

Notched Noise Masking using SmartEP

What is Notched Noise Masking?

Notched noise masking is an ipsilateral masking noise with special characteristics. The notched noise procedure will stimulate the ear with a tone or click stimulus combined with this masking noise.

The notched noise's defining characteristic is a gap in the frequency spectrum, usually corresponding to the same frequency as the stimulus. The Intelligent Hearing System software provides masking for stimulation at 0.5, 0.75, 1, 2, 4 and 8 kHz with a 3 dB cutoff at .75 and 1.5 times the aforementioned frequencies ($Q = 1.33$). To perform this procedure, the system requires special hardware installed, only available on the Universal Smart Box.

Why Use Notched Noise Masking?

By performing a notched noise procedure, we obtain specific information about frequency regions of the cochlea and corresponding acoustic nerve function. This way, we can isolate frequency regions in the cochlea and determine acoustic nerve function without the need of additional calculations and filtering which may affect the signal. More recently, this technique has also been used to screen for Meniere's disease, where the latencies of the major peaks do not shift as they would on a normal subject.

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. The patient must be instructed to relax during testing. It is recommended that the patient avoid stimulants, such as caffeine, before testing.

Electrode Placement

Electrodes may be connected using the following configurations. Inverting electrodes may be placed at the mastoid or ear lobe.

- **Right Inverting (-):** right ear (M2) or (A2).
- **Left Inverting (-):** left ear (M1) or (A1).
- **Non-Inverting (+):** joined channels to high forehead (Fpz) or vertex (Cz).
- **Ground:** low forehead.

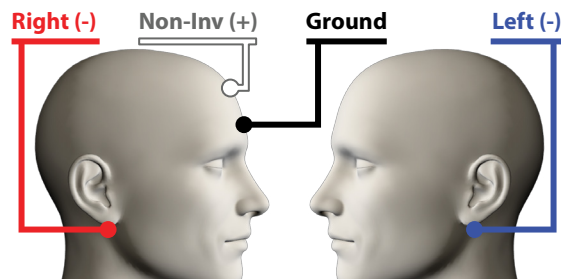


Fig.1 - Dual channel setup for Duet.

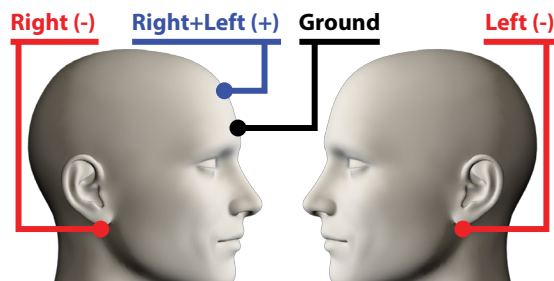


Fig.2 - Dual channel setup for USB

Keep in mind that using different electrode locations will yield recordings with slightly different wave morphology. Consult the SmartEP manual for additional electrode placement details.

Electrode Usage

Surface electrodes are sufficient for acquiring Notched Noise Masking recordings. Clean and prepare electrode sites in order to reduce the impedance and acquire a clearer recording.

Setting up SmartEP

This procedure describes the complete notch noise masking testing procedure using the settings specified in the next section:

1. Complete a normal click ABR at 80 dB HL and label all three peaks.
2. Click on the **[Stim]** button from the control panel and select a pure tone. Enter "5000" for the duration and set the frequency to be tested. Make sure the correct stimulator is selected. Make sure Exact Blackman is the selected envelope.
3. Under the masking options set masking to ipsilateral, and then select the masking level (see next section) and the notch frequency to match your test frequency.
4. Acquire one or two waveforms per frequency, label peak V (right clicking on

the peak position with the recording selected and choosing mark peak V from the popup menu) and drag the bottom markers into position.

5. Select your best-marked recordings for each frequency and send them to an available display page. Then switch the view to that page.
6. Under the **[PROCESS]** menu, set the addition mode to uV weighted, then on that same menu select **[ADD > ALL ON PAGE (PEAK V ALIGNED)]**
7. Repeat the same procedure for the other ear for comparison.

It is extremely important to set the masking values properly, according to the hearing loss configuration. You must create your own norms for your population maintaining the same masking levels for all patients in order to obtain usable recordings. Never over-mask, doing so will result in inaccurate waveforms.

Make sure to select carefully your filter settings in the EEG and Amplifier dialog box. An unfiltered recording can always be filtered digitally to obtain a smoother waveform; however, hardware filtering cannot be undone.

Recommended Test Settings

This table shows the recommended settings for Notched Noise Masking acquisition:

- **Stimulus:** 5 millisecond Exact Blackman tones, or Clicks.
- **Rate:** 21.1/sec.
- **Polarity:** Condensation for 500 Hz tones, Alternating for all others.
- **Transducers:** insert earphones.
- **Intensity:** 80 dB HL.
- **Filters:** 30 – 1500 Hz.
- **Notch Filter:** OFF. ON if there is excessive electrical line noise present.
- **Amplification:** 100x.
- **Analysis Time Window:** 0 to 25 milliseconds for 1, 2, 4 and 8 kHz; 0 to 50 milliseconds for 500, and 750 Hz.
- **Sweeps:** 1024 - 2048.
- **Electrode Montage:** ipsilateral or contralateral array.
- **Masking:** Ipsilateral notched at frequency being tested, if using tone stimuli then masking notch must match.

Suggested Masking Level:

IHS has found that a level of 50 dB SPL is sufficient for masking on normal hearing subjects, across all frequencies. Other values may work better for different hearing profiles.

Analysis

Since label placement is subjective, all results must be evaluated by an audiologist or medical professional trained in notched noise masking techniques. Due to the high variability of the results for this type of recording across populations, norms should be created individually for your region or institution, always using the same masking level across subjects. The following shows a normal pure tone ABR and a Notched Noise Peak V aligned added recording for reference purposes.

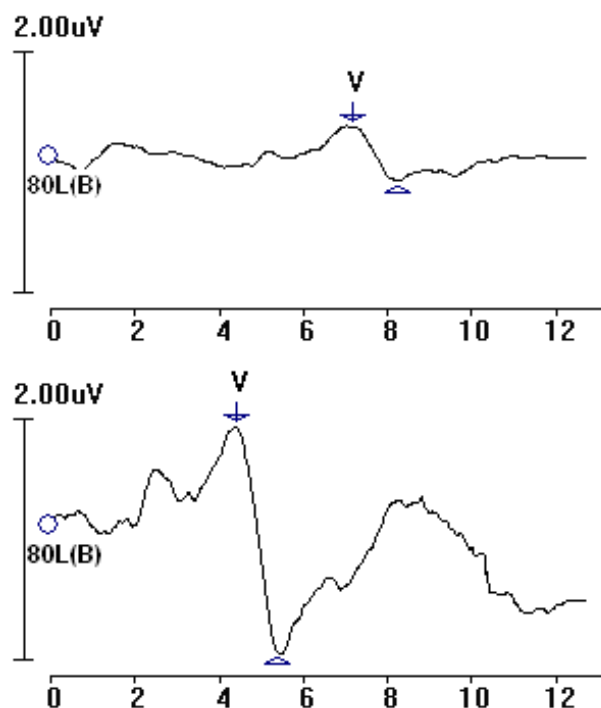


Fig.3 - Comparison waveforms.

A significant difference between the recording acquired from one ear and the other, while differing from your norms, may be considered as an existing pathology. A lack of latency shift across different frequencies may also be indicative of existing pathologies.