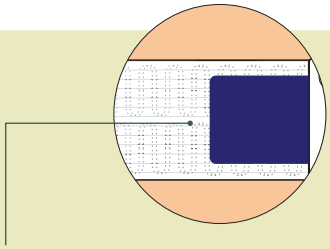
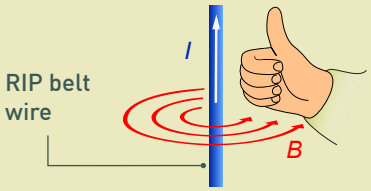


Coils or inductors that produce a magnetic field from a electrical current; the same coils induce an opposing electrical current from a changing magnetic field as the belt expands and contracts



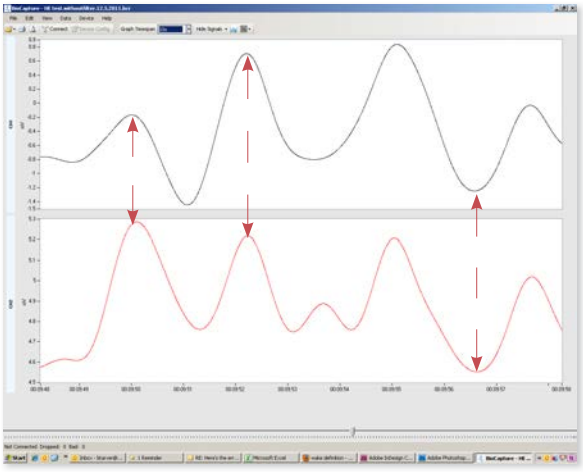
▲ In physics, the "right hand rule" describes a current traveling through wire I (think of the wires of the RIP belt) in a magnetic field B. This rule is the basis of the complex relationship between electricity and magnetism and explains how RIP belts essentially work.

Continued from previous page
field is induced or released by the same belt coils, creating an electrical current in the opposite direction. This opposing electrical current is measured as voltage by BioCapture.

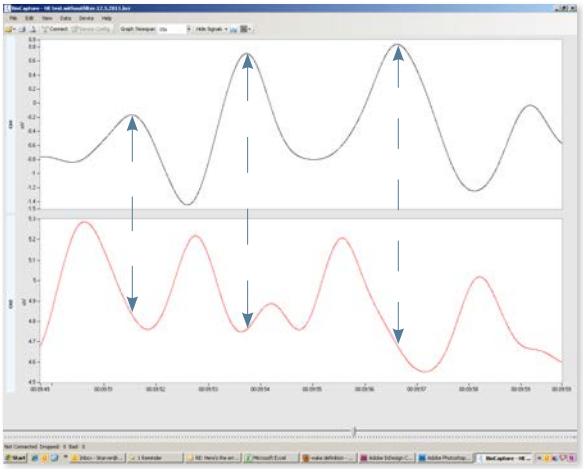
Respiratory effort signal data and paradoxical movement

Normally during inhalation and exhalation, the chest wall and diaphragm are in phase and displace—expand and contract—at the same time. The chest and abdomen respiratory signal display is said to be in paradox when the two signal displays are out of phase and no longer synchronized. The chest and abdominal respiratory effort signals are typically analyzed to determine how close to paradox the chest and abdomen are.

RIP signal data must be exported from BioCapture for further analysis to determine paradox. Afterwards, software analysis programs can add the two signal display data sets together to determine paradox. The sum of both chest and abdominal respiratory effort signal display data is particularly useful as a screen for paradoxical breathing, which can be seen during normal sleep and is most prevalent in serious, life-threatening chest injuries.



▲ Normal respiration while awake; chest and abdominal respiratory effort signal displays are in phase



▲ Respiration with both chest and abdominal respiratory effort signal displays out of phase and close to paradox

Most dreaming occurs during the fifth stage of sleep, known as rapid eye movement (REM) sleep. REM sleep is characterized by eye movement, increased respiration rate and increased brain activity. REM sleep is also referred to as paradoxical sleep because while the brain and other body systems become more active, muscles become more relaxed and some even are paralyzed. In this stage of sleep it is common for respiratory effort signal data for most individuals to become close to paradox.

Ready. Set. Go!

You are now familiar with an essential respiratory effort recording. For further reading on respiratory effort, please refer to the BioCapture User's Guide and/or the following references:

- Guyton and Hall. Textbook of Medical Physiology, 9 Edition, Saunders, Philadelphia, 1996.
- Rhoades, R. and Pflanzer, R. Human Physiology, Third Edition. Saunders College Publishing, Fort Worth, 1996.
- www.library.thinkquest.org/25553/English/basics/brain/index.shtml.

HAVE QUESTIONS? NEED TECHNICAL SUPPORT? WE'RE HERE TO HELP.

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9:00 a.m. - 5:00 p.m. EST, Monday – Friday
E-mail: support@GLNeuroTech.com
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 Acknowledgments: This work utilizes technologies supported by Small Business Innovation Research grants from the National Institutes of Health (NINDS, NHLBI, NIMH) and the Department of Defense.

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