

What is Electrocochleography?

Electrocochleography, ECoChG, is a method to acquire auditory evoked potential responses from cochlear and auditory nerves by providing sound stimulation to the patient's ear. The averaged activity of the potentials on the auditory nerve is known as the action potential (AP, or ABR wave I). The response of the cochlea to the stimulation is known as the summing potential (SP).

The amplitudes, latencies and relationship of AP and SP can be used to diagnose certain pathological conditions. Due to the intensity of these evoked potentials, standard surface electrodes are not suitable for this application; Tip-Trodes, Tympanic Membrane, or Trans-tympanic electrodes must be used for acquisition.

Why acquire ECoChG?

Electrocochleography may be used to diagnose some vestibular and auditory conditions:

- Meniere's disease is a potentially disabling condition that may cause episodes of hearing loss, fluctuating tinnitus, vertigo and aural fullness.
- Perilymphatic fistula is an abnormal communication between the fluid filled inner ear and the air filled middle ear resulting in hearing loss and/or vestibular symptoms.
- The procedure will help identify wave I of the ABR in patients with profound hearing loss. This wave may not be detected on standard ABR testing in patients with such condition.

Other conditions may also be detectable using ECoChG diagnostic testing.

Patient Preparation

The patient must be placed in a comfortable and quiet environment, preferably a sound booth where the patient lies down on a comfortable bed. It is recommended to inform the patient about what sensation to expect when the electrode is placed inside the ear canal.

Electrode Placement

Electrodes may be connected using the following configurations as shown below. Inverting electrodes may be placed at the mastoid or ear lobe. See SmartEP manual for additional placement options.

- **Inverting (-) & Stimulus:** ear canal ipsilateral to the test ear.
- **Non-Inverting (+):** contralateral mastoid.
- **Ground:** forehead.

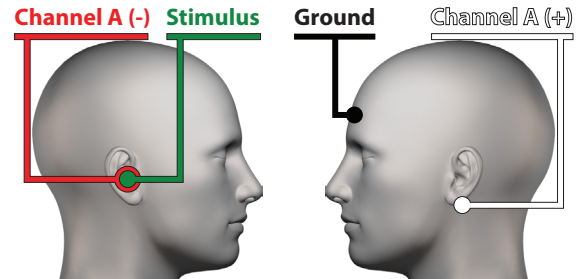


Fig.1 - Horizontal array (right ear) for Duet

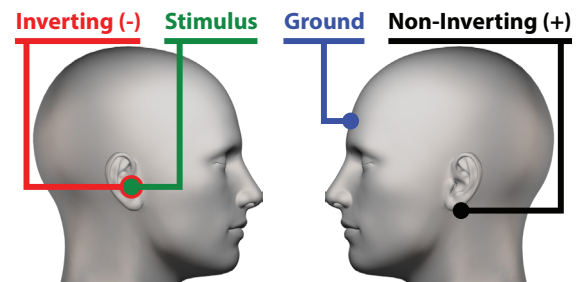


Fig.2 - Horizontal array (right ear) for USB

When recording from both ears the contra Tip-Trode, in the opposite ear canal, may be used as the non-inverting electrode.

Note that the setups in Fig.1 and Fig. 2 will result in a positive SP-AP. To obtain a negative SP-AP, Reverse the (+) and (-) electrodes, or invert the waveform post-acquisition using the Invert option in the Process menu.

Electrode Usage

Surface electrodes are not suitable for this type of acquisition, You may use:

- Tip-Trodes covered with conductive paste placed in the ear canal. These require a special cable that joins the stimulator sound tube and the electrode.
- Tympanic Membrane Wick electrodes. These need to be held in place using the stimulator foam ear-tip.
- Trans-tympanic electrodes. These will also be held in place by the stimulator foam ear-tip.

When analyzing, keep in mind that different electrodes will yield different amplitudes and ratios. Consult the SmartEP manual and the Technical Reference manual for detailed instructions on electrode placement. Use extreme caution when inserting anything into the ear canal, this procedure must only be performed by a qualified medical professional.

Setting up SmartEP

Complete the following steps in the order outlined, use the test settings that fit your testing requirements or use the recommended settings shown on the next section:

1. Under **[PROTOCOL > MODALITY]** in the main menu, make sure **[AUDITORY > ECOCHG]** is selected.
2. Set the stimulus, click on **[STIM]** from the control panel and set the stimulus type, duration, frequency, window, masking and transducer, as necessary.
3. Click on the **[AMPLIFIER]** button on the side panel and set the filters, notch filter, artifact rejection ratio and region and desired amplification.
4. On the control panel, set rate, polarity, intensity and the number of sweeps.
5. Press the **[ACQUIRE]** button to start recording ECoChG responses

SmartEP allows automation of the acquisition process; consult your user's manual to learn how to create your own testing protocol or how to save your settings for future use.

Recommended Test Settings

This table shows the settings that have been proven to work well for ECoChG acquisition. Acquire three or four recordings with the exact same settings for more accurate diagnosis.

- **Stimulus:** 0.1 milliseconds Click.
- **Rate:** 7.1 per second, or 99.9 per second. Use slow rates to enhance the AP component and fast rates to differentiate the SP (still robust) from the AP (now deteriorated).
- **Polarity:** alternating.
- **Transducers:** insert earphones.
- **Intensity:** 90 to 95 dB HL.
- **Filters:** 10 – 1500 Hz, or 1 - 1500 Hz.
- **Notch Filter:** OFF. ON, only if there is excessive electrical line noise present.
- **Amplification:** 75x or 100x
- **Analysis Time Window:** 5 milliseconds.
- **Sweeps:** 1024
- **Electrode Montage:** horizontal array (see figure in previous page)

Obtaining the amplitude ratio

On an ECoChG, the labels that need to be placed are: the action potential (AP), the summing potential (SP) and the Base. to get the SP-AP amplitude ratio:

1. Right click at the point of the recording where the label should be placed.
2. From the context menu, click on the appropriate ECoChG label (Base, SP or AP) from the "Mark Peak" options.
3. Once placed, drag the top marker of the labels to their appropriate place, if needed.
4. Drag the bottom markers for the SP and AP labels to the location of the Base.

Label placement buttons can also be found on the tool bar, just above the waveform display area; click the button, then click the desired location on the selected waveform; drag the markers into place as needed. The SP-AP ratio will be calculated automatically once all markers are in place, it can be found in the data table or the recording info panel.

Obtaining the area ratio

To obtain the area ratio, a couple of additional steps are necessary during peak marking:

1. Right click on the waveform at the location where the Base should be.
2. From the menu, choose **[MARK OTHER PEAK]**. In the new window, make sure the **[AREA]** box, found to the right of the ECoChG markers, is active.
3. Click on the **[BASE]** button to place the marker.
4. Drag the bottom marker of the Base to the valley after AP, as seen in Fig.3. Position it so that the base has an amplitude of 0 uV.
5. Place the markers for SP and AP using the right click menu, or the buttons on the tool bar.
6. Drag the bottom (amplitude) markers of the SP and AP labels to the same location as the Base amplitude marker.

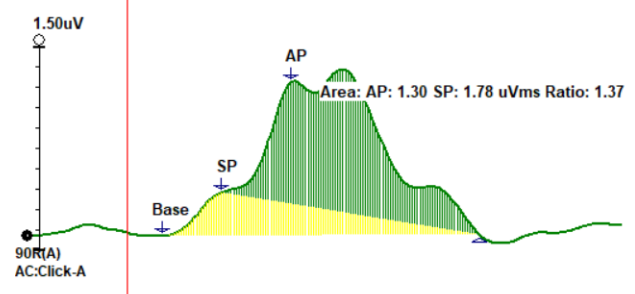


Fig.3 - ECoChG recording and suggested labeling