

Acquiring Transient OAE

using SmartTrOAE

Why acquire Transient OAEs?

Transient OAEs (TEOAE) may be used to diagnose certain auditory conditions. It can provide a health professional with very useful information about types of hearing loss in a patient and other conditions. TEOAE acquisition can help with:

- Infant hearing screening.
- Monitoring of patients with a risk of hearing loss.
- Detection cochlear auditory dysfunction.
- Investigations of cochlear function and diagnosis before medical procedures
- Determination of sensorineural hearing loss causes.
- Investigations of middle ear effusion effects on hearing.

What is TEOAE?

Transient Oto-Acoustic Emissions are responses generated by the test subject's cochlea when provided with a click or tone stimulation. These emissions are prevalent in subjects with normal hearing; subjects with a hearing threshold of 25 dB HL or better. They may also provide an indication of good mid-frequency hearing.

Due to the broad energy distribution of the signal over the frequency range, the responses are recorded using a very sensitive microphone. Once the responses have been acquired, they can be presented in graphic or text form for further examination.

Patient Preparation

The patient must be placed in a comfortable and quiet environment, preferably a sound booth where the patient lies down or sits comfortably. Even though the patient does not need to be in a relaxed state for this test, it is recommended, in order to minimize noise and decrease the possibility of false negatives. To obtain a better recording it is also recommended to inspect the patient's ear canal. Cerumen or debris may partially block the stimulus signals, resulting in incorrect results. Cleaning of the ear canal shall ONLY be performed by a person trained in such procedure in order to prevent any irreversible middle ear damage.

Probe Usage

There are two types of probes available:

- Microphone-Stimulator probes, like the 10D, are self contained units that can deliver the stimulus and pick up the response. These are the standard probe used for clinical OAE.
- Microphone probes, like the 10B+, contain only microphones and stimulus delivery tubes, which allow any kind of stimulator to be attached, forgoing bulk in benefit of flexibility. Microphone only probes are especially useful when testing at frequencies higher than those allowed by probes with a built in stimulator. This type of probe is better suited for animal research.

Probes should be used with an appropriate tip to provide a good seal and reduce external noise and minimize test times.

Setting up SmartTrOAE

Acquiring Transient OAE's is SmartTrOAE's function. The system may be setup with a few clicks of the mouse. Complete the following steps in the order outlined, use the test setting that best fit your requirements, or use the recommended settings shown:

1. Make sure that "Automatic Gain" is selected under the settings menu and that acquisition is set to non-linear mode when testing intensities above 65 dB SPL.
2. Click on **[STIMULUS > SELECT STIMULUS]** from the main menu and define the stimulus settings if using other than the standard 75 microsecond click.
3. Set the number of sweeps, intensity levels and rate of stimulation on the control panel at the bottom of the screen.
4. Set the artifact rejection as desired using the lever on the right hand side of the screen.
5. Place the probe on the test ear. Make sure to achieve a good fit. Probe fit will be checked automatically before starting acquisition.
6. Press the **[RIGHT]** or **[LEFT]** button to acquire TEOAE's for that particular ear.

Suggested Parameters

This list shows the most commonly used settings for TEOAE acquisition:

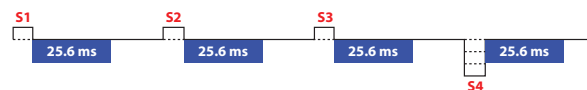
- **Stimulus:** 75 microsecond click.
- **Rate:** 19.30 Per second.
- **Sweeps:** 1024, 512 for screening.
- **Intensity:** 90 to 95 dB SPL.
- **Acquisition Mode:** Non-linear for intensities over 65 dB SPL, Linear otherwise.
- **Artifact Rejection:** 6% or higher as needed.
- **Passing Criteria:** 3 out of 5 passing with 6 dB SNR minimum and 90% Correlation.

Linear vs. Non-Linear

Linear acquisition stimulates with clicks of the same polarity and intensity.



Non-Linear acquisition reverses the polarity and increases the intensity of every fourth click.



Analysis

As the test is being completed, the system will average the responses to each sweep and place them in a time domain and a frequency domain graph, facilitating response analysis. The average meatal response, which occurs in the first 6 milliseconds, is also shown.

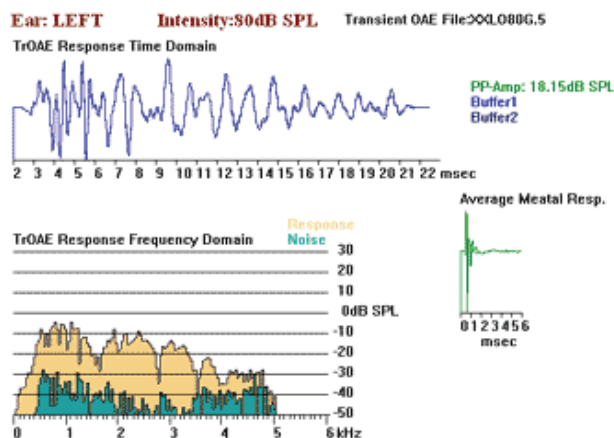


Fig.1 - Sample TEOAE recording

A normal strong and consistent Transient OAE response will be shown with the time domain buffers overlapping each other, where the difference between the waveforms is minimal. The differential signal can be seen by selecting **[SHOW > SHOW PLOT DIFFERENCE CURVE]** from the main menu. Ideally, the plot difference curve will be very small when compared to the response buffers.

The presence of cochlear function is assumed for frequencies with amplitudes greater than 6 dB above the noise floor, which usually corresponds to a cross correlation score higher than 80%. Responses are expected from patients with a normal middle ear and pure tone sensitivity higher than 25 dB HL. Responses are not expected from patients with an abnormal middle ear or cochlear HL higher than 35 dB HL. Although Transient OAEs are a broadband response (1 - 5000 Hz), some narrow frequency band information can be obtained using the Time-Frequency analysis utility found in the control panel. Below the frequency graph, the software provides a 5 band breakdown giving a response/no-response result for each.

Screening with Transient OAEs

Transient OAEs are helpful to determine the overall health of the cochlea and can be used to screen newborns for hearing defects. SmartTrOAE is both a diagnostic and a screening Transient OAE system. The frequency band information found under the frequency domain graph can be used for this purpose. By default, a screening Pass requires that a response is detected on 3 of the 5 bands. To modify the requirement, click on **[PROTOCOL > PASSING CRITERIA]** from the main menu. When screening newborns, keep in mind that they may still have some amniotic fluid inside their ear canals; they should be re-screened after the fluid has drained.

Notes on Spontaneous OAE

All SmartTrOAE systems have the capability of acquiring spontaneous OAEs. Spontaneous OAEs are emissions produced by healthy ears without the need of stimulation. Only about 60% of the population has some form of spontaneous emissions, being more prevalent in females than in males. During a spontaneous OAE test, a sync pulse is sent to the subject's ear to provide a reference point for signal averaging, while the emissions are recorded outside the time frame influenced by the sync pulse. To start a spontaneous OAE test in SmartTrOAE, select **[PROTOCOL > MODALITY > SPONTANEOUS]** from the main menu, and then click on the Left or Right button to start acquisition for the corresponding ear. Although not recommended, asynchronous acquisition can be achieved by setting the intensity to 0 dB.