Evoked Response Amplifier Module

The Evoked Response Amplifier Module (ERS100A) is a single channel, high gain, extremely low noise, differential input, biopotential amplifier designed to accurately amplify the very small potentials (<200 nv) associated with evoked response measurement. The ERS100A is designed for use in the following applications:

- Auditory Brainstem Response Testing
- Visual Evoked Response Testing
- Somatasensory Response Testing
- Nerve Conduction Velocity and Latency Recording

The ERS100A will connect directly to any of BIOPAC's series of Ag-AgCl lead electrodes. Typically the EL204S or EL208S shielded electrodes are recommended for evoked response measurements. Use two shielded electrodes (EL208S) for the signal inputs and one unshielded electrode (EL208) for Ground. Adhesive disks for these electrodes don't work very well for scalp attachment if hair is present. In this case, use electrode gel (GEL100) and tape the electrode lightly into place. Another option is to use a conductive adhesive paste like Ten20® or Collodion HV®.

The ERS100A has built in drive capability for use with shielded electrode leads. Shielded leads are typically required, as the ERS100A has a frequency response which extends through the 50/60Hz interference bands. Furthermore, the ERS100A is used to amplify extremely low level signals which can be easily corrupted by interfering signals.

The ERS100A incorporates selectable gain and bandwidth options to perform a variety of evoked response testing. The ERS100A is typically used with two shielded electrodes for signal input and one unshielded electrode for ground. In nearly all cases of stimulus response testing the ERS100A will be used in conjunction with the STM100A, along with the MP100WS. The STM100A is a general purpose stimulator which can be used to present auditory, visual or mechanical stimulus signals.

For most types of evoked response testing, the MP100 will be operating in Averaging Mode. Typically, the Stimulus Output (usually a pulse) will be provided by I/O 15. The pulse on I/O 15 is output just prior to the data collection pass. I/O 15 provides a pulse output which can be user specified with 1 μs resolution. Similarly, the Latency (time between data collection passes) can be specified with 1 ms resolution. A useful feature of the Averaging mode is Artifact Rejection. If the input signal falls outside of the specified bounds, then that particular data collection pass is rejected and not counted as part of the collective average.

Auditory evoked potentials, like the ABR, can be recorded using the ERS100A. The STM100A is used to present the auditory pulse or "click" to the auditory stimulator, such as the ER-3A TubePhone. To record the ABR, the active (Vin+) electrode is placed at the earlobe or mastoid and the reference (Vin-) electrode is placed at the vertex. The ground electrode is placed at the forehead.

Visual evoked potential (VEP) tests, like the P300, can be implemented using the ERS100A. These tests are very similar to ABR tests, except the stimulation source is the visual equivalent of the auditory "click". Typically, the stimulation source is a reversing checkerboard pattern, displayed on a video monitor. To record the P300, the active electrode is placed on the occipital lobe and the reference electrode on the earlobe or mastoid. The Ground electrode is placed on the forehead.

Somatasensory response tests can be implemented using the ERS100A. These tests are very similar to ABR and VEP tests, except the stimulation source is usually an electrical pulse or mechanical impulse applied at some point along the leg or arm. Somatasensory tests are used to characterize the perception of touch. Active electrodes are usually placed on an earlobe, and passive electrodes are placed on the contralateral earlobe. The ground electrode is placed on the forehead.

General nerve conduction velocity tests can also be performed using the ERS100A. Typically these tests don't require the extensive averaging required for auditory or visual evoked response measurements, so the ultra low noise characteristics of the ERS100A are not critical for best results. However, the ERS100A will work exceptionally well for these applications.

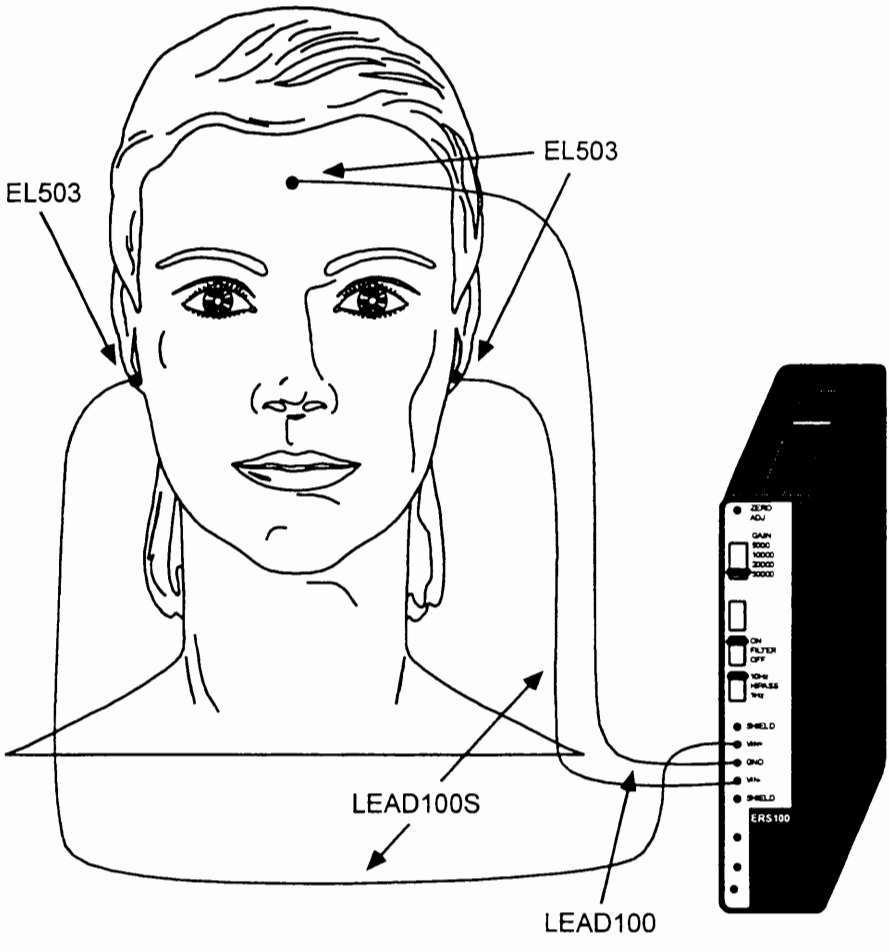
ERS100A specifications

Input Impedance	
Differential	2MW
Common Mode	1000MW
Maximum Input Voltage	±10V
Frequency Response	
Filter Off and 1 Hz Hipass	1.0 to 3000Hz
Filter Off and 10 Hz Hipass	10 to 3000Hz
Filter On	100 to 3000Hz
CMRR	100dB minimum
Noise Voltage	
Filter Off	0.58 µV (rms)
Filter On	0.48 µV (rms)

Gain Settings

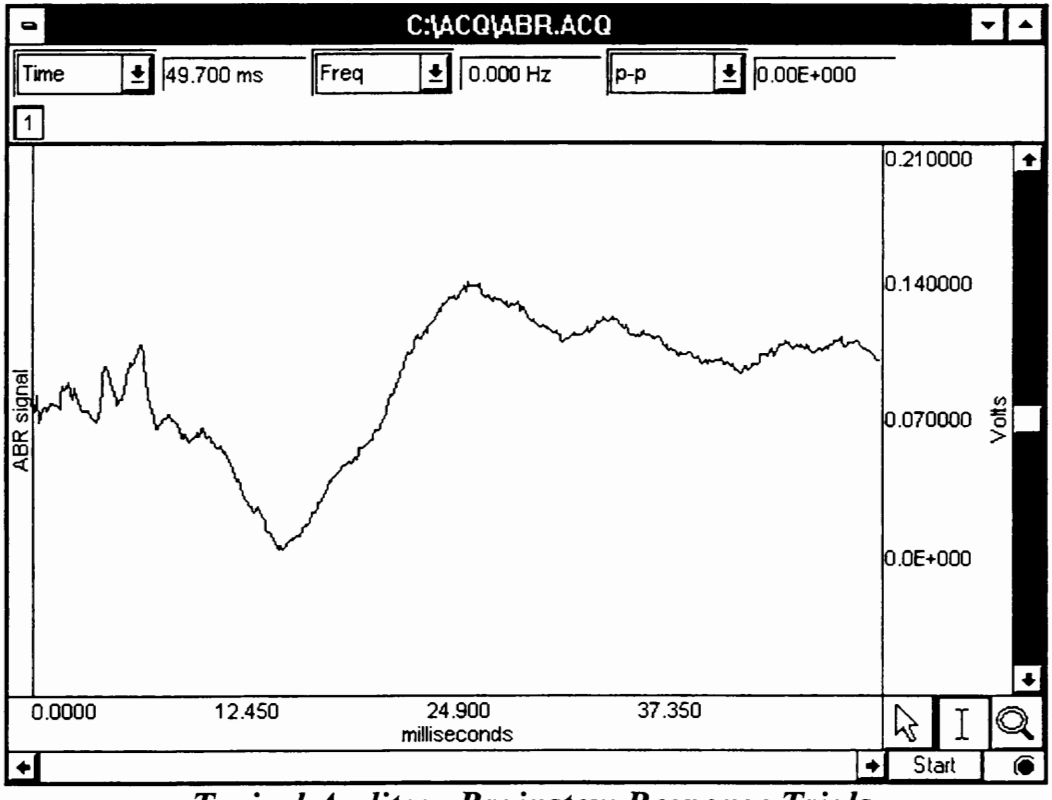
Input Signal Range (pk-pk)	**Gain**
4.0 mV	x5000
2.0 mV	x10000
1.0 mV	x20000
0.4 mV	x50000

The following illustration shows the electrode connections to an ERS100A module for Auditory Brainstem Response (ABR) recording. The acoustical signal is presented to the active ear using a calibrated auditory earphone like the TubePhone-ER3A (OUT101).



ABR Electrode Placement Example

The following graph illustrates a 2000 trial ABR test performed using the ERS100A with the STM100A and OUT101 (TubePhone-ER3A). The MP100WS collected the data in the Averaging mode.



Typical Auditory Brainstem Response Trials