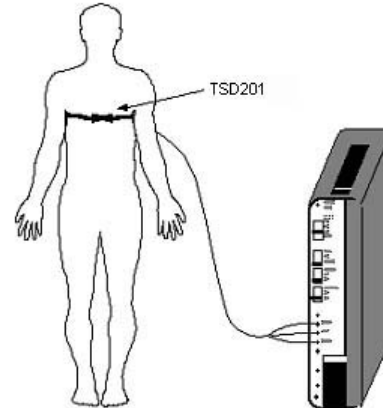


RSP100C – RESPIRATION PNEUMOGRAM AMPLIFIER MODULE

The RSP100C respiration pneumogram amplifier module is a single channel, differential amplifier designed specifically for recording respiration effort. The RSP100C is designed for use in the following applications:

- Allergic responses analysis
- Exercise physiology studies
- Psychophysiological investigations
- Respiration rate determination
- Sleep studies



The RSP100C works with the TSD201 respiration transducer to measure abdominal or thoracic expansion and contraction.

The RSP100C includes a lower frequency response selection switch that permits either absolute (DC) or relative (via a 0.05 high pass filter) respiratory effort measurements.

The following illustration shows the placement and connections for recording thoracic respiration effort using the RSP100C and the TSD201 respiration transducer.

RSP100C AMPLIFIER MODULE SETTINGS

The RSP100C has three built-in filters and a number of different gain settings for the different uses of the transducer.

Type of Use	Gain Setting	Low Pass Filter	.5 Hz Filter	.05 Hz Filter
General	10	10 Hz	DC	DC
Exercise Physiology	10	1 Hz	.5 Hz	.05 Hz
Small Animal	20+	10 Hz	.5 Hz	.05 Hz

General

For most measurements with little or no subject movement. The most common setting is with all three filters at their bottom settings (10 Hz, DC, and DC) and the gain set at 10. This allows any signals slower than 10 Hz (cyclic rate) to pass, and is usually good for most measurements with little or no subject movement.

Exercise physiology

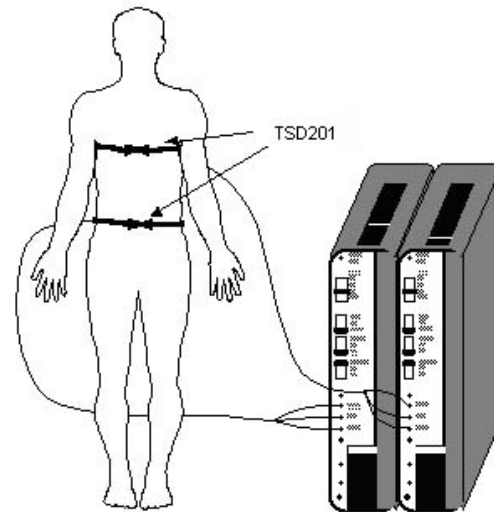
The transducer produces the best signal at the lowest gain and with all three filter settings at their top position (1 Hz, .5 Hz, and .05 Hz). This setting will allow only a signal between .5 Hz and 1 Hz to be transmitted, filtering out most of the signal interference due to extraneous chest and abdominal movement resulting from limb motion.

Smaller animals

For measurements with very small changes in thoracic circumference, increase the gain to magnify the signal. Increase the gain until a clear signal is obtained, but not so much that the signal is clipped.

PLACEMENT AND CONNECTIONS

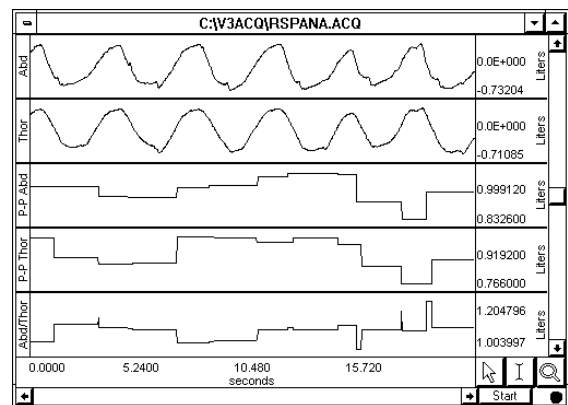
This illustration shows the placement and connections to record thoracic and abdominal respiration effort using two RSP100C amplifier modules and two TSD201 respiration transducers.



Connections for Thoracic and Abdominal Respiratory Effort Measurement

This graph shows the relationship between abdominal and thoracic expansion and contraction.

Calculate the peak-to-peak values for both abdominal and thoracic respiration effort were calculated with *AcqKnowledge*, and then the two peak-to-peak values were compared in the lowest channel. When abdominal breathing effort changes with respect to thoracic breathing effort, the lowest channel will quantify the extent of the change.



Thoracic vs. Abdominal respiration effort data

FREQUENCY RESPONSE CHARACTERISTICS

The 0.05 Hz high pass lower frequency response setting is a single pole roll-off filter. The 0.5 Hz high pass lower frequency response setting is a two pole roll-off filter.

See also: Sample frequency response plots: 1 Hz LP
 10 Hz LP

RSP100C CALIBRATION

None required.

RSP100C SPECIFICATIONS

Gain:	10, 20, 50, 100
Output Range:	±10 V (analog)
Frequency Response	
Low Pass Filter:	1 Hz, 10 Hz
High Pass Filter:	DC, 0.05 Hz, 0.5 Hz
Excitation Voltage	±0.5 V
Noise Voltage:	0.2 µV rms – amplifier contribution
Signal Source:	TSD201
Weight:	350 g
Dimensions:	4 cm (wide) x 11 cm (deep) x 19 cm (high)
Input Connectors:	Three 1.5 mm male Touchproof sockets (VIN+, Ground, VIN-)

AMPLIFIER MODULES

*100C series modules*

The 100C series biopotential/transducer amplifier modules are single channel, differential input, linear amplifiers with adjustable offset and gain. These modules are used to amplify smaller voltage signals coming from raw electrodes and transducers (typically less than ± 0.01 volt). In addition to amplifying signals, most of the 100C series modules include selectable signal conditioning ability so that data may be filtered or transformed as it is being collected.

- **Biopotential modules:** ECG100C, EEG100C, EGG100C, EMG100C, EOG100C, ERS100C
- **Transducer modules:** EDA100C; PPG100C; RSP100C; SKT100C
- **MRI Smart modules**—advanced signal processing circuitry removes spurious MRI artifact from the source physiological data: ECG100C-MRI; EDA100C-MRI; EEG100C-MRI; EMG100C-MRI; PPG100C-MRI.

Modules can be cascaded by snapping the modules together. Up to sixteen 100C series modules can be connected to the MP System at any one time.

IMPORTANT

When cascading modules, it is important to remember that **no two amplifiers may be set to the same channel**. If two connected amplifier modules are left on the same channel, then contention will result and both amplifier outputs will give erroneous readings.

Amplifier offset Set by the zero adjust control trim potentiometer near the top of the module. The offset control can be used to adjust the zero point or “baseline” of a signal.

Gain Switch The four-position slide Gain switch controls sensitivity. Lower gain settings will amplify the signal to a lesser extent than higher gain settings. If the signal plotted on the screen appears to be very small for a given channel, increase the Gain for that particular channel. Conversely, if the signal seems to be “cropped” at +10 Volts or –10 Volts, decrease the Gain.

Connections Transducers and electrodes connect to the amplifiers using 1.5 mm female Touchproof connectors.

- Electrodes** The biopotential amplifier modules use a three-electrode arrangement (VIN+, GND, VIN-). Although certain applications may require different arrangements of electrodes and/or transducers, some generalizations about electrode and transducer connections can be made. Electrodes measure the electrical activity at the surface of the skin, and since electricity flows from - to +, measuring the flow of a signal requires that there be (at least) one “-” electrode and (at least) one “+” electrode. An additional electrode, a “ground” (or earth) electrode is used to control for the general level of electrical activity in the body.
- Leads** Typically, electrode leads are used to connect individual electrodes to the xxx100C amplifier. Most electrode leads are shielded, which means they introduce less noise than an unshielded lead. A shielded electrode lead has an extra jack on one end that plugs into the SHIELD input on the amplifier modules. A standard electrode lead configuration consists of two LEAD110S electrode leads (one connected to the VIN + input and one to the VIN - input on the amplifier) and a single LEAD110 (connected to the GND input on a biopotential amplifier).
- Transducers** Transducers, on the other hand, are not designed to measure electrical activity directly and usually involve simpler connections. The transducers discussed in this manual translate physical changes (in temperature, for instance) into electrical signals. Connections for individual transducers are discussed in each section.
- Channel** The active channel is selected using the channel select switch on the top of the module. The channel select switch can direct the amplifier output to one of sixteen possible MP System input channels. *Remember to make sure that each amplifier module is set to a unique channel.*
- Zero Adjust** On input signals, a limited range in baseline level (DC offset) can be “zeroed out” using the zero adjust potentiometer. Typically, the zero adjust will not have to be used (as it is preset at the factory). However, some of the 100C series modules can measure DC signals and, in certain circumstances, signal “zeroing” may be required.
- Setup** All 100C Series biopotential or transducer amplifiers incorporate specific gain, coupling and filtering options that are appropriate for the biopotential type or transducer signal that requires measurement. Generally, when an electrode or transducer is inserted into the corresponding 100C series module, the amplifier will immediately produce a useful output, with no user adjustments necessary.
- Certain functionality is added to each module to optimize its performance with its intended signal measurement. For example, all 100C series biopotential amplifiers incorporate a selectable interference filter. When the interference filter is on, 50/60 Hz interfering signals are suppressed.
- Filters** All 100C series amplifiers are constructed with filters that have a high degree of phase linearity. This means the 100C series modules will filter signals with as little distortion as possible. These modules also incorporate protection circuitry to limit input current in the event of input signal overload. Notch and bandstop filters have the potential to cause distortion, especially in the form of “ringing” in the data stream; biopotential hardware notch filters are implemented in conjunction with LP or HP functions to minimize distortion.
- Line Freq** Line Frequency is set using the recessed switch boxes on the left panel of the amplifier module (50 Hz = all switches down, 60 Hz = all switches up). It is important to select the correct line frequency for your geographical region. Typically, U.S. line frequency is 60 Hz; Europe and China 50 Hz. Contact BIOPAC for additional line frequency information. All MP biopotential amplifier modules which contain a 50/60 Hz notch filter only engage the filter when the pass filter is also ON:
- ECG100C, EEG100C, EOG100C amplifiers: the 50/60 Hz notch is only engaged when the 35 Hz LPN low pass notch filter switch is set to ON.
 - EMG100C, ERS100C amplifiers: the 50/60 Hz notch is only engaged when the 100 Hz HPN high pass notch filter switch is set to ON.

See individual module sections for details.