

Welcome to the new PATH MEDICAL NEWSLETTER. This publication is intended to highlight features of our products, tips on best practices, and how-to's. We hope that you find the information valuable and would love to have your feedback and suggestions for topics. Please write to us at [academy@pathme.de](mailto:academy@pathme.de).

## **Electrocochleography**

### **General Overview**

Evoked potentials are recorded electrical activity of the nervous system in response to stimuli. Evoked potentials are relatively small, thus requiring signal averaging to record them. For the auditory system, they are evoked by different auditory stimuli and can be recorded from the cochlea to the auditory cortex, although typically not all in the same recording. Auditory evoked potentials are used to assist with the estimation of threshold levels, to help with the diagnosis of certain sites of lesions and pathologies, and to assess sound processing, although these potentials for higher-level processing are referred to as event related potentials.

Auditory evoked potentials are typically recorded away from the site of origin and thus are far-field potentials. They can be broken down into short, middle, and long latency potentials. Short latency potentials such as electrocochleography and the auditory brainstem response are some of the smallest potentials and the responses get larger as they progress up the auditory pathway with the late latency responses being the largest. This document will cover electrocochleography (ECochG).


ECochG is the earliest electrical activity in the auditory system and has a very short latency of occurring at approximately 0-5 milliseconds. It is composed of the Cochlear Microphonic (CM), the Summating Potential (SP) and the Action Potential (AP), which corresponds with wave I of ABR. The origin of ECochG is the cochlea and auditory (VIII<sup>th</sup> Cranial) nerve. More specifically, the CM comes from the hair cells and perhaps predominantly from the outer hair cells (OHC) receptor potential that mirrors the stimulus. The CM cannot be seen when using an alternating polarity stimulus. The SP is from the inner and outer hair cells and thus, both the CM and SP are presynaptic responses generated at the level of the cochlear hair

cells. The AP on the other hand is a postsynaptic response from the afferent fibers of the 8th cranial nerve and is the summed response of synchronous firing of auditory nerve fibers. Electrode location will impact the ECoChG amplitude such that the closer the electrode location is to the cochlea the larger the response amplitude. Most ideally to get the largest response amplitude, an electrode, usually a needle electrode, is placed on the cochlear promontory and is referred to as a transtympanic recording. The drawback is that it is the most invasive and the electrode must be placed by a physician/surgeon. The second approach is to have the electrode placed into the ear canal or on the tympanic membrane and referred to as an extratympanic recording. Examples of electrodes used in this approach include Tiptrode, a gold foil coated insert earphone foam, a TM or tymptrode or gold/silver ball electrodes. While this approach is the least invasive the response amplitude is lower than with a transtympanic recording with the lowest response amplitude occurring with the tiptrode electrode. PATH MEDICAL uses tiptrodes with an alligator tip electrode (see Figure 1), although it is possible to use other electrodes.



Figure 1. Electrode set up on the SENTIERO / ADVANCED

## **ECoChG by PATH MEDICAL**

Navigate to the pre-set protocol page select a protocol. Changes can be made to that protocol once it is selected by pressing the tools  icon. This will enable the selection of the stimulus to use, choosing between clicks or tone bursts (Figure 2) and the stimulus presentation level is selected (Fig 3).

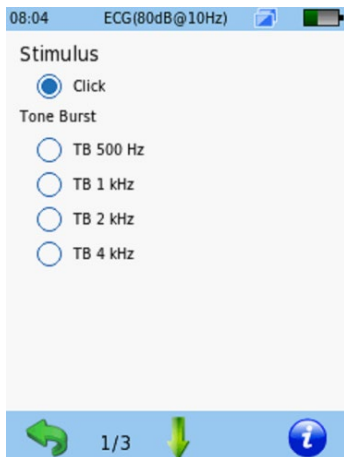


Figure 2. The first screen of protocol options setting on the SENTIERO / ADVANCED

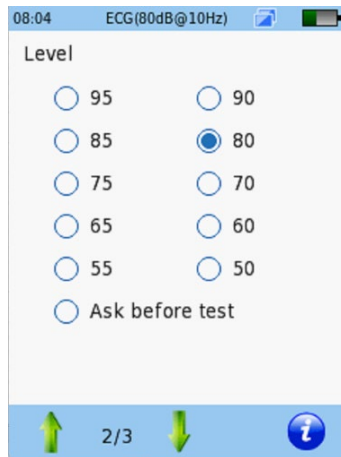


Figure 3. The second screen of protocol options setting on the SENTIERO / ADVANCED

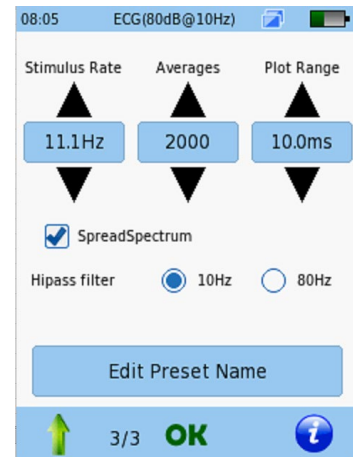


Figure 4. The third screen of protocol options setting on the SENTIERO / ADVANCED

Next, as shown in Figure 4, select the stimulus rate, the number of averages, and the plot range. The stimulus rate goes from 8 to 90.4 Hz. The slower the rate, the better the response and a recommendation is to use 11.1 Hz for this device. The maximum plot range on this device is 12 msec. When using tone burst stimuli the rise-fall time and the plateau need to be set. The plot range, therefore, needs to account for the length of the tone burst. For click stimuli, a plot range of 4-6 msec is sufficient.

The last selection is for activation of SpreadSpectrum. SpreadSpectrum alters the stimulus repetition rate slightly to avoid interference such as from electrical interference from power mains.

Lastly, is the ability to change the button name to easily identify the new protocol that was made. This is done by selecting 'Edit Preset Name' button and type in a new name then press OK.

For the PATH MEDICAL Sentiero Advance Equipment, the recommended electrode montage is to have the recording electrode (white lead) on the high forehead (+/non-inverting) with reference or (-/inverting) electrode (red lead) on test ear and ground electrode (black lead) on the cheek to make it easier to switch between ears as shown in figure 5. An alternative placement for the ground electrode is to place it on the opposite mastoid. With this electrode montage, the waves will point upwards.

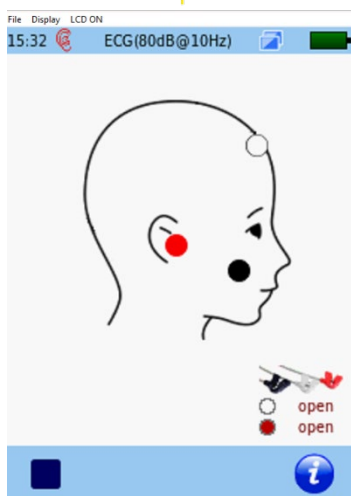


Figure 5. Recommended electrode montage on the SENTIERO / ADVANCED with upward tracings.

To have the waves downward pointing, switch the recording (white electrode) and the reference electrode (red electrode).

Alternative electrode placement can be found in the literature (e.g., McFarlane & Sanchez, 2023) include placing the ground electrode on low forehead/nasion with recording electrode (+/non-inverting/white electrode) on test ear and reference electrode (red electrode) on the opposite ear. This electrode montage will show the waveform pointing upwards. Using this same setup but having the waveform downward pointing, simply reverse the reference electrode (red electrode) on tested ear and recording electrode (white electrode) on opposite ear.

On the Sentiero Advanced, the results are displayed showing both rarefaction and condensation results, the addition of rarefaction and condensation results and the subtraction of rarefaction and condensation. Displaying the results like this allows for the visibility of both the CM and the SP in the different views.

## References

McFarlane KA, Sanchez JT. Exploring Electrode Placements to Optimize the Identification and Measurement of Early Auditory Evoked Potentials. *Audiol Res.* 2023 Dec 11;13(6):978-988. doi: 10.3390/audiolres13060085. PMID: 38131810; PMCID: PMC10740558.