

# Verification & Counseling of Digital Hearing Instruments with the AURICAL® PMM System



## Course Outline

- Brief Company Overview
- Brief Product Solutions Overview
- What is Verification & Why Should We Do It?
- Goals– What Are Yours?
- AURICAL Overview
- Basic Probe-Microphone Terminology
- AURICAL PMM Step-by-Step
- Other Tools Available in PMM
- Resources

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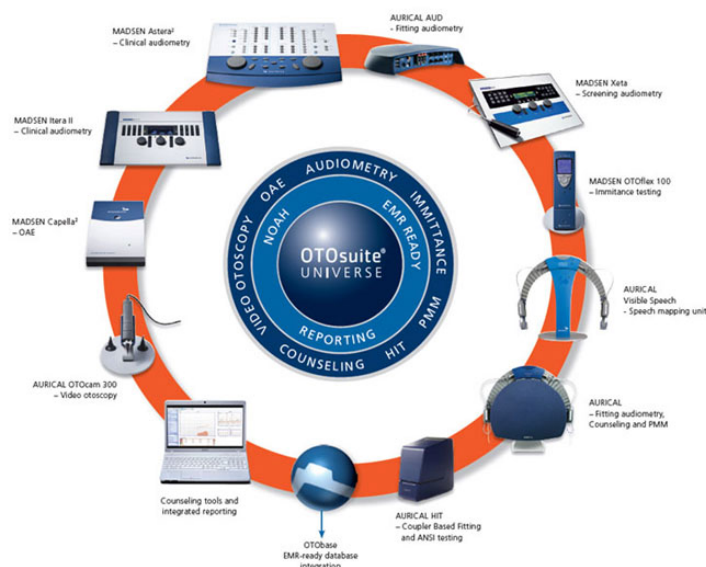
- Who Are We?

Otometrics – Develops, manufactures and markets computer based audiological, otoneurologic & vestibular instrumentation in more than 70 countries globally. Product brands include MADSEN, AURICAL, ICS, & OSCILLA

Audiology Systems– National partnership of industry professionals, audiologists and local audiology & vestibular experts who work together to distribute products, educate and serve as a resource to our customers



## Our Product Line



## What Is Verification?

Measure(s) to determine if the hearing instrument(s) meet a particular standard and are performing as expected. Verification is objective. Examples: Does gain match a validated, prescriptive target? Is Directionality working? Etc.

Not to be confused with **Validation** which is subjective and utilized to determine how effective the hearing aids are or how much benefit the patient is receiving from hearing aids in their daily life. Examples: COSI, APHAB, word recognition in noise tests, etc.

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## Why Conduct Probe Microphone Measures?

- Because AAA & ASHA or my employer says I should...
- What you see in the manufacturer's fitting screen may not be what's happening in the patient's ear
- Patient satisfaction
- Fewer return visits
- Demonstrate performance of key hearing instrument features such as noise reduction



## AAA Guidelines

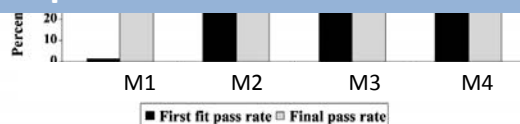
“Guidelines for the Audiologic Management of Adult Hearing Impairment “

1. Choice of assessment signal
  - Speech or speech-like signal should be used
2. Physical fit
3. Occlusion effect
4. Gain verification
5. Output verification
6. Aided soundfield threshold
7. Verification of special features
  - Directional mics, telecoils, etc.



## What You See on the Manufacturers' Screen May Not Be What's Happening In the Ear

**64% of “first-fit” hearing aids did NOT come within +/- 10 dB of NAL-NL1 target at 1 or more frequencies**



**Figure 1.** The percentage of fittings that came within  $\pm 10$  dB of the NAL-NL1 target in the frequency range 0.25 to 4 kHz using the first fit program of the aids (black bars) and after adjustments in frequency-gain response (light gray bars), for four different types of digital hearing aids.

Source: H. Aazh and B. Moore, *Journal of the American Academy of Audiology*; 18:653–664 (2007)

## Patient Satisfaction MarketTrak VIII

### The impact of the hearing care process on patient success

| Consumer perceptions of protocol<br>steps performed by HHP | Success                     |                             |
|--|-----------------------------|-----------------------------|
|  | Below<br>Average<br>(n=331) | Above<br>Average<br>(n=407) |
| ★ Hearing tested in sound booth                            | 76                          | 88                          |
| ★ Real ear measurement verification                        | 31                          | 51                          |
| ★ Subjective benefit measurement                           | 7                           | 32                          |
| ★ Objective benefit measurement                            | 53                          | 79                          |
| ★ Customer satisfaction measurement                        | 6                           | 23                          |
| ★ Loudness discomfort measurement                          | 58                          | 82                          |

Source: Kochkin, S.; "MarkeTrak VIII: The Impact of the Hearing Healthcare Professional on Hearing Aid User Success"  
The Hearing Review, April 2010; Volume 17, Number 4: Pages 12, 14, 16, 18, 23, 26, 27, 28, 30, 32, & 34

## Patient Satisfaction MarketTrak VIII

### The impact of the hearing care process on patient success

- Real-ear measurement verification : +20%
- Subjective benefit measurement: + 25%
- Objective benefit measurement: + 26%
- Customer satisfaction measurement: + 17%
- Loudness discomfort measurement: 24%

Source: Kochkin, S.; "MarkeTrak VIII: The Impact of the Hearing Healthcare Professional on Hearing Aid User Success"  
The Hearing Review, April 2010; Volume 17, Number 4: Pages 12, 14, 16, 18, 23, 26, 27, 28, 30, 32, & 34

## Probe Microphone Measures (PMM)

- Offers the only way to measure (rather than estimate) what is happening in the patient's ear canals
- Factors the individual variations into the fitting
- Offers you OBJECTIVE guidance in your fittings
- Provides you an opportunity to demonstrate features and counsel appropriately

## What Are Your Clinical Goals For PMM?

- Do you want to match a prescription target?
  - Which prescription target?
- Do you want to simply make speech audible but comfortable?
- Make sure the sound is subjectively acceptable to the patient?
- Simply counsel?
- More than one of these?



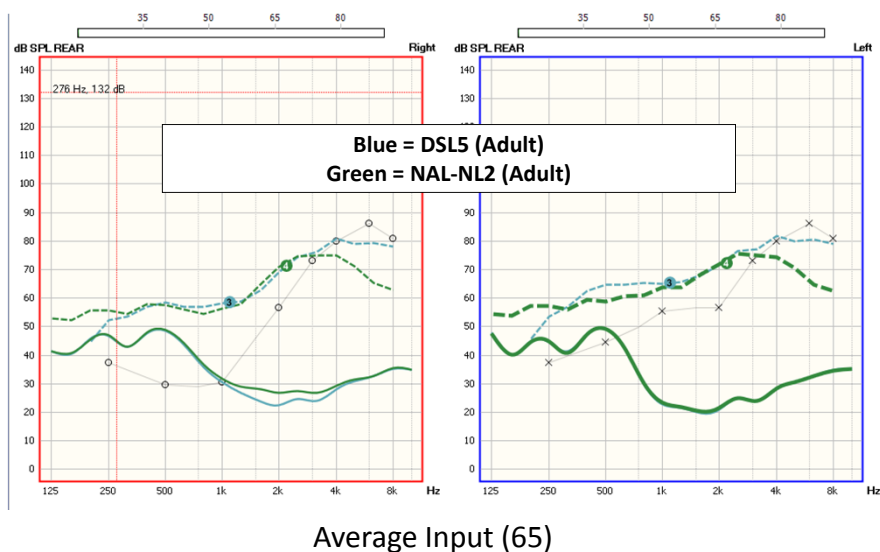
## A Word About Prescription Targets

- Two most commonly utilized are NAL and DSL
  - Current versions are NAL-NL2 & DSL 5
- NAL-NL2 is a threshold based algorithm which aims to maximize speech intelligibility for any input level of speech while keeping the overall loudness of speech at or below normal overall loudness.\* Variables such as gender and experience with hearing instruments are considered in latest version
- DSL 5 is a fitting algorithm which aims to amplify speech so that it is audible, comfortable and undistorted across the broadest frequency range possible while taking into account such variables as age of onset of hearing loss (children) and listening environment\*\*

\*From [www.nal.gov.au](http://www.nal.gov.au)

\*\* From [www.dslio.com](http://www.dslio.com)

## Comparison of NAL-NL2 and DSL 5



## Targets Available within AURICAL PMM

Fitting Details

Target Rule: **DSL v5.0** (selected)  
 DSL v5.0  
 NAL-NL1  
 NAL-NL2  
 Manual  
 DSL v4.2

Date of Birth: 02/02/61

Fitting Mode: DSL v5.0

Applied REUG: NAL-NL2

Applied RECD: Predicted (DSL 5.0)

H.I. Type: BTE

Transducer: Insert Tip

Venting: None

Use Bone Conduction: No

Amplification: Binaural

Applied UCL: Predicted

☐ Use OpenREM calibration

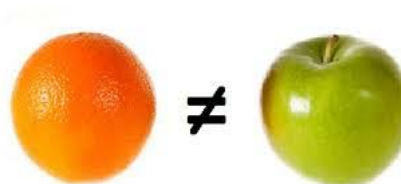
☐ Show for each new client

>> Advanced Setting

Apply Close Help

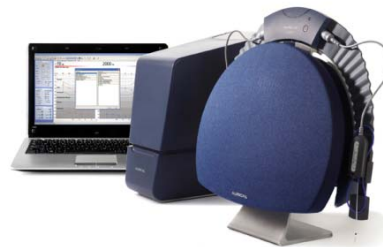
## Another Word About Prescription Targets

- Remember, a proprietary hearing aid manufacturer's target is **NOT** necessarily the same thing as NAL or DSL and their proprietary method may be the default fitting formula
- If you fit with formula ABC don't expect it to match DSL on NAL



## AURICAL PMM

- AURICAL has 3 available components including an audiometer (AURICAL AUD), the Hearing Instrument Test Box (AURICAL HIT) and the Probe Microphone Measures (AURICAL PMM)
- Today we are focusing only on the PMM component



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## The PMM unit

- Verify fittings – with or without prescriptive targets
- Complete **wireless** and **binaural PMM** solution that adds unprecedented flexibility and freedom to fitting
- User tests, binaural capability and pre-defined measurement sequences make it fast and easy to use
- Has convincing tools help you clearly demonstrate the real benefits of hearing instruments



## What Are the Verification Tools within PMM?

### Probe Mic Measures

Prescriptive  
Target  
Based  
Fitting

Speech  
Mapping

Advanced  
Feature  
Assessment

## Terminology

The basics of “R” and “G”

- If it’s an “**R**” value that means it refers to an absolute response and measures dB SPL
- If it’s a “**G**” value, that means it refers to a difference value. That is, input level is subtracted from the output value



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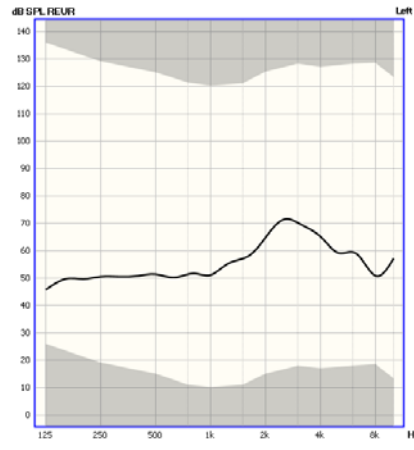
## Terminology

### Common Measures

#### **REUR**

#### **Real Ear Unaided Response**

dB SPL measured across frequencies, in the open (unaided) ear canal for a given input signal



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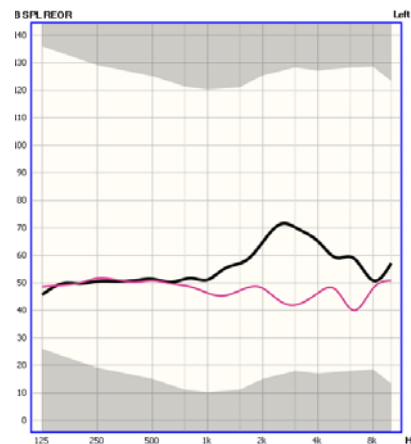
## Terminology

### Common Measures

#### **REOR**

#### **Real Ear Occluded Response**

dB SPL measured across frequencies, in the ear canal, with the hearing instrument in place but turned OFF (not amplifying)



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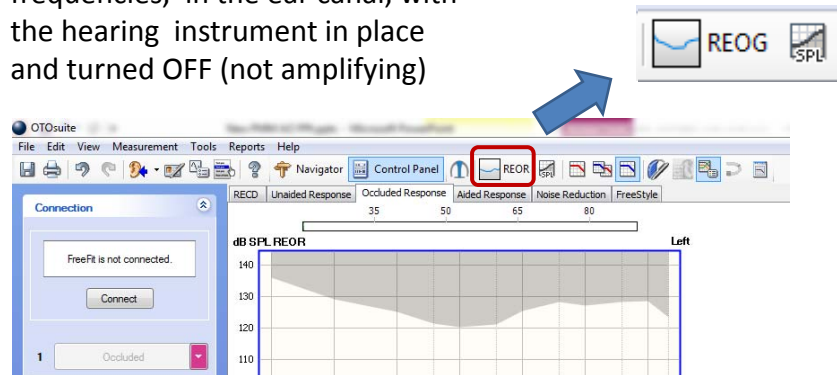


## Terminology

### Common Measures

#### **REOR & REOG**

dB SPL measured across frequencies, in the ear canal, with the hearing instrument in place and turned OFF (not amplifying)

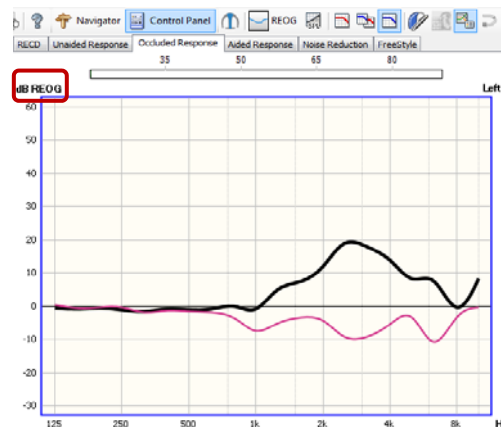


## Terminology

### Common Measures

#### **REOG**

dB difference value of REOR with the input signal subtracted out

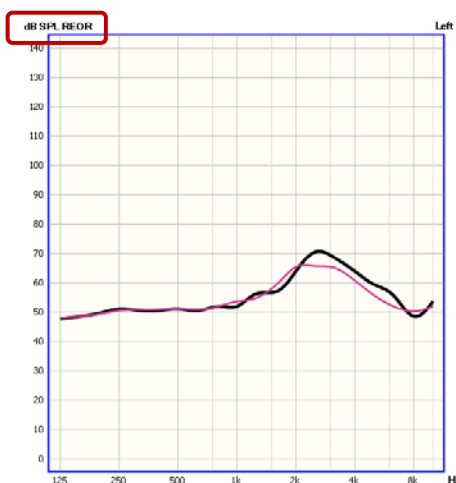


## Terminology

### Common Measures

#### **REOR & REOG**

dB SPL measured across frequencies, in the ear canal, with the hearing instrument in place and but turned off (not amplifying)



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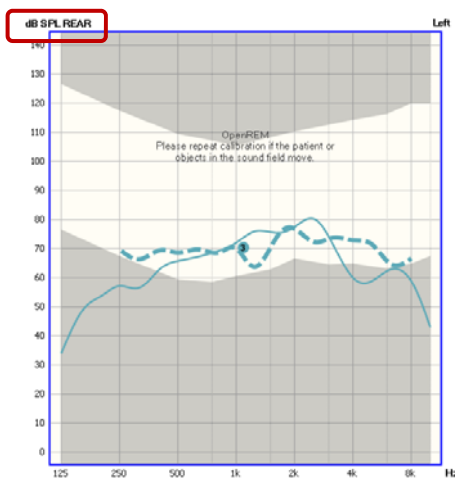
## Terminology

### Common Measures

#### **REAR**

#### **Real Ear Aided Response**

The frequency response (in dB SPL) of a hearing instrument that is in the ear and turned on, to a particular input signal



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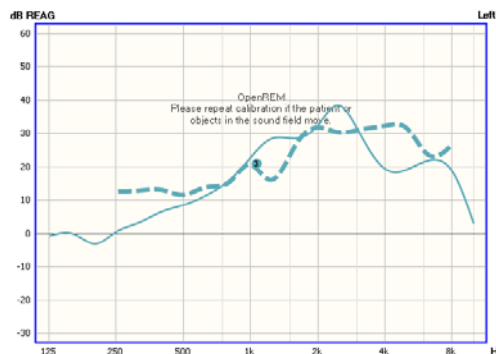


## Terminology

### REAG

#### Real Ear Aided Gain

The frequency response (in dB SPL) of a hearing instrument that is in the ear and turned on, with the input signal value subtracted out



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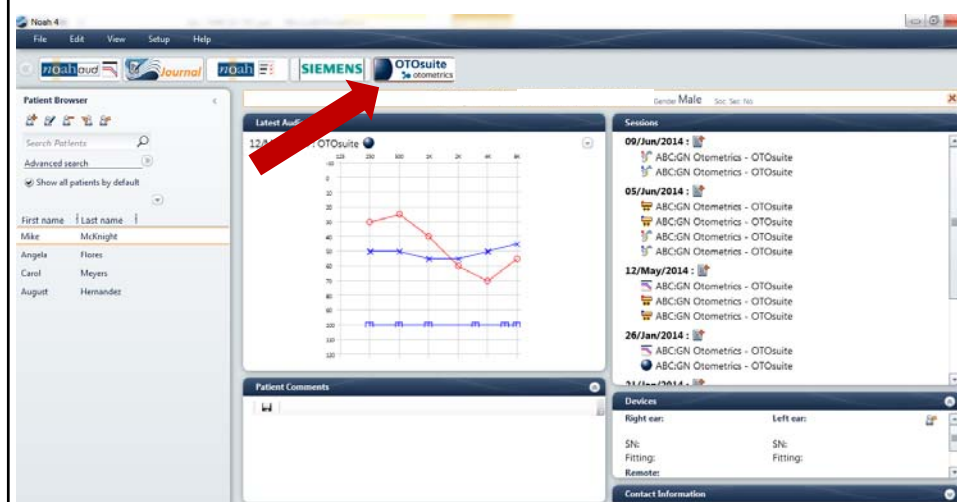
## Please Refer to Your Handout “AURICAL PMM Quick Guide”

Part of your handouts for  
this course

Simply click on the file  
and save to your  
computer for future  
reference

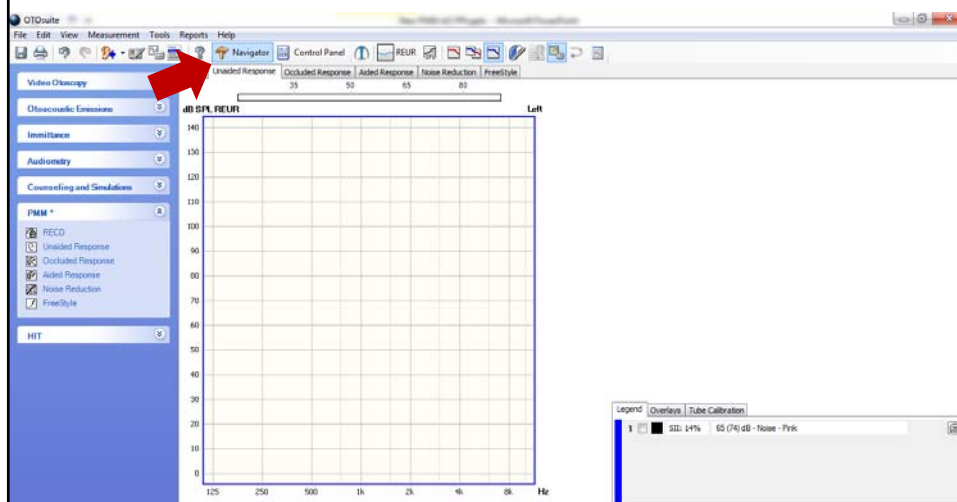


## Launching OTOsuite from within NOAH



## Navigating to PMM within OTOsuite

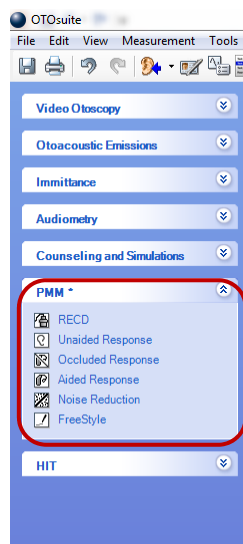
### OTOSuite View



## PMM Menu Items

### OTOSuite View

Within “Navigator” View  
Several PMM Measures  
Readily Available



### A Quick Note About Coupler Based Fittings

- Applies real ear to coupler transforms and measurements are made in the test chamber when PMM isn't possible.(e.g. children and difficult to test adults)
- An approach which results in highly accurate predictions of real-ear hearing instrument performance, while considering individual ear acoustics

## A Quick Note About Coupler Based Fittings

- CBF procedures eliminates the variability associated with sound field measures
- All HI programming & verification conducted under highly controlled acoustic conditions
- Procedure is fast, efficient and reduces the degree of cooperation required from the patient



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## A Quick Note About Coupler Based Fittings

**Probe Microphone = Coupler Microphone**

**Reference Microphone = Reference Microphone**

**FreeField Speaker = HIT Speaker**

- With appropriate acoustic transforms, the coupler can serve as substitute for the ear (for most measurements)

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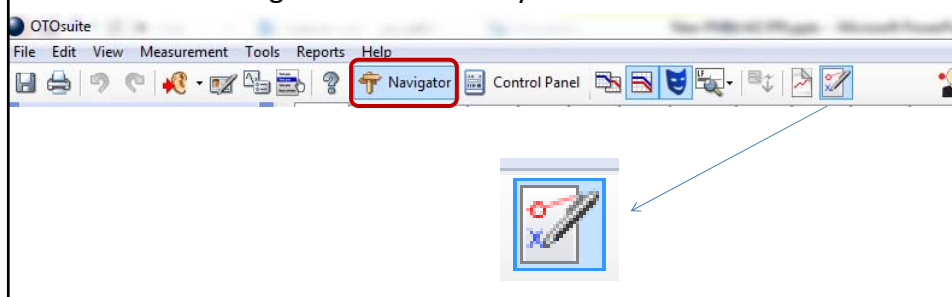


## Let's Get Started

### Audiogram

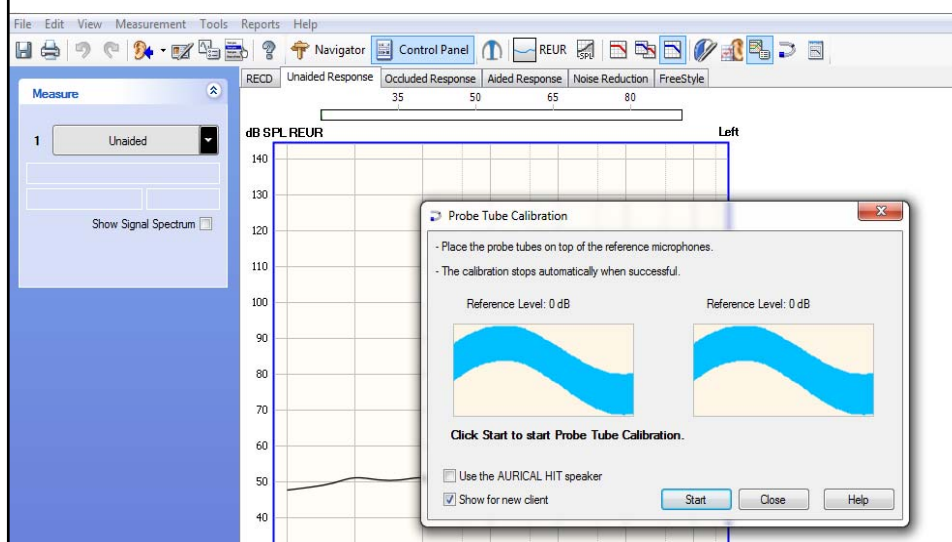
If you are working from within NOAH the audiometric data will be carried over to PMM

If you are working with PMM in standalone mode you can manually enter the audiogram by first clicking on "Tone" and then selecting the "Manual Entry" Icon



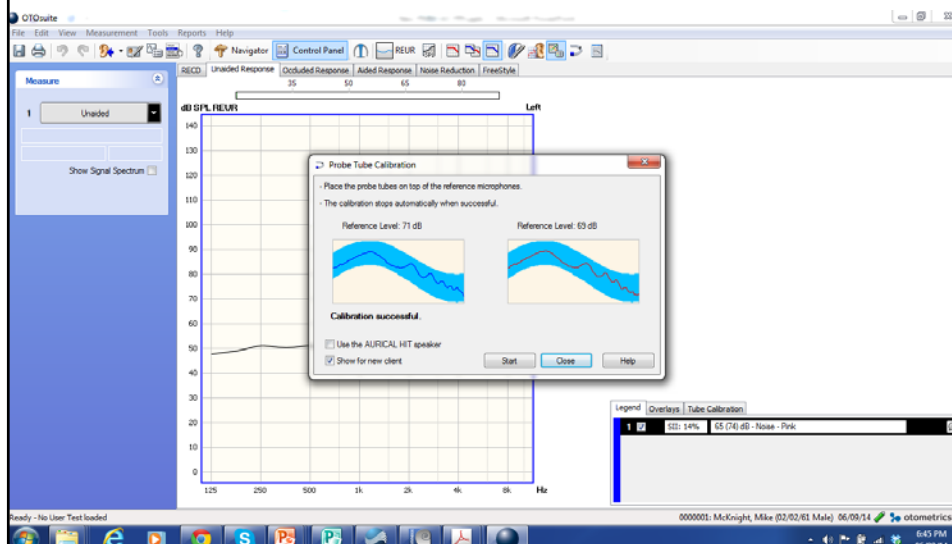
## Step One: Probe Tube Calibration

### Control Panel & Unaided Response



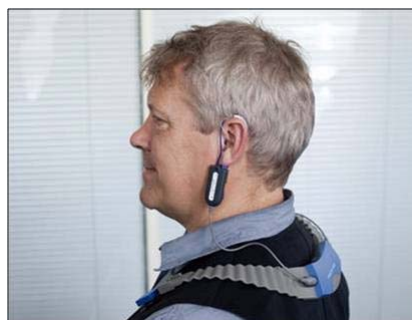
## Step One: Probe Tube Calibration

### Calibration Complete



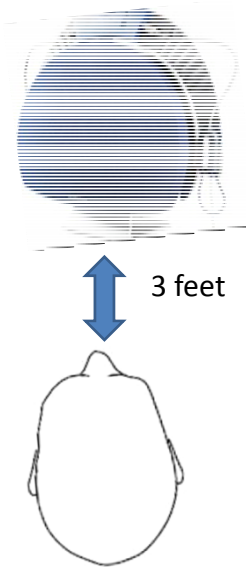
## Step Two: Patient Setup

- Drape the AURICAL PMM Collar (FreeFit) around the back of the patient's neck
- Hang the probe housings around the patient's ears
- Adjust the blue cords to fit snugly around the ear by pulling on either end of the cords



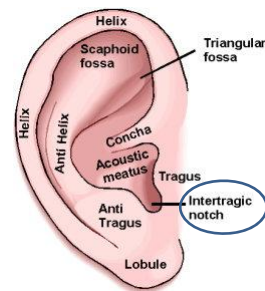
## Step Two: Patient Setup

- Position the patient such that their nose (0 degrees azimuth) is facing the AURICAL PMM speaker
- Position them such that they are approximately 3 feet from the speaker



## Step Two: Patient Setup

- Insert the probe tube in the ear canal to a depth of 3-5 mm past where the hearing instrument delivers the sound
- General guidelines:
  - Adult male– 30 mm past the intertragal notch
  - Adult female– 28 mm past the intertragal notch
  - Children– 20-25 mm past the intertragal notch
- To assist with placement, utilize the black guide on the probe tube and the built-in ruler on the probe



## Step Three: Fitting Details

- The **Fitting Details** dialog box can be opened with either the icon on the tool bar or the keyboard shortcut of **F10**
- It is important to customize these options for each fitting to select the desired target and to ensure that both the targets and the measurements are accurate
- If you are fitting an “open” BTE be sure to select “**Use OpenREM calibration**”



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## Step Three: Fitting Details



**Fitting Details**

|                             |                                   |
|-----------------------------|-----------------------------------|
| Target Rule: NAL-NL2        | Date of Birth: 02/02/61           |
| Fitting Mode: Real Ear      | Gender: Male                      |
| Applied REUG: Measured REUG | Applied RECD: Predicted (NAL-NL2) |
| H.I. Type: BTE              | Transducer: Insert Tip            |
| Venting: Occluded           | Use Bone Conduction: No           |
| Amplification: Bilateral    |                                   |

☒ Use OpenREM calibration
 ☐ Show for each new client

>> Advanced Setting
 Apply
Close
Help

## Step Three: Fitting Details

**Fitting Details**

Target Rule: NAL-NL2

Fitting Mode: Real Ear

Applied REUG: Measured REUG

H.I. Type: Custom Average REUG

Venting: KEMAR

Amplification: Predicted (DSL 5.0)

Date of Birth: 02/02/61

Gender: Male

Applied RECD: Predicted (NAL-NL2)

Transducer: Insert Tip

Use Bone Conduction: No

☒ Use OpenREM calibration

☐ Show for each new client

>> Advanced Setting

Apply Close Help

## Step Three: Fitting Details Advanced Settings

**Fitting Details**

Target Rule: DSL v5.0

Fitting Mode: Real Ear

Applied REUG: Measured REUG

H.I. Type: BTE

Venting: None

Amplification: Binaural

Date of Birth: 02/02/61

Applied RECD: Predicted (NAL-NL2)

Transducer: Insert Tip

Use Bone Conduction: No

Applied UCL: Predicted

☒ Use OpenREM calibration

☒ Show for each new client

<< Advanced Settings

Program Type: Quiet

No. of Channels: Noise

Compression type: Non-linear

Client Type: Adult

RECD Type: HA2 Tip

REUG Orientation: 0°

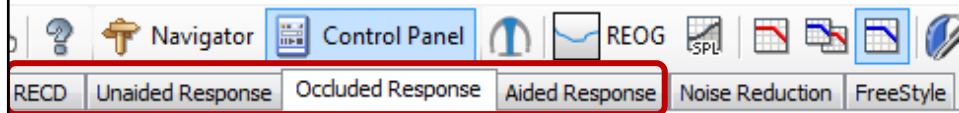
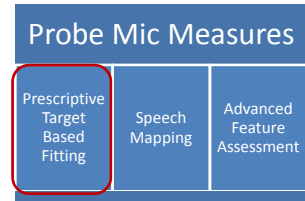
Applied REDD: Average (LTASS)

Apply Close Help

## Step Four: Running Measures

- A typical workflow is already laid out for you on the screen

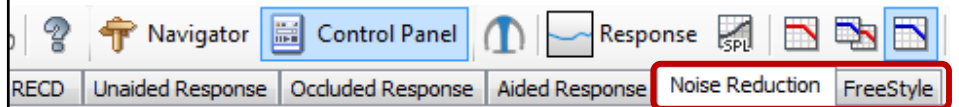
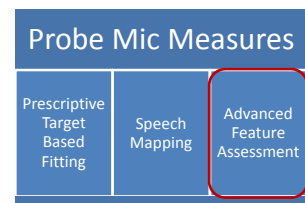
- Unaided Response
- Occluded Response
- Aided Response



## Step Four: Running Measures

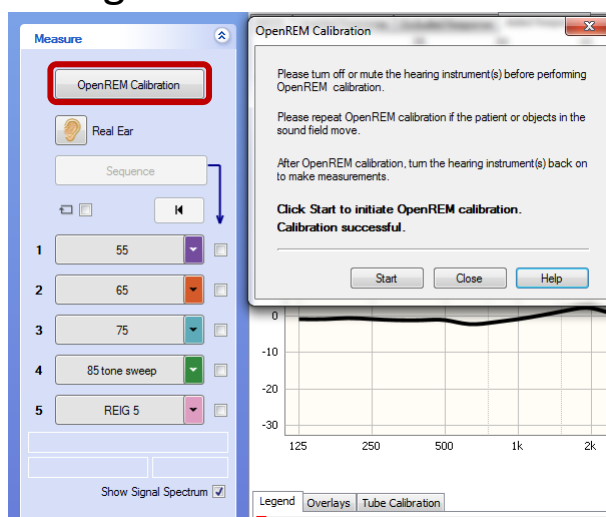
- A typical workflow is already laid out for you on the screen

- Noise Reduction
- FreeStyle



## Step Four: Running Measures

- If measuring an open BTE please be sure to run the OpenREM calibration prior to your first measurement

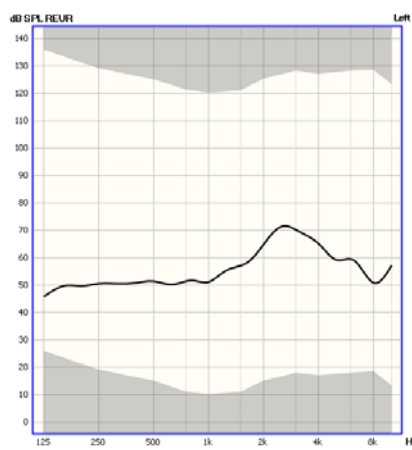


## Step Four: Running Measures

### REUR

#### Real Ear Unaided Response Pink Noise– 5 seconds

- dB SPL measured across frequencies, in the open (unaided) ear canal for a given input signal
- Usually expect a peak on the measurement curve around the 3k Hz region with a 2<sup>nd</sup> smaller peak around 6k Hz
- Expect “natural gain” of about 12-18 dB at the peak



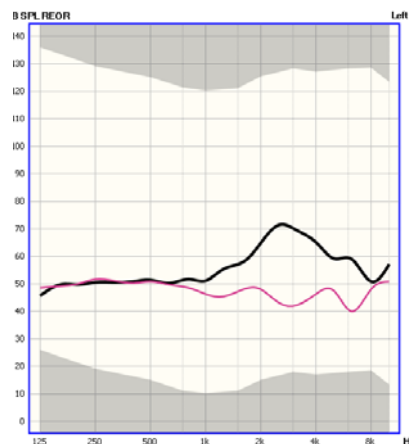
## Step Four: Running Measures

### REOR

#### Real Ear Occluded Response

#### Pink Noise– 5 seconds

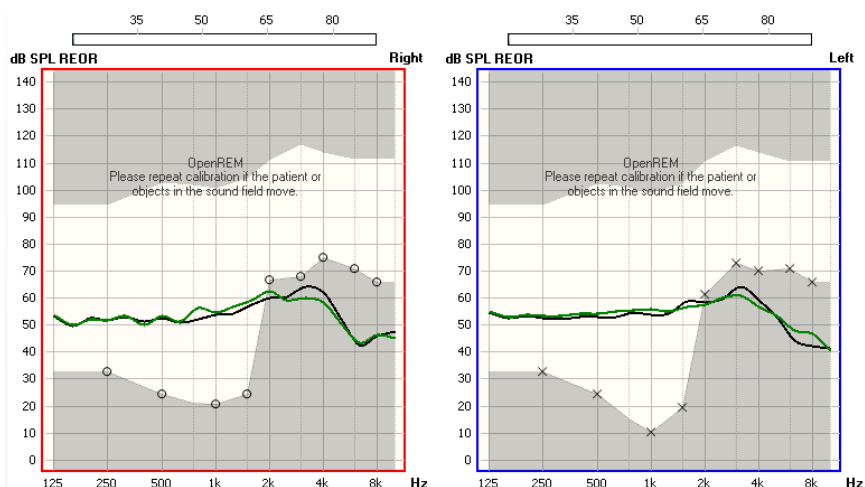
- dB SPL measured across frequencies, in the ear canal, with the hearing instrument in place but turned OFF (not amplifying)
- Can be used to find out how “open” an open fit hearing aid is by comparing the unaided and occluded measurements



## Step Four: Running Measures

### REOR

Open? (black unaided, green occluded)



## REOR– Why Is It Important?

- Tells you if the ear canal response was altered by the placement of the domes/aids
- **If an true open fitting is the goal, there should be NO CHANGE in the ear canal resonance between REUR and REOR**
- If an open fitting is the goal and occlusion is present, alter or change the dome
- If an open fitting is the goal, occlusion is not present, but patient has occlusion type complaints, may have to alter the frequency response of the HA

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## Step Four: Running Measures

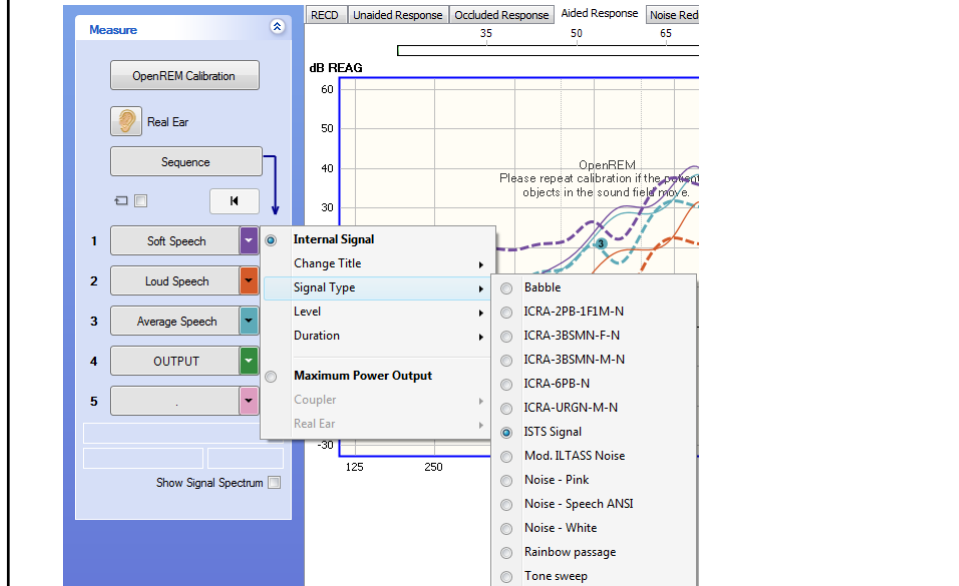
### REAR

#### Real Ear Aided Response

**Stimulus: Your choice– 14 seconds for one measure; approximately 45 seconds for avg, soft and loud**

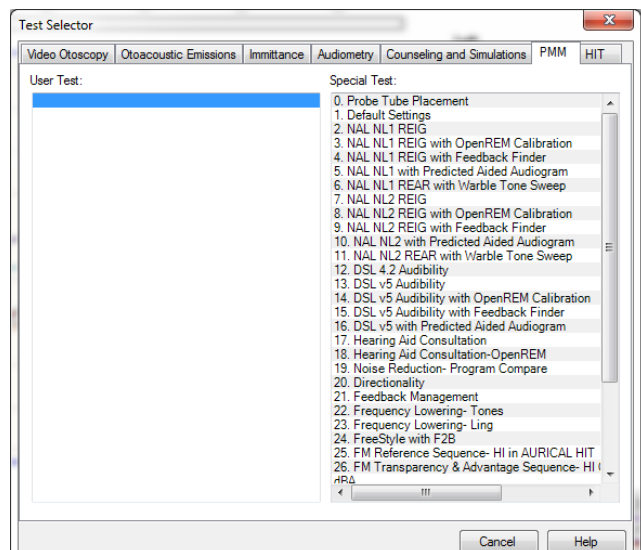
- The frequency response (in dB SPL) of a hearing instrument that is in the ear and turned ON, to a particular input signal
- Choose a speech or speech like stimulus such as ISTS or ICRA
- Your choice as to whether to match target or not but it's a great starting point
  - At a minimum ensure that speech is audible but not uncomfortable at different loudness levels

## Choosing A Stimulus



## Test Selector

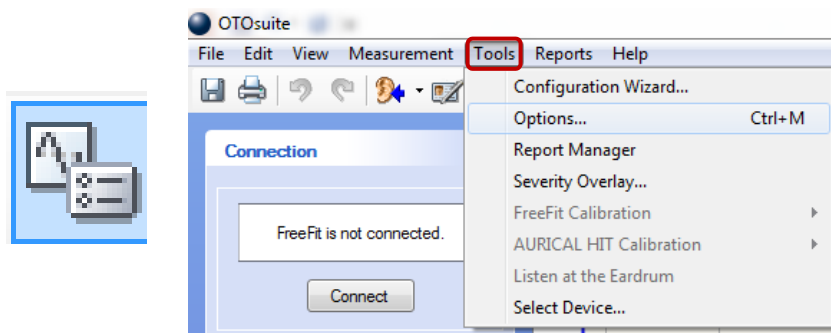
Navigate to  
"Test  
Selector"  
via the icon  
or F8



## Set Options

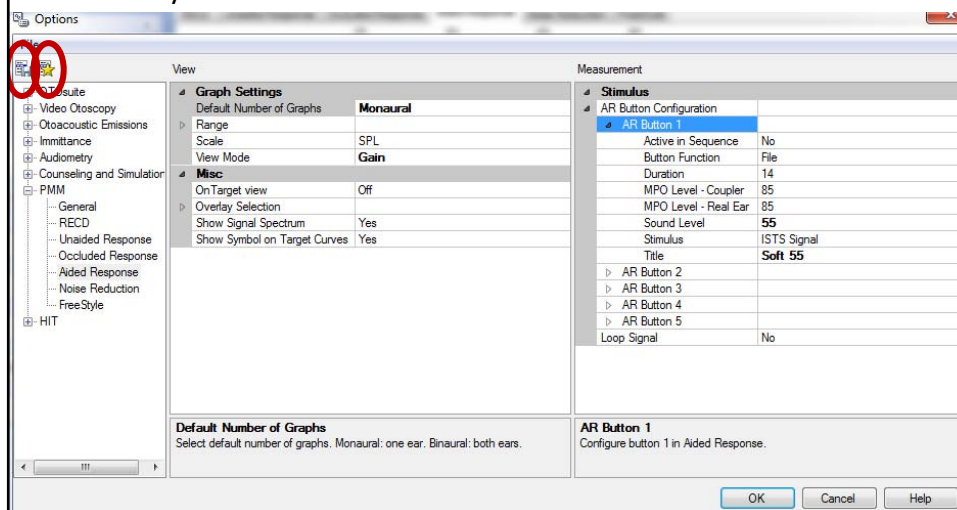
### Customize

- Either by selecting the icon seen here or by choosing Tools > Options you can easily customize the test sequence to your needs



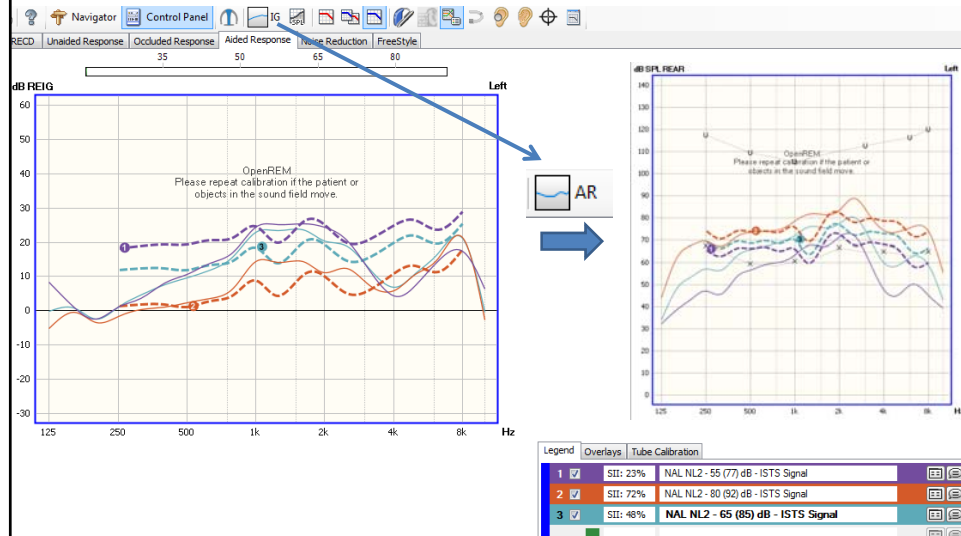
## Set Options

Be sure to choose the star icon “Save Options as Startup Settings” if you want to make these settings available the next time you enter the software



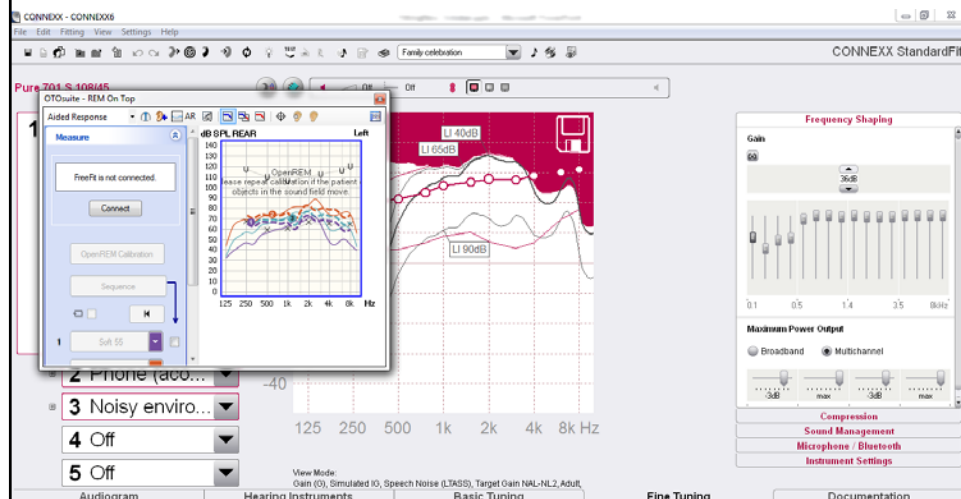
# Step Four: Running Measures

REAR/REAG & REIG– 3 input levels 45 seconds



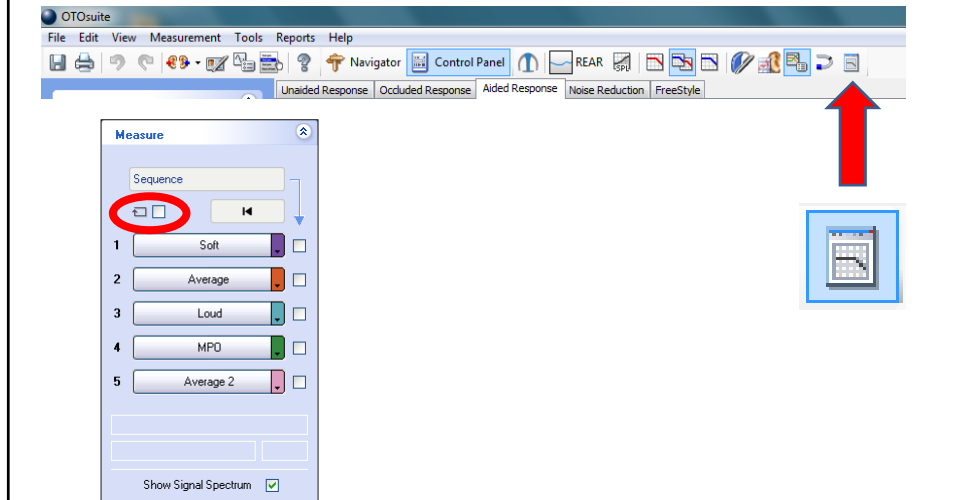
# Step Four: Running Measures

On Top Mode



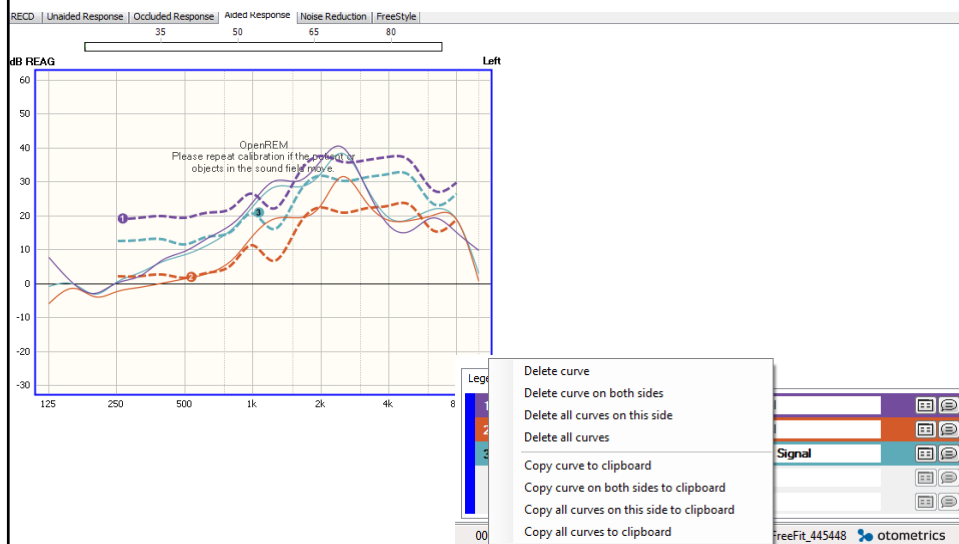
## Step Four: Running Measures

### On Top Mode & Continuous Loop



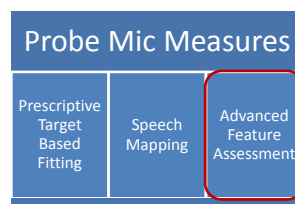
## Step Four: Running Measures

### Deleting Curves

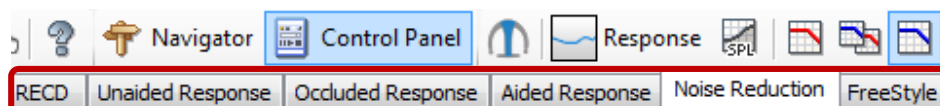


## Step Five: Demonstrating Features

- A typical workflow is already laid out for you on the screen



- Noise Reduction
- FreeStyle



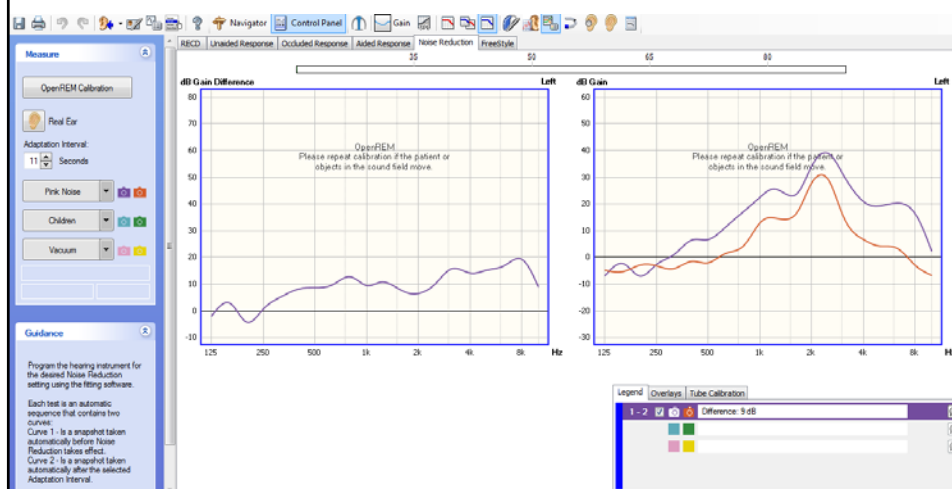
## Step Five: Demonstrating Features

### Noise Reduction– 15 seconds

- Demonstrates how steady state noise is reduced via the hearing instruments noise reduction algorithm
- May be heard as well as seen on the PMM screen during testing
- Great way to verify that the noise reduction system is working and is aggressive enough for the patient's preferences

## Step Five: Demonstrating Features

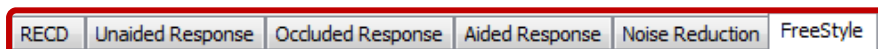
### Noise Reduction



## Step Five: Demonstrating Features

### FreeStyle

- FreeStyle is a dedicated demonstration section within PMM
- Numerous features can be demonstrated such as feedback managers, directional microphones, wind noise, etc.
- Allows for easy comparison of curves run with features turned on/off
- Professional's playground to test the instruments



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## Step Five: Demonstrating Features FreeStyle

### Directional Microphones– 30 to 60 seconds

- Face the client away from the speaker
- Make an initial measurement for a 65 dB speech signal with the HI in omni-directional mode
- Make a second measurement with fixed-directionality engaged (OR have fixed directionality engaged for both measurements and make measurement one with the client facing the speaker and measurement two facing away from the speaker)

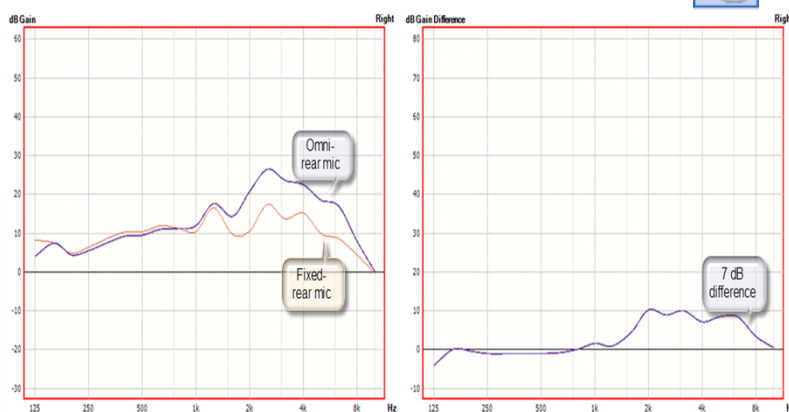
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## Step Five: Demonstrating Features FreeStyle

### Directional Microphones



## FitAssist™ Tools

- OnTop Mode
- Occluded Probe Detector
- Listen at the Eardrum
- OnTarget™

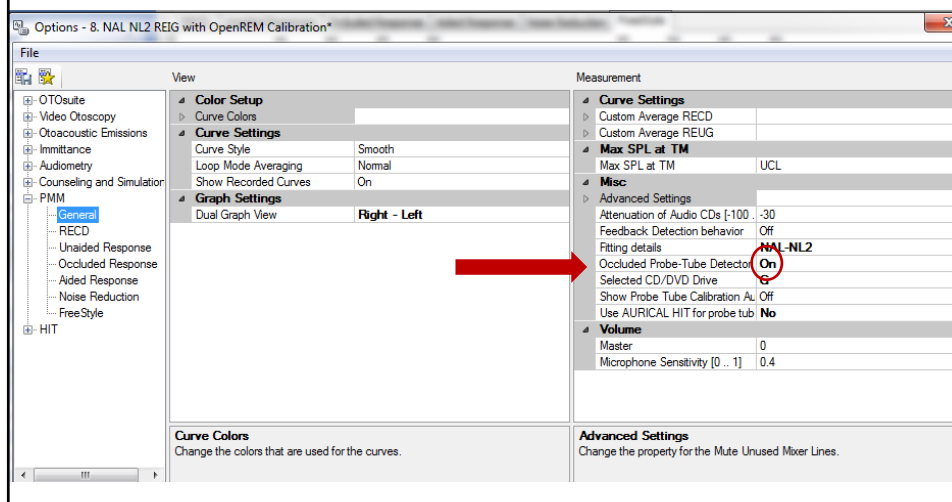
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## FitAssist™ Tools

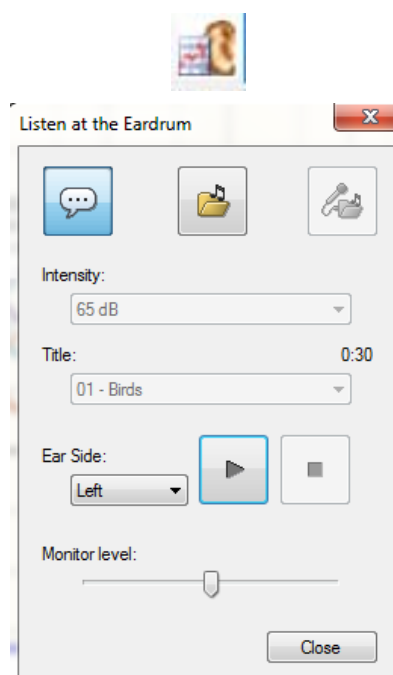
### Occluded Probe Detector



## FitAssist™ Tools

### Listen at the Eardrum “Live”

1. Click “Listen at Eardrum” icon to open the dialog box seen at right
2. Click the “Live” icon
3. Select the ear to monitor (1 at a time)
4. Select the ear to play, and click “Play” button. You can talk to the patient or have a 3<sup>rd</sup> party talk. The microphone in the probe picks up the signal at the eardrum. A recording is also made
5. Use the Monitor Level slider to change the output to the headphones. You can click the “Pause” button to stop and restart the recording at any time. Click the “Stop” button to end the recording



## FitAssist™ Tools

### OnTarget™

- New FitAssist tool available within PMM
- Simple, easy way to match target based upon a simple baseline fitting



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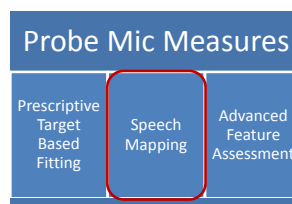
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## FitAssist™ Tools

### Speech Mapping

- Provides a visual display of the short-term spectrum of sounds in the ear being provided by the hearing instrument(s) in real time
- Provides a simple and visible view of the audibility of sounds
- Not intended to match a prescribed target but rather to ensure audibility of speech within the patient's dynamic range
- Often utilized as a counseling tool



## FitAssist™ Tools

### Speech Mapping

- Available as part of the “Counseling and Simulations” Section of OTOsuite
- Other tools such as “Hearing Loss Simulator” and “Hearing Instrument Simulator” are also found here



## FitAssist™ Tools

### Speech Mapping

- No “Targets” in the Visible Speech system
- Some speech reference is needed for counselling and setting reasonable expectations
- “Speech Banana” is an appropriate representation of conversational speech
- Simple normalisation approach to illustrate the nature of hearing loss and concept of amplification

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## FitAssist™ Tools

### Speech Mapping

#### Goals

- Soft speech should be audible
- Conversational speech should be comfortable
- Loud speech should be loud, but comfortable

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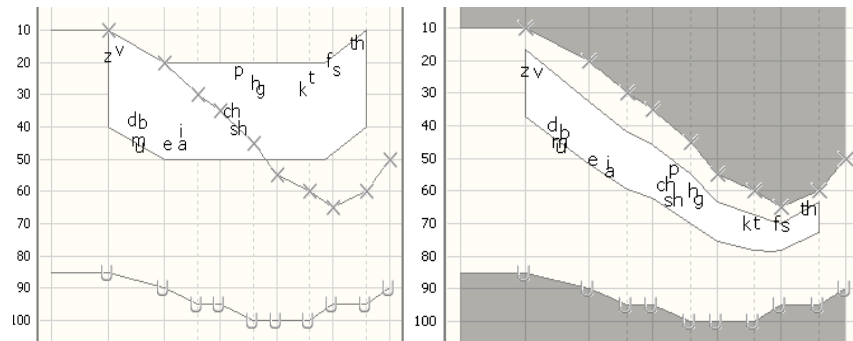
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## FitAssist™ Tools

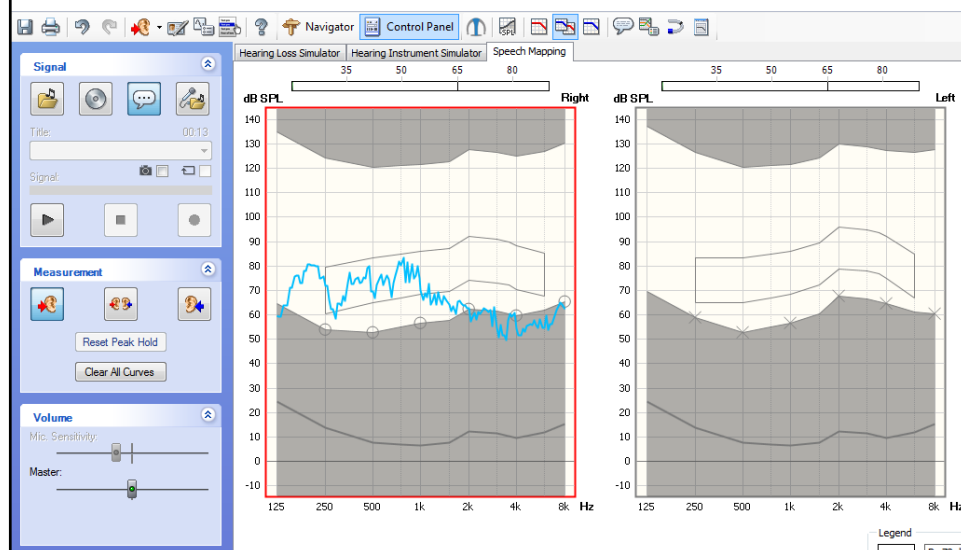
### Speech Mapping

- Speech spectrum is mathematically transformed so that it occupies the same proportion of the hearing impaired person's dynamic range as it does the normal hearing person's dynamic range. This is the "customized" speech banana



## FitAssist™ Tools

### Speech Mapping



## Resources

Please visit us online at:

[www.AudiologySystems.com](http://www.AudiologySystems.com) and at [www.Otometrics.com](http://www.Otometrics.com)

Or please call us at:

**855-283-7978**

You can also find additional fitting resources at:

<http://www.otometrics.com/Knowledge-Center/fitting>

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