Science **made** smarter

Additional Information

Equinox Evo

D-0135940-B 2025/07

Interacoustics

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1 Getting started

1.1 About the Equinox Suite

The AC440 module of the Equinox Suite, henceforth referred to as ‘Suite’, is the PC-based audiometry module for the Equinox Evo audiometer. It is located on the AUD tab on the upper right-hand corner of the screen.

The REM and HIT tabs allow you to see data on your patient previously collected with the Affinity Compact. The REM tab displays Real Ear Measurements, while the HIT tab shows Hearing Instrument Testing data, which can be used for comparison with the hearing aid manufacturer’s data sheets. When the Suite is in Simulation mode, the REM and HIT tabs let you explore the possibilities the Affinity Compact offers in these areas.

The Suite acts as an independent two-channel audiometer. It features tone audiometry for air and bone, speech testing and a variety of masking and signal types. Stimuli are presented using the PC keyboard, mouse, or a dedicated audiometry keyboard.

The dedicated keyboards for the Equinox Evo.

Test results are displayed on screen and are saved to the associated database (e.g., Noah, OtoAccess®). They are immediately available for inspection, hearing aid fitting, printout, export, and so on. The Suite can also be operated by an external database in stand-alone mode.

The Suite is flexible, enabling the individual clinician to tailor the system according to their specific preferences. It permits the creation of an unlimited number of personalized test protocol settings and functions for different purposes and/or for different clinicians working at the same location. The Suite also provides you with the option to make individual print layouts, keep reports electronically, and compare thresholds to previous sessions. These numerous setup options can be very helpful and time saving in the daily clinical work environment.

In addition to the setup functions, the Suite contains counselling tools to help both patients and relatives to get a better understanding of the consequences of hearing impairment and why hearing amplification may be needed.

The following tests can be performed with the Suite:

1. Air Conduction Audiometry
   a. High Frequency Audiometry
   b. Multi Frequency audiometry
2. Bone Conduction Audiometry
3. Speech Audiometry
4. Master Hearing Aid (MHA)
5. Hearing Loss Simulation (HLS)
6. SISI
7. Weber
8. ABLB/Fowler
9. Stenger
10. TEN test
11. QuickSIN
12. Tone Decay
13. ANL
14. SIQ Speech in Quiet
15. SIN Speech in Noise
16. IA-AMTAS
17. Audible Contrast Threshold (ACT™)
18. Masking Level Difference (MLD)
19. Pediatric Screen
20. Tone in noise
21. Free Field+

1.2 Launching the Suite

Ensure that the Equinox Evo is powered on and connected to your PC before opening the Suite. If the hardware is not detected, the Suite will open in Simulation mode. This is identifiable by the icon shown below on the left side of the screen. If the unit is connected, the second icon below will appear, indicating that a device is present and connected.

1.2.1 Launching from OtoAccess®

For further instructions about working with OtoAccess®, please see the OtoAccess® operation manual.

1.2.2 Launching from Noah

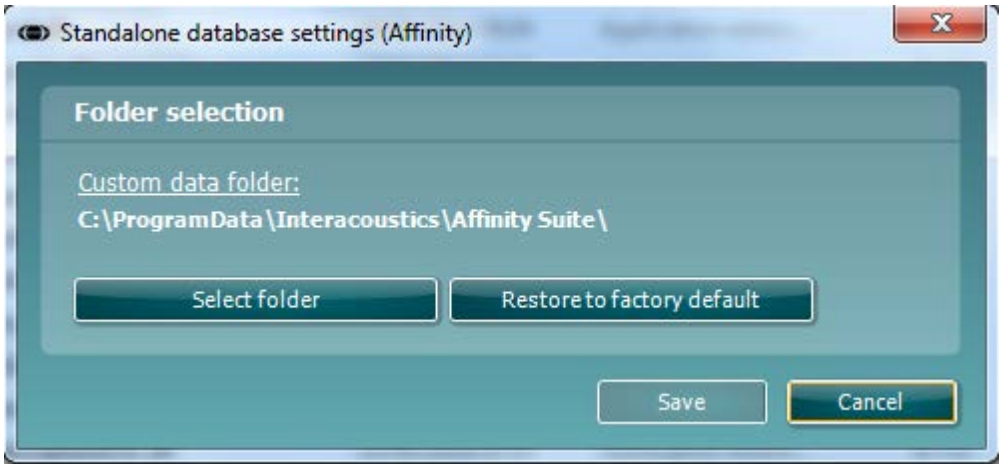
If you have the Equinox Suite installed on your computer, the icon to launch it will automatically appear in HIMSA's Noah 4.

For further instructions about working with Noah, please see the Noah operation manual.

1.2.3 Standalone database settings

We have made it possible for the user to change the location for the standalone data to be stored. This has been a request to improve the security of the information stored so that data isn't stored locally but on a network drive.

This can be changed by going to the following location, C:\Program Files (x86)\Interacoustics\AffinitySuite, and launching the application titled FolderSetupAffinity.exe. By doing this, the below window will be shown.



This allows you two options:

On pressing 'Select folder' the windows system dialogue is opened where you can choose the custom location where you would like your data to be stored.

On pressing 'Restore to factory default' any custom changes to the folder made in the previous 'Select folder' option can be reverted to the default.

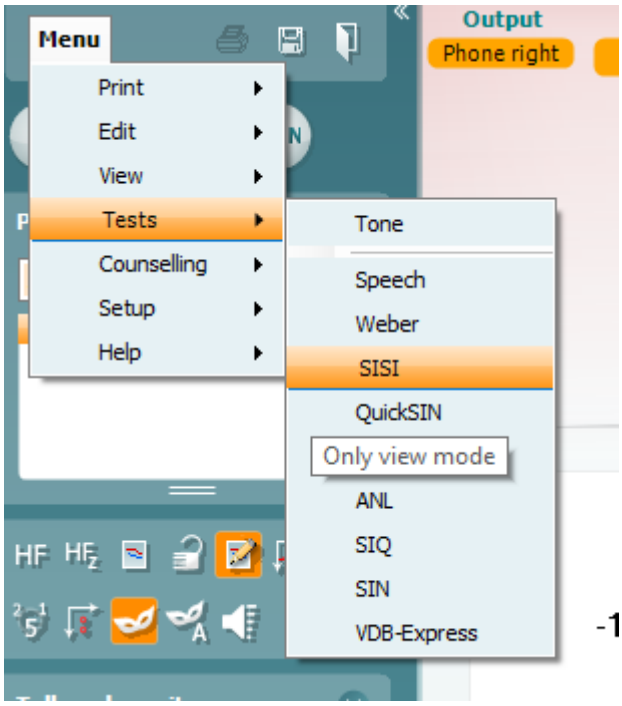
After making any changes the 'Save' button will light up giving you the option to apply your changes.

1.2.4 View data without license

The Equinox Suite has the ability to allow you to view and review data on a system which is not fully licensed without disconnecting your device. For example, should your Equinox Evo not be licensed for REM, you can still see the REM data performed via another system in the same suite.

When this happens the module which is unlicensed will show in a view mode, this is reflected in the session browser. An example of this is shown below.

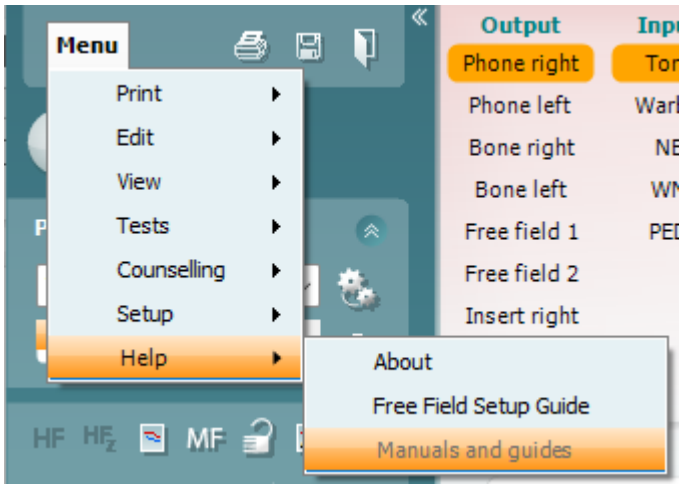
In the Audiometry Test list there will be a list of the tests which are unlicensed with a hover note ‘Only view mode’, to indicate when a test is unlicensed in your Suite but will still allow you access the test screen.



When you enter a test which is unavailable the HUD will be completely greyed out and the data is only permitted to be viewed and not interacted with.

1.3 Quick guides

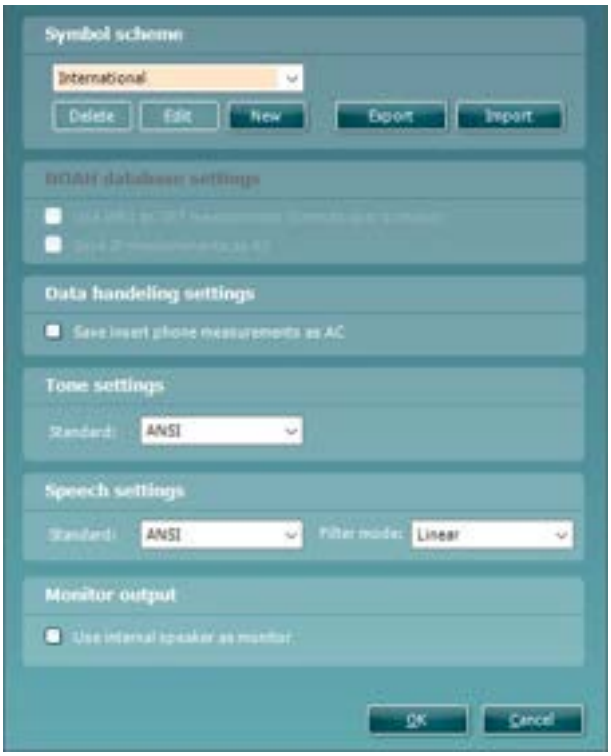
Several quick guides have been developed to support the users of the Equinox Evo, these can be found in your software by navigating to ‘Manuals and Guides’ in all modules of the software.



1.4 General setup

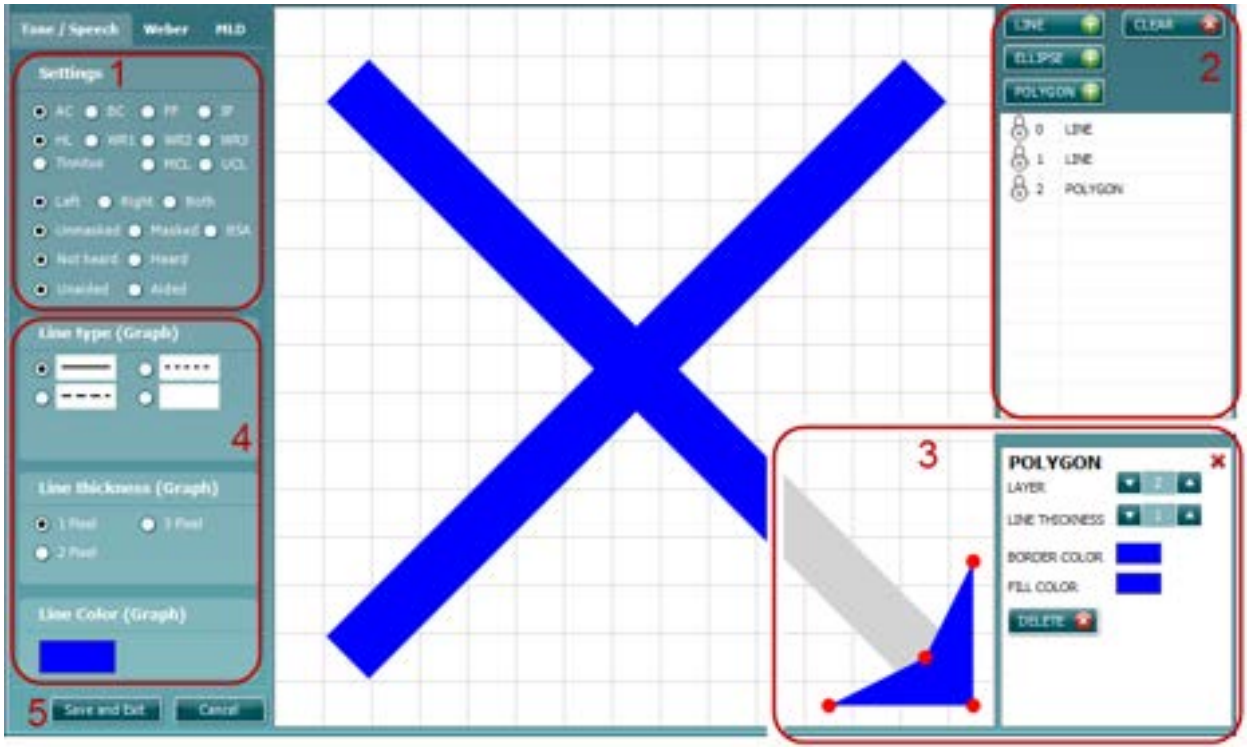
In the *General Setup* you can select overall settings which are valid for all tests and protocols.

To enter the General setup, select **Menu > Setup > General Setup.**



1.4.1 Symbol editor

You enter the symbol editor by either pressing **Edit** on an existing symbol scheme or by pressing **New** after which you are asked to type a name and select which of the existing symbol schemes should be your starting point for the new set.



Note: This screen contains three tabs (*Tone and Speech*, *Weber,* and *MLD*).

1) Select Tone/Speech, Weber or MLD tab. In the Tone/speech tab each combination of radio buttons stands for an individual symbol. It shows the following groups:

   AC, BC, FF and IP;

   HL, WR1, WR2, WR3, Tinnitus, MCL and UCL;

   Left, Right and Both;

   Unmasked, Masked and BSA

   Not heard and Heard

   Unaided and Aided

2) When pressing the **Line**, **Ellipse** or **Polygon** button a new element is added to the current symbol. The existing elements can be clicked for editing as well. Pressing Clear results in removing all elements of the current symbol.

3) The element options are shown when an element is selected. Now point with your mouse from where-to-where elements must be placed. Existing elements can be reshaped by dragging the red dots. A line thickness that shows well in the audiogram is thickness 50. The border of filled polygons is never plotted. When done editing an element press the red cross in the top right corner.

4) The *Line type*, Line *thickness* and *Line Color* options refer to the lines that connect symbols in an audiogram and apply to the currently shown symbol.

5) When done editing all symbols, press **Save and Exit** to store your results. Pressing **Cancel** results in disregarding all changes.

1.4.2 Noah database settings

The option **to 'Use WR1 as SRT measurement (German User Scenario)**' enables the data to be stored in a specific manner for third party EMR systems to read and display the speech test data as SRT thresholds.

The setting to '**Save IP measurements as AC**' allows the user to store all insert earphone measures as standard AC audiometry thresholds. This is useful specifically with some hearing aid fitting software which may not read the audiometry when inserts are used.

1.4.3 Tone and speech settings

1) Select your preferred *Standard* for **Tone settings**. The dropdown list allows you to choose between *ANSI* and *IEC*.

2) Under **Speech settings** use the dropdown list to choose the desired *Standard*. Choose between *ANSI, IEC, Sweden,* and *Norway*.

3) In *Filter mode* choose the preferred filtering *Linear, FF equiv.* (Free Field Equivalent) and *Non-linear*.

Linear	If choosing *Linear* the system will add filters giving the output of the transducer linear characteristics.
FF equiv.	If choosing *FF equiv* the system will add filters giving the output of the transducer free field characteristics.
Non-Linear	If choosing *Non-linear* you omit filters to be able to use a higher intensity for the speech testing. It will enable the system to go as high as 100 dB and if the *+20* button  is clicked to 120 dB

Note: If changing the standard for Tone or Speech, the AC440 must be re-started. If running under OtoAccess® also re-start the database.

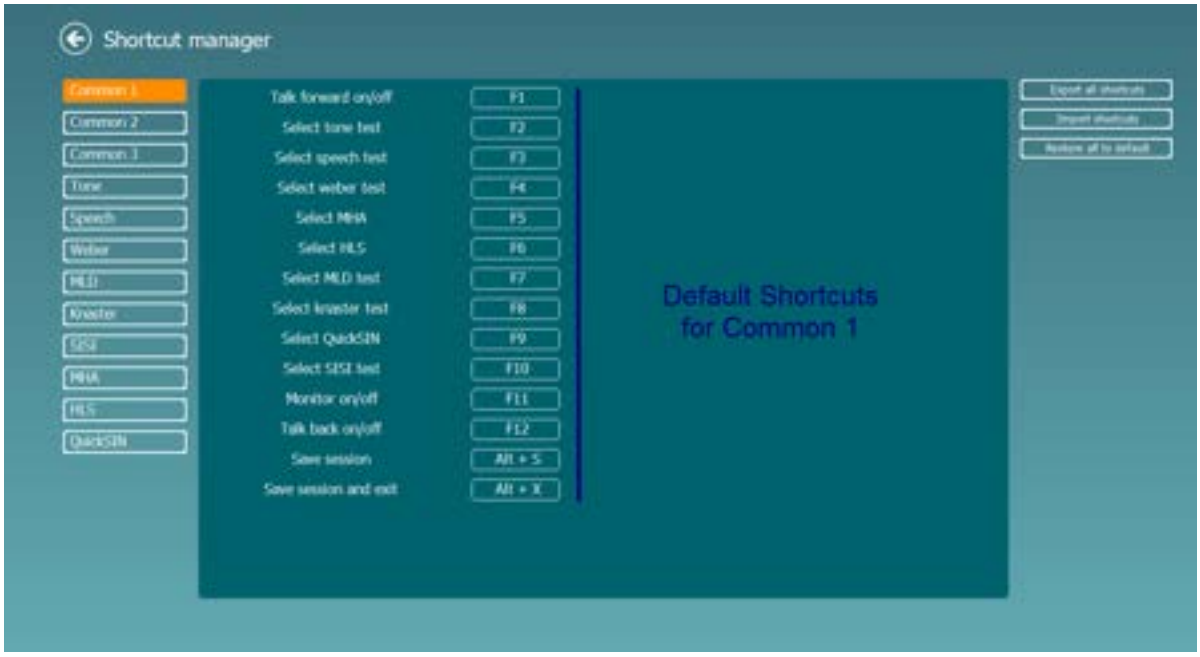
1.4.4 Monitor output

To use the internal speaker of the Equinox Evo as a monitor speaker you need to go into the General **Setup and enable the bottom check mark in the** Monitor output **section.**

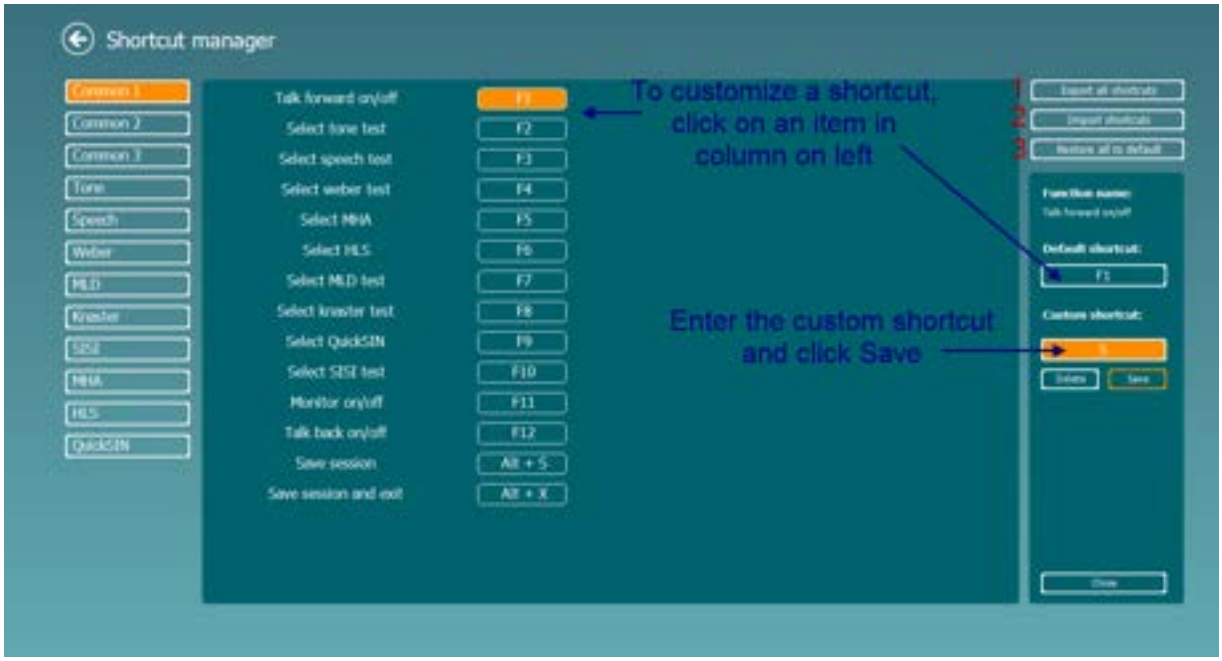
1.5 PC shortcut manager

The PC Shortcut Manager allows the user to personalize PC keyboard shortcuts in the AC440 Module. To access the PC Shortcut Manager, go to **Menu > Setup >PC Shortcut Keys** in the AUD module. It can also be accessed by pressing **Ctrl + Alt + Shift + S** simultaneously when in the AUD module.

To view the default shortcuts, click on the items in the left-hand column.



To personalize a shortcut, click on the column in the middle and add the custom shortcut in the field on the right hand of the screen.



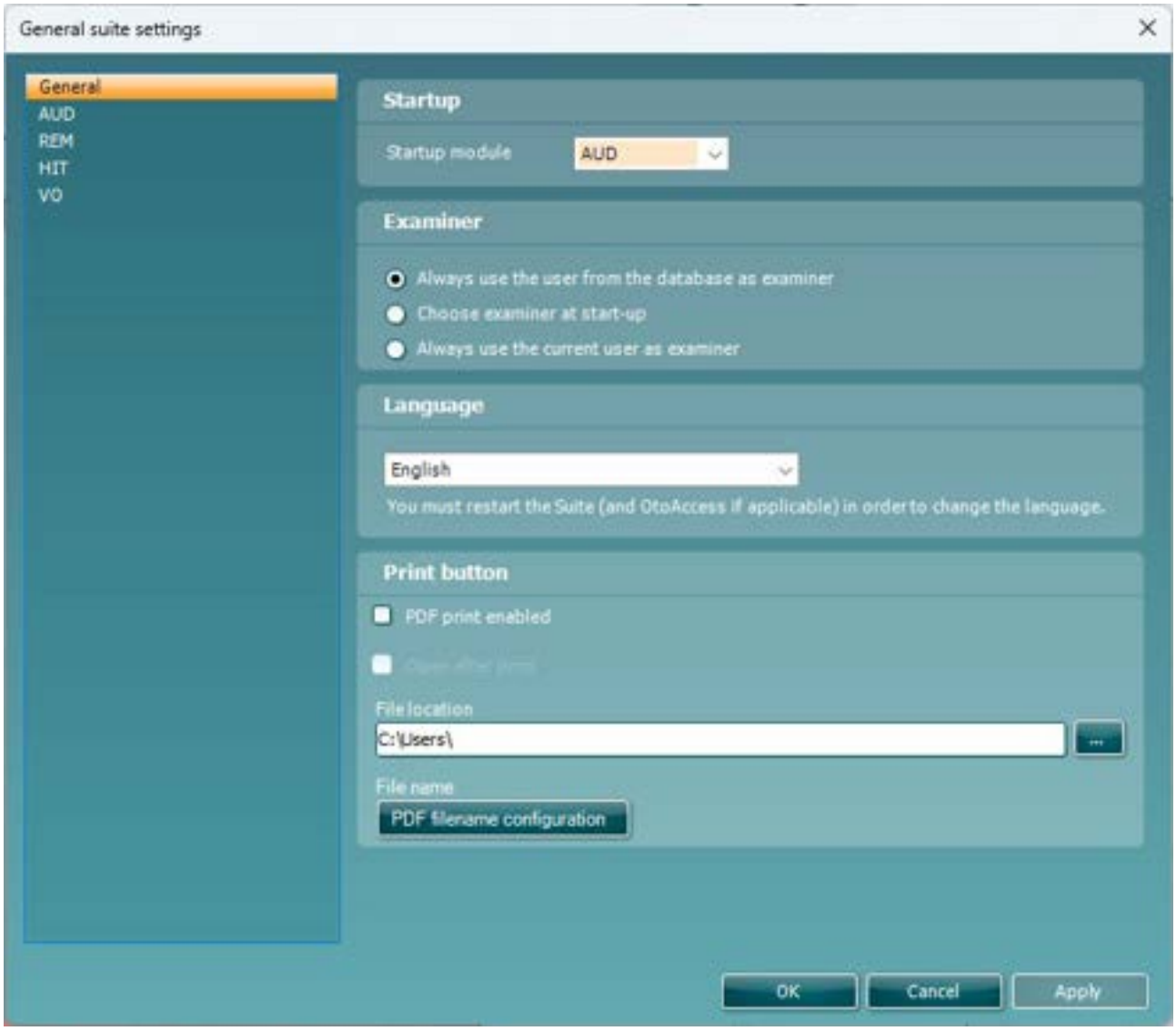
1) Export all shortcuts: Use this function to save custom shortcuts and transfer them to another computer.

2) Import shortcuts: Use this function to import shortcuts that have already been exported from another computer.

3) Restore all defaults: Use this function to restore the Factory Settings default .

1.6 General suite settings and examiner

In *General suite settings* you find setup items that apply to all modules of the suite. To enter the General Suite settings, enter **Menu > Setup > General suite settings**.



1.6.1 Start-up

Choose which module will be visible on starting up the Suite: AUD, REM, HIT or VO.

1.6.2 Examiner settings

At start-up the Suite by default sets the examiner identical to the user of the database through which the Suite was opened. However, when using Noah, you can choose to have the Suite prompting for the current user at start-up. **Note that database traceability features are lost or corrupted** when the examiner in the Suite is chosen differently from the database user.

You have the following options:

- Always use the user from the database as examiner.
- Choose examiner at start-up.
- Always use the current user as an examiner.

When choosing *Choose examiner at start-up* the window shown below pops up at start-up. By default, the last examiner is pre-selected.

Note that for each examiner a log file is stored on your local PC, that contains preferences regarding how the visuals of the Suite are being used. It is remembered which protocol was used last or which protocol is set as default start protocol. Also, the state of items that can be collapsed or hidden in the user interface are logged for each examiner.

You can print the examiner with your sessions.

1.6.3 Languages

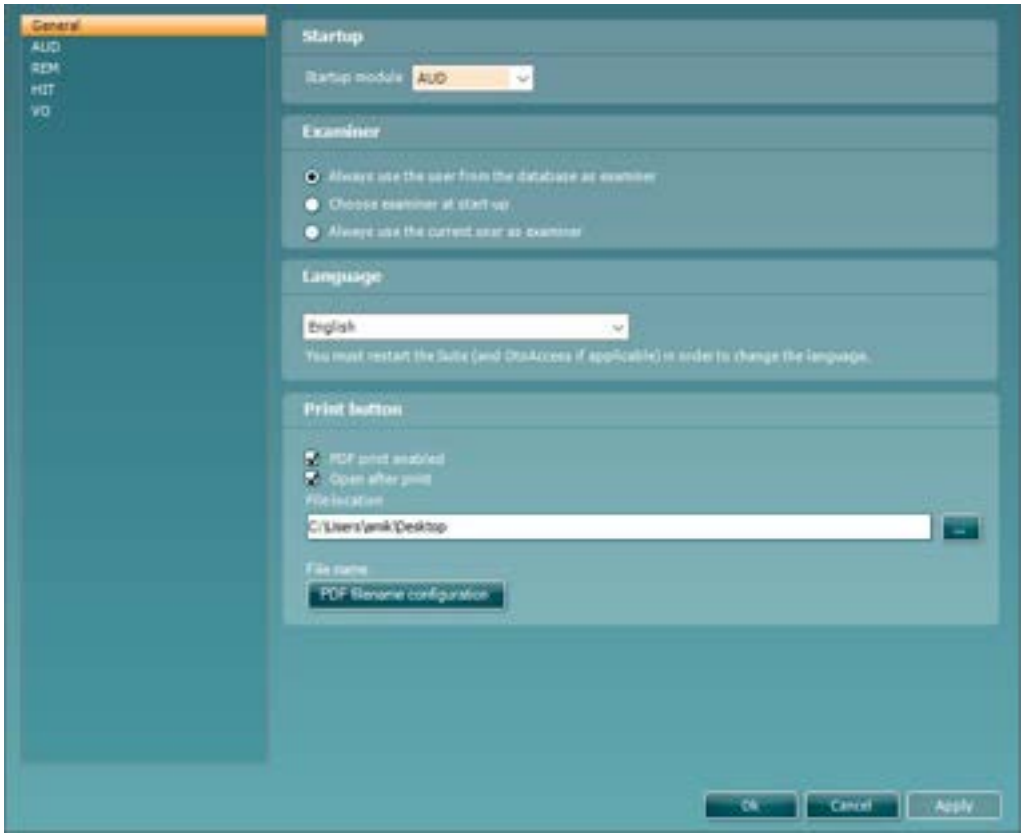
From the drop-down menu, choose the desired language. The available languages within the software are:

- Chinese (Simplified)
- Czech
- English
- Finnish
- French
- German
- Greek
- Italian
- Japanese
- Korean
- Norwegian, Bokmål (Norway)
- Polish
- Portuguese
- Russian
- Spanish
- Swedish
- Turkish

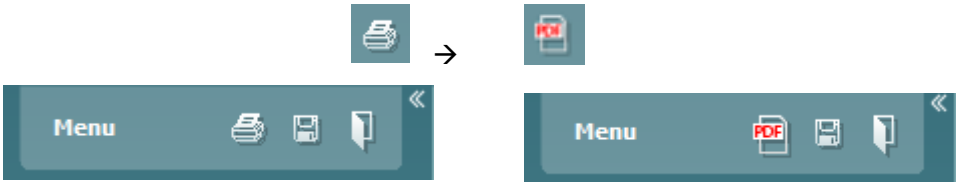
1.6.4 PDF print

The PDF Printing feature gives the ability to store a PDF file locally on the PC. This is a benefit for paperless documenting of patients test data and for sharing data with people who do not have the Interacoustics Suites. This feature is present for all modules of the Equinox Suite once enabled.

This setting can be enabled via **Menu > Setup > General suite settings**. This will then open the below window:



In the bottom section of this window, you can see the settings for the Print button. Checking ‘PDF print enabled’ will lead to the print button in the Suite to change as pictured below:



The other setting to ‘Open after print’ results in the file being opened for viewing once the PDF print button has been pressed.

Finally in this section you can specify where the PDF printed file is stored.

Note: Should you have PDF print enabled but you wish to print conventionally then you can still perform a physical paper print in the Suite by the following steps **Menu > Print > Print**.

1.7 Password protection

When password protection is enabled the following menu items are greyed out and therefore not be altered.

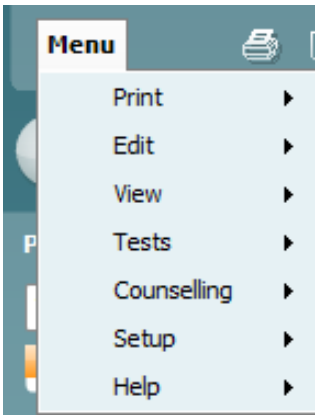
To activate or change a password, select **Menu > Setup > Password protection** and enter and confirm your password. In case no password was used previously you must leave the current password empty. You remove password protection by leaving the new password empty.

To temporarily disable the password protection, select **Menu > Setup > Unlock protection** and enter your password in the pop-up window.

The password and protection apply to all modules of the suite.

1.8 Menu

The AC440 Menu gives you access to **Print, Edit, View, Tests, Counselling, Setup,** and **Help**.

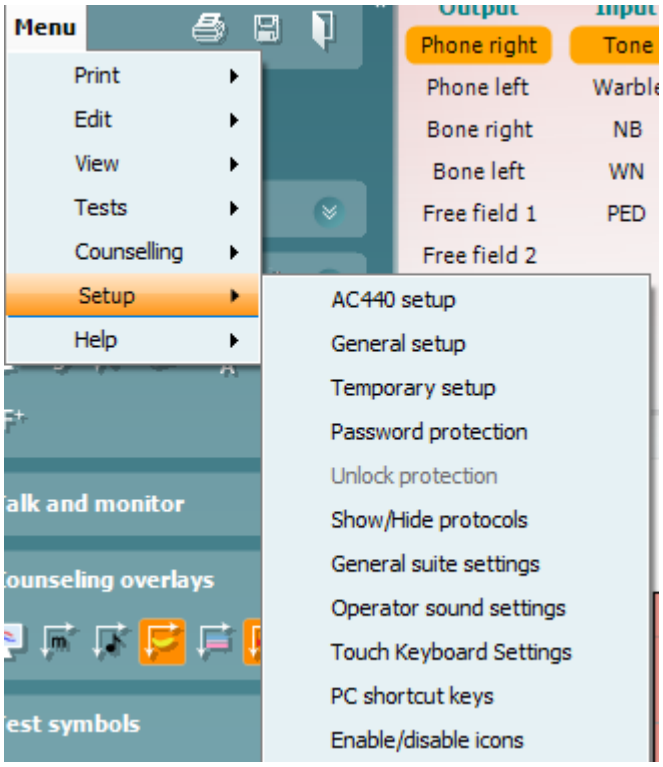


- **Menu > Print > Print** will prompt the system to print using the selected print template (see section 4.1)
- **Menu > Print > Print preview** prompts a print preview of the current protocol using the print template which is linked to the current protocol. Note that you are prompted to select a template if the protocol did not include a template (see how to create a print layout in section 4.1.1)
- **Menu > Print > Print layout** opens the print wizard window from where you can select or create a template to print the current protocol (see section for details regarding the Print Wizard 4.1).
- **Menu > Edit > Transfer to current session** will move a currently viewed historical audiogram to the current session.
- **Menu > Edit > Export** will prompt the system to export the session as an XML formatted file.
- **Menu > Edit > Swap audiometric data from ears** allows you to swap data from right to left and left to right for the current test only.
- **Menu > View > Reset visual settings** sets all user interface settings back to default (as they appear for a new user).
- **Menu > View > Save current window position** saves the position of the AC440 window on the PC screen so that it will open at this exact position every time. This is for example practical if running other software modules at the same time.
- **Menu > Tests > Tone** opens the Tone test
- **Menu > Tests > Speech** opens the Speech test
- **Menu > Tests > Weber** opens the Weber test
- **Menu > Tests > SISI** opens the SISI test[1]
- **Menu > Tests > MHA** opens the MHA screen[2]
- **Menu > Tests > HLS** opens the HLS screen[3]
- **Menu > Tests > QuickSIN** opens the QuickSIN test[4]
- **Menu > Tests > Tone Decay** opens the Tone Decay test[5]
- **Menu > Tests > ANL** opens the ANL test

[1] The SISI test requires an additional software license.
[2] MHA requires an additional software license.
[3] HLS requires an additional software license.
[4] QuickSIN requires an additional software license.
[5] Tone Decay requires an additional software license.

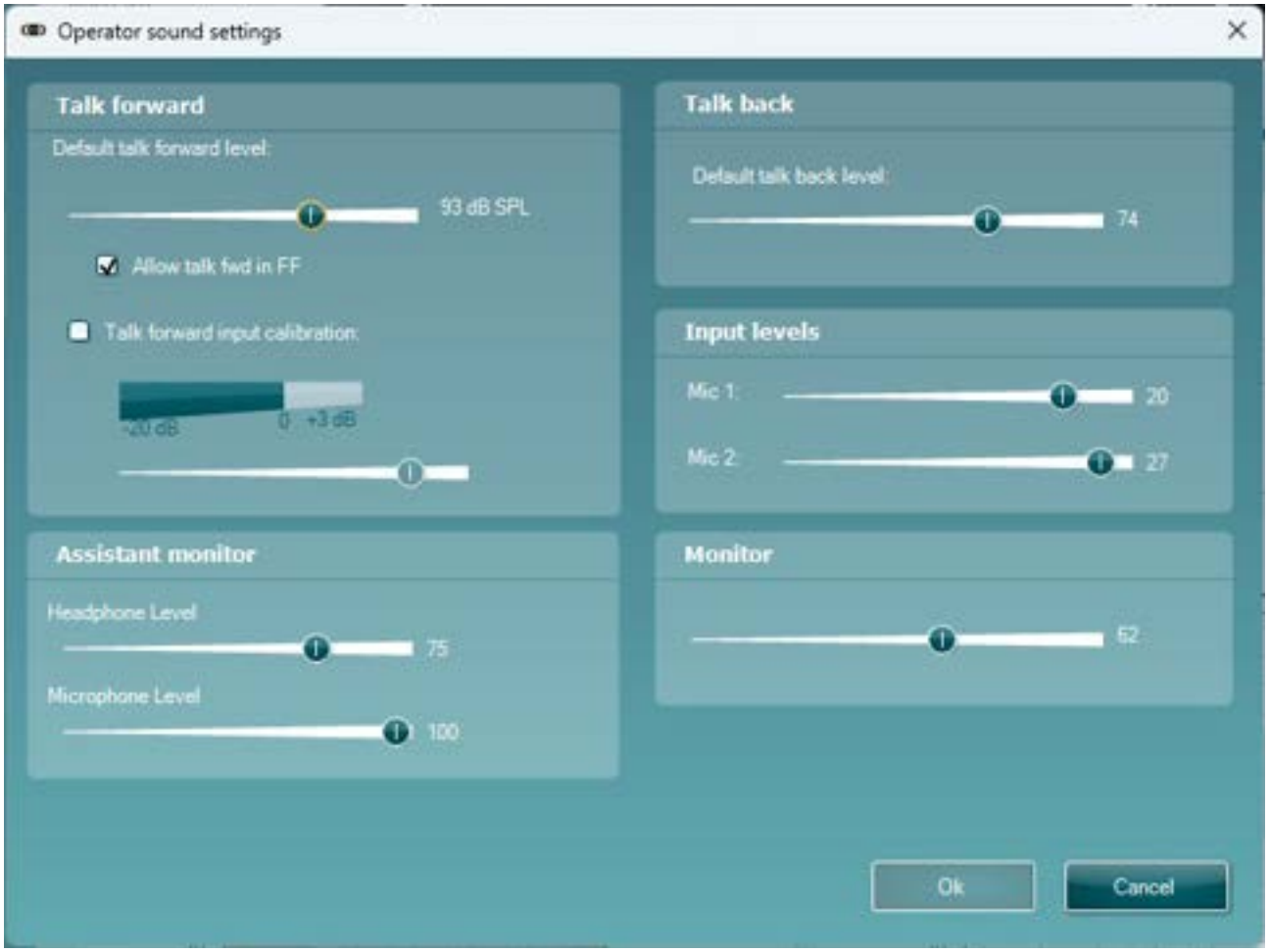
- **Menu > Tests > SIQ** opens the SIQ test
- **Menu > Tests > SIN** opens the SIN test
- **Menu > Counselling > Sound Studio** launches SoundStudio if installed

1.8.1 Menu > Setup >...

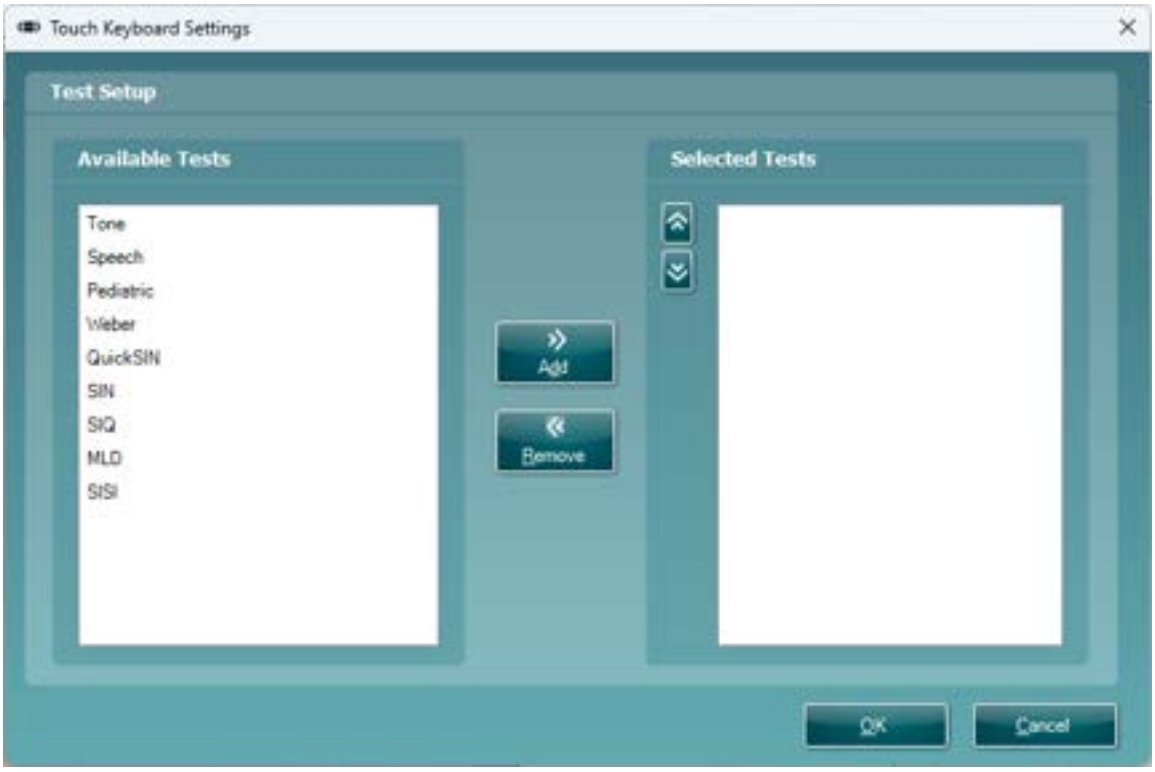


- **… AC440 setup** opens the AC440 where you can setup customized test protocols (see section 1.10 for details)
- **… General setup** opens the General setup where settings valid for all tests can be selected (see section 1.6 for details)
- **… Temporary setup** opens the Temporary setup where temporary settings for the specific session can be selected (see section 1.10.20 for details)
- **… Password protection** allows you to create or change a password and thereby protect your AC440 settings (see section 1.7).
- **… Unlock protection** allows you to temporarily disable password protection (see section 1.7).
- **… Show/hide protocols** bring forth a screen allowing you to select test protocols which are to be shown in the *List of defined protocols* and deselect the test protocols which are to be hidden.
- **…General suite settings** open the General suite settings in which items are found that apply to all modules (see section 1.6). It is also here where the language for the Suite can be selected. The system must be restarted for a new language selection to take effect.

- **… Operator sound settings** open the Operator sound settings allowing you to change talk forward and talk back settings, monitor and assistant monitor levels without the need of having these permanently locked within the protocol.



- **… Touch Keyboard settings:** Select here which tests need to be available on the Touch Keyboard (optional accessory) and the order in which they are presented.



- **… PC Shortcut Keys** opens the PC shortcut manager, where the clinician can customize PC shortcuts from the default if desired.
- **… Enable/Disable icons** lets you select the icons you wish to see in the Suite.
- **Menu > Help > About** prompts a message box showing information regarding *Suite version, Hardware version,* and *Firmware version*. Please note that if you are experiencing problems with the system this information should be sent to the manufacturer along with the description of the issue.

Note: Press **License** to be able to type in a new license code.

1.9 Protocol settings

There are many different demands and wishes regarding how an audiometer should both function and appear depending on the specific situation and national standards. One of the greatest advantages of the AC440 module is the flexibility enabling you to tailor the Suite according to your specific preferences in the so-called “test protocols”. These test protocols are created in the AC440 setup which will be described in this section.

This manual will cover the use of factory/standard test protocols as well as how to create individual test protocols for different purposes or different clinicians working in the same facility.

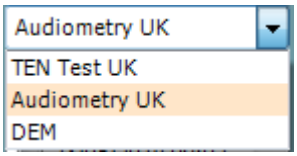
The following sections describe the setup options for all tests even though you most likely will only need to set up a few. This chapter should be seen as a work of reference where single functions can be looked up rather than a step-by-step guide.

1.9.1 Selecting a test protocol

1) Open the AC440 from your patient management system, Noah, OtoAccess® or via stand-alone.

2) Go to the AC440 Setup by following **Menu > Setup > AC440 Setup**

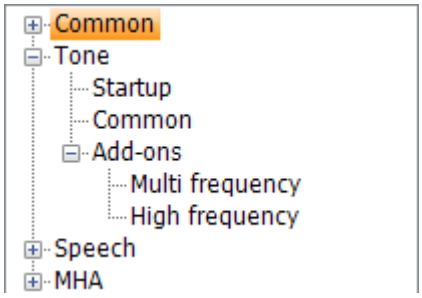
3) In the **List of protocols,** both factory test protocols with standard/factory test parameters and personalized test protocols can be accessed and selected from the list (e.g.,”AC440” and “Joan Jones”).



Note: Certain test protocols may be hidden from this test protocol selection using the *Show/Hide protocol* function found under **Menu > Setup > show/hide protocols**

About the AC440 setup:

In the AC440 Setup tests will be listed to the left. Unfold each menu to access its options. Each test contains the following options:



Start-up: These are the settings for which the test will start up

Common: Allows for setting up more general settings of the specific test

Add-ons: Allows for setting up add-on features/subtests if available for a test. These require a special licence.

Note: Some setup screens contain more than one tab offering multiple user controls.

In each setup screen you will find three buttons in the lower right corner:

Clicking **OK** will close the AC440 setup and save all changes.

Clicking **Apply** will save changes but without closing the AC440 Setup. The change will, however, immediately be active and visible on the screen behind the setup dialog.

Clicking **Cancel** will close the AC440 setup without saving any changes made.

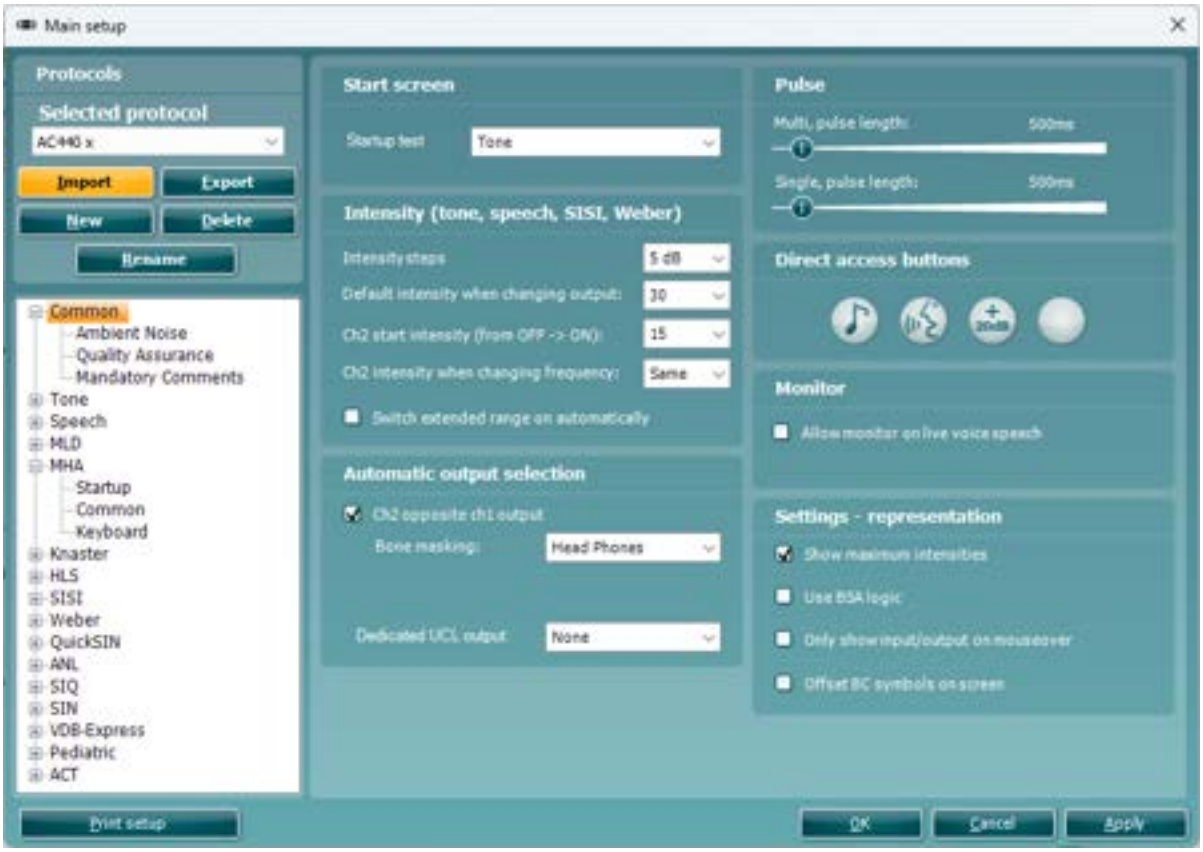
1.9.2 Creating new protocols

1) Click **Menu > Setup > AC440 setup** to enter the Main setup.

2) Click **New** to create a new test protocol and fill in the *Name* field (e.g., *"Joan Jones"*).

1.9.3 Common setup

1) The specifics of the test can be selected starting in the *Common* screen shown below:



2) Choose in which test the system should begin under **Start Screen**. Note that *MLD* is greyed out since it can only be performed after obtaining the hearing thresholds.

   Note: Some tests are purchased as additional licenses for the AC440. If a license has not been purchased, the test will be greyed out in the start screen selection, and it will not be shown in the 'test tree' of the protocol settings.

3) Select the default start **Intensity (Tone, Speech, SISI, Weber)**. Use the dropdown lists to select the preferred settings. Checking *Switch extended range on automatically* allows the user to go to high intensities without the need for manual activation of the extended range. The extended range opens automatically as soon as the cursor moves into that area of the audiogram.

4) In the **Automatic output selection,** the *Ch 2 opposite Ch 1 output* can be ticked. This way channel 2 will automatically choose the opposite output as channel 1 (e.g., if channel 1 is set to *Right*, channel 2 will automatically select *Left*). At *Bone masking:* the user sets which transducer is chosen by default to mask bone measurements. This option will not be active if *Ch 2 opposite Ch 1 output* is not used.

5) Adjust the **Pulse** of the test signal. If *Multi Pulse* or *Single Pulse* are selected the pulsation length (in mS) can be adjusted using the sliders. Note the option to add multi or single pulse in the front screen (as shown on the graph).

6) Direct Access Buttons: right click on the buttons to decide which direct access buttons appear on the main AC440 screen. Up to 4 buttons can be displayed.

7) If desired, allow **Monitor** on live voice speech. This function is rarely necessary as it is likely to cause acoustic feedback. However, if the test is performed under circumstances where this is not the case, monitoring of live voice can be allowed by ticking the check box.

8) Under **Settings – representation** tick *Show maximum intensities*. This will allow for showing/not showing the transducer maximum intensities in all tests. This is the dark shaded area on the graph that can in the tone audiogram be (de)activated by the dedicated button under *Counselling overlays*  .

9) *Use BSA logic* forces the audiometry to use symbols according to the standards of the British Society of Audiology (BSA).

10) *Only show input/output on mouseover* will hide the not selected input and output options while the mouse is not over it and results thereby in a calmer screen.

 ←→ 

11) *Offset BC symbols on screen* allows for the BC icons to be offset from the central lines indicating their frequency – this is purely to allow simpler identification of ear side BC values when they are displayed as a single Audiogram.

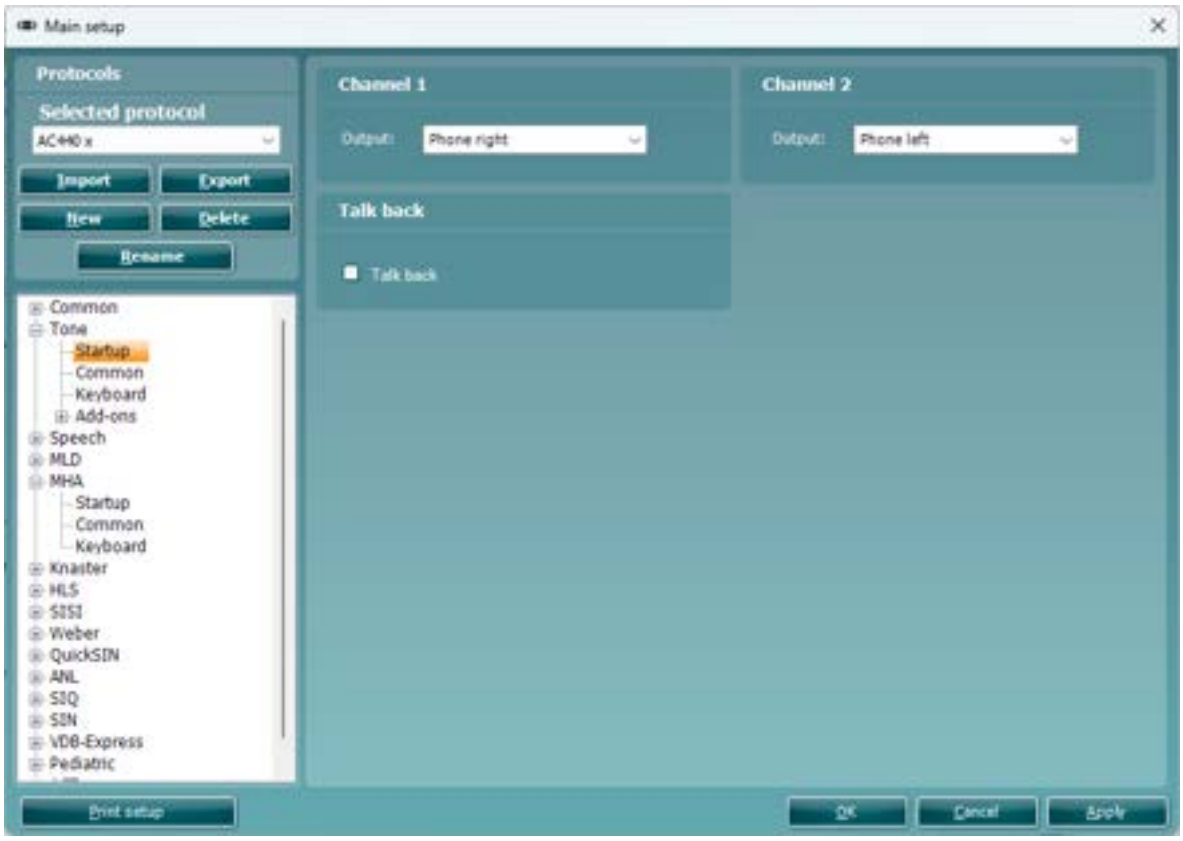
If you expand the Common settings, you will have the option to adjust settings for general common settings, Ambient Noise, Quality Assurance and Mandatory Comments.

Mandatory Comments allow you to enable a setting which forces the user to comment on the test session when saving the session. This is to ensure relevant session comments are provoked to be stored alongside the session data.

1.9.4 Tone testing setup

Start-up

1) To enter the *Start-up* options for tone testing unfold the **Tone** options and click *Start-up*.

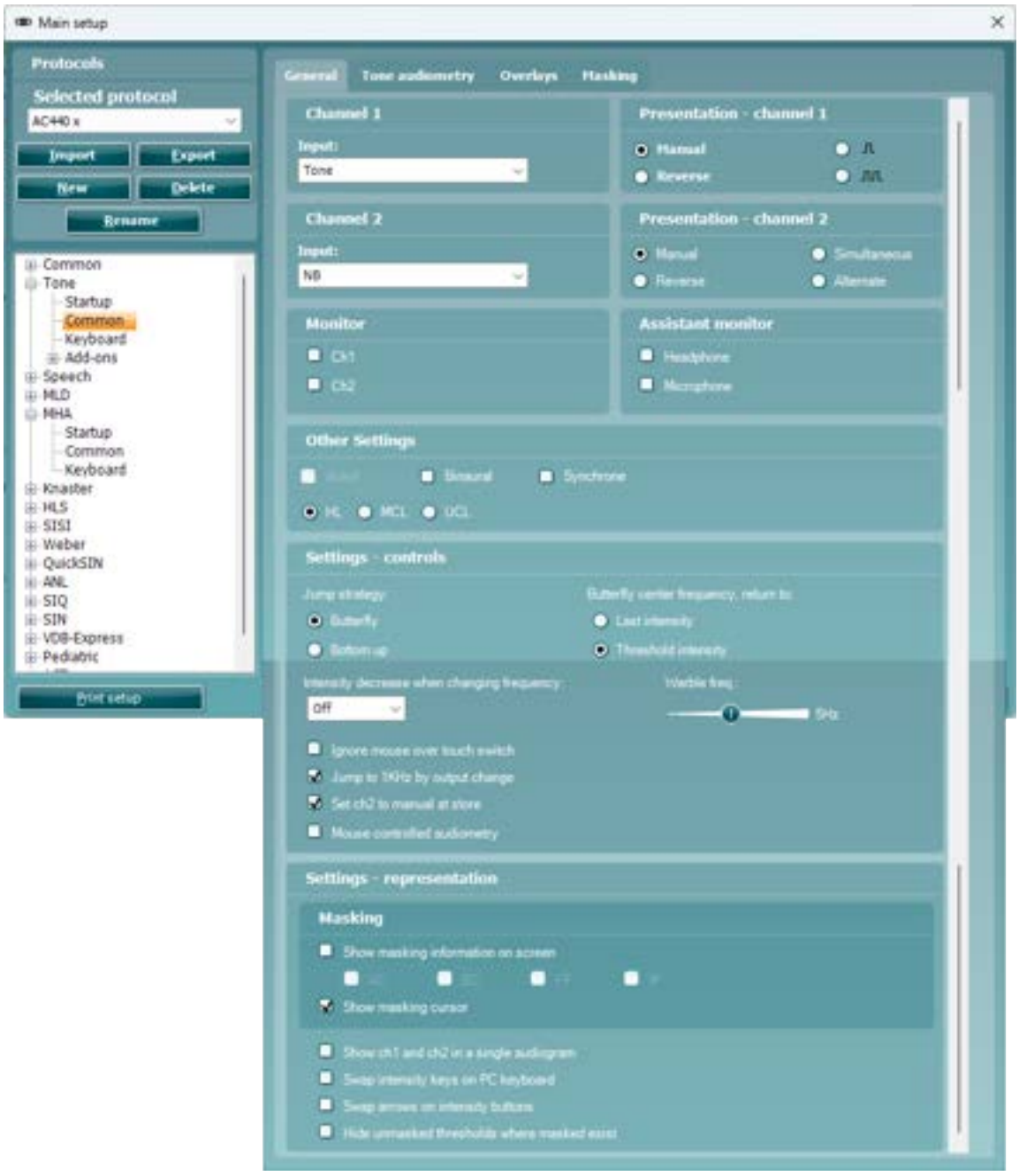


2) Default *Output* of **Channel 1** and **Channel 2** can be selected from the two dropdown lists. The selection will differ depending on which transducers are calibrated.

3) The **Talk back** can be activated by ticking the check box.

Common:

4) To enter the *Common* options for tone testing unfold the **Tone** options and click *Common.* Here you can adjust some of the more frequent tone audiometry settings, starting with the **General** settings.



Note: This screen contains four tabs (*General*, *Tone audiometry, Overlays* and *Masking*).

5) Default input for **Channel 1** and **Channel 2** can be set using the dropdown lists. Select between *Tone, Warble tone, NB* (Narrow Band noise), and *WN* (White Noise) for both channels.

In addition, *TEN Noise* can be selected for channel 2 (if purchased). See more information about the TEN test in Appendix 1.

Channel 1 and **Channel 2 Presentation:** You have the option to tick *Manual* so that the stimulus is only presented when manually activated. Ticking ***Reverse*** will cause the signal to be presented continuously, only disappearing when the stimulus is activated.

Single Pulse and ***Multi Pulse*** presentation for channel 1. The duration of the stimulus can be adjusted in the common options described above. Furthermore, you may wish to have presentation on both channels and tick ***Simultaneous*** which will lock channel 1 and channel 2 together, or have the presentation on the two channels alternating to each other and tick ***Alternate.***

6) Under **Monitor** one or both channels may be ticked if monitoring is preferred. The level of the monitoring can be set using the slider.

7) In **Other settings** you can tick *Aided* if audiograms usually are obtained with hearing aids and/or *Binaural* if both ears are tested at the same time. Both aided and binaural measures are stored as separate thresholds.*HL* (Hearing Level), *MCL* (Most Comfortable Level) or *UCL* (Uncomfortable Levels) may also be ticked depending on your preference. These are also stored as separate thresholds.

8) **Settings**

   a. *Ignore mouse over touch switch* which will make AC440 ignore the cursor touching the stimuli area in the front screen. Instead, you will need to present the stimulus manually using the PC keyboard or an audiometer keyboard.
   b. When ticking *Jump to 1 kHz by output change* the cursor will jump back to test 1 kHz upon output changes.

9) The *Jump strategy* contains three different options:

Butterfly	The cursor will start at 1kHz and move upwards in frequency as the thresholds are stored. After testing the high frequencies, the cursor will move back to re-test 1kHz and move downwards. When jumping back to 1kHz the Butterfly strategy can be set to start the re-test at either the default start intensity or the intensity of the first threshold.
Bottom up	The cursor will start at 1kHz and move upwards. When the high frequencies are tested, the cursor will jump to the lowest test frequency and move upwards towards 1kHz.
None	Frequencies are changed manually using the arrow buttons in the main screen, the PC keyboard, or the dedicated keyboard.

10) For *Intensity decrease when changing frequency*, choose the level to decrease to when changing the test frequency, using the drop-down menu.

11) By activating *Set ch2 to manual after store*, you assure that masking is automatically switched off when storing a point and jumping to the next frequency.

12) Ticking mouse controlled audiometry will allow audiometry to be performed using the mouse.

13) If testing with warble tones the frequency of the warble tones can be adjusted in the *Warble Frequency* slider. This may for example be helpful if testing patients with tinnitus.

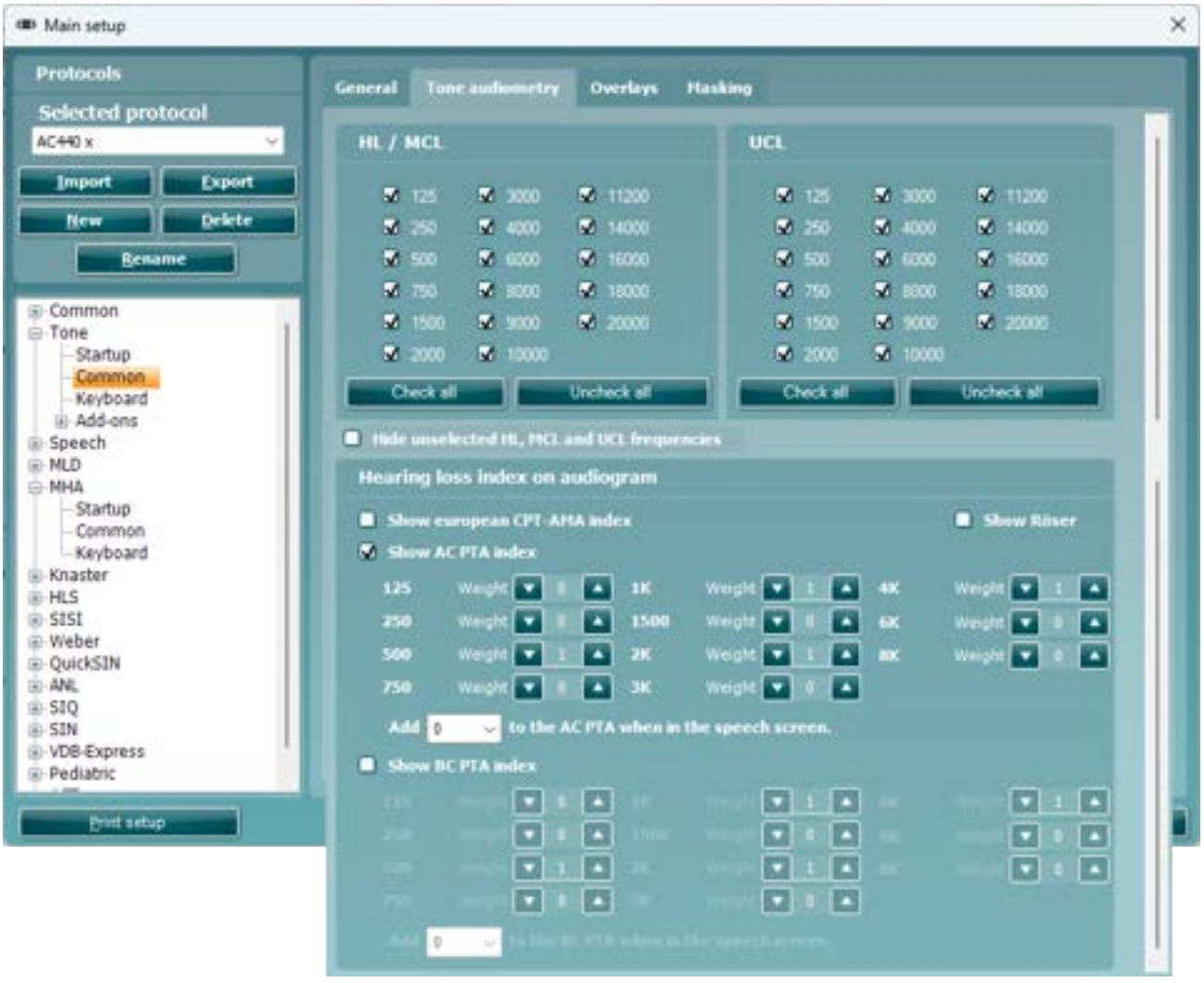
14) Under **Masking** in ***Settings – representation***: Tick *Show masking information on scree*n if you want the masking intensity for every threshold to be visible on screen. You may choose to see the masking information for air conduction (*AC*), bone conduction (*BC*), free field (*FF*) and insert phones (*IP*).

    If ticking *Show masking cursor,* a cursor indicating the masking level will be visible on channel 2.

15) Tick *Show Ch1 and Ch2 in a single audiogram* to show a single audiogram by default.

16) Choose *Swap intensity keys on PC keyboard* and *Swap arrows on intensity buttons* to change the direction when adjusting intensity and frequency.

17) *Hide unmasked threshold where masked exist* will only display the masked (i.e., real) thresholds by default. This option can also be selected by right mouse click on the audiogram.



18) Under the **Tone audiometry** tab, you can select the desired test frequencies for **HL/MCL** and **UCL** by ticking the preferred frequencies. Use the *Check all* or U*ncheck all* buttons to help if needed.

If the unselected frequencies are <u>not</u> to be visible on the graph, then also tick *Hide unselected HL, MCL and UCL frequencies*. This way only the selected frequencies will appear on the audiogram.

19) The **Hearing loss index on audiogram** allows for ticking *Show European CPT-AMA index*, *Show AC PTA index* or *Show BC PTA index*. The European CPT-AMA is calculated using the values from the table below which ensures that the different frequencies are weighted to display a correct quantification of impairment due to the hearing loss. The dropdown menu below these settings for PTA index indicate the number of additional decibels you wish to add to the threshold when entering speech for the initial stimulus level.

HV* (dB)	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**
10	0.2	0.3	0.4	0.1
15	0.5	0.9	1.3	0.3
20	1.1	2.1	2.9	0.9
25	1.8	3.6	4.9	1.7
30	2.6	5.4	7.3	2.7
35	3.7	7.7	9.8	3.8
40	4.9	10.2	12.9	5.0
45	6.3	13.0	17.3	6.4
50	7.9	15.7	22.4	8.0
55	9.6	19.0	25.7	9.7
60	11.3	21.5	28.0	11.2
65	12.8	23.5	30.2	12.5
70	13.8	25.5	32.2	13.5
75	14.6	27.2	34.0	14.2
80	14.8	28.8	35.8	14.6
85	14.9	29.8	37.5	14.8
90	15.0	29.9	39.2	14.9
95	15.0	30.0	40.0	15.0
100	15.0	30.0	40.0	15.0

If selecting the PTA index, you can choose the frequencies that should be included in the calculation. The default setting will be 500, 1000, 2000, and 4000 Hz (Fletcher index). In this calculation method all frequencies are equally weighted and averaged to give the figure.

A further example of the Fletcher index is as follows:

$$\frac{\text{500Hz Threshold + 1kHz Threshold + 2kHz Threshold + 4kHz Threshold}}{4} = \text{PTA Score}$$

Should one of the frequencies have a double emphasis then the following calculation will be applied.

$$\frac{\text{500Hz Threshold + (2 x 1kHz Threshold) + 2kHz Threshold + 4kHz Threshold}}{5} = \text{PTA Score}$$

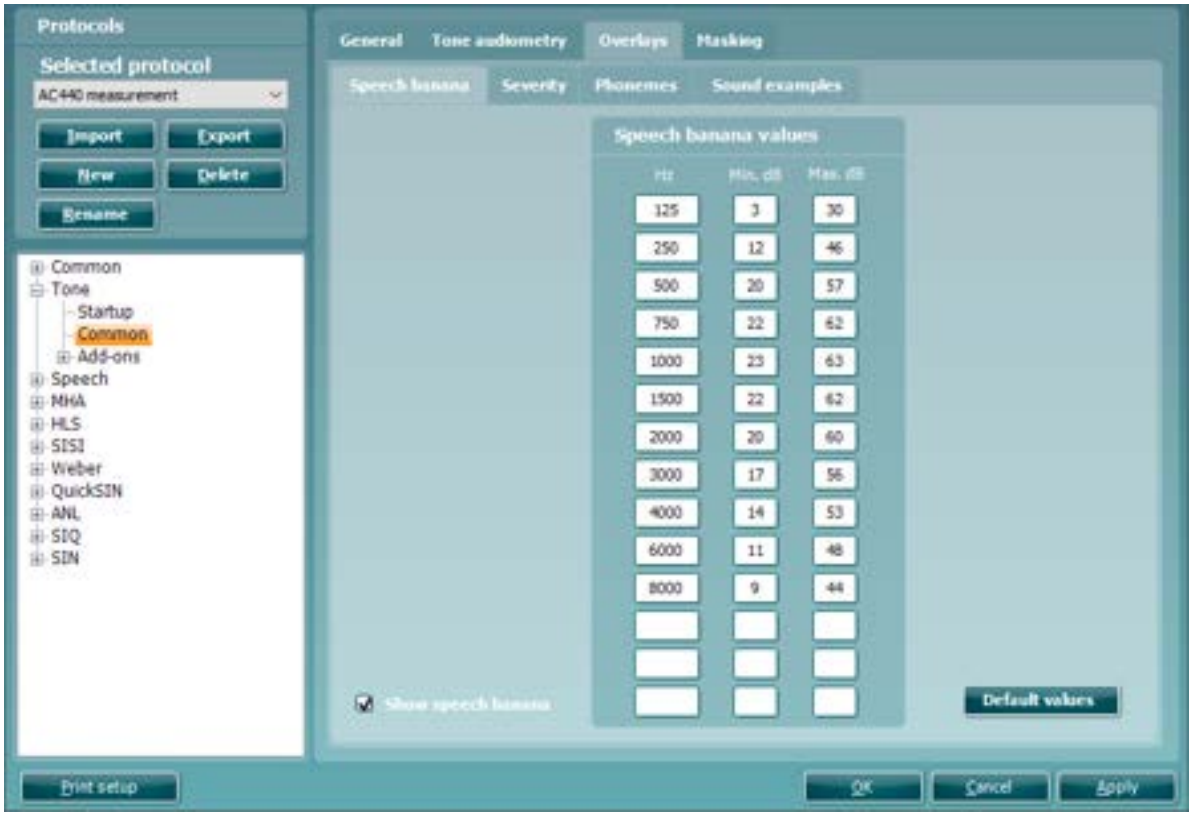
The PTA index calculation is used to give an average hearing level value to allow categorization of the patients hearing loss shown on the audiogram. This score is used in certain markets to determine whether hearing rehabilitation should be reimbursed by their government/public funding or not (should it reach a certain threshold/value). This calculation can be configured as there are different frequency emphasis in certain languages/market, for example some countries have their own calculation which includes a double emphasis of 1kHz.

In addition to an AC PTA index, you can also calculate a BC PTA index. The settings in this screen are an exact replication of the settings and application used in the AC PTA index, but the calculation will now be made for BC thresholds.

The PTA index also provides the option to add a certain level to the result using the dropdown list.

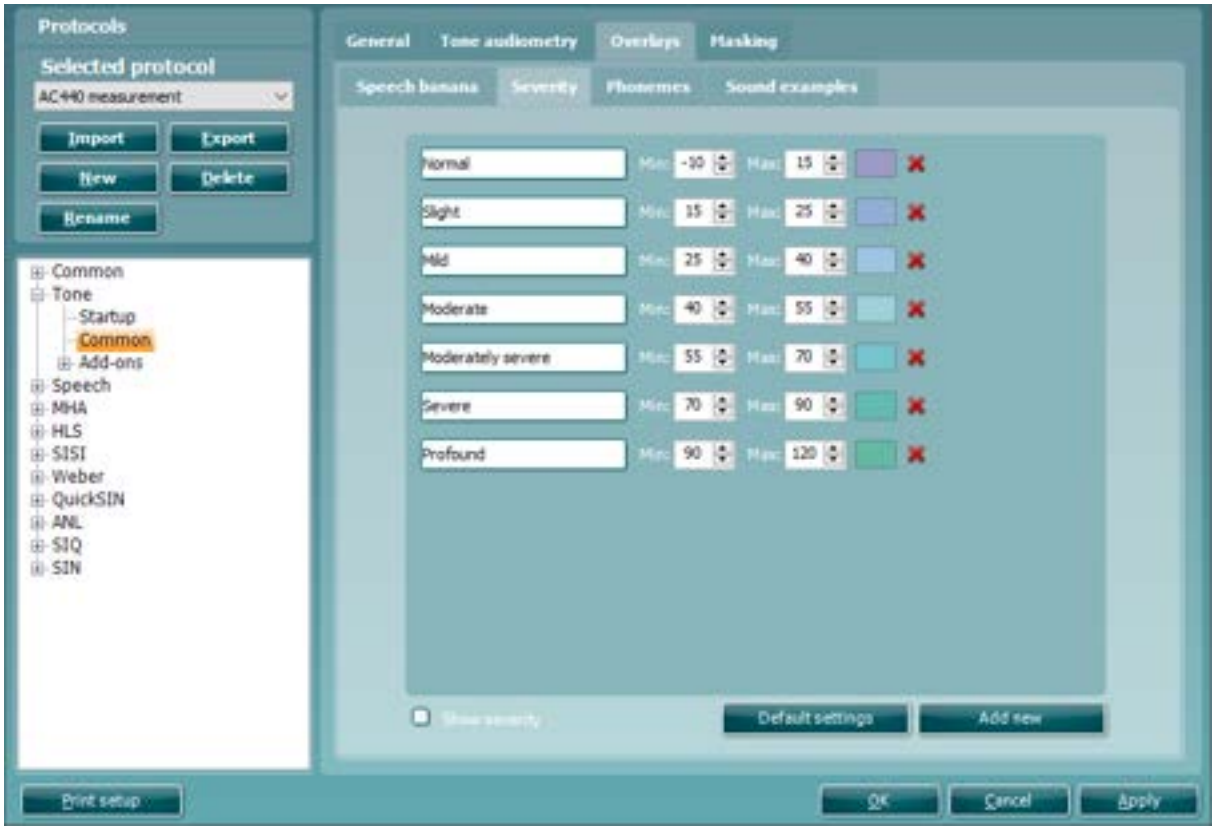
This is useful since the PTA is often used to determine the start intensity for speech testing. If you prefer to start the speech test at for example15 dB above PTA, this can be selected in the dropdown list:

Note: The PTA is calculated for insert phones and headset. However, if values for both are stored, no PTA value is calculated.



20) Since the speech banana is language dependent the AC440 allows for entering individual speech banana values. Enter your values for the upper and lower margin of the speech banana under **Top part of banana** and **Bottom part of banana**.

21) For counselling purposes, you can tick *Show speech banana* in the **Speech Banana** tab. This allows for a speech banana view in shading in the audiogram screen. In the tone audiometry test screen, the dedicated button under *Counselling overlays,*  , also allows for (de)activating the speech banana.

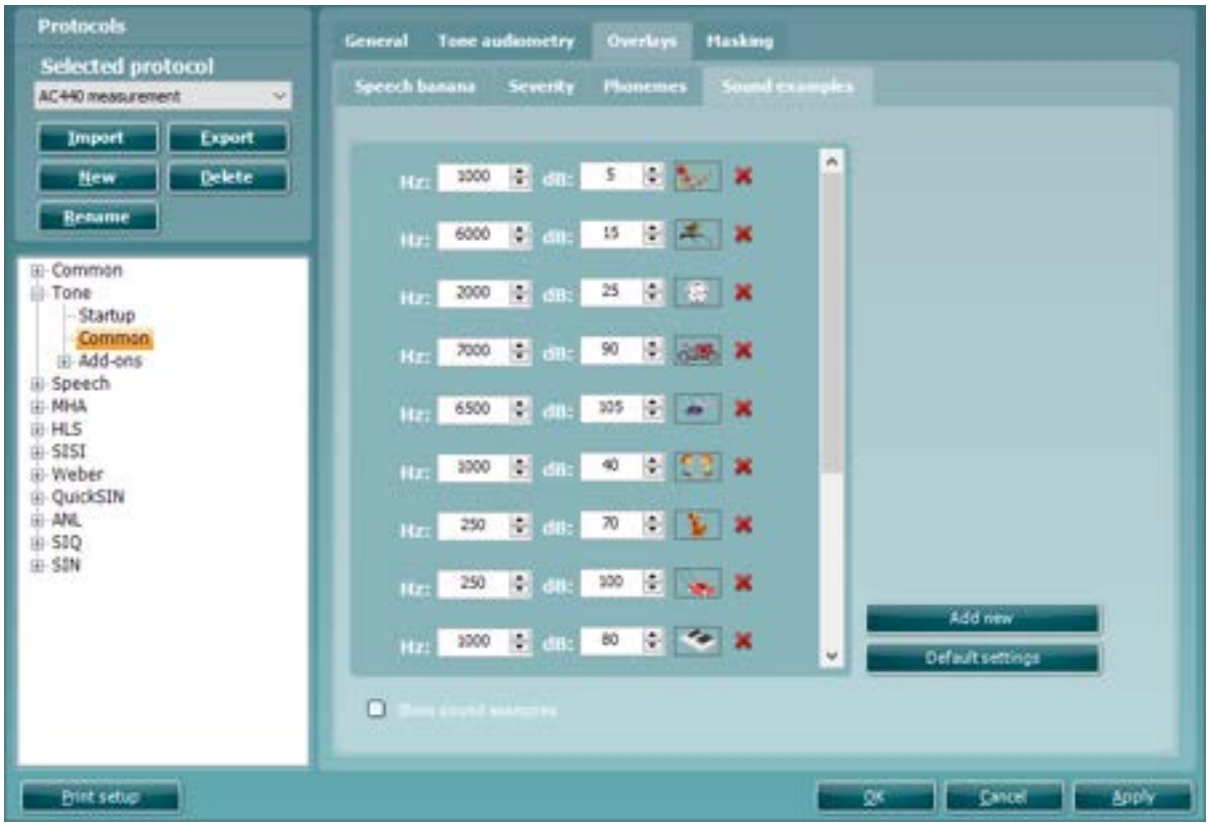


22) A **Severity** indication can be set up by defining the label, minimum and maximum dB, and color for each indication in the audiogram.

23) For counselling purposes, you can tick *Show severity* in the **Severity** tab. This allows for severity indications in the audiogram screen. In the tone audiometry test screen, the dedicated button under *Counselling overlays,*  , also allows for (de)activating the severity indications.

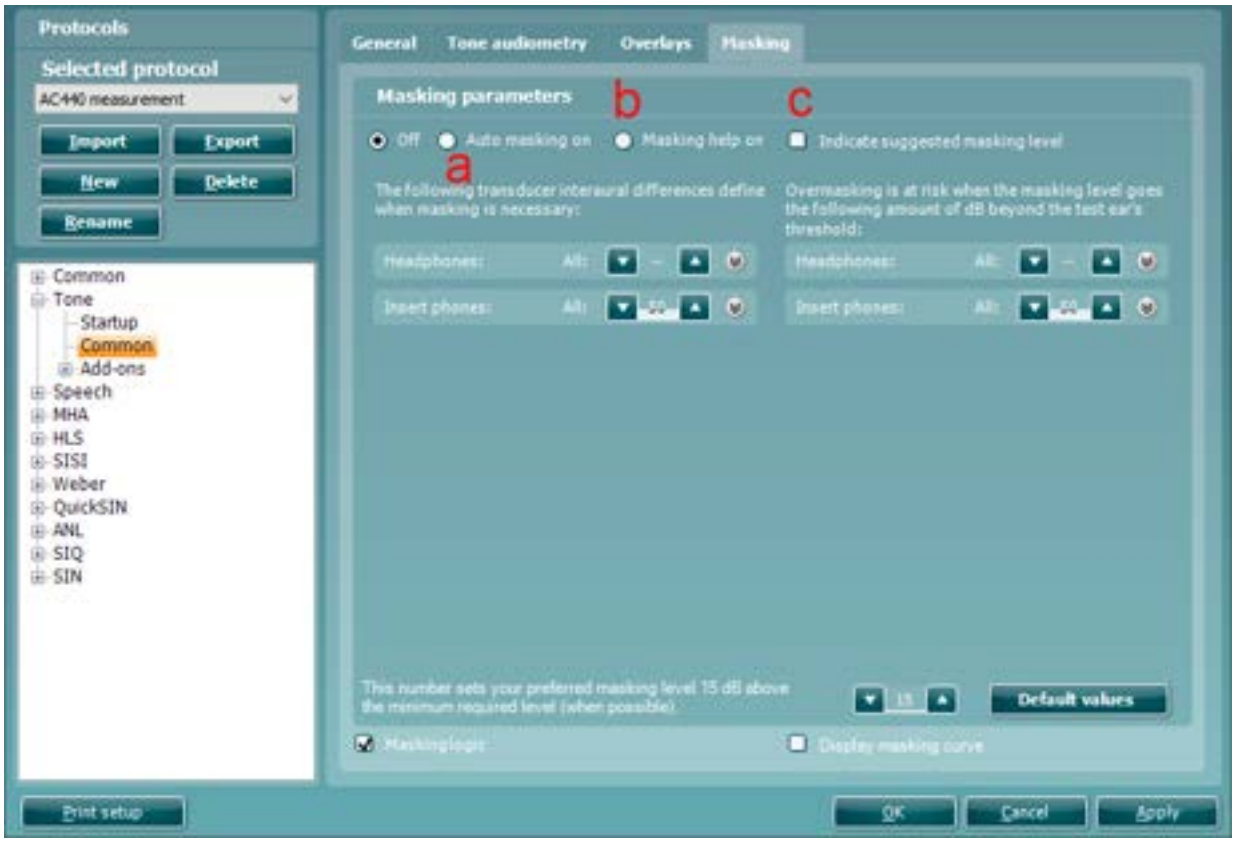
24) The **Phonemes** to be shown in an audiogram can be set up by defining the labels and positions of all phonemes. Indicate how the font size should appear on screen.

25) For counselling purposes, you can tick *Show phonemes* in the **Phonemes** tab. This allows for phonemes in the audiogram screen. In the tone audiometry test screen, the dedicated button under *Counselling overlays,*  , also allows (de)activating the phonemes.



26) The **Sound examples** to be shown in an audiogram can be set up by defining the positions of all examples. When adding a new picture, you are asked to point out where the picture can be found. Note that the file type must be *.png to allow transparent background colors.

27) For counselling purposes, you can tick *Show sound examples* in the **Sound examples** tab. This allows for sound examples in the audiogram screen. In the tone audiometry test screen, the dedicated button under *Counselling overlays,*  , also allows (de)activating the sound examples.



28) **Masking** Tab: In this section, the tester can decide if Automasking or Masking Help should be turned on. The user can also change the interaural differences as well as the default values for over masking.

a. Auto masking on: masking will start automatically where required

b. Masking Help on: a light on channel 2 will indicate if masking is required and whether there is undermasking or overmasking occurring

c. Indicate suggested masking level: will suggest the masking level that should be used

In this section the user can configure their Automasking feature by adjusting the interaural difference levels depending on the transducer selected. They can also adjust the level at which the transducer will be overmasking.

Audiometer Keyboard (additional accessory):

The screen display (shown below) allows you to set up most of the keyboard buttons according to individual preferences. Multiple functions can be added to a single button and if done so all commands are executed when the keyboard button is pressed. Some functions have additional options after they are added to a keyboard button; for example, toggling through the available outputs. **Note:** The keyboard functions must be set up for each test individually.

a. Select the keyboard required **Please note:** only 1 keyboard can be selected per protocol

b. Tick/Untick this box if you wish to show/hide the image of the keyboard in this window

c. The keyboard image is interactive. Selecting the keyboard buttons on the image will automatically guide the user to that key. **Please note:** Some button are locked for editing

d. Press the unfold icon to make additional settings available.

e. Delete a command from a keyboard button by clicking the white cross.

f. Select or deselect the options as you prefer to use them

g. Unfold to see available command options

h. Click on the white ‘plus’ sign to add new command options to the relevant key

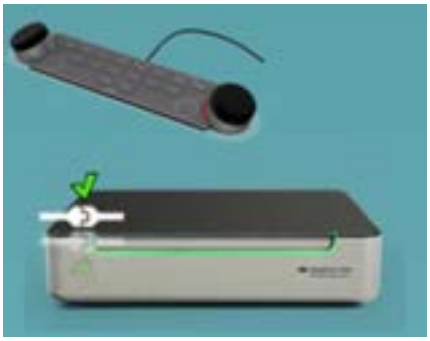
Pressing the left rotating dial will enable/disable ‘Talk forward function.’ Pressing the right rotating dial will enable/disable the ‘Talk back’ option.

The Audiometer Keyboard has an LED light indicator which changes status during different operations. These different colors and their statuses are listed and shown below.

RED-Light:	Indicates right ear selected
BLUE-Light:	Indicates left ear selected
YELLOW-Light:	Indicates free field measurement
LIGHT-BLUE	Indicates that keyboard is connected but inactive e.g.: when conducting REM
NO-Light:	Indicates the channel is off

A dimmed light indicates that the keyboard has entered power saving mode. This can happen in any of the colors mentioned above.

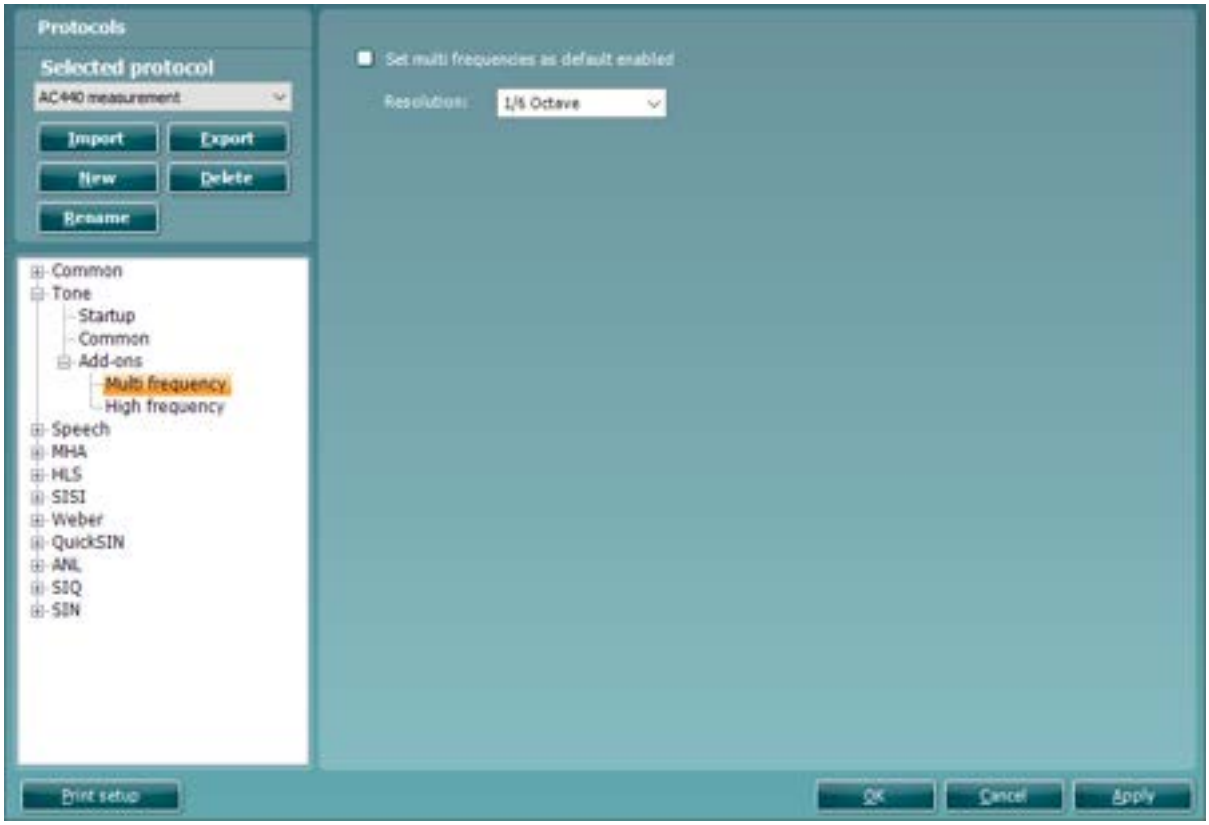
When the keyboard is connected, the picture below will appear at the bottom left hand corner of your screen.



Add-ons:

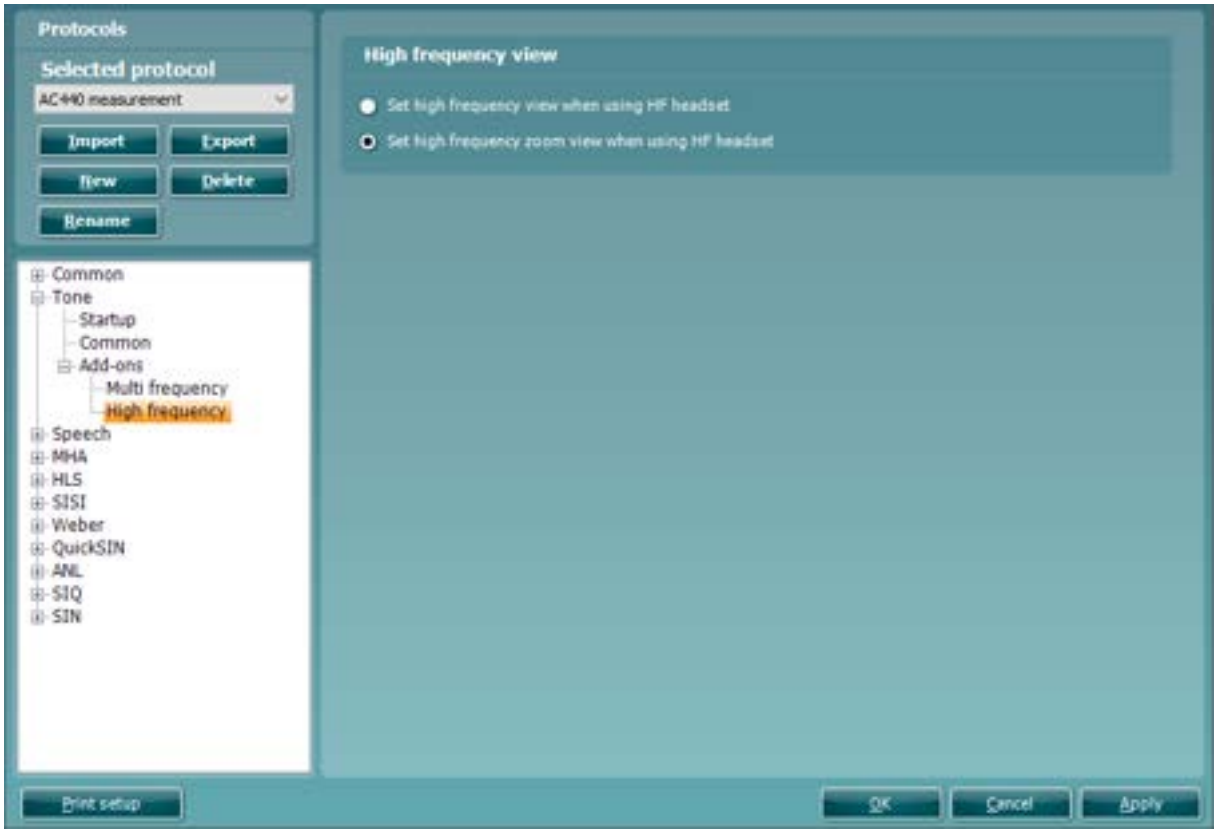
29) To enter the *Add-on* options for tone testing unfold the **Tone** options and click the plus in front of *Add-on.* Then select *Multi Frequency*.

30) Here settings for *Multi Frequency* can be adapted. Adjust the frequency *Resolution* using the dropdown list.



Tick *Set multi frequencies as default enabled* to set the function to be default as on (for further description of multi frequency testing please see section 3.1.2)

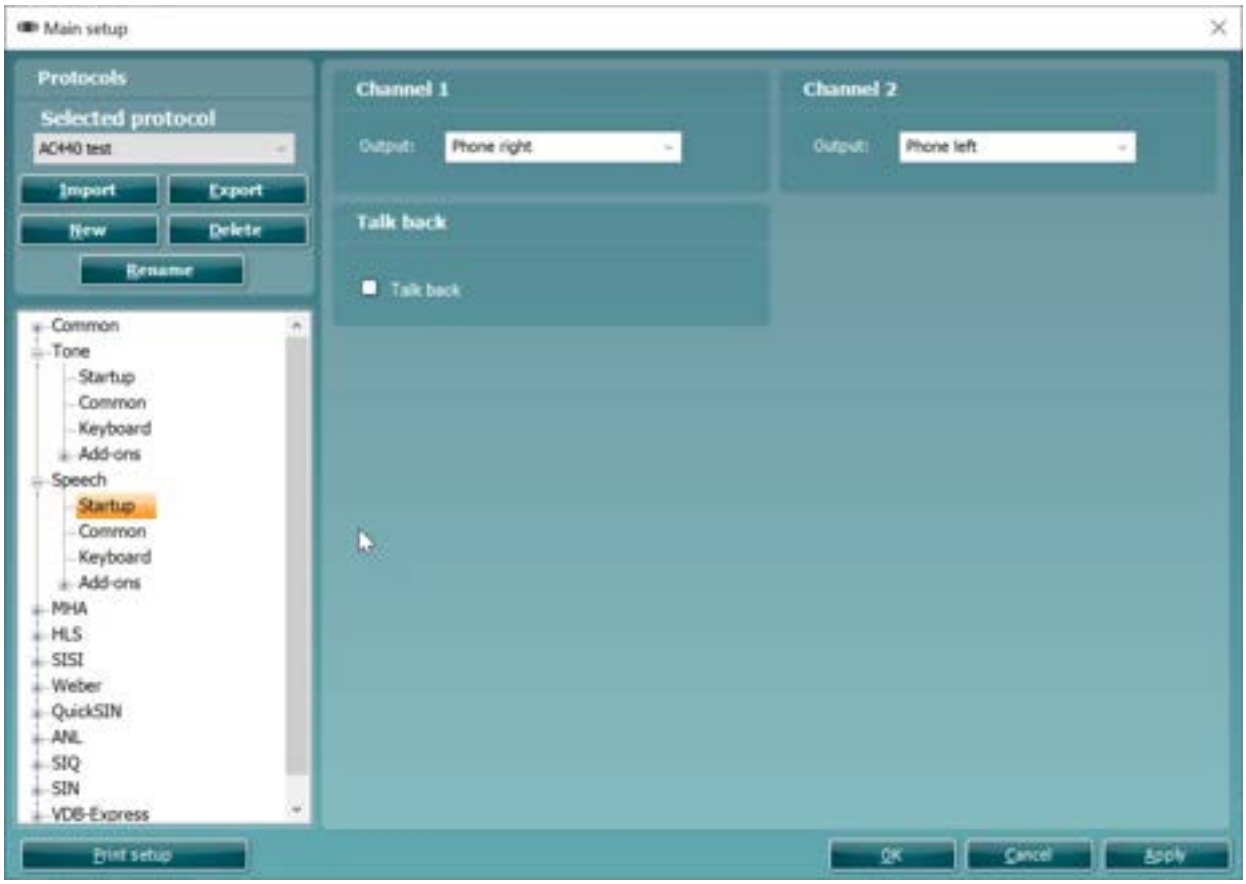
The *High frequency* Add on tab allows you to configure which view is shown when a HF headset is enabled. The High frequency view allows you to see the whole audiogram and the higher frequencies together in one graph, however the High Frequency zoom focuses on the high frequencies above 8kHz only.



1.9.5 Speech testing setup

Start-up

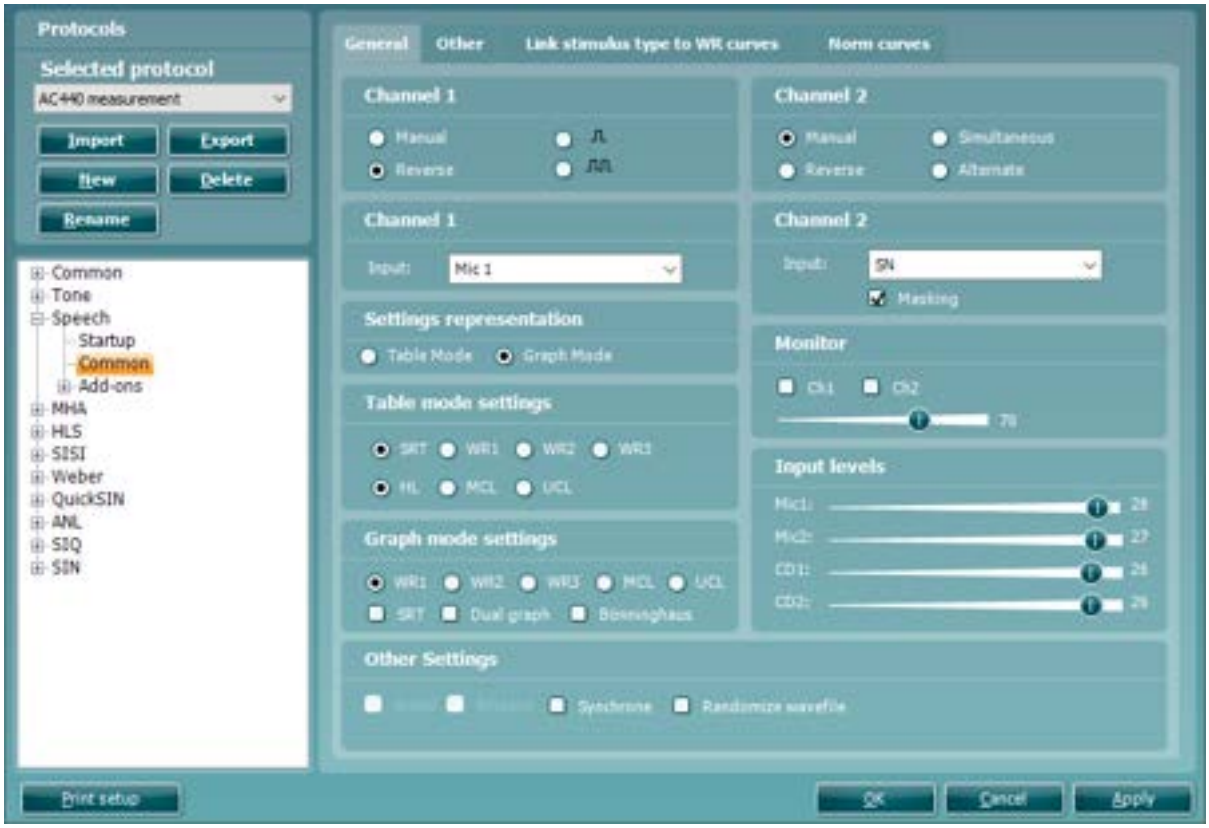
1) To enter the *Start-up* options for speech testing, unfold the **Speech** options and click *Start-up.*



2) Select the default output of **Channel 1** and **Channel 2** in the two dropdown lists. The selection will differ depending on which transducers are calibrated.
3) Activate the **Talk back** by **ticking** the **check box.**

Common

4) To enter the *Common* options for speech testing unfold the **Speech** options and click *Common.*



Note: This screen contains four tabs (*General, Other, Link stimulus type to WR curves,* and *Norm curves*).

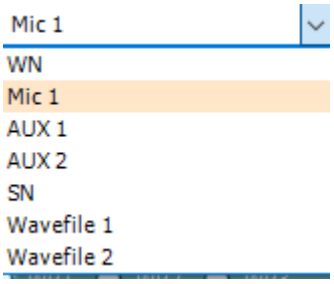
5) Set the **Channel 1** and **Channel 2**. You have the option to tick *Manual* so that the stimulus is only presented when manually activated. Ticking *Reverse* will cause the signal to be presented continuously, only disappearing when the stimulus is activated.

You also have the option to select between *Single Pulse* and *Multi Pulse* presentation for channel 1. The duration of the stimulus can be adjusted in the common options described above. Furthermore, you may wish to have presentation in both channels and tick *Simultaneous* which will lock channel 1 and channel 2 together or have the presentation in the two channels alternating to each other and tick *Alternate.*

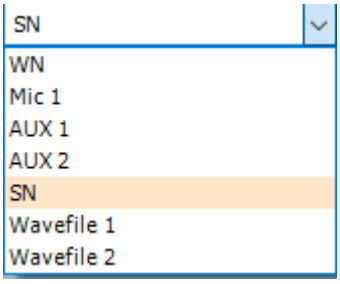
6) The default input for **Channel 1** and **Channel 2** can be setup using the dropdown lists. Select between *Mic1, AUX1, AUX2, WN* (White Noise), *SN* (Speech Noise), *Wavefile1* and *Wavefile2* as input for channel 1, and *Mic1, AUX1, AUX2, WN* (White Noise), *SN* (Speech Noise), *Wavefile1* and *Wavefile2* as input for channel 2.

Note that since AUX and microphone are not automatically considered masking signals you can tick *Masking* below the channel 2 input selections. This ensures that the AC440 considers the AUX input masking.

Channel 1

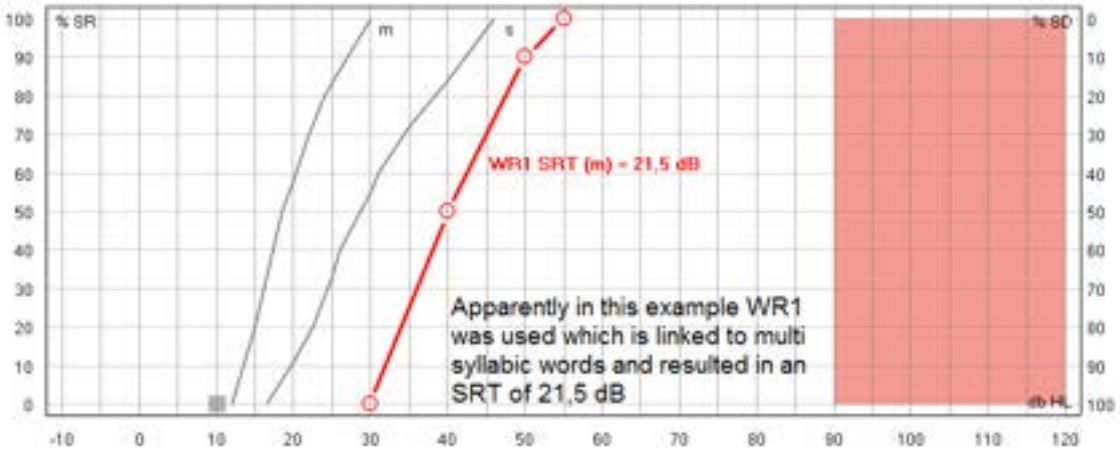


Channel 2



7) In **Settings – representation** you can choose between *Table Mode* and *Graph Mode*.

- **Graph Mode:** If you select Graph Mode, the results are displayed in a graph.
  Show SRT on speech audiogram calculates the SRT value based on the norm curve (the distance in dB from the point where the norm curve crosses 50% to the point where the speech curve crosses 50%) like shown below. The result is then an expression of how much you need to turn up the level compared to normal for the patient to be able to repeat 50%.
  The calculation is based on the *m curve* if using multi syllabic words and the *s curve* if using single syllabic words.



Note that the norm curves change based on the speech material. You must therefore ensure that WR1, WR2 and/or WR3 are linked to single or multisyllabic words to show the SRT. If no stimulus is linked to the WR curves, no SRT will be shown on the speech screen.

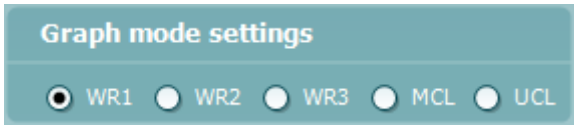
- **Table Mode:** If selecting Table Mode, the test results are displayed in a table.

  When clicking “store” the intensity level is shown in the table. Unlike Graph mode, no calculation of the SRT takes place. The table mode records the level at which you found the SRT.

  When changing *Transducer*, *Test Type* (HL, MCL, UCL), and *Aided* (Aided or Binaural) a new SRT is recorded.

8) Under **Table mode settings** you can decide whether the testing should start with SRT, WR1, WR2, WR3, HL, MCL, or UCL. The type of speech material for each WR can be selected in the *Link stimulus types to WR curves* (see later in this section).

9) Under **Graph mode settings** you can decide whether the testing should start with WR1, WR2, WR3, MCL, or UCL. The type of speech material for each WR can be selected in the *Link stimulus types to WR curves* (see later this section).

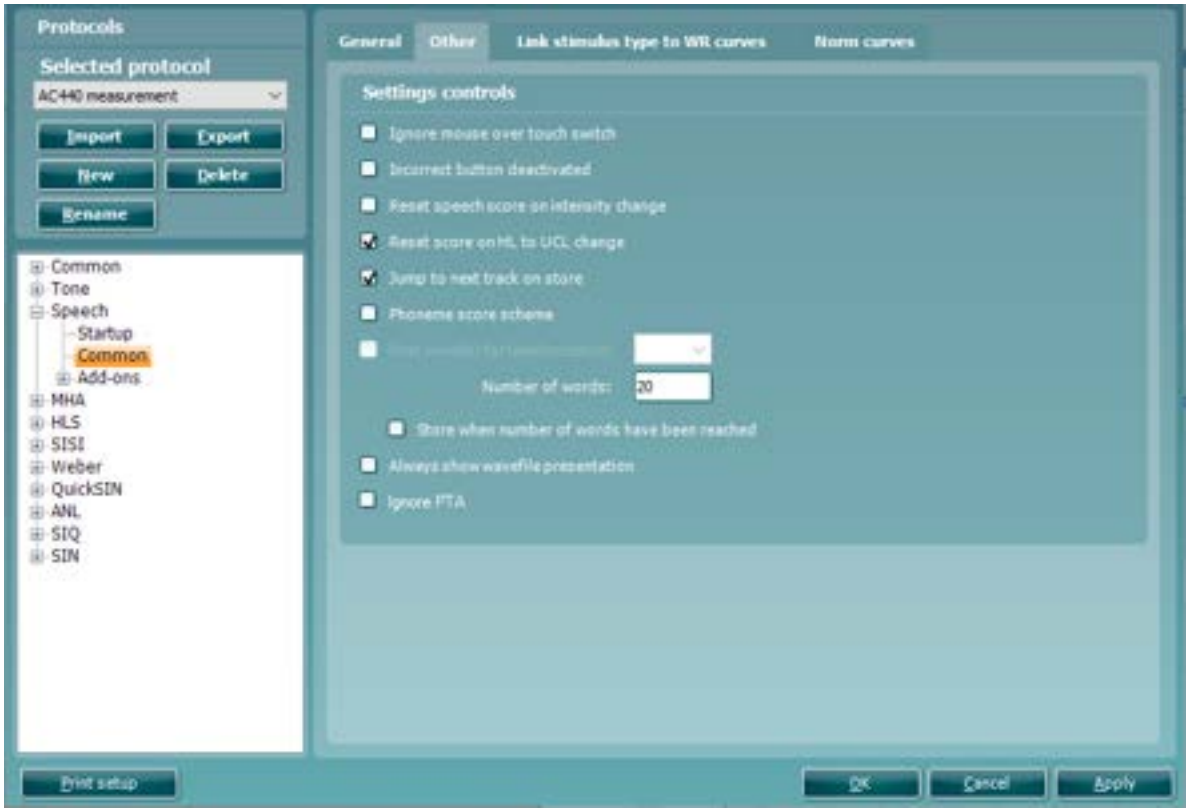


10) Under **Other settings** you can tick *Aided* if audiograms usually are obtained with hearing aids and/or *Binaural* if both ears are tested at the same time. This will result in a separate speech curve. Ticking *Synchrone* will activate the corresponding button in the front screen by default locking the distance in input level between Ch1 and Ch2 for masking purposes  .

11) Under **Monitor** one or both channels may be ticked if monitoring is preferred. The level of the monitoring can be set using the slider bar.

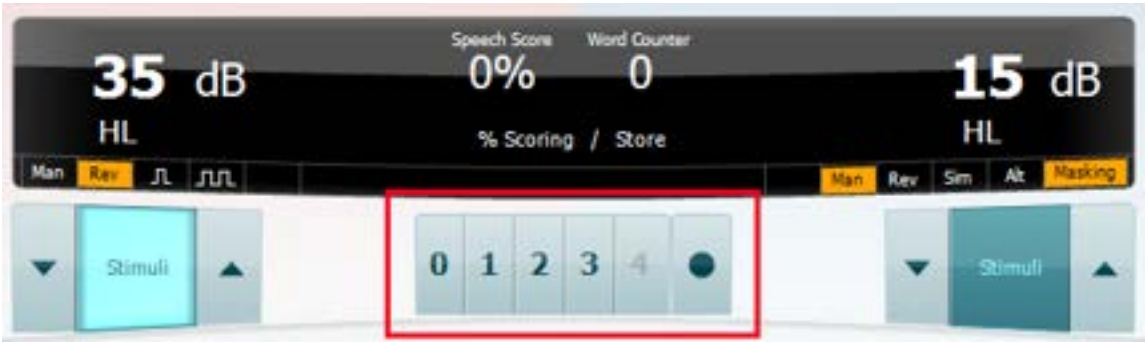
12) Adjust the **Input Levels** for the selected input. It may be practical to set a default value in this screen if you always use the same input. Note that the input level can also be selected in the speech screen by pressing shift and adjusting the input to 0 VU (see section 3.2).

13) Under the **Other tab** additional speech test functions are available.



14) **Settings – controls** include the following options:

- *Ignore mouse over touch switch*: The AC440 will ignore the mouse touching the stimuli area. The function is embedded to avoid accidentally presenting a stimulus.
- *Incorrect button deactivated*: The incorrect button will be greyed, and only correct answers are counted.[6]
- *Reset speech score on intensity change*: The score will return to zero when the intensity is changed. This is useful to avoid accidentally storing a measurement point in the speech graph which was measured over different speech levels.
- *Reset score on HL to UCL change*: Ensures that if the test is toggled from HL to UCL the scoring will restart so that the UCL test does not build on the HL scoring.
- *Jump to next track on store* makes sure that a new word list is used for every point measured. In case word lists contain enough words for several points, it can be disabled. Notice that the word scoring can be reviewed by hovering the mouse over measured data points. It however only shows the words of the list in which the point started its measurement.
- *Phoneme score scheme*: Allow phoneme scoring during the speech test. The front screen will allow you to specify if 0, 1, 2, 3 or 4 phonemes are correctly repeated as illustrated below.



- *First word(s) for familiarization*: Set several “practice words” using the dropdown list (if *Phoneme score scheme* is ticked). If for example set to 3, the first three words will not be calculated in the final score as these are trial words.
- *Number of words*: Type in several words for the actual scored test. Note that this will be ignored when using wave files since the number of words in this case will be dependent on the selected speech material.
- *Stop when the number of words has been reached* automatically stores the point after reaching the number of words that is indicated at *number of words*.
- *Always show wavefile presentation* assures that your preferred wave files are also shown on screen when selecting microphone or CD as input.
- *Ignore PTA* allows you to ignore the PTA score setting which is shown under tone audiometry. This can typically be set as a start intensity for speech testing.

[6] This may be useful if testing with wave files. In the wave file settings, you can set time limits so that after a certain period the word will be scored as incorrect. In this case the incorrect button is not needed

15) Linking a type speech material to a WR curve:

Under the **Link stimulus to WR curve** tab a certain type of speech material can be linked to the individual WR curves. If a clinic for example always uses multi syllabic numbers for WR1 and single syllabic words for WR2, you can link these materials to the curves and corresponding buttons in the front screen.

- Mark the type of material in the selection list
- Click on the arrow pointing towards the WR curve to which the material should be linked
- The material will then jump to the selected WR

16) Unlinking a type of speech material from a WR curve:

- Mark the type of material
- Click on the arrow pointing back to the selection
- The material will then jump back to the selection list

17) **User defined WR labels** allow you to name or label the speech material which will then be selectable for the print layout (see 2.1.1 for how to make a personal print layout). Additionally for table mode testing the check boxes indicate which labels are available as buttons in the test screen.

18) Under the **Norm curves** tab the norm values appearing in the speech graph can be changed.

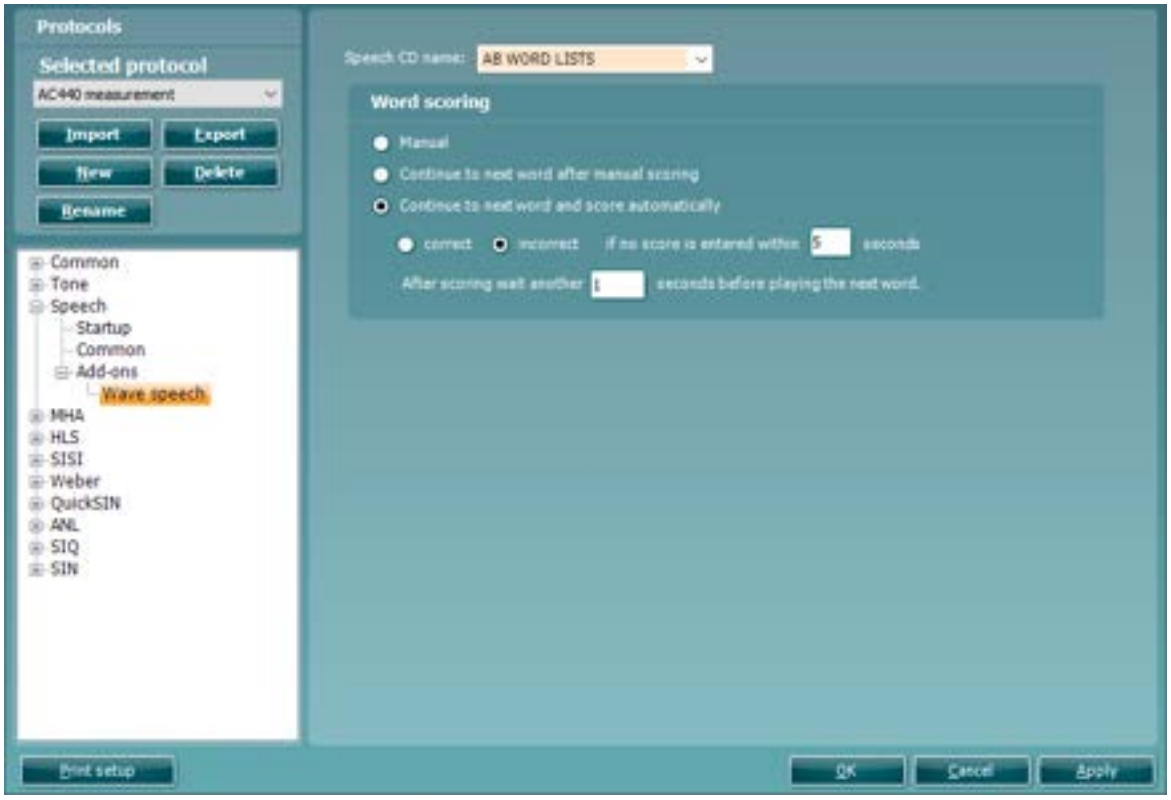
19) For **Phone norm curves** both *Multi syllabic* and *Single syllabic* norm values for speech tests obtained with head phone can be edited or replaced with other norm material. The default norm material is in accordance with the DIN 45 626 standard.

20) For **FF norm curves** both *Multi syllabic a*nd *Single syllabic n*orm values for speech tests obtained in free field can be edited or replaced with other norm material. The default norm material is in accordance with the DIN 45 626 standard.

Add-ons

21) To enter the *Add-on* options for speech testing unfold the **Speech** options and click *Add-ons.* In this screen the AC440 can be setup to do speech testing using wave files[7].

22) Select your speech material in the *Speech CD name* dropdown list. Selecting the dash '-'results in not having word lists available in the test screen.



23) **Word scoring** includes the following options:

- *Manual*: Full manual control over the speech test, which is initiated, stopped, and scored manually.
- *Continue to next word after manual scoring*: Presents the next word, number, or sentence immediately after you have scored the previous work to be either correct or incorrect.
- *Continue to next word and score automatically*: The AC440 can be timed to wait for a certain number of seconds before continuing with the next word, number, or sentence regardless of whether it the previous work was repeated correctly or incorrectly. Additionally, you can decide whether the word, number, or sentence should be assumed *Correct* or *Incorrect* when continuing the test if no score has been entered.

In the white section below, you can specify the exact duration of the pause between clicking the correct button and presenting the next word, number, or sentence by entering the desired number of seconds.

[7] Speech testing with wave files is an additional license (ISF440)

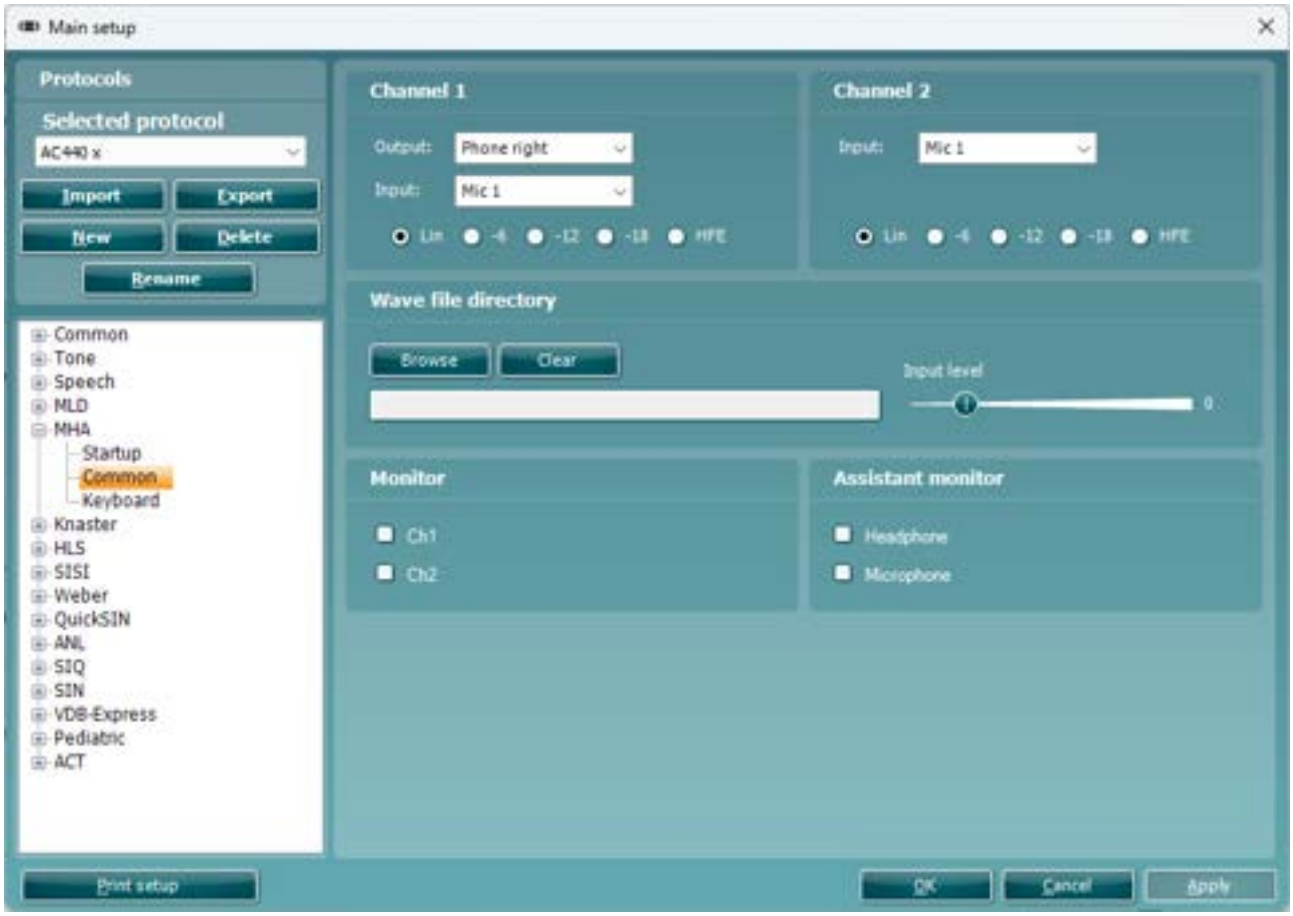
1.9.6 MHA counselling[8] setup

Start-up

To enter the *Start-up* options for MHA counselling unfold the **MHA** options and click *Start-up*. **Talk back** can be enabled by ticking the check box.

Common

To enter the *Common* options for MHA counselling unfold the **MHA** options and click *Common*.



1) Set the output and input for channel 1 and the input for channel 2 under **Channel 1** and **Channel 2 Input** using the dropdown lists. The output chosen for channel 1 will automatically also apply for channel 2.

2) Select the default start filter. The different filters are illustrated below:

Lin	no filtering
-6 per octave	Minor high pass filtering
-12 per octave	Minor - Medium high pass filtering
-18 per octave	Medium – Major high pass filtering
HFE (-24 per octave)	Major high pass filtering

[8] Master Hearing Aid (MHA) requires an additional software license.

3) Under **Monitor** one or both channels may be ticked if monitoring is preferred. The level of the monitoring can be set using the slider

4) If **Wave files** are chosen as input, you can browse for them by clicking *Browse*. If a group of wave files are already chosen and you wish to browse for new ones, click *Clear*. The *Input level* of the wave files can be adjusted to the left using the slider.

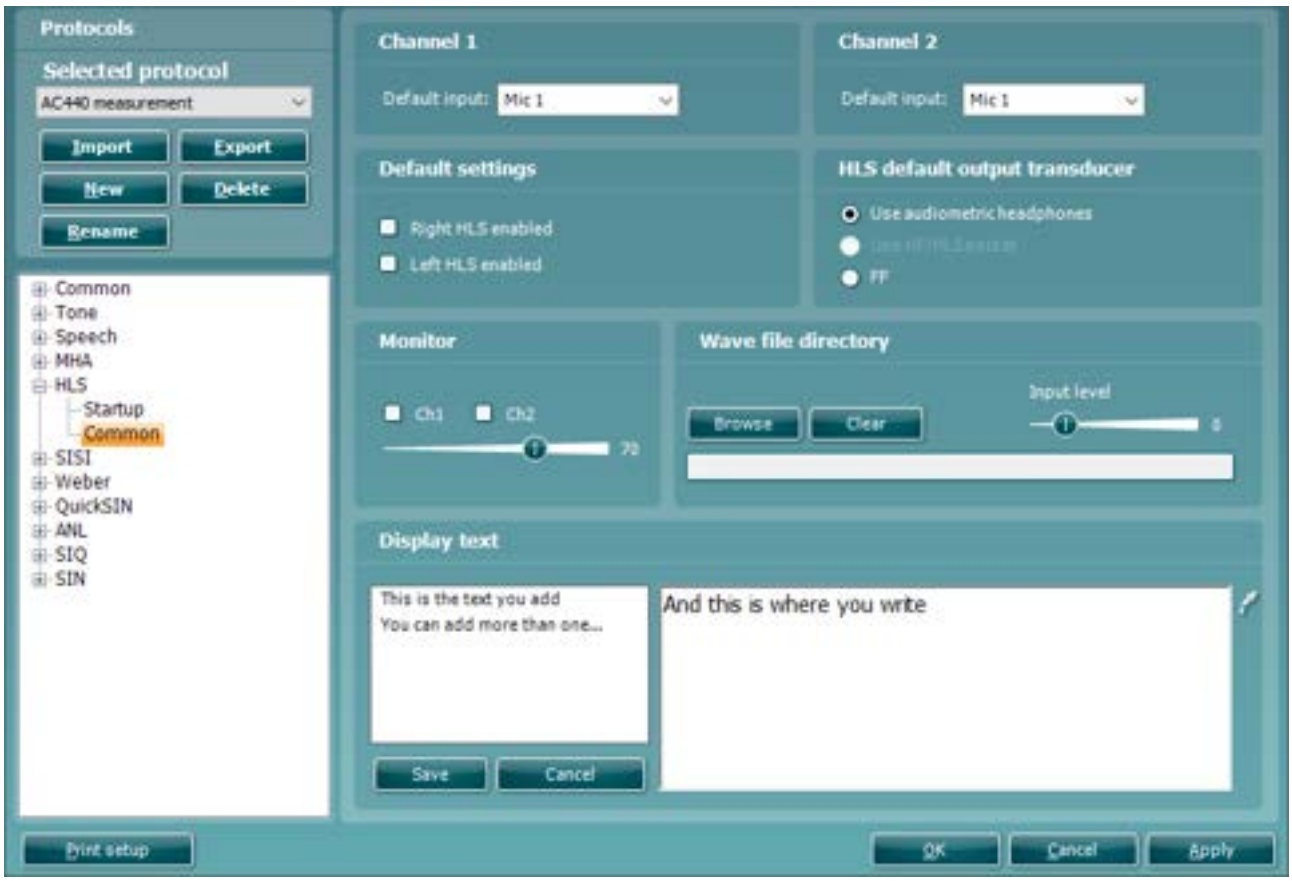
1.9.7 HLS counselling[9] setup

Start-up

To enter the *Start-up* options for HLS counselling, unfold the **HLS** options and click *Start-up*. Determine the **Talk back** level using the check box to set the Talk back default.

Common

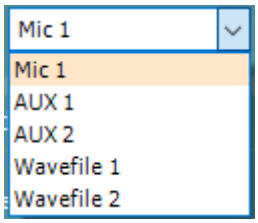
To enter the *Common* options for HLS counselling unfold the **HLS** options and click *Common*.



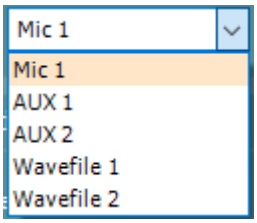
[9] Hearing Loss Simulation (HLS) requires an additional software license.

1) Set the *Default input* for **Channel 1** and the *Default Input* for **Channel 2** using the dropdown lists. Select if the test should be conducted through *Mic1, Mic2, CD1, CD2*, or *Wave files.*

Channel1



Channel 2



2) Under **Default settings** it can be decided whether the HLS should be enabled immediately when opened using the check boxes. If the check boxes are not ticked the HLS will need to be enabled manually using the *Right* and *Left* buttons in the front screen.

3) Select the **HLS default headset**.

4) Under **Monitor** one or both channels may be ticked if monitoring is preferred. The level of the monitoring can be set using the slider.

5) If **Wave files** are chosen as input, you can browse for them by pressing *Browse*. If a group of wave files are already chosen and you wish to browse for new ones, press *Clear*. The *Input level* of the wave files can be adjusted to the left using the slider.

To setup the patient monitor text:

1) Go to **Menu >Setup >AC440 Setup**

2) Choose the protocol desired protocol to modify.

   a. If choosing a default protocol, you will need to copy the existing settings and create a new one before modifying the settings

   b. If choosing a custom protocol, you can modify the settings directly, without needing to copy

3) Go to **HLS >Common>Display Text**

4) Click Add, which will activate a cursor, type in the desired text. (The Add button changes to a Save button). Click Save when done.

5) To change the text color, click on the dropper icon

6) To save the text, click on Save

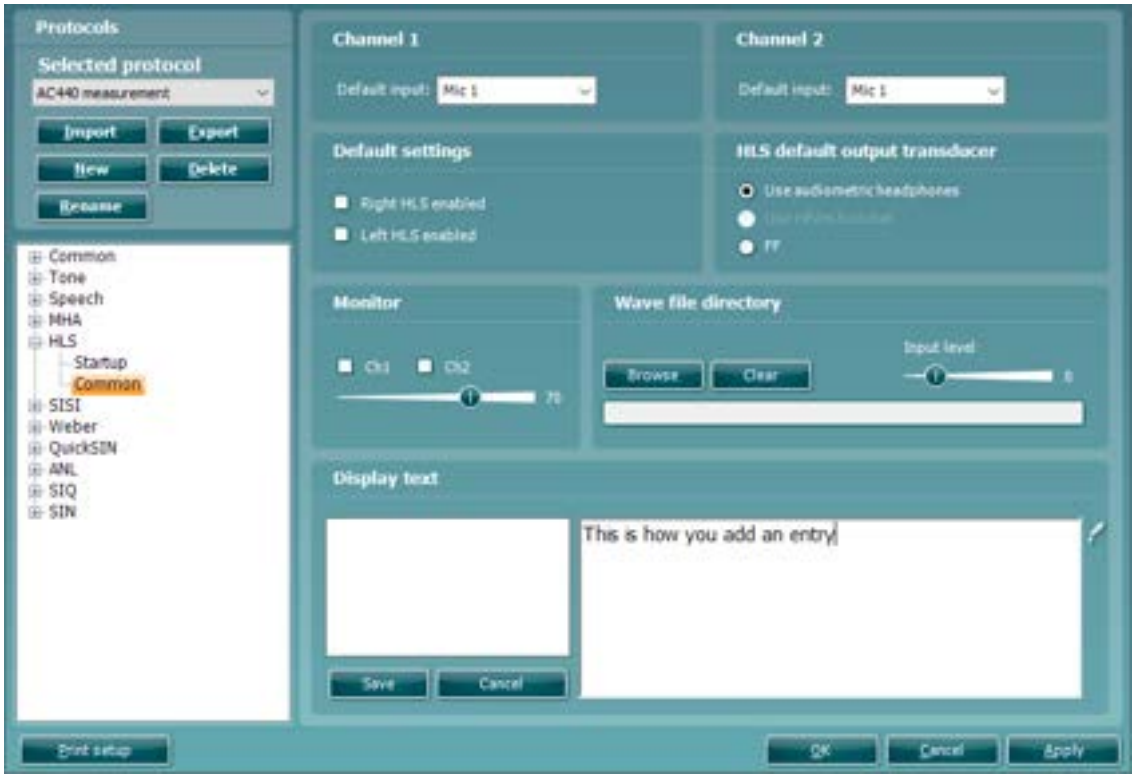
7) Multiple sentences and paragraphs can be added by steps 4 and 5

8) To Delete the entry, highlight the entry, and click Delete

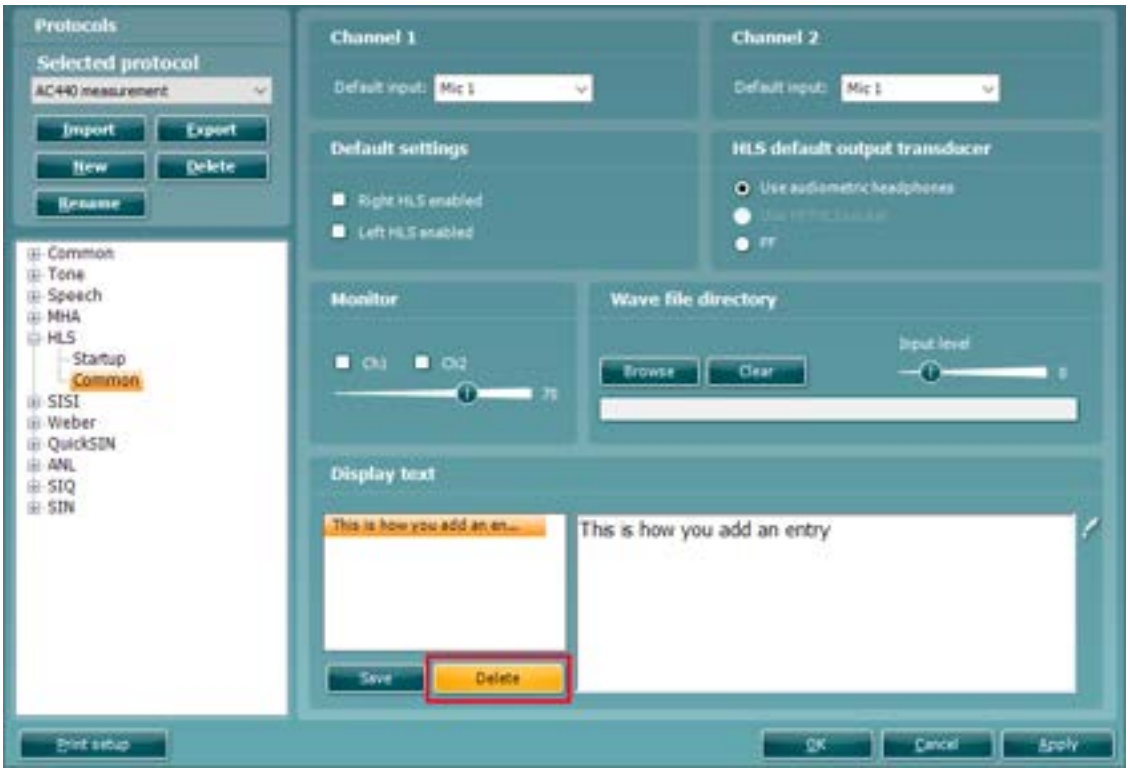
9) Once finished, click on Apply to apply the changes

10) Click on the main Save button to save the setup changes.

Adding an entry:



Deleting an entry:



Using the patient monitor text feature:

1) Choose the protocol in which the Patient Monitor Text has been activated
2) Go to the Menu>Tests > HLS
3) Ensure that Mic1 transducer is chosen
4) Go to Counselling Overlays window and click on the Patient Monitor Text button
5) This will launch the Patient Monitor with including text.
6) Choose the text to be used during the hearing loss simulation
7) Use the Zoom slider to make text bigger or smaller

1.9.8 SISI testing[10] setup

Start-up

Go to **Menu > Setup > AC440 setup > SISI > Startup** to activate **Talk Back** as a default.

Common

Go to **Menu > Setup > AC440 setup > SISI > Common** to define common settings for the SISI test:

- **Input and output settings** for channel 1 and channel 2.
- **Enable/disable monitoring** of channel 1 and channel 2.
- **Enable/disable the microphone** or the **headphone** of the Assistant Monitor headset.

[10] SISI requires an additional software license.

1.9.9 Weber testing setup

Start-up

Go to **Menu > Setup > AC440 setup > Weber > Startup** to activate **Talk Back** as a default.

Common

Go to **Menu > Setup > AC440 setup > Weber > Common** to define common settings for the SISI test:

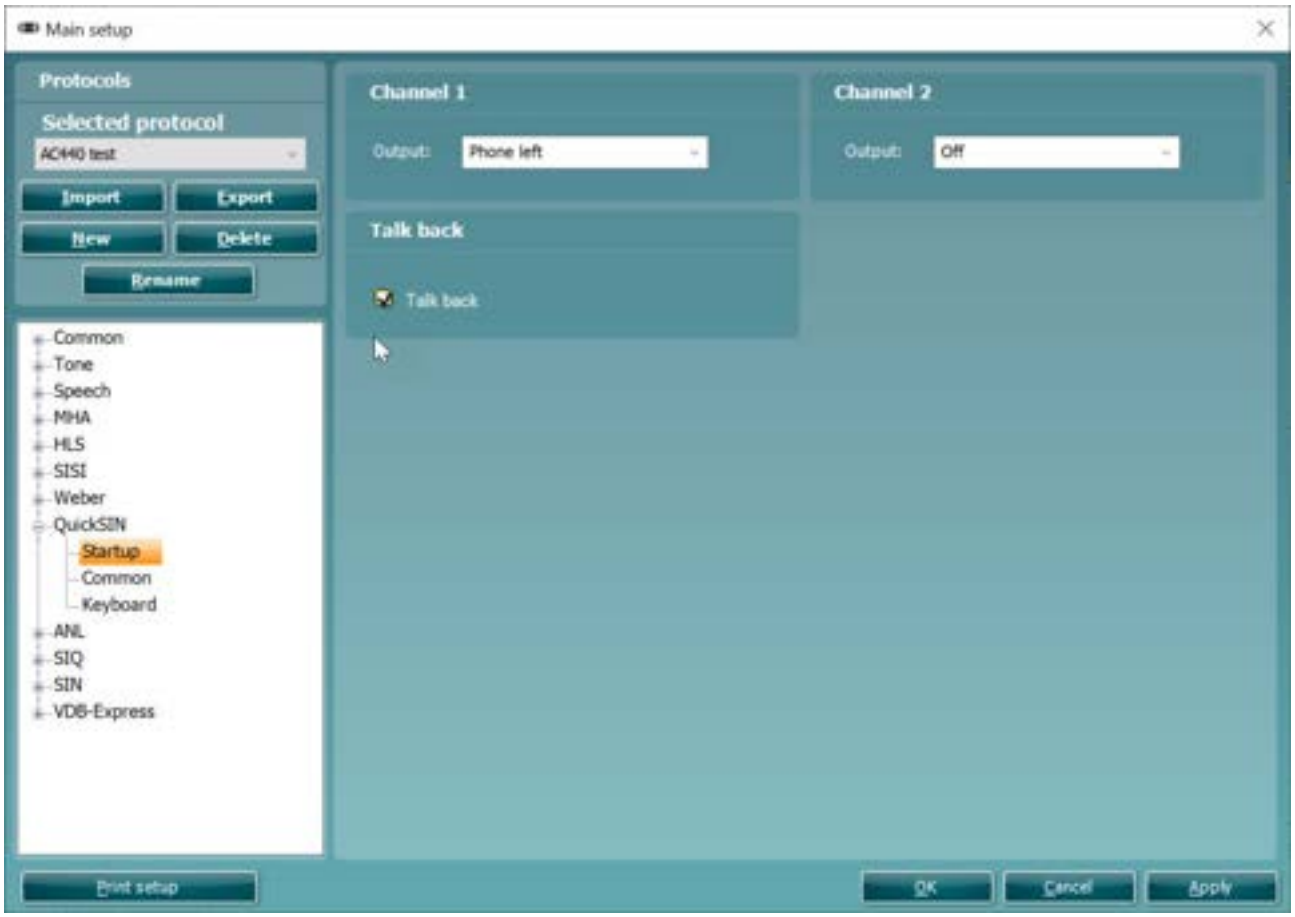
- **Enable/disable show symbols in tone audiogram**. You can choose to show the Weber symbols alongside your tone audiogram. This allows them to be viewed in the Tone screen so you can see them without needing to enter the dedicated Weber screen
- **Enable/disable monitoring** of channel 1 and channel 2.
- **Enable/disable the headphone** or **microphone** of the Assistant Monitor headset.

1.9.10 QuickSIN[11] setup

Start-up

To enter the *Start-up* options for QuickSIN testing unfold the **QuickSIN** options and click *Start-up*.

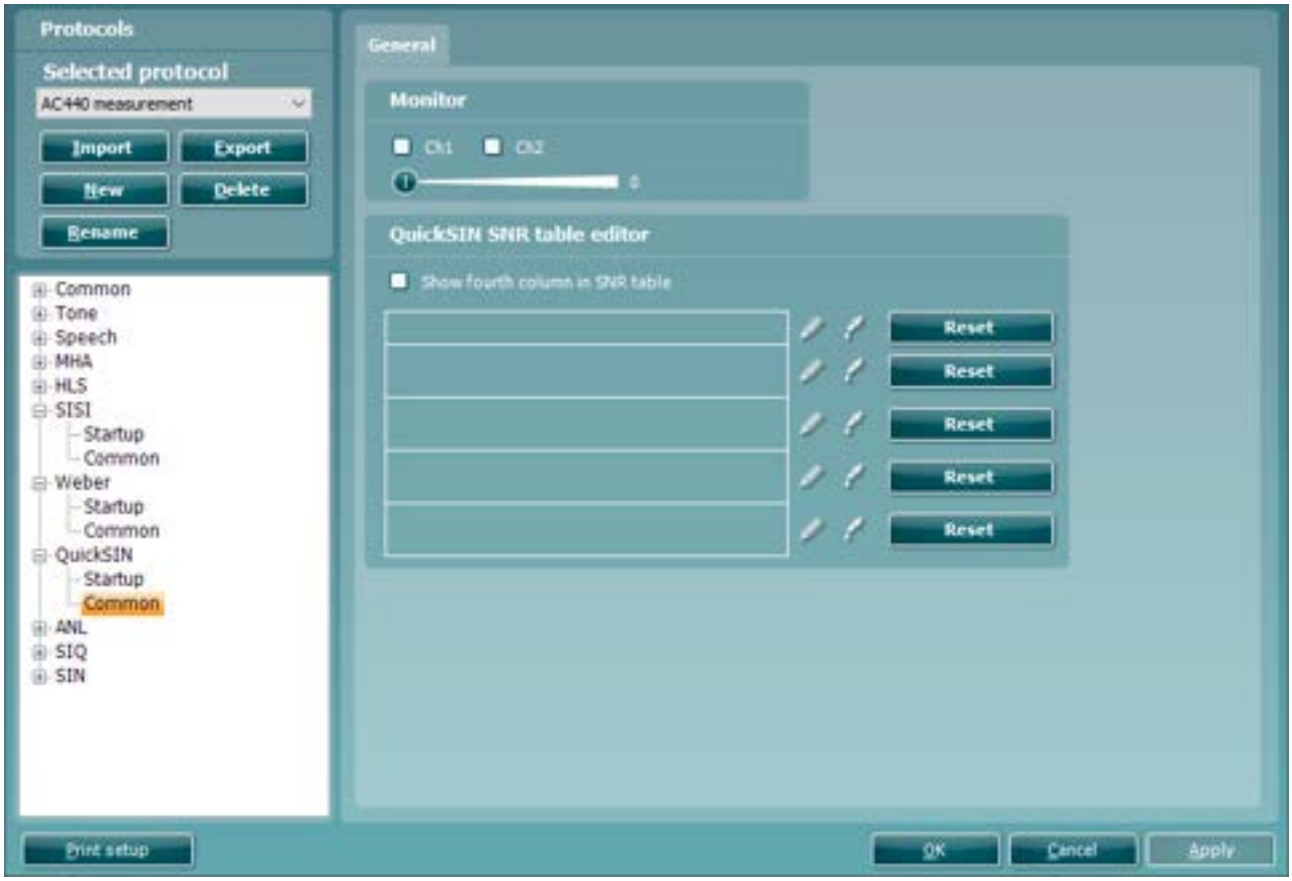
1) Select the default output for **Channel 1** and **Channel 2** using the dropdown lists.



[11] QuickSIN requires an additional software license.

Common

To enter the *Common* options for QuickSIN testing unfold the **QuickSIN** options and click *Common*.

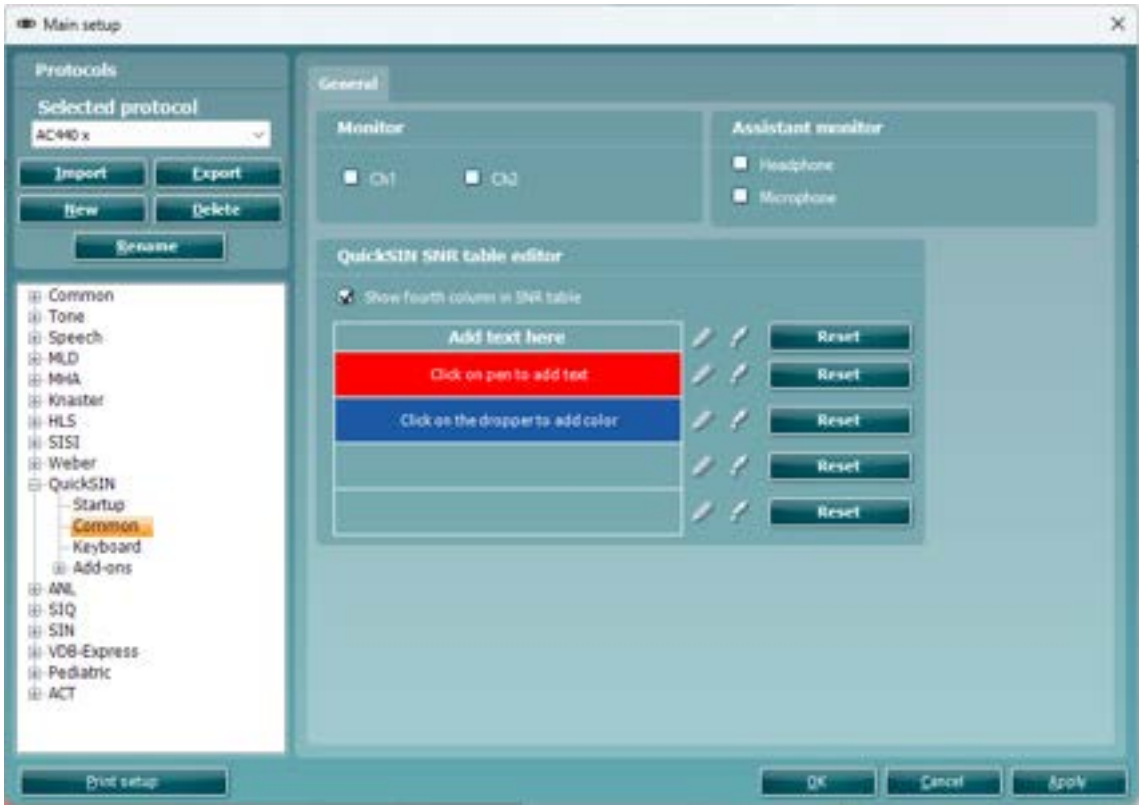


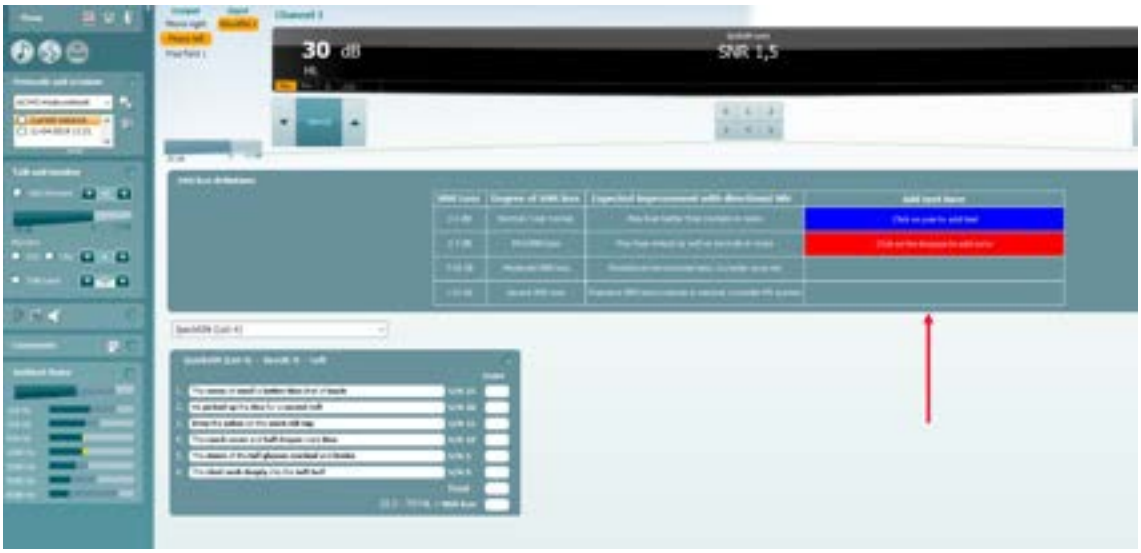
2) Select **Monitor** for channel 1 (Ch1) and channel 2 (Ch2) using the check boxes and adjust the level using the slider.

1.9.11 QuickSIN additional features setup

Adding a fourth column to the SNR loss definitions table:

1) Go to: **Menu >Setup >AC440 >Main Setup >QuickSIN >Common**
2) Insert a checkmark in the “show fourth column” box
3) Click on the pencil icon to enter text in the text box
4) Click on the dropper icon to add color to the text box

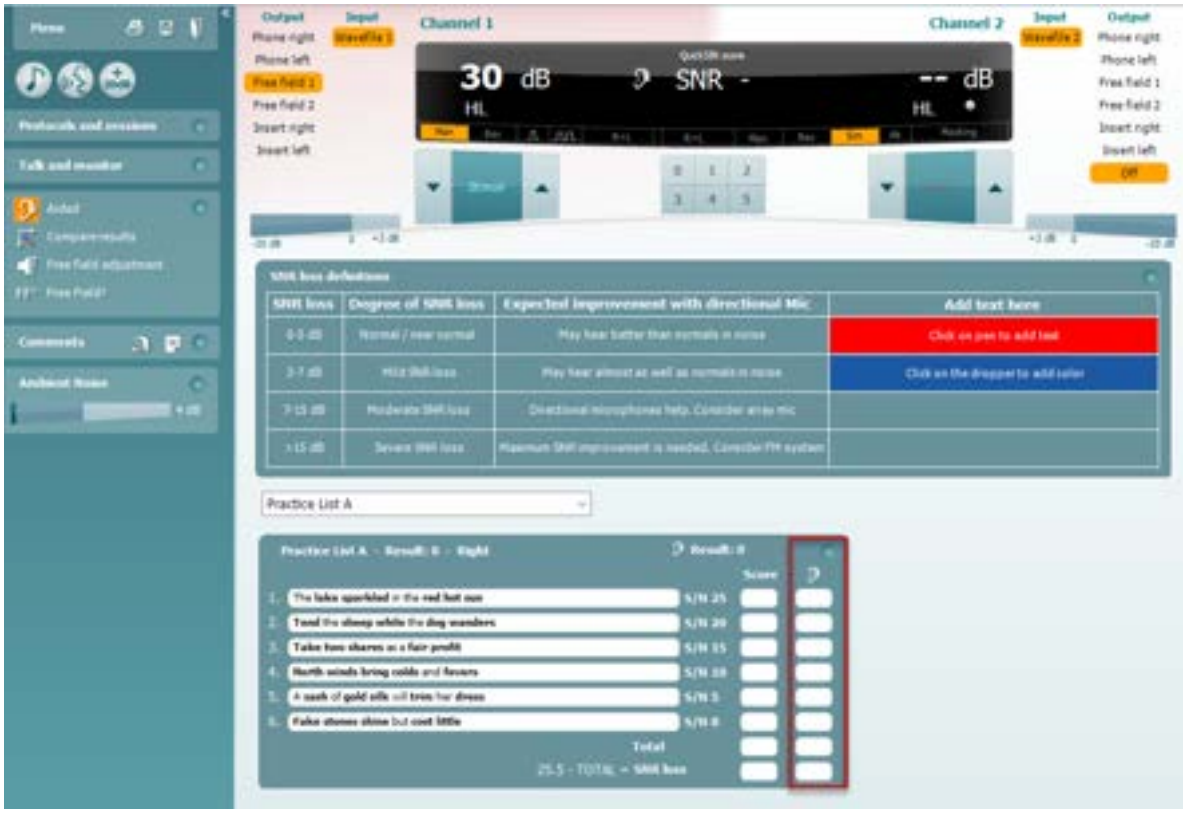




Aided QuickSIN is now possible when selecting the free field transducer.

To activate Aided QuickSIN:

1) Ensure you are in the QuickSIN screen
2) Select Free Field as the Transducer; this will activate the “Aided” function.
3) Click on the Aided button; this will add an extra column on to the QuickSIN scoring table

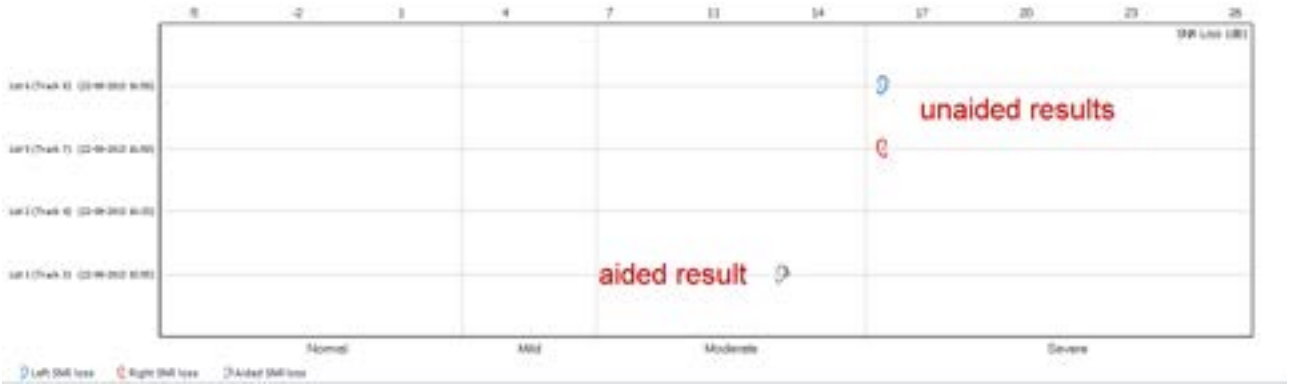


Comparing aided and unaided QuickSIN scores over time:

Clinicians are now able to compare the Unaided and Aided SNR scores.

To view the scores in a graph view, click on the graph icon 

To view the scores in a graph view, but using the patient monitor, click on Patient Monitor 

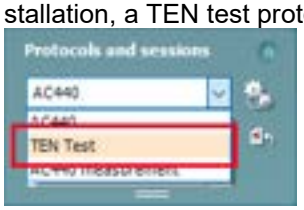


1.9.12 ABLB/Fowler and Stenger setup

ABLB/Fowler and Stenger can be performed by adjusting the Tone or Speech settings in the user interface. (See section ABLB/Fowler 3.1.10).

1.9.13 TEN test[12] setup

For your convenience, the TEN test can be selected as a pre-defined test protocol which is made according to the methods of Brian Moore. Depending on which regional settings were selected during the software installation, a TEN test protocol can be selected in the *List of defined Protocol*s:



Note: If a TEN test protocol is not visible it can be made available by selecting **Menu > Setup > Show/hide protocols**.

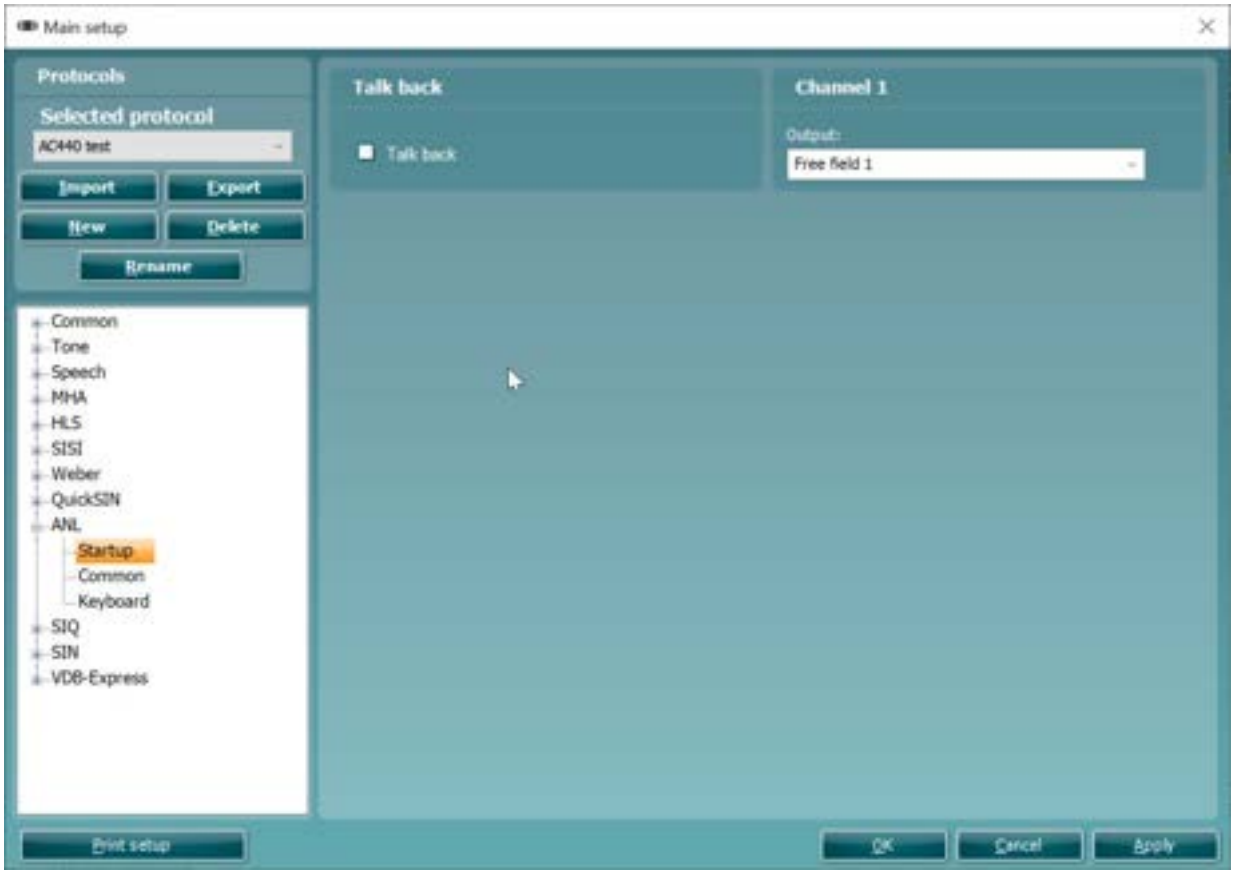
1.9.14 ANL test setup

Start-up

To enter the *Start-up* options for ANL testing, unfold the **ANL** options and click *Start-up*.

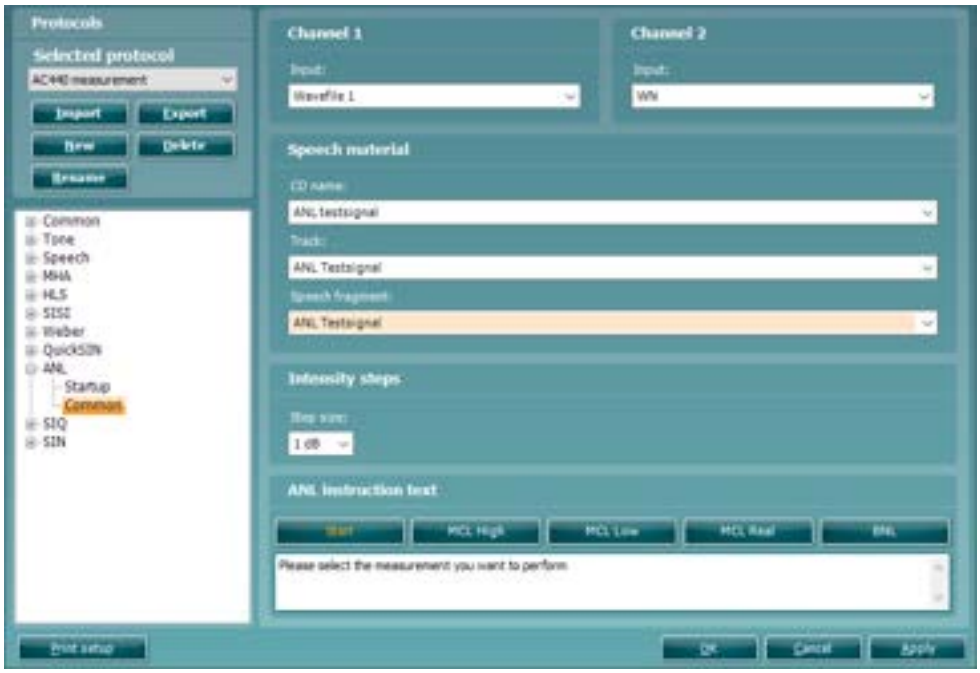
1) Select the default output for **Channel 1** from the dropdown list.
2) The **Talk back** level can be activated as a default.

[12] TEN test requires an additional software license



Common

To enter the *Common* options for ANL testing unfold the **ANL** options and click *Common*.



1) Select your desired **Channel 1 input** via the Input dropdown list.

2) Select your desired **Channel 2 input** via the Input dropdown list.

3) Choose your **Speech Material** via this section. The CD chosen corresponds to material which is already available in your Speech Audiometry test screen. This requires that the material has been extracted via the speech extraction tool.

   The dropdown allows you to choose your CD Name but also the Track and individual Speech Fragment you wish to use.

   It is important for the running of the test that each dropdown has been selected.

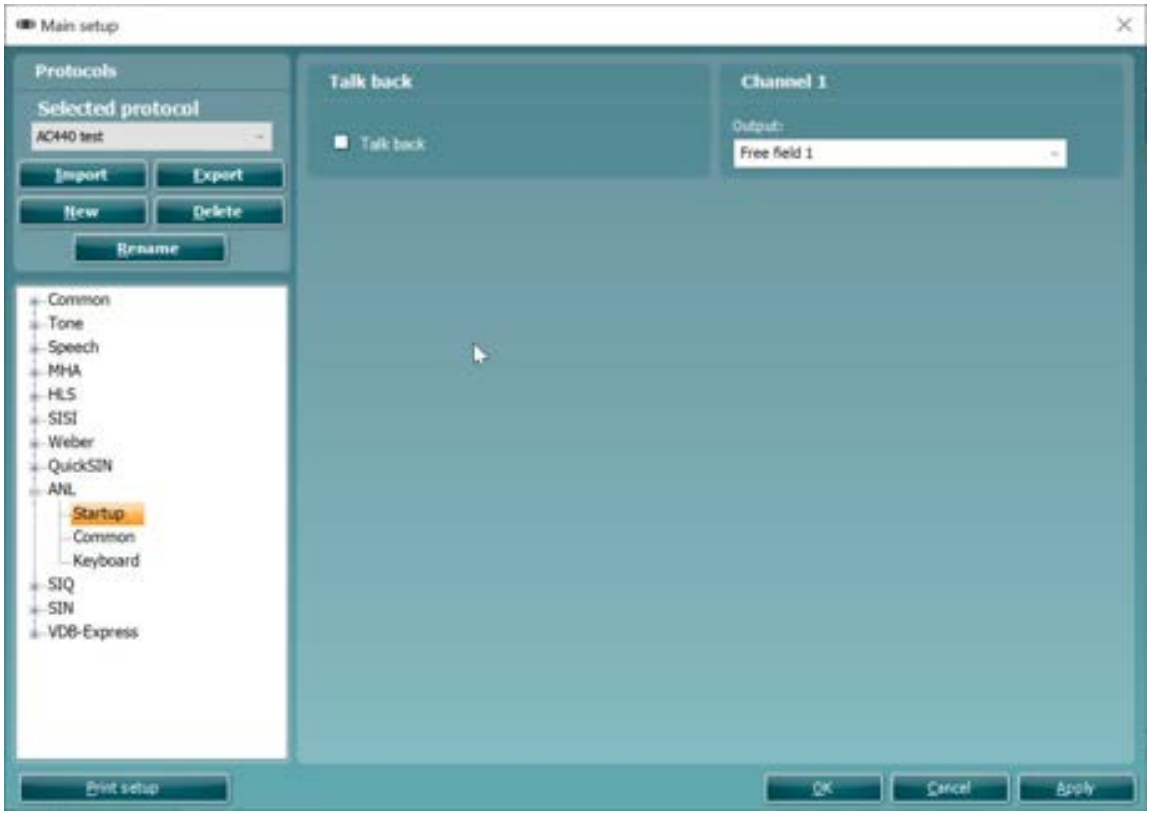
4) Choose your **Intensity steps** via this section. This will alter the step size you can change your stimulus by.

1.9.15 SIQ test setup

Start-up

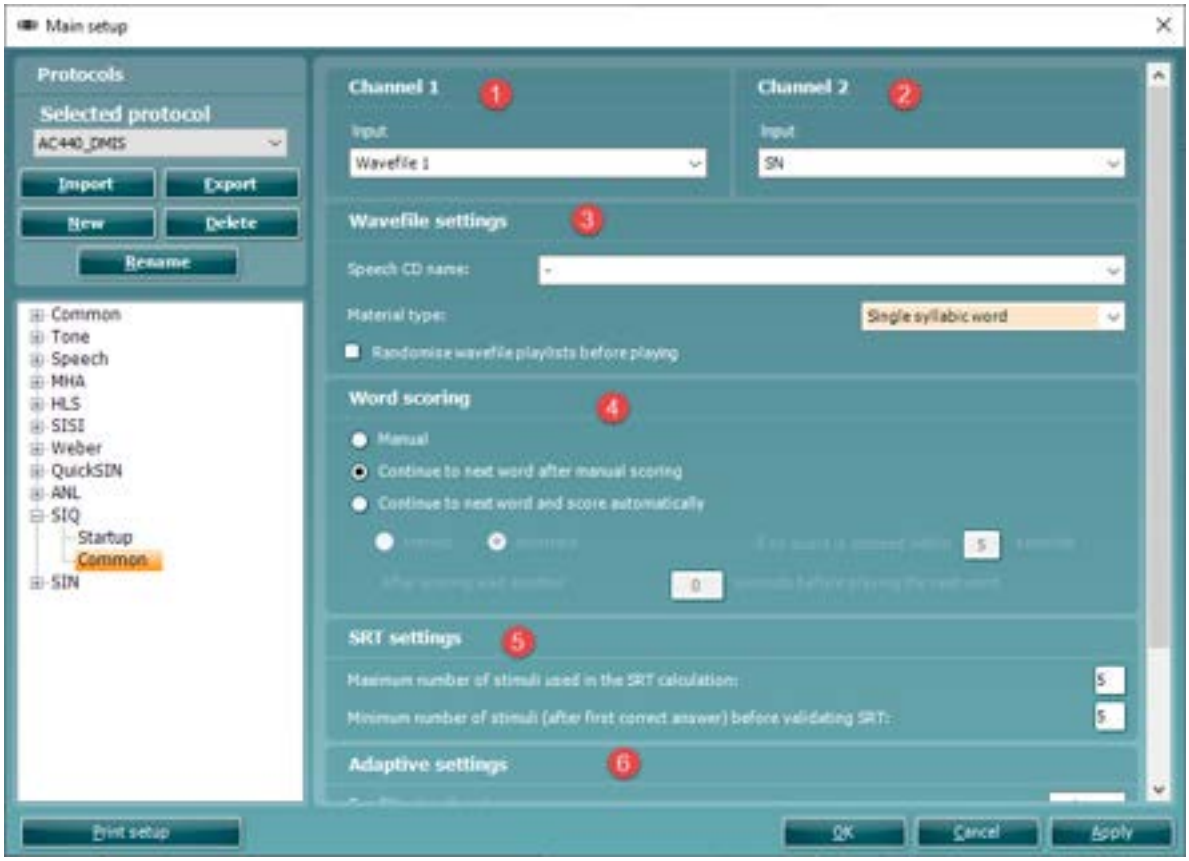
To enter the *Start-up* options for SIQ testing unfold the **SIQ** options and click *Start-up*.

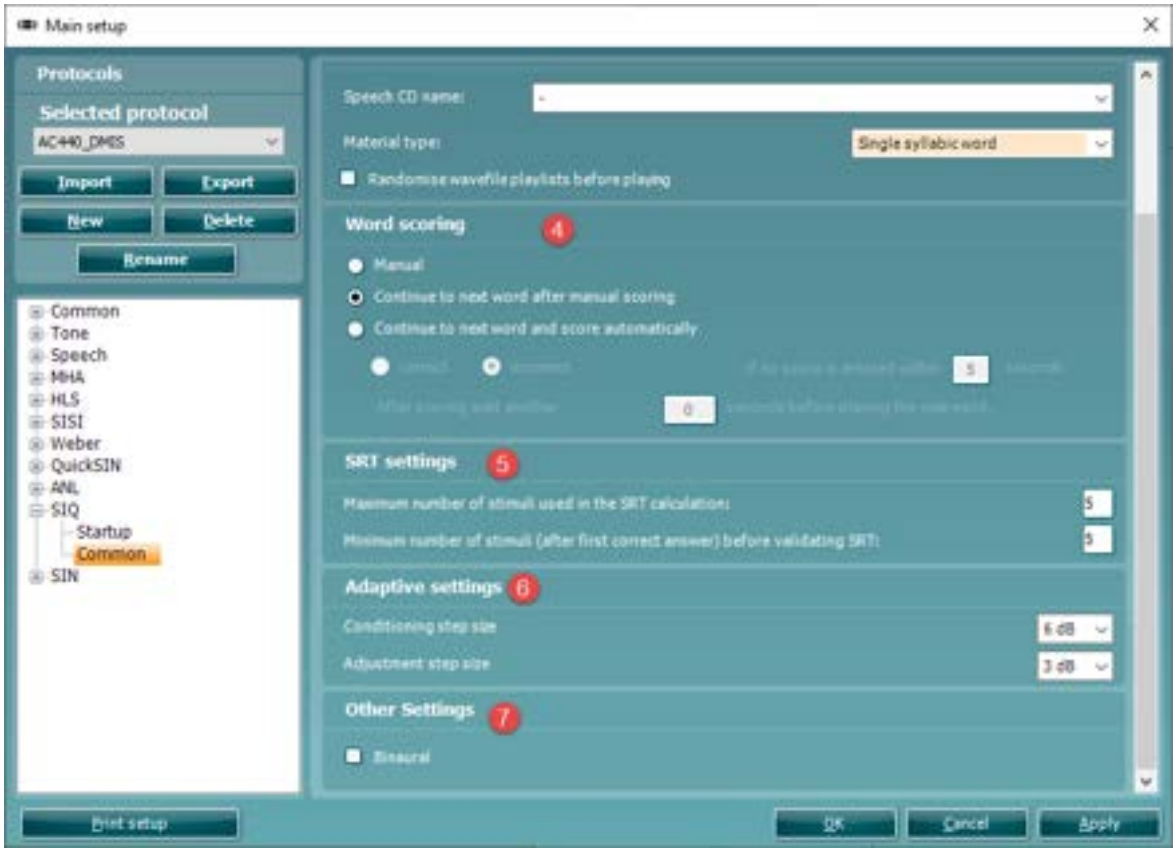
1) Select the default output for **Channel 1** from the dropdown list.
2) Select the default output for **Channel 2** from the dropdown list.
3) The **Talk back** level can be activated as a default.



Common

To enter the *Common* options for SIQ testing unfold the SIQ options and click *Common*.





1) Select your desired **Channel 1 input** via the Input dropdown list.

2) Select your desired **Channel 2 input** via the Input dropdown list.

3) Choose your **Speech Material** via this section. The CD chosen corresponds to material which is already available in your Speech Audiometry test screen. This requires that the material has been extracted via the speech extraction tool.

   You can select your default **material type** in this drop down which will automatically make the system search for the relevant material for this type of test.

   If you check the **Randomise wavefile playlists before playing** checkbox then the material will be played in a random order.

4) Specify how you would like the software to behave for the **Word Scoring** via this section. This will allow you to change the logic of the system depending on how the responses are scored.

5) The **SRT Settings** allow you to specify the max number of stimuli used for the SRT calculation and the minimum number of stimuli required after the first correct score before the system calculates an SRT score.

6) The **Adaptive Settings** allow you to specify the step size of both the conditioning step and the adjustment once the test has begun.

   You can also specify which channel is adaptive – allowing you to choose if the signal or the noise will change according to the patients' response when performing the test.

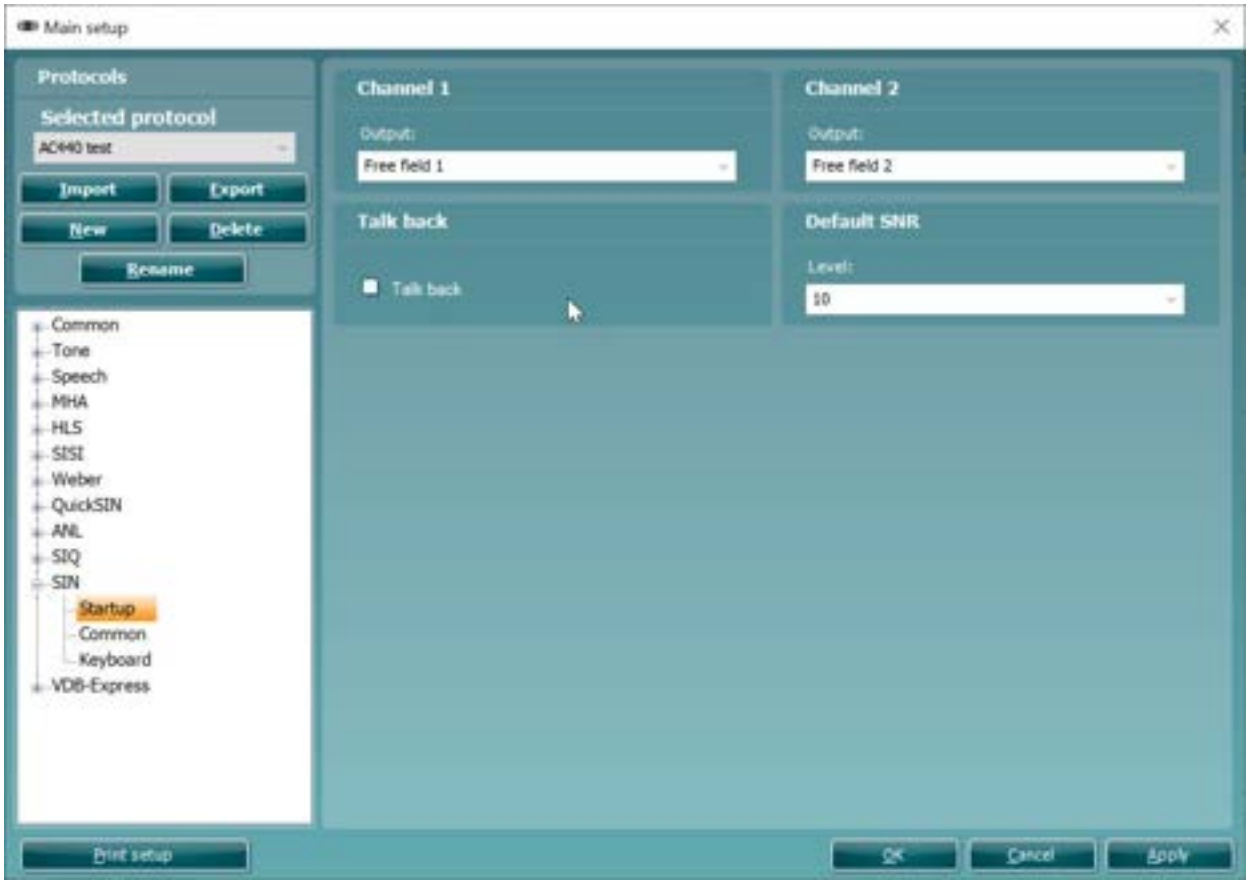
7) The **Other Settings** allow you to default the test as Binaural.

1.9.16 SIN test setup

Start-up

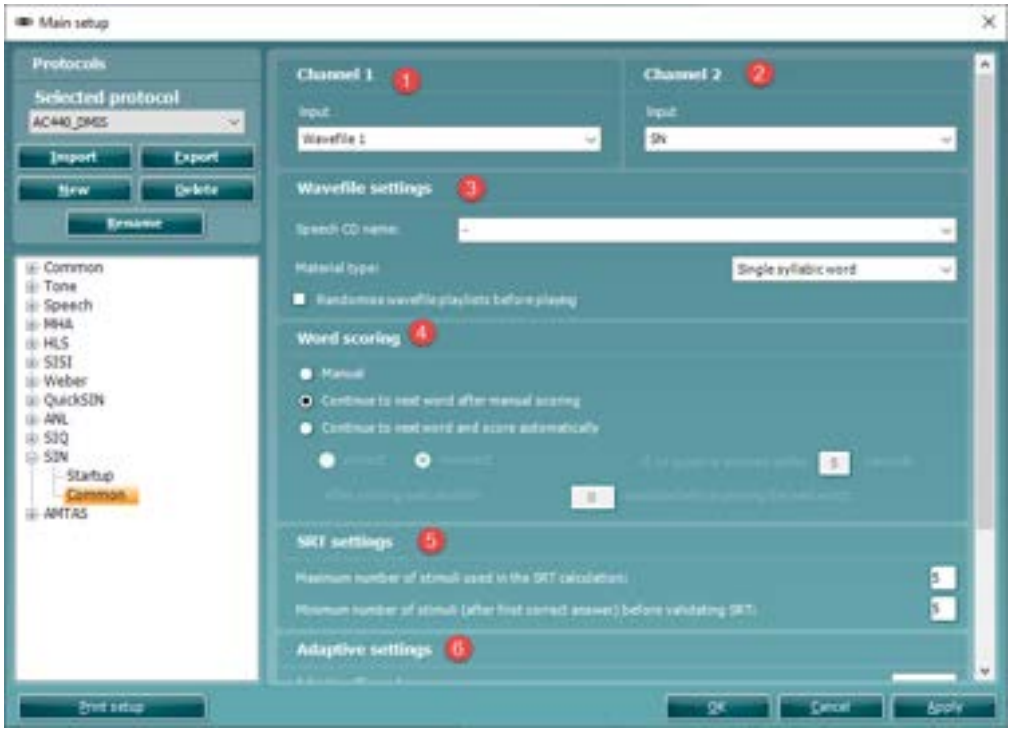
To enter the *Start-up* options for SIN testing unfold the **SIN** options and click *Start-up*.

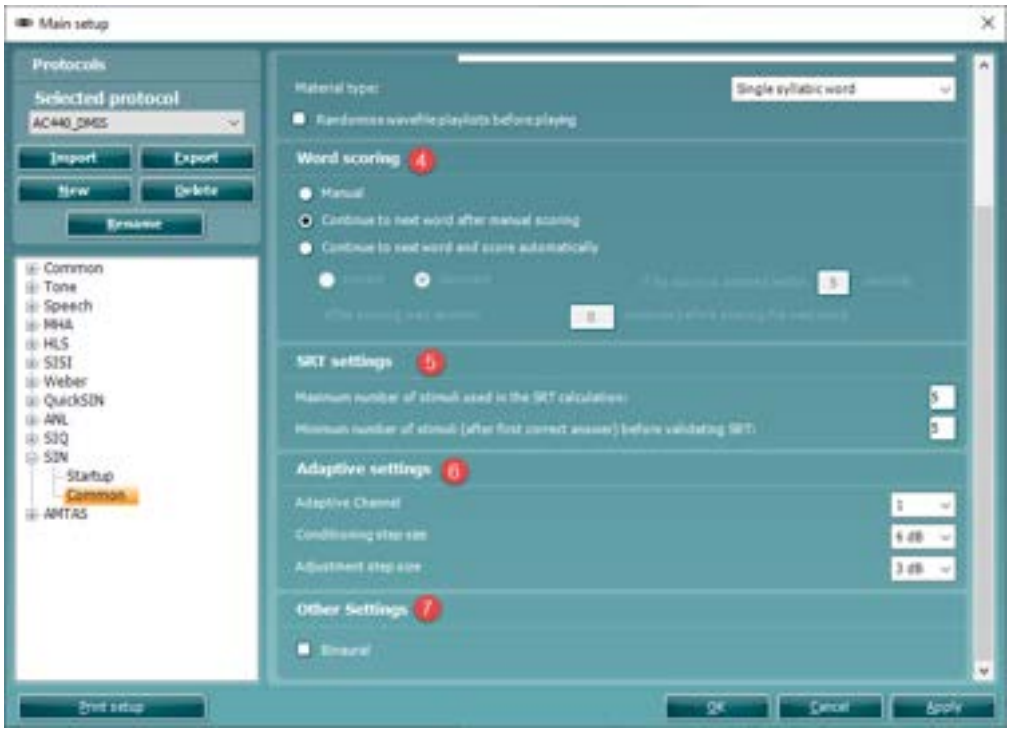
1) Select the default output for **Channel 1** from the dropdown list.
2) Select the default output for **Channel 2** from the dropdown list.
3) The **Talk back** level can be activated as a default.
4) The **Default SNR** section allows you to specify the start SNR level for your testing.



Common

To enter the *Common* options for SIN testing unfold the SIN options and click *Common*.





1) Select your desired **Channel 1 input** via the Input dropdown list.

2) Select your desired **Channel 2 input** via the Input dropdown list.

3) Choose your **Speech Material** via this section. The CD chosen corresponds to material which is already available in your Speech Audiometry test screen. This requires that the material has been extracted via the speech extraction tool.

You can select your default **material type** in this drop down which will automatically make the system search for the relevant material for this type of test.

If you check the **Randomise wavefile playlists before playing** checkbox then the material will be played in a random order.

4) Specify how you would like the software to behave for the **Word Scoring** via this section. This will allow you to change the logic of the system depending on how the responses are scored.

5) The **SRT Settings** allow you to specify the max number of stimuli used for the SRT calculation and the minimum number of stimuli required after the first correct score before the system calculates an SRT score.

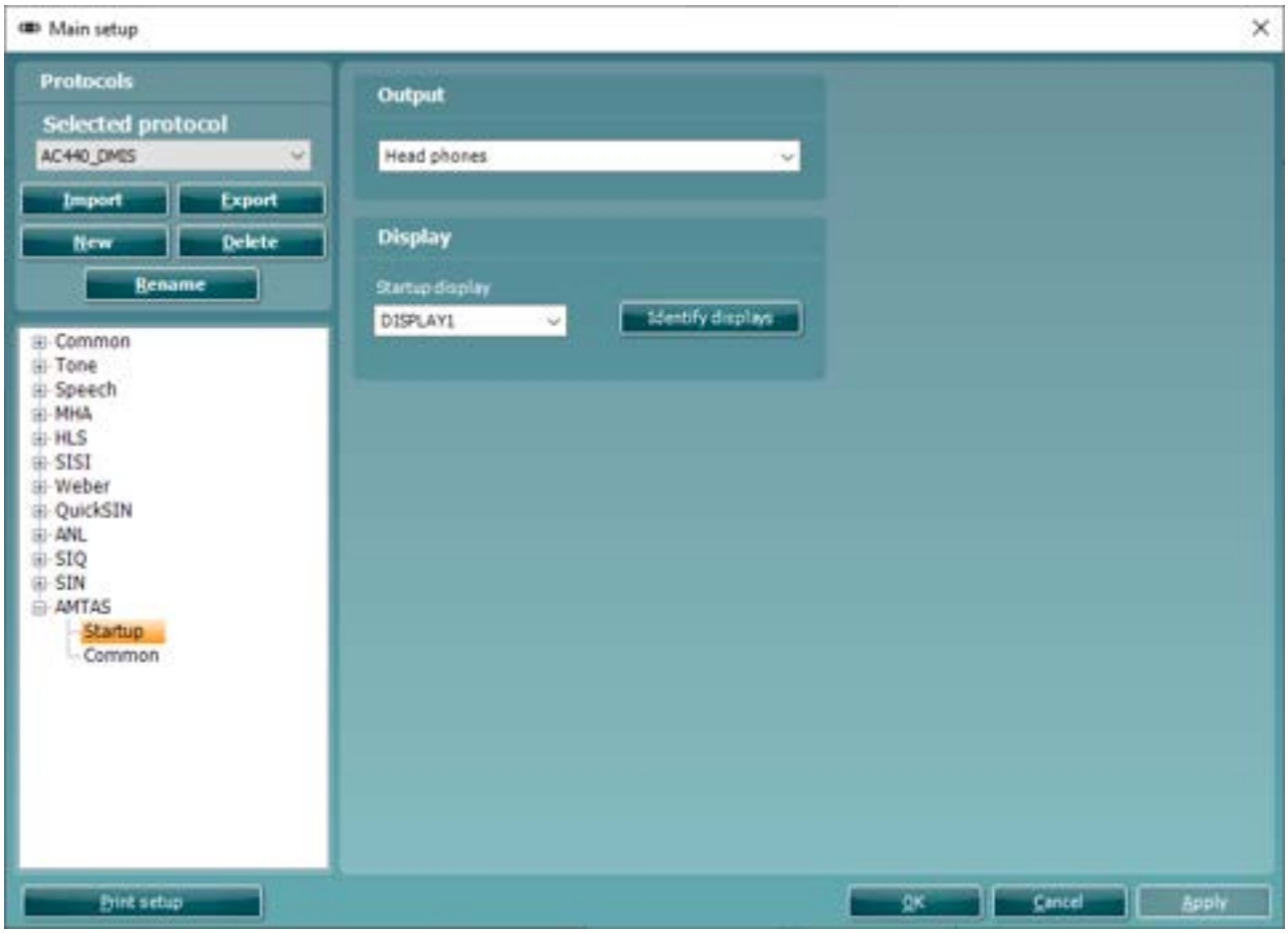
6) The **Adaptive Settings** allow you to specify the step size of both the conditioning step and the adjustment once the test has begun.

   You can also specify which channel is adaptive – allowing you to choose if the signal or the noise will change according to the patients' response when performing the test.

7) The **Other Settings** allow you to default the test as Binaural.

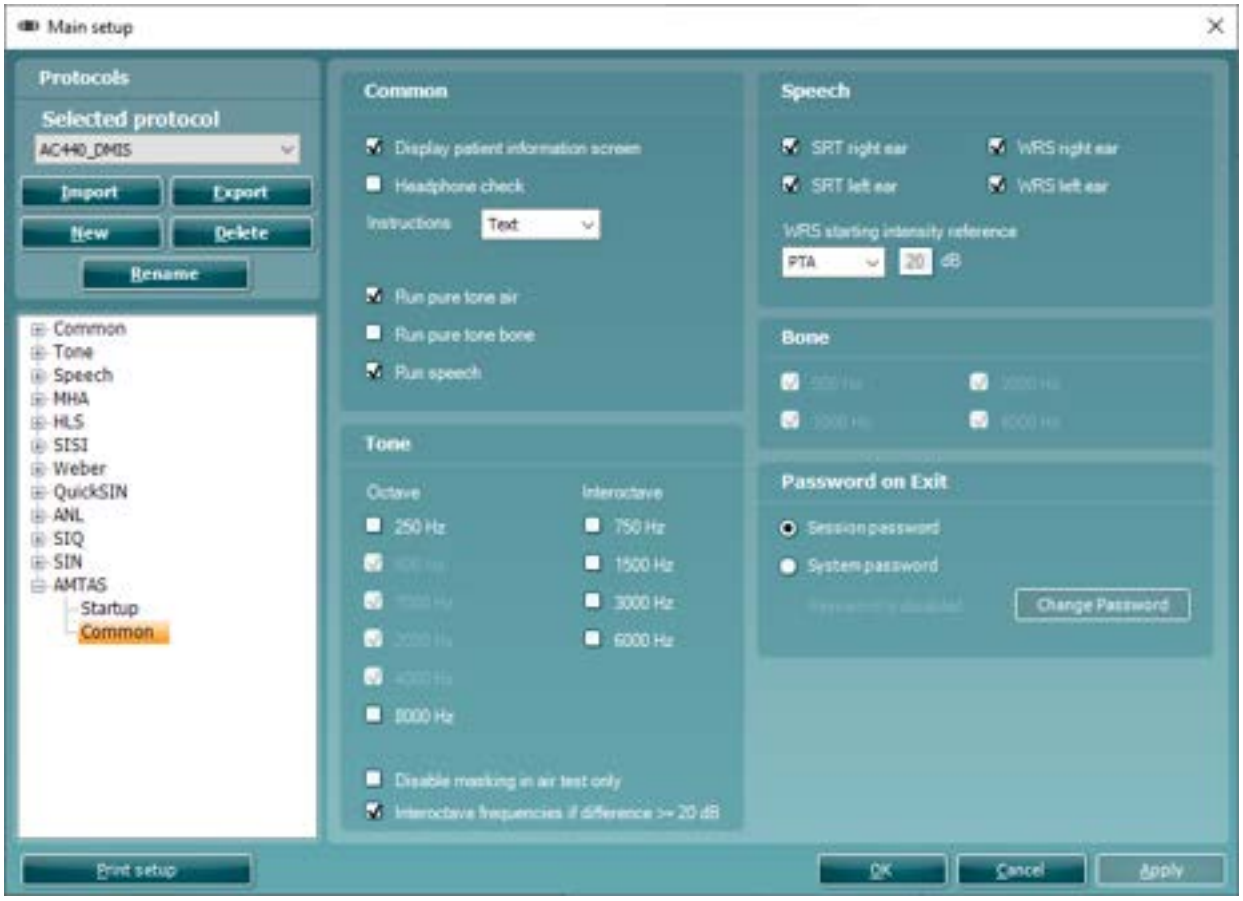
1.9.17 IA-AMTAS test setup

Start-up



In this screen you have the possibility to choose the default AC transducer you wish to perform your test with.

You also have the option to select which display you wish to show your IA-AMTAS test on, this is for selecting the appropriate monitor for the patient to use when conducting the test. Pressing the 'Identify displays' button will help to indicate which monitor is which.



Settings in this window include:

Common

- Selection on whether you wish to see the **patient information screen** or not.

  This information is relevant to the patient's name and date of birth which is displayed in the top bar of the software, you can toggle this on/off.

- **Headphone check**.

  This setting enables a dedicated screen which checks that the headphones have been mounted correctly before the test begins. Sound is played from the dedicated left or right ear sides and the sound should correspond to the side that the patient hears it to confirm that the headphones have been correctly mounted.

- How you wish to see the **instructions** for the IA-AMTAS test. (Video, Text, or None).

  This setting corresponds to the instructions which are provided to the patient at the beginning of the test about how to react/perform the test. This can be shown in video or text format or removed completely.

- Which pure tone tests you wish to include.

  Here you can select which pure tone testing you wish to include in the test, some prefer to only run pure tone air when screening so that the BC transducer doesn't need to be included. You can toggle pure tone air and pure tone bone on/off.

- Run a Speech Test. You can toggle on/off if you wish to run speech testing as part of the IA-AMTAS process.

Tone

In this section you can select which audiometric frequencies you wish to test (including their inter-octaves) by toggling on/off against the frequency. Notice that 500, 1000, 2000 and 4000 Hz are included as default.

You also can **disable AC masking** here should you not wish to include masking for AC thresholds.

To **enable/disable inter-octave testing when there is a difference of 20dB** between standard octave thresholds you can toggle on/off the setting at the bottom of the tone section.

Speech

In this section you can choose which test types you wish to perform on each ear.

In the bottom of this section there is a setting to specify the starting intensity reference for the Word Recognition Score. There are three options for this, to use the Pure Tone Average (PTA) found in your tone audiometry, to use the SRT threshold found for the specific ear side or to use a fixed intensity which you can enter in the box alongside this setting.

Bone

Here you can choose which frequencies you wish to test BC tone for. By default, 500, 1000, 2000 and 4000 Hz are enabled to correspond to the AC frequencies.

Password on Exit

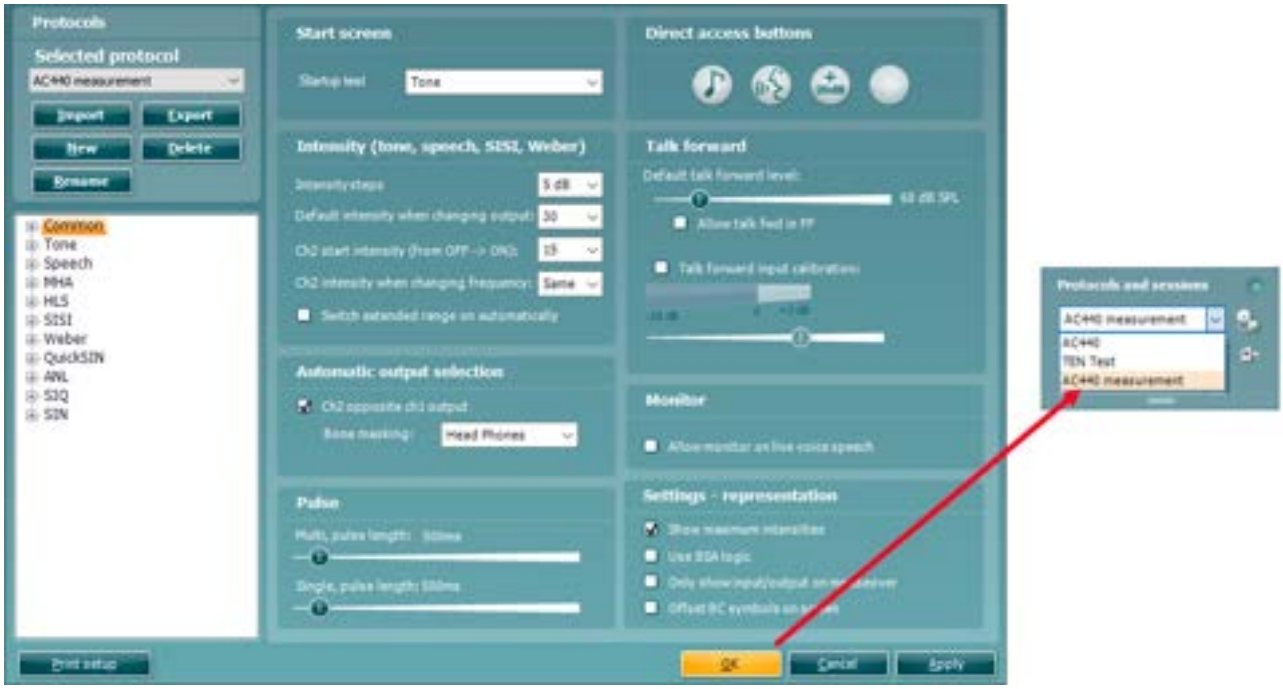
These settings are configured to manage how the system will behave should you wish to exit the test mid-session.

It can be configured to request the System Password or the Session Password. If the Session password is chosen, then this is created each time the IA-AMTAS test begins and required the operator to re-enter that password to exit the test.

An example of this is shown below.

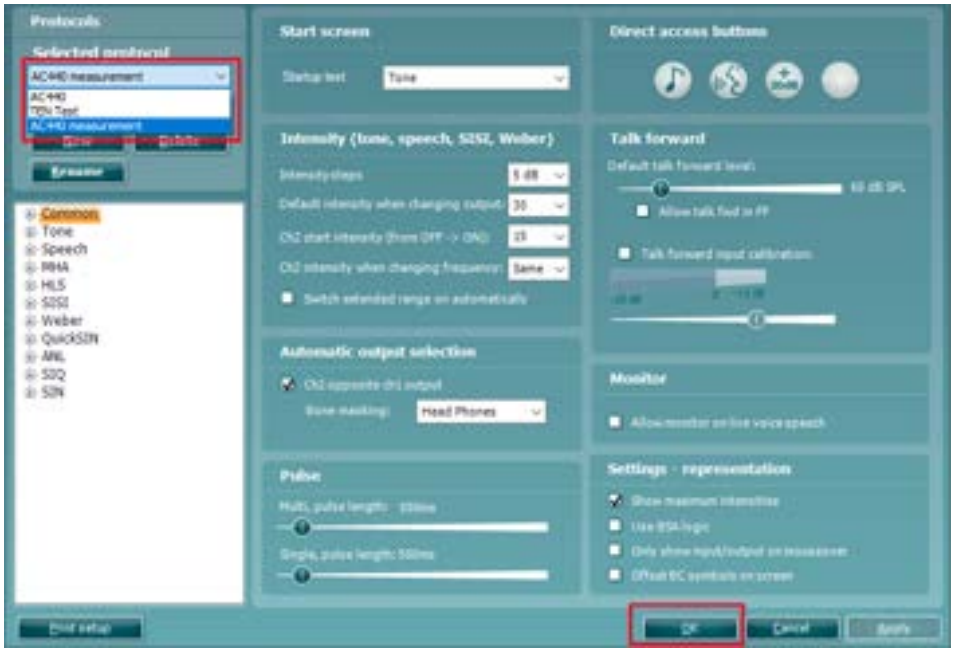
1.9.18 Finishing the test protocol

Press **OK** in the lower right-hand corner of the AC440 setup screen to save the customized test protocol. The test protocol can then be found in the *Protocols and sessions* dropdown list in the front screen.



1.9.19 Changing a test protocol permanently

You can at any time make changes to an individual test protocol by entering the AC440 setup again as when creating the test.



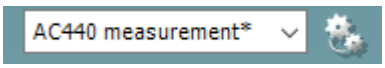
1) Under **Settings** find the test protocol using the *Name* dropdown list.

2) Browse the setup options as if creating a test protocol (see section 1.10) and amend as desired.

   When finished, click **OK** (or **Apply**) to save the changes.

1.9.20 Changing a test protocol temporarily

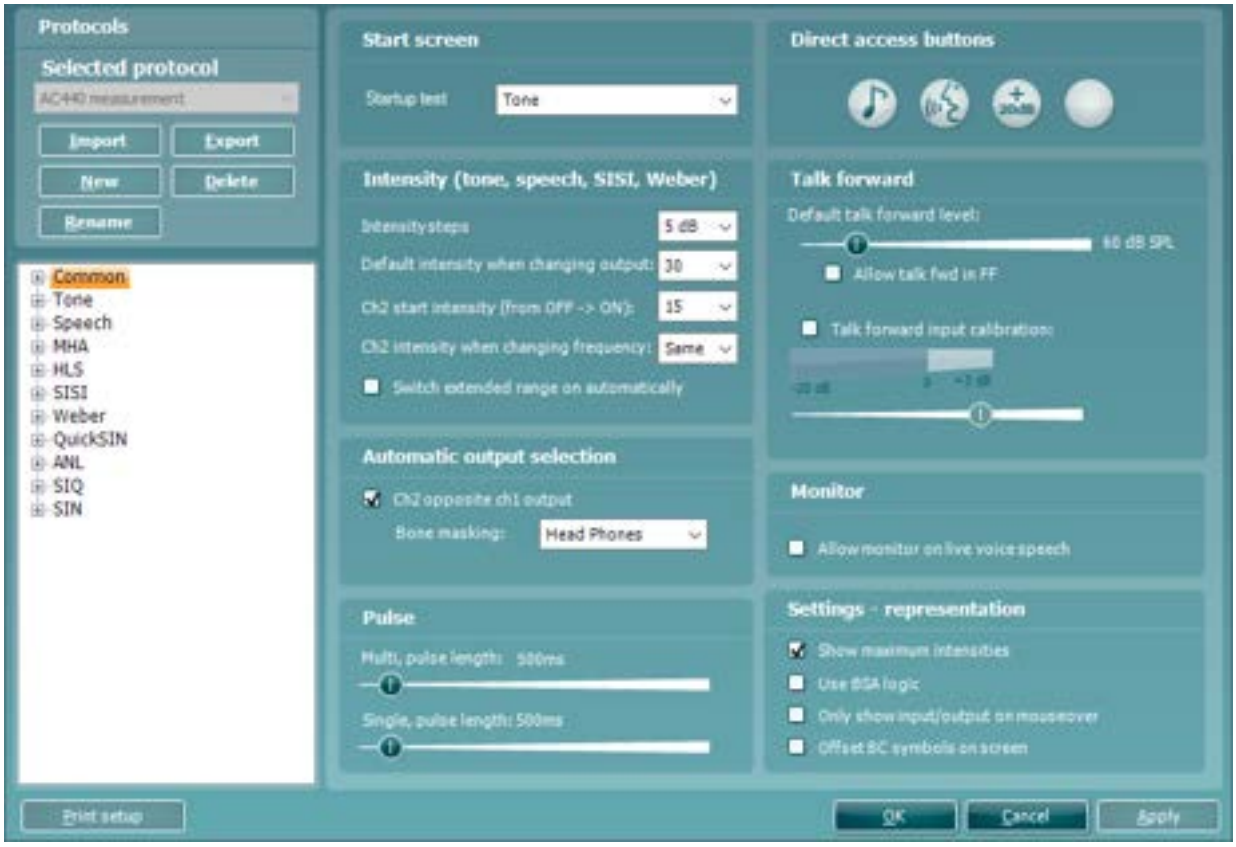
You may from time to time run into a patient with special needs requiring advanced or different testing parameters. In this situation the *Temporary Setup* can be helpful. The setup changes made here will be specific to the session. The test protocol name will be supplemented with an asterisk (*) to indicate that changes have been made to original test protocol. After saving the protocol will change back to the default selected protocol making you ready for your next patient.



1) Enter the *Temporary Setup* by clicking the button in the front screen  (or alternatively select **Menu>Setup>Temporary setup**).

2) The Temporary Setup is identical to the AC440 setup. However, functions that cannot be changed temporarily will be greyed out.

   Browse the setup options to make temporary changes as if creating a test protocol (see section 1.12.2).

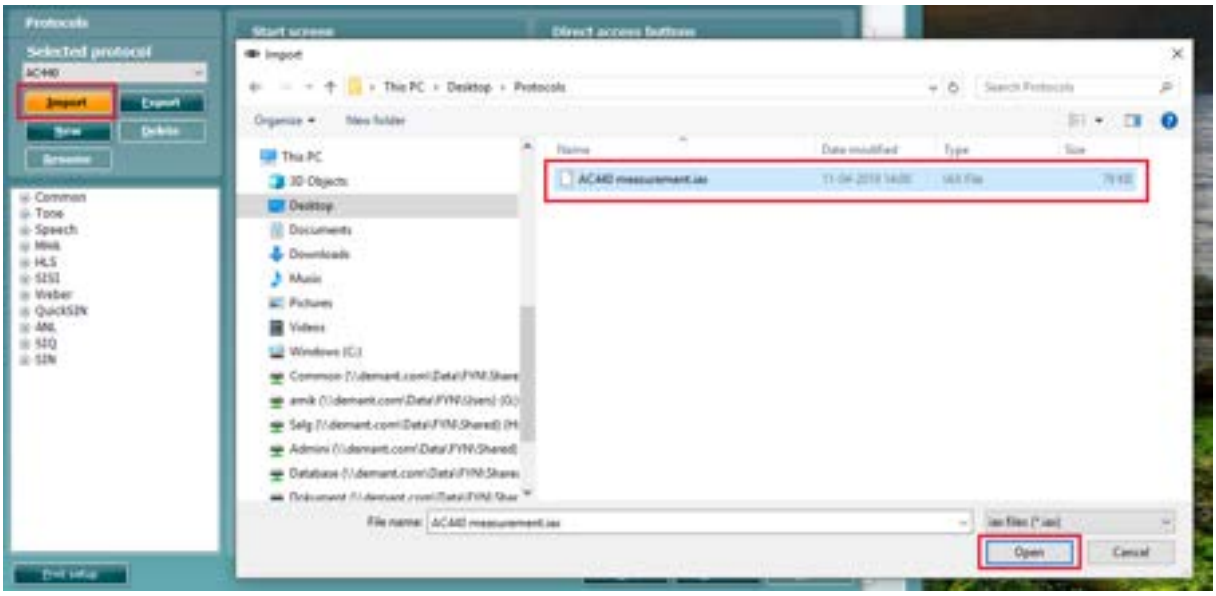


1.9.21 Importing and exporting test protocols

The AC440 also allows you to import and export test protocols to other AC440 users.

1.9.22 Importing a test protocol:

1) Go to the AC440 Setup (**Menu > Setup > AC440 setup**).



2) Click **Import** and browse to the location on the PC or USB where the test protocol file has been saved.

3) Click **Open**.

4) The test protocol will then appear under **Name**.

5) After saving it by clicking **OK** the test protocol can be selected in the *List of defined protocols* in the front screen.

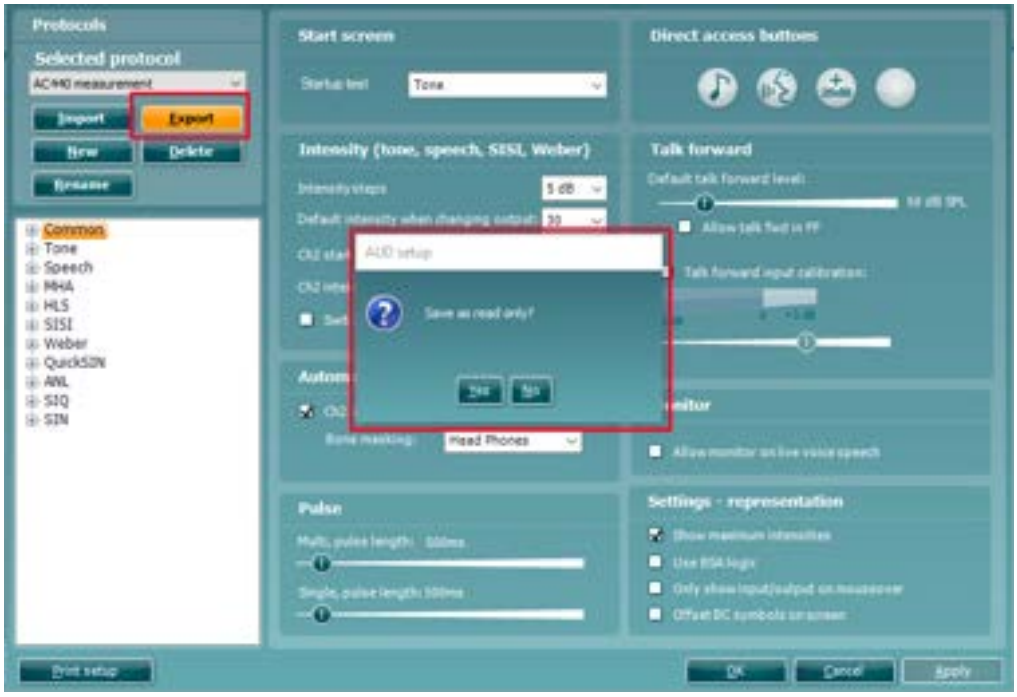
Note that settings of imported protocols cannot be edited if they were exported as “read only”.

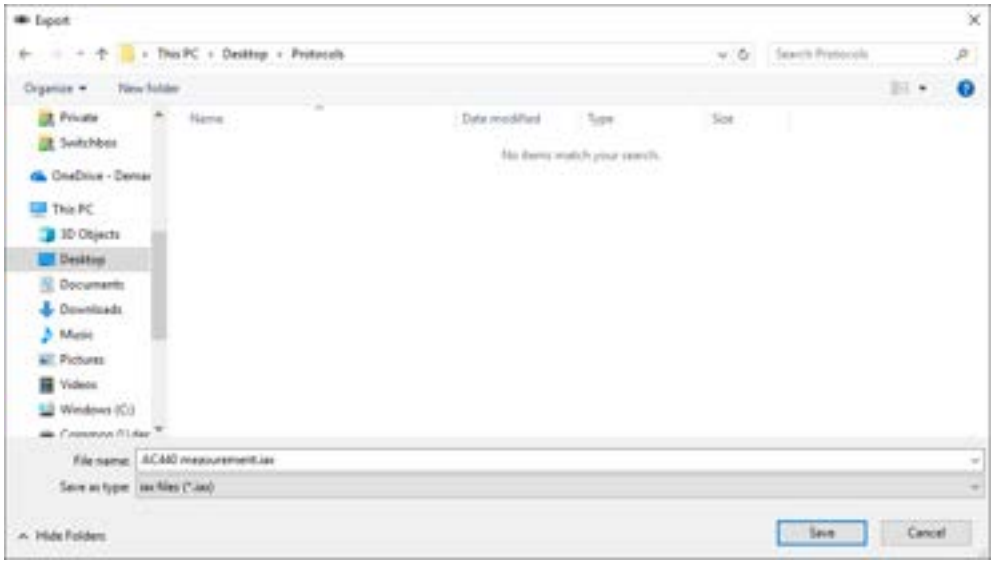
1.9.23 Exporting a test protocol:

1) Go to the AC440 Setup (**Menu > Setup > AC440 setup**).

2) Click on **Export**.

3) Select if the file is to be saved as “read only”. In this case the protocol file is locked and the clinician receiving it will not be able to make changes to it.





4) Browse for the location on the PC or USB where the test protocol is to be placed.

5) Click **Save**. Other AC440 users will then be able to upload the test protocol using the Import function.

2 General functionality

2.1 Tone screen elements

The following section describes the elements of the tone screen.

Menu	**Menu** provides access to Print, Edit, View, Tests, Counselling, Setup, and Help
	**Print** allows for printing the session's acquired data.
	**Save & New Session** saves the current session in Noah or OtoAccess® and opens a new one.
	**Save & Exit** saves the current session in Noah or OtoAccess® and exits the Suite.
	**Collapse** the left side panel.

Go to Tone Audiometry activates the tone screen when in another test.

Go to Speech Audiometry activates the speech screen when in another test.

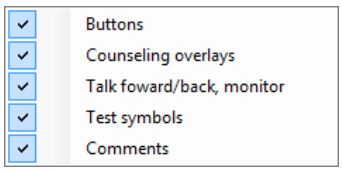
Extended Range +20 dB extends the testing range and can be activated when the testing dial setting gets within 50 dB of the maximum level of the transducer.

Note that the extended range button will flash when it needs activation for reaching higher intensities.

To switch on the extended range automatically, select the **Switch extended range on automatically** by going to the setup menu.

Fold an area so that it only shows the label or the buttons of that area.

Unfold an area so that all buttons and labels are visible

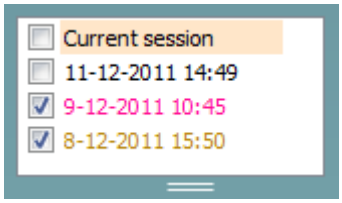


Show/hide areas can be found by right mouse clicking on one of the areas. The visibility of the different areas as well as the space that they take on the screen is locally saved to the examiner.

Go to **Menu > Setup > Enable/Disable icons** to show or hide individal icons.

List of Defined Protocols allows for selecting a test protocol for the current test session. Please refer to section 1.12 for more information about protocols. Right mouse click on a protocol allows the current examiner to set or deselect a default start-up protocol.

Temporary Setup allows for making temporary changes to the selected protocol. The changes will be valid for the current session only. After making the changes and returning to the main screen, the name of the protocol will be followed by an asterisk (*).



List of historical sessions accesses historical sessions for comparison purposes. The audiogram of the selected session, indicated by the orange background, is shown in colors as defined by the used symbol set. All other audiograms that are selected by check marks show on screen in the colors as indicated by the text color of the date and time stamp. Note that this listing can be resized by dragging the double lines up or down.

Right Clicking on a historical session will allow you to see exactly which measurements have been performed in that session. This is useful when trying to find a special test amongst several sessions without opening the session individually to find the data you need.

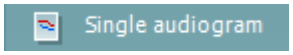
The tests which have been performed will have a green light next to them.

You can also click on **Deselect all selected sessions overlays** after right clicking on the sessions to remove any historic session overlays you have chosen to display.

Go to Current Session brings you back to the current session.

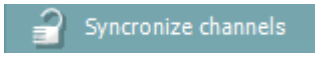
High Frequency shows frequencies on the audiogram However, you will only be able to test in the frequency range the selected headset is calibrated for.

High Frequency Zoom activates high frequency testing and zooms in on the high frequency range. Please refer to section 3.1.1 for more information on high frequency testing.



Single audiogram toggles between viewing the information of both ears in a single graph and two separate graphs.

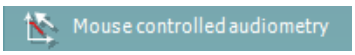
Multi frequencies[13] activate testing with frequencies in between the standard audiometric test frequencies. The frequency resolution can be adjusted in the Suite setup.



Synchronize channels locks the two channels together. This function may be used to perform synchronous masking.

Edit Mode button activates the editing function. Left clicking on the graph will add/move a point to the position of the cursor. By right clicking on a point, it is possible to **Delete** the recorded point or the entire curve. Furthermore, right mouse click provides the option to **Add unmasked threshold, Add no response, Add masked threshold**, **Add masked-no-response threshold, Copy bone thresholds to other ear,** and **Hide unmasked thresholds where masked exist**.

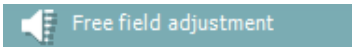
[13] MF requires an additional license for the AC440. If not purchased, the button is greyed out.



Mouse controlled audiometry enables you to do the audiometry using the mouse only. The stimulus is presented with the left mouse button, and the threshold is stored with the right mouse button.

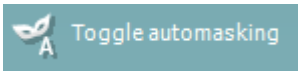
The **dB step size** button indicates to which dB step size increment the system is currently set. It rotates from 1 to 2 to 5 dB and the larger number indicates the setting.

The **hide unmasked threshold** will hide those unmasked thresholds where masked thresholds exist.



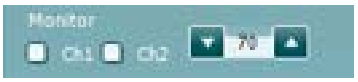
The **Free field adjustment** tool allows you to perform a referencing procedure for Free field Audiometry and Speech Audiometry measurements.

Toggle Masking Help will activate or deactivate the Masking Help.



Toggle Automasking will activate or deactivate the Automasking feature.

Talk Forward activates the Talk Forward microphone. The arrow keys can be used to set the talk forward level through the currently selected transducers. The level will be accurate when VU meter indicates to be at zero dB.



Selecting the **Monitor Ch1** and/or **Ch2** check boxes allow you to monitor one or both channels through an external loudspeaker/headset connected to the monitor input. The monitor intensity is adjusted by the arrow keys.

The **Talk back** check box enables you to listen to the patient. Note that you need to be equipped with a microphone connected to the talk back input and an external loudspeaker/headset connected to the monitor input.

The **Assistant Monitor** section is for communication between the operator and an assistant. Checking the **Headphone** box will allow the assistant to hear the operator. Checking the **Microphone** box will allow the assistant to talk to the operator.

When the operator activates Talk back while **Headphone** is enabled, the assistant can hear the patient as well.

The **Patient monitor** opens an always-on-top window with the tone audiograms and all its counselling overlays shown. This provides an easier layout to counsel the patient. The size and position of the patient monitor gets saved for each examiner individually.

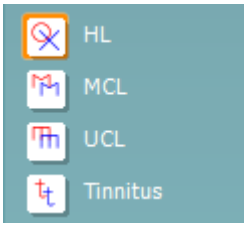
The **Phonemes** counselling overlay shows phonemes as it is configured in the protocol that is currently in use.

The **Sound examples** counselling overlay shows pictures (png-files) as they are set up in the protocol that is currently in use.

The **Speech banana** counselling overlay shows the speech area as it is set up in the protocol that is currently in use.

The **Severity** counselling overlay shows the degrees of hearing loss as it is set up in the protocol that is currently in use.

The **Max. testable values** overlay highlights the area beyond the maximum intensity that the system allows. This reflects the transducer calibration and differs when the extended range is activated.



Selecting **HL**, **MCL**, **UCL** or **Tinnitus** sets the symbol types that are currently in use by the audiogram for different tests. HL stands for hearing level, MCL stands for most comfortable level and UCL stands for uncomfortable level. Note that these buttons display the unmasked right and left symbols of the currently selected symbol set.

Each type of measurement is saved as a separate curve.

Binaural and **Aided** allows for indicating if the test is performed with hearing aids or binaurally with corresponding symbols. The measurements will be saved as separate curves.

In the **Comments** section you can type comments related to any audiometric test. The used space by the comments area can be set by dragging the double line with your mouse. Pressing the  button opens a separate window for adding notes to the current session. The report editor and comment box contain the same text. In case the formatting of the text is important, this can only be set within the report editor.

On pressing the button you will see a menu which allows you to specify the hearing aid style on each ear. This is just for note taking when performing aided measurements on your patient.

After saving the session, comment changes can only be made within the same day until the date changes (at midnight). **Note:** These timeframes are limited by HIMSA and the Noah software, and not by Interacoustics.

The **Output** list for channel 1 provides the option to test through head phones, bone conductor, free field speakers or insert phones. Note that the system only shows the calibrated transducers.

The **Input** list for channel 1 provides the option to select pure tone, warble tone, narrow band noise (NB) and white noise (WN).

Note that the background shading is according to the side that is selected, red for right and blue for left.

The **Output** list for channel 2 provides the option to test through head phones, free field speakers, insert phones or insert masking phone. Note that the system only shows the calibrated transducers.

The **Input** list for channel 2 provides the option to select pure tone, warble tone, narrow band noise (NB), white noise (WN) and TEN noise[14].

Note that the background shading is according to the side that is selected, red for right, blue for left, and white when off.

Man and **Rev** allows toggling between Manual and Reverse test modes. In manual the stimulus is presented only when manually activated. In reverse the signal is presented continuously until interrupted by the tone switch.

Pulsation allows for single and continuous pulsating presentation. The duration of the stimulus can be adjusted in the Suite setup.

Sim/Alt allows togging between Simultaneous and Alternate presentation. Ch1 and Ch2 will present the stimulus simultaneously when Sim is selected. When Alt is selected, the stimulus will alternate between Ch1 and Ch2.

R+L function allows the sound to be routed to both earsides.

The function is available for relevant tests only.

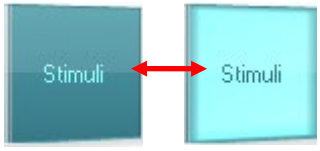
[14] TEN noise requires an additional license for the AC440. If not purchased, the stimulus is not available.

Masking indicates if channel 2 is currently in use as a masking channel and in that way makes sure masking symbols are used in the Audiogram. For example, in paediatric testing through free field speakers, channel 2 can be set as a second testing channel. Note that a separate store function for channel 2 is available when channel 2 is not used for masking.

dB HL Increase and **Decrease** buttons allow increasing/decreasing the intensities of channel 1 and 2.

The arrow keys on the PC keyboard can be used for increasing/decreasing channel 1 intensities.

PgUp and PgDn on the PC keyboard can be used for increasing/decreasing channel 2 intensities.



Stimuli buttons will light up when hovering the mouse over it. This indicates the presentation of a stimulus.

A right mouse click in the Stimuli area will store a no response threshold. A left mouse click in the Stimuli area will store the threshold at the current position.

Channel 1 stimulation can also be obtained by pressing the space bar or left Ctrl key on the PC keyboard.

Channel 2 stimulation can also be obtained by pressing the right Ctrl key on the PC keyboard.

Mouse movements in the Stimuli area for both channel 1 and channel 2 can ignored depending on the setup.

Frequency and Intensity display area shows what is currently presented. To the left the dB HL value for channel 1 is shown and to the right for channel 2 In the centre the frequency is displayed.

Notice that the dB dial setting will flash when attempting to exceed the maximum available intensity.

The **patient response indicator** will appear in between these values when the patient response button is depressed. The color of this indicator will depend upon which patient response side is used, a red light indicates the right patient response, and a blue light indicates the left patient response.

Frequency increase/decrease increases and decreases the frequency respectively. This can also be obtained using the left and right arrow keys on the PC keyboard.

Storing thresholds for channel 1 is done by pressing **S** or by a left mouse click in the attenuator of channel 1. Storing a no response threshold can be done by pressing **N** or by a right mouse click in the stimuli button of channel 1.

Storing thresholds for channel 2 is available when channel 2 is not the masking channel. It is done by pressing **<Shift> S** or by a left mouse click in the stimuli button of channel 2. Storing a no response threshold can be

done by pressing **<Shift> N** or by a right mouse click in the attenuator of channel 2.

The **hardware indication picture** indicates whether the hardware is connected. **Simulation mode** is indicated when operating the software without hardware.

When opening the Suite, the system will search for the hardware. If it does not detect the hardware, it will automatically run in Simulation mode.

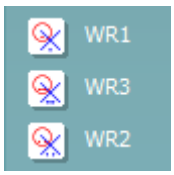
The **Examiner** indicates the current clinician who is testing the patient. The examiner information is saved with a session and can be printed with the results. This information is taken from the login on the database from which the Suite is launched, or the suite can be configured in the 'General Suite Settings' to request an examiner name on start-up.

For each examiner, the Suite stores how it is set up with regards to the use of space on the screen. The examiner will find that the suite starts up looking the same as it did the last time they used the software. Additionally, the examiner can select which protocol must be selected at start up by right-clicking on the protocol selection list.

2.2 Speech screen elements

The following section describes the elements of the speech screen, in addition to the tone screen.

Input levels sliders allow for adjusting the input level to 0 VU for the selected input. This ensures that correct calibration is obtained for Mic1, AUX1, and AUX2. On the VU Meter the dial intensity is achieved when the signal is at the 0 mark.



WR1, **WR2** and **WR3** (Word Recognition) allows selecting different speech list setups as defined by the selected protocol. The labels of these lists which go along with these buttons can also be customized in the protocol setup.

Binaural and **Aided** function allows for indicating if the test is performed binaurally or while the patient is wearing hearing aids.

The **Output** list for channel 1 provides the option to test through head phones, bone conductor, free field speakers or insert phones. Note that the system only shows the calibrated transducers.

The **Input** list for channel 1 provides the option to select white noise (WN), speech noise (SN), microphone 1 or 2 (Mic1 and Mic2), CD1, CD2 and wave file.

Note that the background shading of the speech Audiogram is according to the side that is selected, red for right and blue for left.

The **Output** list for channel 2 provides the option to test through head phones, free field speakers, insert phones or insert masking phone. Note that the system only shows the calibrated transducers.

The **Input** list for channel 2 provides the option to select white noise (WN), speech noise (SN), microphone (Mic1 and Mic2), CD1, CD2 and wave file.

Note that the background shading is according to the side that is selected, red for right, blue for left, and white when off.

Speech Scoring:

a) **Correct:** A mouse click on this button will store the word as correctly repeated. The **left** arrow key can also be used for storing as correct.

b) **Incorrect:** A mouse click on this button will store the word as incorrectly repeated. The **right** arrow key can also be used to score as incorrect.

*When using the graph mode, the correct/incorrect scoring is assigned by using the **Up** and **Down** arrow keys.

c) **Store:** A mouse click on this button will store the speech threshold in the speech graph. A point can also be stored by pressing **S**.

Phoneme scoring:

a) **Phoneme scoring:** If phoneme scoring is selected in the Suite setup, mouse click on the corresponding number to indicate phoneme score. Clicking on the Up arrow and the Down arrow keys will score as correct and incorrect, respectively.

b) **Store:** A mouse click on this button will store the speech threshold in the speech graph. A point can also be stored by pressing **S**.

Frequency and Intensity display show what is currently presented. On the left the dB value for channel 1 is shown, and on the right side, the dB value for channel 2 is shown.

In the centre, the current *Speech Score* in % and the *Word Counter* monitor the number of words presented during the test.

Shuffled wave file testing

By clicking on the Shuffle icon, you can randomize the order of the wave files for speech test presentation.

Re-clicking on the Shuffle icon will allow you to revert to the non-randomized presentation of the material.

When looking through the material, you can quickly see which list has been randomized, as the Shuffle icon is highlighted with orange.

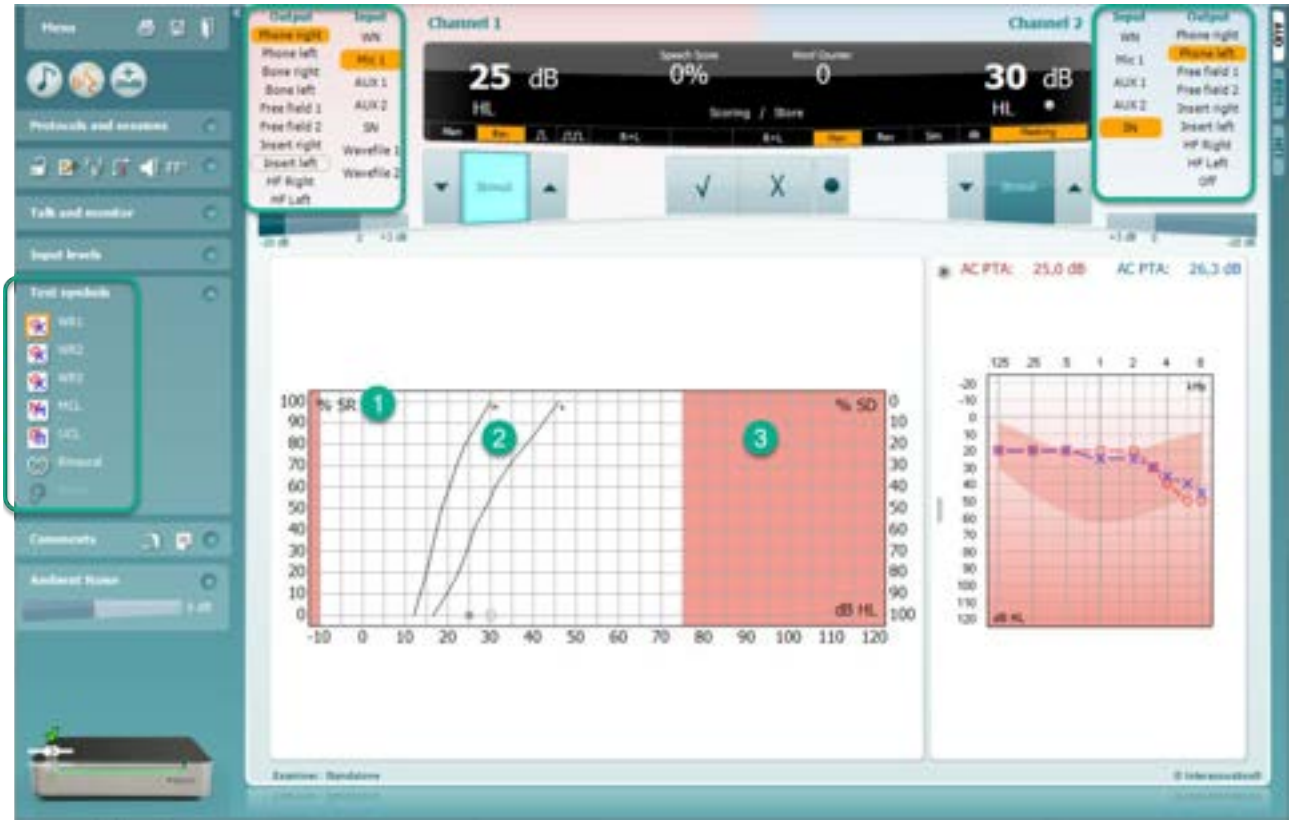
The shuffle function is also implemented in other areas of the software where speech wave files are used, e.g. in the SIN and SIQ tests.

The shuffle function can be enabled by default in the protocol. Please go to **Menu>Setup>AC440 setup>Speech>Common>General>Other Settings** and check the box 'Randomize wavefile'.

Shuffle function is disabled

Shuffle function is enabled.

2.2.1 Speech audiometry in graph mode



Graph mode presentation settings under “Test Symbols” and in the presentation options (Ch1 and Ch2) in the upper part of the screen shows where you can adjust the test parameters during the test.

1) **The graph:** The curves of the recorded speech graph will be displayed on your screen.

   The x-axis shows the intensity of the speech signal, and the y-axis shows the score in percent.

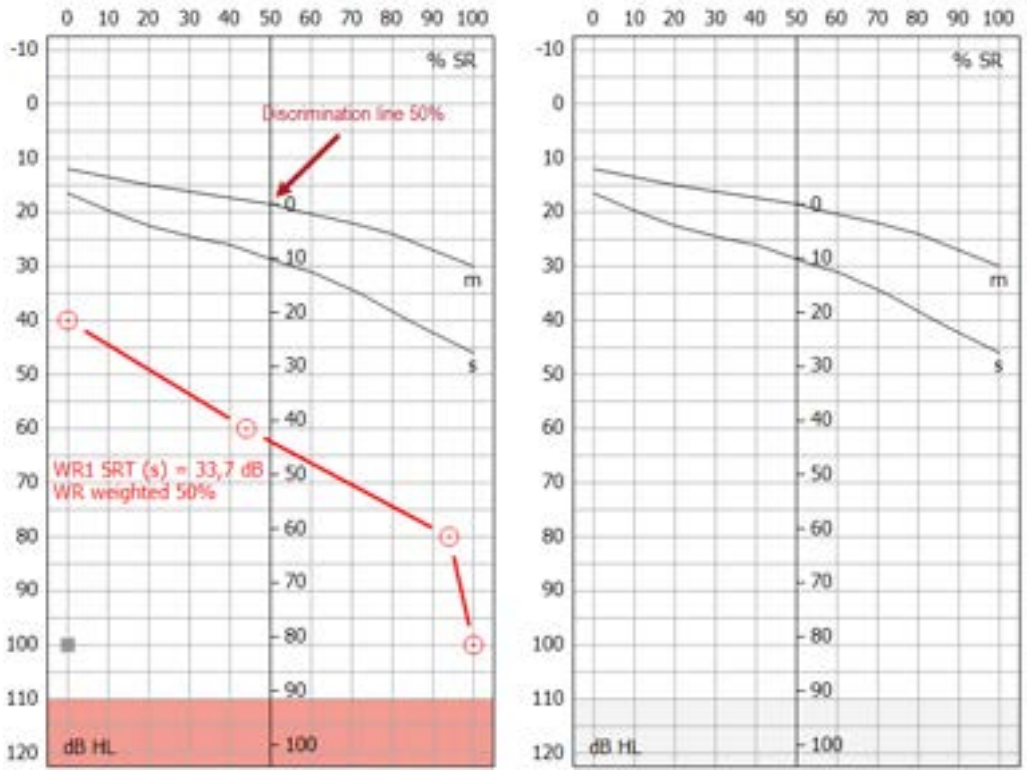
   The score is also displayed in the black display in the upper part of the screen, along with a word counter.

2) **The norm curves** illustrate norm values for **S** (Single syllabic) and **M** (Multi syllabic) speech material respectively. The curves can be edited according to individual preferences in the AC440 setup.

3) The shaded area illustrates the maximum intensity the system will allow. The *Extended Range +20 dB* button can be pressed to go higher. The maximal loudness is determined by the transducer calibration.

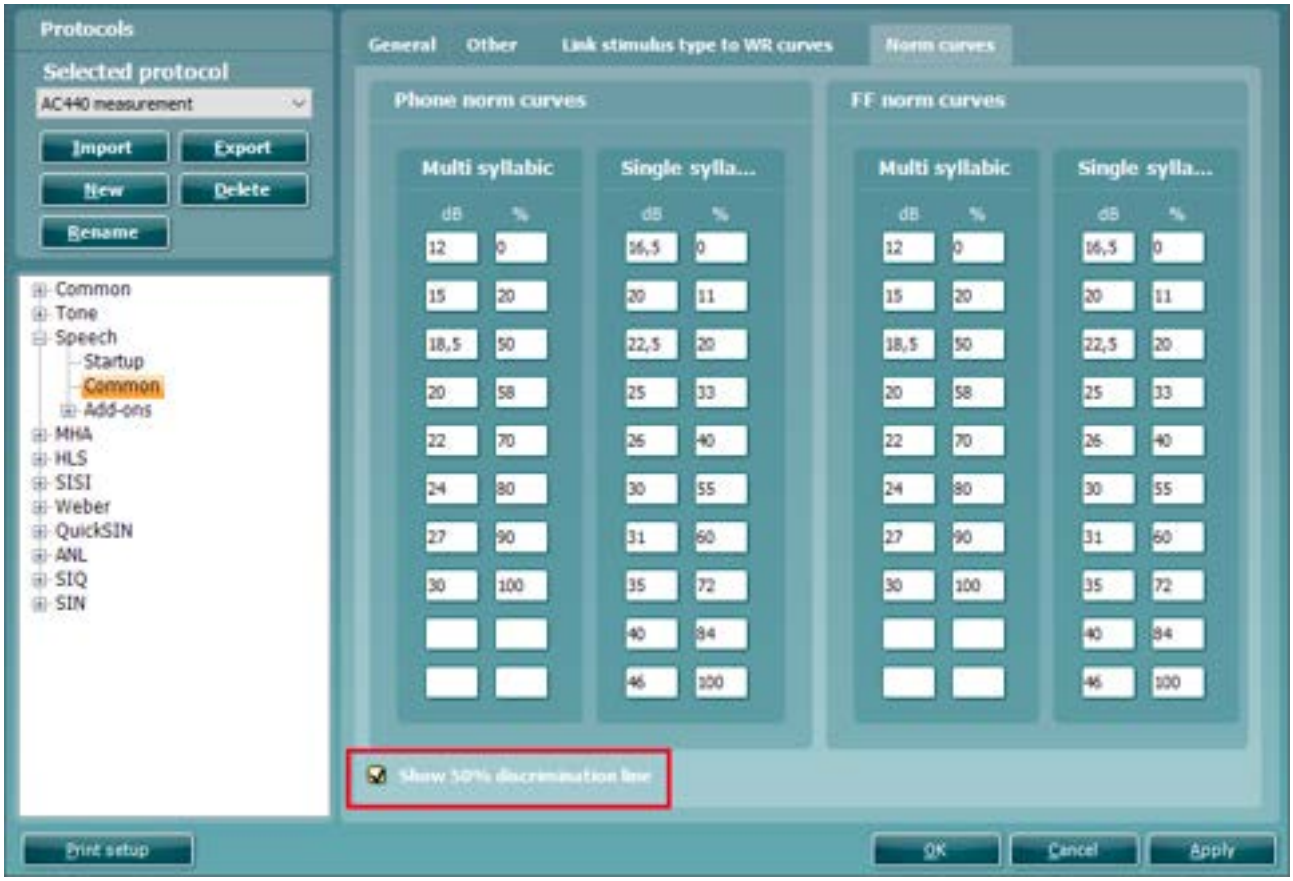
2.2.2 Dual speech graphs

The graphs can be shown as a dual audiogram to show right and left ear (see example below). Please go to **Menu>Setup>AC440 setup>Speech>Common>General>Graph mode settings and** check the box ‘Dual graph to enable this view by default.



2.2.3 50% discrimination line

The Graph View allows you to add a 50% discrimination line (see above dual audiogram image for example). Please go to **Menu>Setup>AC440 setup>Speech>Common>Norm curves** This is enabled by checking on the 'Show 50% Discrimination Line' setting in the Speech Norm Curves setup (see image below).

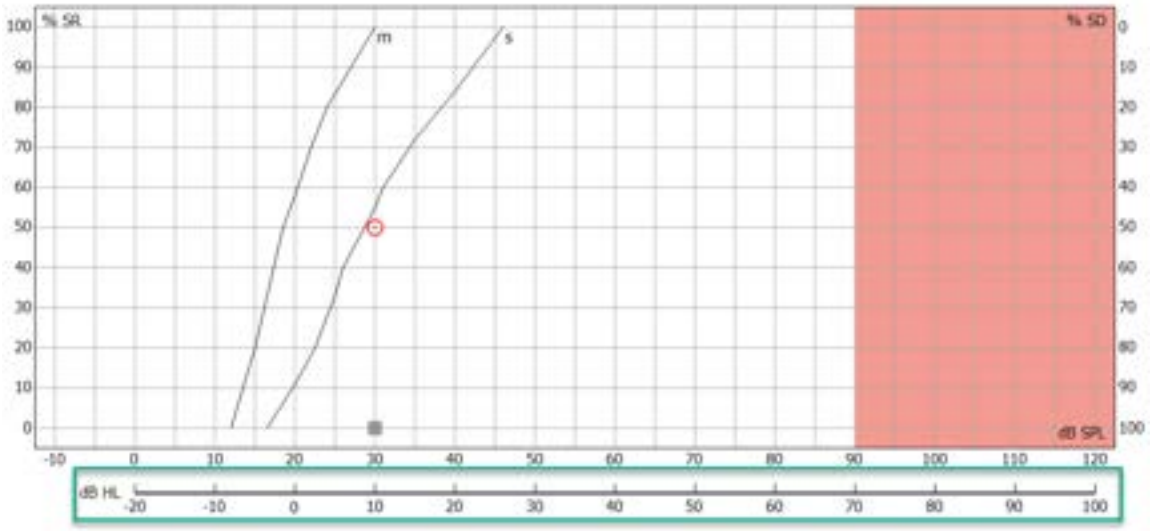


2.2.4 IEC dB hearing level scale

The ability to view the dB HL level scale against the speech audiogram is implemented within Free Field testing for markets using the IEC standard. This brings the ability to see all your measurements, regardless of transducer used, in the dB HL domain.

The setting for this needs to be amended under the ‘General Setup’, as highlighted in the image below.

Once this setting has been enabled, your Speech graph will show an additional scale at the bottom of the graph indicating the dB HL value. See the example of this below.



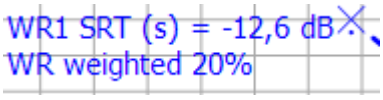
2.2.5 Bönninghaus & Röser calculation

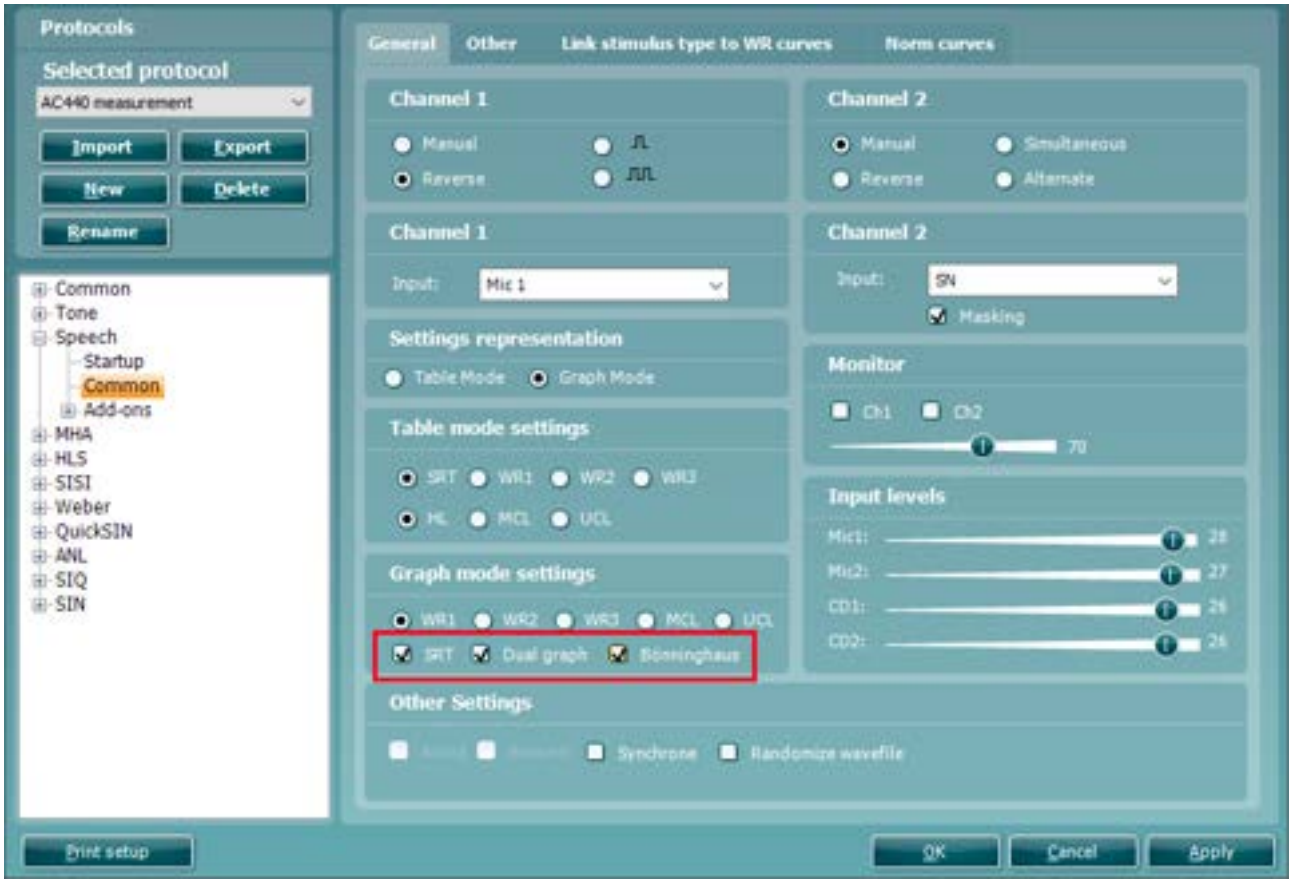
The Bönninghaus & Röser calculation has been implemented for the German market.

This is a marker to recognize the accuracy of the test in relation to the patient's audiometry and to identify when the patient is suitable for compensation/insurance.

Settings in the speech setup need Bönninghaus and SRT enabled to show this score.

The score will appear as WR weighted (see example below).





NOTE: The Bönninghaus & Röser Calculation is intended for use with the Freiburger Speech Test and the Freiburger Speech Norm Curves.

2.2.6 Speech audiometry in table mode

The Table Mode consists of two tables:

1) The **SRT** (Speech Reception Threshold) table: When the SRT test is active, it is indicated in orange There are also options to conduct speech audiometry to find **MCL (**Most Comfortable Level) and **UCL** (Uncomfortable Loudness Level). These are also highlighted in orange when activated.

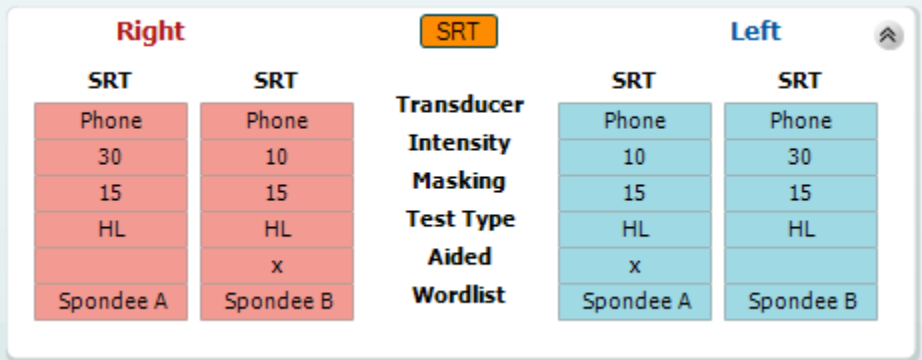
2) The **WR** (Word Recognition) table: When WR1, WR2, or WR3 is active the corresponding label will be orange.

2.2.7 The SRT table

The SRT table (Speech Reception Threshold table) allows for measuring multiple SRTs using different test parameters, e.g. *Transducer, Test Type, Intensity, Masking,* and *Aided*.

Upon changing *Transducer, Masking*, and/or *Aided* and re-testing, an additional SRT entry will appear in the SRT table. This allows for multiple SRT measurements to be shown in the SRT table. The same can be applied for when performing MCL (Most Comfortable Level) and UCL (Uncomfortable Loudness level) speech audiometry.

Please refer to section 3.2.1 for more information about Speech Reception Threshold testing.

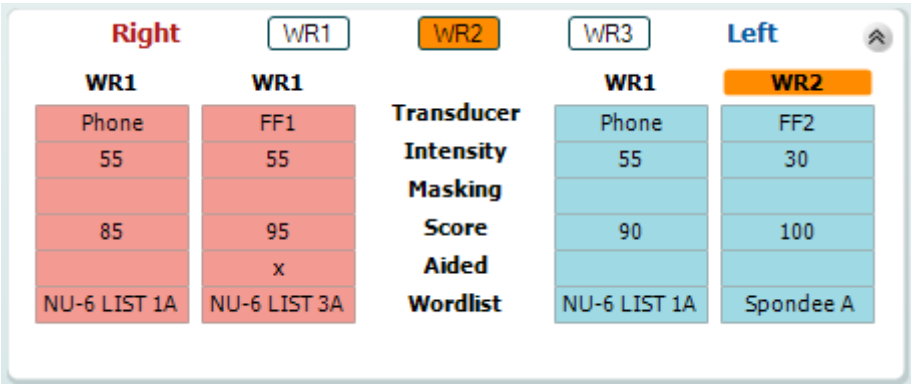


2.2.8 The WR table

The word recognition (WR) table allows for measuring multiple WR scores using different parameters (e.g., *Transducer, Test Type, Intensity, Masking, Binaural* and *Aided*).

Upon changing Transducer, Masking, Binaural and/or aided re-testing an additional WR entry will appear in the WR table. This allows for multiple WR measurements to be shown in the WR table.

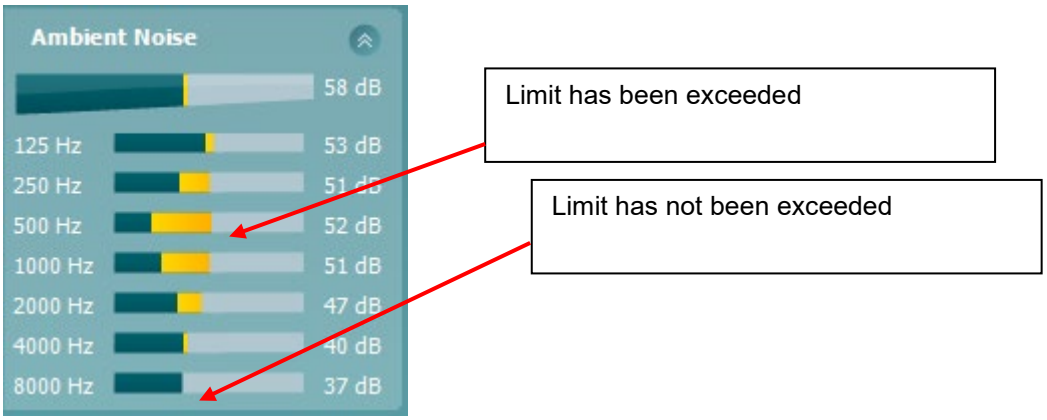
Please refer to section 3.2.3 for more information about Word Recognition testing.



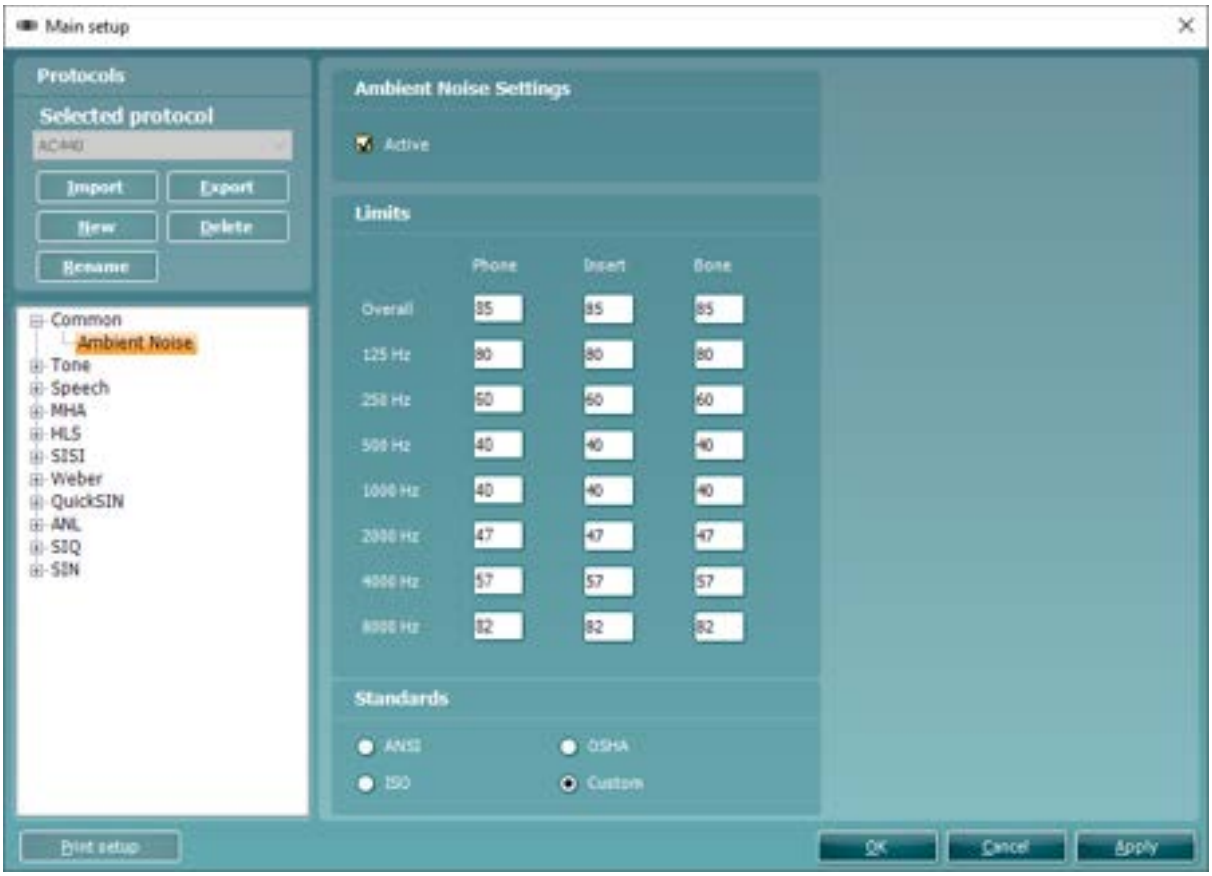
2.3 Ambient noise

The Ambient noise feature allows you to monitor the test environment for any noise during audiometry. This is particularly useful when testing in suboptimal conditions or conductings tests via tele-audiometrt, where you are not physically present in the test environment.

The Ambient Noise monitor will appear in the left panel of the AUD screen when enabled. It shows the average noise level at the top and then individual frequency levels below. It will show darker bars (limits) and orange bars above this when the limit is exceeded, see example below.



Ambient noise configuration



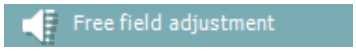
In the Ambient Noise configuration, you have the options to activate the Ambient Noise feature.

You will also notice that there are boxes to input the limit levels for different transducers and their associated frequencies, you can only manually input these values when on a Custom standard. These will be greyed out when a standard is chosen (e.g., ANSI, OSHA, or ISO).

The maximum permissible ambient noise values are based on values required to assess a patient with a 0dB hearing loss across all frequencies.

2.4 Free field adjustment

The Free field Adjustment feature in the AUD module allows you to refresh your FF speaker calibration when moving your equipment between different environments or simply to reconfirm your speaker calibration in a fixed setup.



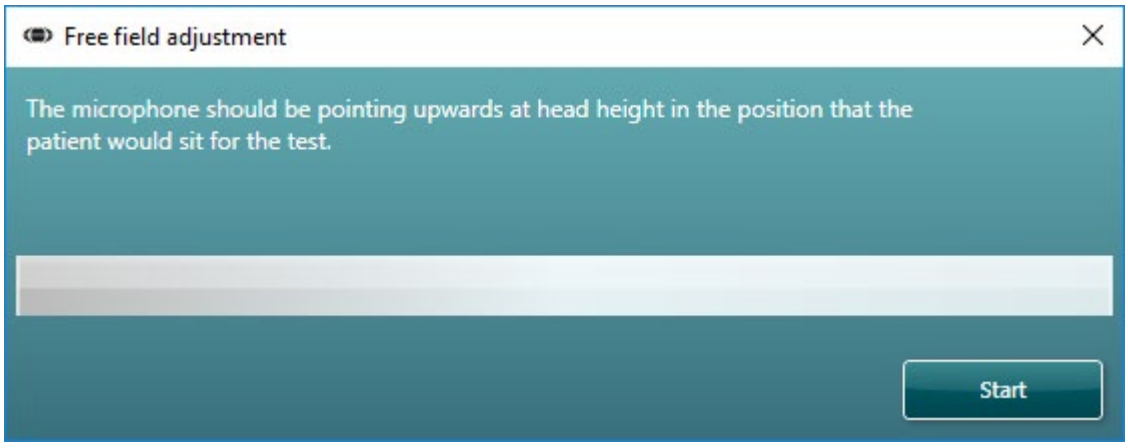
This feature works by playing several stimuli to the Ambient-cal mic when it is placed upright in the position that the patient should sit during testing. The process is fully automated and when completed the system will apply corrections based on the room acoustics to ensure that the correct stimulus is played when performing free field tone or speech audiometry.

This process removes the need to have your instrument fully re-calibrated for new environments.

Note: Please keep the environment silent during this process and any interfering noise will affect the calibration levels set or cause the process to fail.

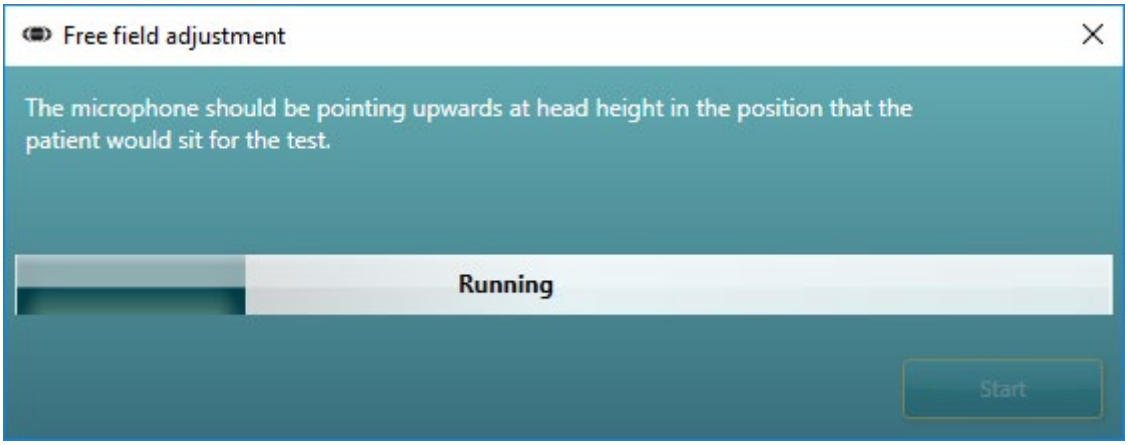
Note: This process does not overwrite your existing calibration files, it simply adds a correction to them so that the correct stimulus is applied at the reference point in your new environment. On closing the suite this correction is removed.

Note: This should be performed for each patient you wish to test in the new environment as the stored calibration data in the unit is not overwritten/changed by this process.

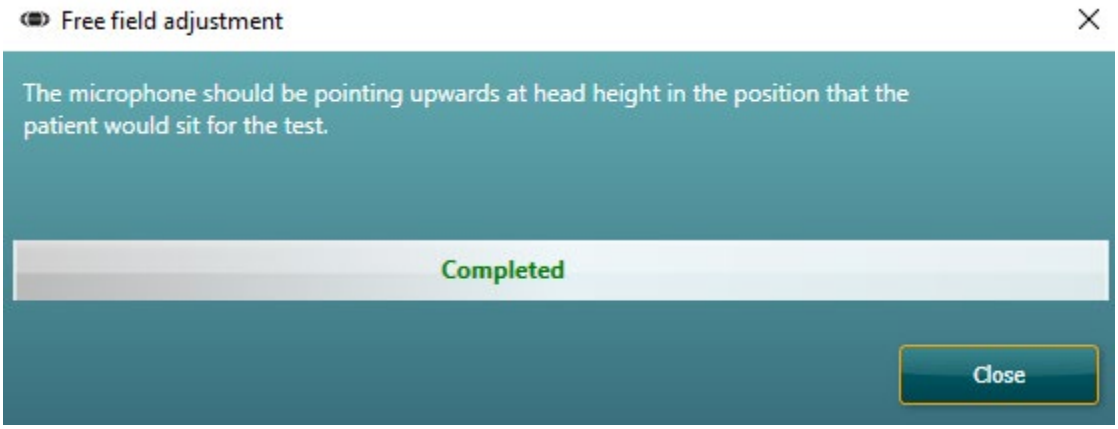


During the process you should hold the FF calibration microphone in the postion and height that the patient will be tested, as shown below.

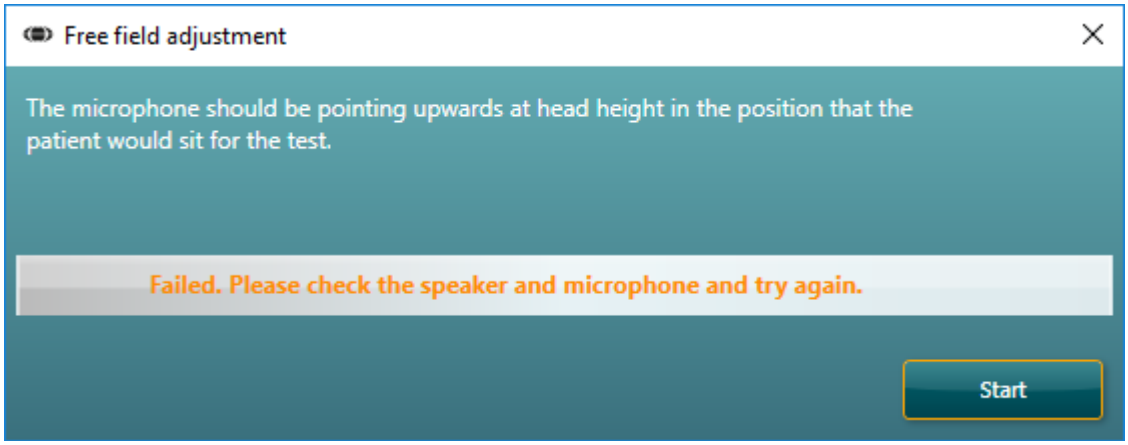
When the FF adjustment process is in progress you will see the bar begin to fill and there will be several stimuli played from the speaker(s) to the Ambient-cal mic.



Once completed the Free field adjustment window will state ‘completed’, see example below.



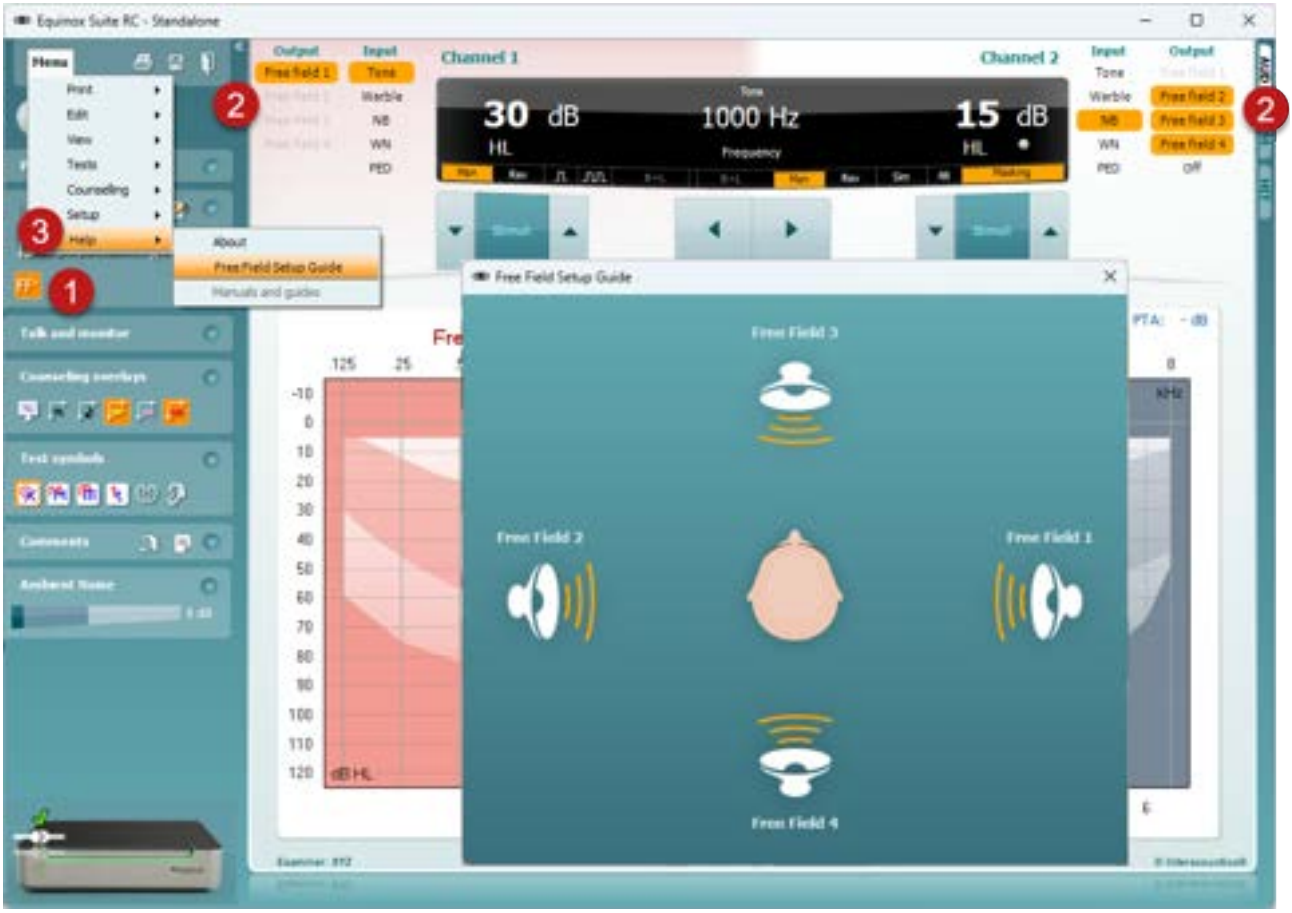
Should the Free field adjustment process fail midway then the window will state that it has failed and that you should check your Ambient cal mic and speaker.


Free field adjustment
The microphone should be pointing upwards at head height in the position that the patient would sit for the test.
Failed. Please check the speaker and microphone and try again.
Start

2.5 Free Field+

The Suite offers the possibility to test with 2 speakers or to activate Free Field Plus to access additional 2 speakers.

1. Use the **FF+ icon** to activate Free Field Plus mode.
2. Choose the **output and input** in channels 1 and 2.
3. Go to **Menu > Help > Free Field Setup Guide** to see the position of the speakers that the hardware is set up with.



Free Field Plus in the Suite

2.6 Quality assurance

The Quality Assurance feature is designed to monitor the software during use and provide live feedback to the clinician to ensure that the expected workflow is followed. This is typically beneficial when working in a large infrastructure with sites spread over a wide geographical area; it helps to ensure the same quality of care is maintained throughout the organization.

The behavior and parameters which the Quality Assurance feature is controlled by are configured in another software program called the ‘Configuration Manager’.

Indicator status

Each indicator can be represented as four different colors which will reflect its analysis status.

The four colors are:

QA Indicator Color	Status description
Grey	This indicates that the feature is inactive, meaning that relevant actions for this indicator have not begun yet for the system to perform this analysis. All icons will be grey on start up.
Green	This indicates that sufficient criteria to ensure a correct workflow have been satisfied and no further action is required.
Yellow	This indicates that a certain aspect of the indicators criteria needs to be re-viewed, but this is not urgent.
Red	This indicates that something mandatory has not been applied and further action is required to correct it.

Each indicator can be hovered over with the mouse to give further description of its status, as example ‘Phone Left: 500Hz’. In addition to this, you can click on the indicator to see this description in a small window, where you can also comment against it in the comment field below (see image of this window below).

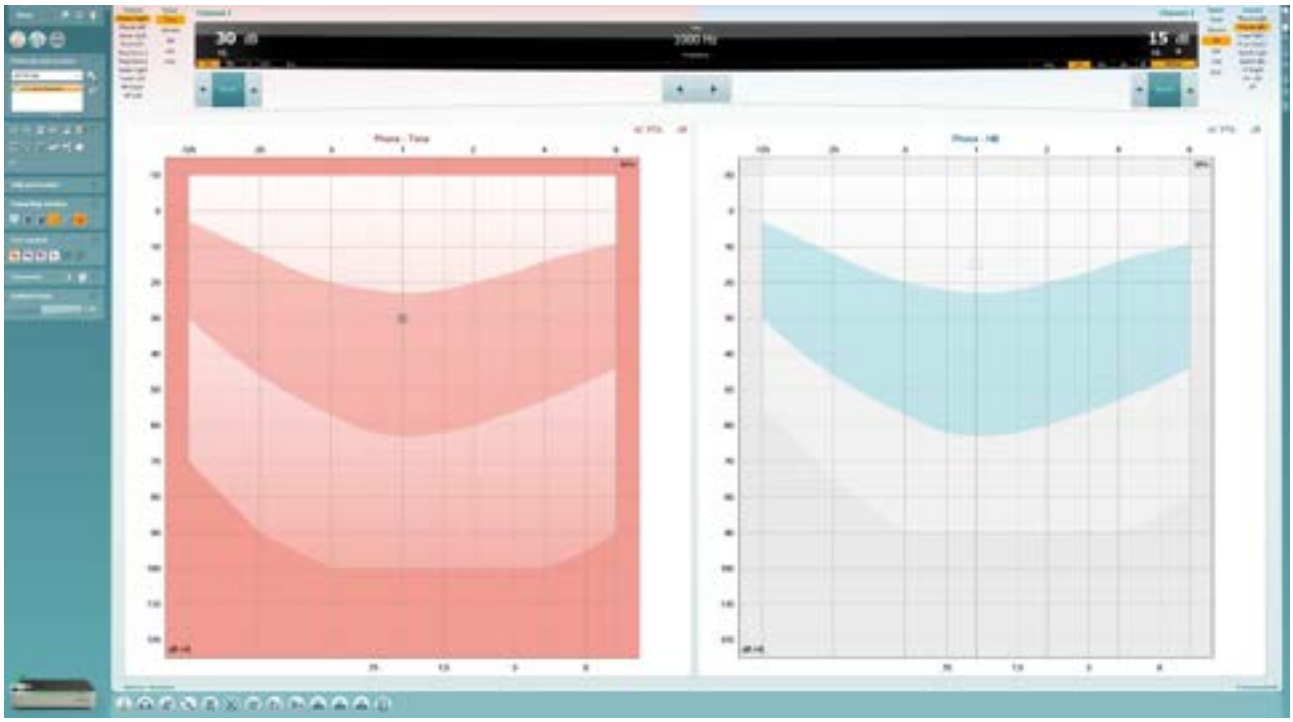
The ability to comment has been created to allow the clinician the opportunity to justify certain actions which would lead to a non-conformance status (yellow or red), yet they have followed protocol or have reason otherwise for why they cannot achieve a green status indicator.

Once the user has commented against the indicator a small report logo will appear on the indicator to allow quick identification of items with comments when reviewing the data. An example of this is shown above.

If the following box has been ticked within the configuration manager, a pop up box will appear upon saving the session showing exactly which QA indicator is missing a comment.

Audiometry quality assurance indicators

The Audiometry Quality Assurance indicators can be found at the bottom of the Audiometry test screen in the Equinox Suite software, shown in the image below.



In addition to the image above here is a zoomed in image of the different Quality Assurance indicators.

There are thirteen different indicators which assist and guide the users surrounding different focus points.

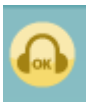
Audiometry indicator description

The below section will describe each indicator available in the Audiometry screen and its functionality individually. Each indicator can be configured individually by the system administrator for your organisation. This is performed using a tool which is described later in this document.

 Pure Tone Bracketing

This indicator is assessing the bracketing procedure when performing tone audiometry. It is looking for a set procedure and workflow to be demonstrated by the clinician following the patients input using the patient indicator.

As example, it can look for specific intensity step increment/decrement following patient interaction and correct threshold identification/storage in relation to number of responses per stimulation.

 Transducer Used

This indicator is checking which AC transducer has been applied. Typically, it should highlight green when the default AC transducer which has been specified in the protocol. It will highlight yellow if another has been used.

 Frequencies required

This indicator is analysing whether all the required frequencies have been tested using the relevant transducer. If a frequency has been missed, then the indicator will highlight red and will describe further which frequencies are required.

 Inter-octave frequency requirements

This indicator is analysing significant drops in intensity between the standard octave frequencies. When there is a significant drop (this is configurable) the indicator will alert that the inter-octave frequency needs to be tested.

 Bone only on second ear

This indicator is assessing when the BC testing is required on the opposite ear. This is typically required when there is a persistent air-bone gap following masking. The indicator will alert when this is required.

 Recorded vs Live Speech

This indicator is assessing whether live speech (microphone or auxiliary input) or recorded speech files have been used in the test session. It will indicate when the live speech methods have been used.

PTA/SRT agreement

This indicator is assessing the correlation between the Pure Tone Average (PTA) score from the tone audiogram and the Speech Recognition Threshold (SRT) in the speech audiometry. They should typically confirm within a specific configurable percentage of one another, otherwise the indicator will highlight red.

Excessive Use of CNT, DNT and NR response symbols in Tone Audiometry

This indicator is assessing excessive use of Could Not Test (CNT), Did Not Test (DNT) and No Response (NR) response symbols on the tone audiogram. There is typically a percentage of acceptable storage points of these type, and the QA indicator will activate when this has been exceeded.

Excessive Use of CNT, DNT and NR response symbols in Speech Audiometry

This indicator is assessing excessive use of Could Not Test (CNT), Did Not Test (DNT) and No Response (NR) response symbols on the speech audiogram. There is typically a percentage of acceptable storage points of these type, and the QA indicator will activate when this has been exceeded.

Effective masking rule – AC

This indicator is assessing whether the correct masking logic and levels have been applied for AC thresholds. It will indicate when further action is required and describe the frequencies which require further attention.

Effective masking rule – BC

This indicator is assessing whether the correct masking logic and levels have been applied for BC thresholds. It will indicate when further action is required and describe the frequencies which require further attention.

Effective masking rule – Speech

This indicator is assessing whether the correct masking logic and levels have been applied for Speech thresholds. It will indicate when further action is required and describe where further attention is required.


Test required

This indicator assesses whether the required audiometry tests have been performed within the test session. If a test has been missed, then it will indicate red.

3 How to test

This section will give a short introduction to the clinical applications of the Suite. The methods described here primarily based on the textbooks by Stach (1998) and Katz (2002) and describes one way of performing the individual tests. Other standards may, however, dictate other procedures.

3.1 Tone audiometry

In air conduction audiometry, a test signal is presented to the test subject via headphones or insert phones. The test subject responds to the signal by pressing a patient response button. The audiometric threshold is defined as the lowest intensity at which the patient can detect the test signal 50% of the time

The purpose of air-conduction audiometry is to establish the hearing sensitivity at various frequencies. The test provides information about the conductive and sensory systems of hearing but cannot distinguish between conductive and sensorineural hearing losses.

Required items:

- The Equinox Evo hardware
- Licensed AC440 Audiometry module
- Headphones or insert phones
- A response button

Test procedure:

Open the Equinox Suite through your patient management system, Noah or OtoAccess®.

1) Ensure you are in the AUD module of the Suite, and if needed, select a test protocol in the **List of Protocols**.

2) Perform otoscopy to make sure that any anatomical abnormalities are considered, and that cerumen is not obstructing the ear canal. Perform a medical history to find out whether there are any confounding factors which may prevent you from performing the test or make considerations for. It is also good to ask if the patient is experiencing tinnitus. If yes, you may consider doing the test using warble tones or narrow band noise instead of pure tones which can be hard to distinguish from the tinnitus at some frequencies.

3) Select the input and output for **channel 1**.

   If masking is needed, use the **channel 2** to determine masking level and frequency. Note that this decision is usually made after performing an unmasked audiogram based on differences in thresholds. Channel 2 should be muted or switched off in the beginning of the evaluation. If preferred, Auto Masking or Masking Help can be turned on.

   These features are intended to help the inexperienced clinician when masking is required.

4) Explain to the patient that they will hear several different tones through the headphones and that they should press on the response button whenever the tone is audible, even if it is very faint.

5) Place the headphones over the patient's ears and begin the audiometry test. If one ear is assumed to have worse hearing compared to the other, start the audiometry on the better ear. If the hearing level is assumed to be equal on both ears, start on the right.

6) Use the arrow buttons on the PC keyboard or an audiometer keyboard to set the frequency and intensity. You may also choose **Mouse controlled audiometry** to do the audiometry using only the mouse. Left click to stimulate and right click to store the threshold.

7) Begin the testing at 1000 Hz at an intensity which you think the patient should hear. A normal start level would be approximately 40 dB for a person assumed to have normal hearing and 30 dB above presumed threshold if hearing loss is present. However, the start intensity should never exceed 70-80 dB.

8) Present the stimulus for approximately 2 seconds and wait for the patient to respond. The Stimuli area will light up while presenting, visually indicating that the stimulus is presented. The stimuli can be presented three ways:

   a. Pressing on the space bar

   b. Hovering the mouse over the Stimuli button

   c. Using the stimuli button on an audiometry keyboard (additional accessory)

9) If no reaction is obtained, increase the intensity by 10dB steps until the patient responds. If the patient has a severe hearing loss you may want to press the **Extended Range +20 dB** button, which allows activation above a 55 dBHL intensity of compatible transducers.

10) You may now begin the threshold search using the Hughson Westlake procedure, known as the *"10 down, 5 up"* method: Present the stimuli. If the patient hears it, decrease by 10 dB. If the patient does not hear it, increase by 5 dB. The threshold is set at the intensity where the patient can perceive the tone 50% of the time during the ascending portion of the threshold search (when increasing by 5 dB). Typically, the tone should be heard 2 out of 3 times to be considered the threshold. .

11) In case of mistakes during the test you can right click on the threshold which will prompt a menu with edit options: **Add unmasked threshold, Add no response, Add masked threshold, Add masked-no response threshold, Copy bone thresholds to other ear, Delete threshold, Delete curve,** and **Hide unmasked thresholds where masked exist**.

12) If the difference between the two ears exceeds 40 dB (55 dB if using insert phones) there will be a risk of cross hearing (e.g., the good ear is responding to the tone presented to the worse ear). In this case

you may consider retesting the worse ear while masking the better ear. Masking can be activated using the Ch2 input and output dropdown lists in the upper part of the screen.

13) If you have other audiograms on the patient saved in Noah or OtoAccess® you can compare the new audiogram to a previous one using the session list. This is done by using the checkboxes of the historic sessions that you like to overlay.

14) To save the audiogram press **Save** or **Save and Exit** .

3.1.1 High frequency audiometry[15]

High frequency audiometry (above 8 kHz) is performed using the same procedure as normal air conduction audiometry. Note, however, that you are only allowed to test within the range of the headset calibration. That is, if the headset is only calibrated for a range of 125 Hz – 8 kHz, you will not be allowed to present tones at higher frequencies.

High frequency audiometry is helpful when testing hearing impairments caused by ototoxicity, noise exposure and acoustic traumas as these mainly affect the high frequencies. This frequency area is more susceptible to the effects of external factors such as medications and loud noises than the low and middle frequencies.

Required items:

- The Equinox Evo hardware
- Licensed AC440 Audiometry module within your Equinox Evo hardware with High Frequency functionality
- A calibrated high frequency audiometric headset
- A response button

[15] Requires additional license

Test procedure:

1) Open the AC440 module through your patient management system, Noah or OtoAccess®.
2) If needed select a test protocol in the **Protocols and sessions**.
3) To perform a high frequency audiometry, press the **HF** button  or **HFz** button  in the front screen.
4) Conduct high frequency audiometry using the normal air conduction audiometry method (see section 1.6 above for details), ensuring that you are using the correct headset for high frequency stimulation.

3.1.2 Multi frequency audiometry

Multi frequency audiometry lets the clinician test more frequencies than the traditional audiometric test frequencies. This may be useful when dealing with steeply sloping hearing impairments as it becomes possible to obtain a more precise measure of the slope of the hearing loss. It is also helpful in the evaluation of tinnitus as is provides the option to match the tinnitus.

Required items:

- The Equinox Evo hardware
- Licensed AC440 Audiometry module with Multi Frequency functionality
- Headphones or Insert phones
- A patient response button

Note: If doing Multi Frequency testing in the high frequencies (8-20 kHz) a high frequency headset must be used.

Test procedure:

1) Open the Equinox Suite through your patient management system, Noah or OtoAccess®.
2) Select the AUD Tab and If needed select a protocol from the **List of Protocols**.
3) To perform a multi frequency audiometry, click the **MF** button on the left hand-side panel. You may want to check that the multi frequency settings are in accordance with your preference in the AC440 setup.
4) Conduct high frequency audiometry using the normal air conduction audiometry method (see section 3.1 above for details). The cursor will jump in small frequency steps during the test providing you with multiple thresholds and a detailed curve.

Note: Evaluation of tinnitus can be used for both the purpose of identifying the nature of the sound the patient is experiencing and the purpose of masking the sound. Instruct the patient that you will now try to reproduce the exact sound that they are experiencing as precisely as possible. Start by finding the frequency and subsequently finding the amplitude using 5 dB steps. This way the patient only needs to concentrate on one thing at the time. After replicating the tinnitus, present a noise (NB) to the ear where the sound is experienced. Increase the noise in 5 dB steps until the patient claims that the tinnitus is masked (Nielsen & Carver 1997).

3.1.3 Bone conduction audiometry

In bone conduction audiometry, the test signal is presented by a bone vibrator placed on the mastoid. The bone vibrator uses the skull to transfer the vibrations to the cochlear and bypasses the outer and middle ears. Bone conduction thresholds thereby provide a measure of the cochlear and retro cochlear function

regardless of the outer and middle ear function; therefore, it allows you to distinguish between conductive, sensorineural, and mixed hearing thresholds detected through Air conduction Audiometry. The difference which is detected between the bone and air conduction is called the air-bone gap. It is recommended to start a hearing assessment first with air-conduction measurements, followed by bone conduction measurements.

Required items:

- The Equinox Evo hardware
- Licensed AC440 Audiometry module
- A calibrated bone conductor
- A patient response button

Test procedure:

1) Open the AC440 module through Noah or OtoAccess®.
2) If needed select a test protocol in the **List of Protocols**.
3) Prior to bone conduction audiometry, perform the *Air conduction audiometry,* as described in section 3.1.
4) Place the bone conductor on your patient's head and choose *Bone Right* or *Bone Left* from the **channel 1** output dropdown list and select the desired test signal (typically Tone). In the **channel 2** input and output dropdown lists you can decide whether masking is to be employed. If so, you will need to place the airconduction headset on the non-test ear of the patient as well.

Notes:

- Without appropriate masking applied where necessary, you cannot know which cochlea is responding, as there is always no interaural attenuation in bone conduction audiometry. We will assume that it is the better ear that is responding. In the case of asymmetrical hearing losses, bone conduction masking should always be considered.
- The Equinox Evo can be calibrated to mastoid or forehead bone conduction measurements. In the **Menu>Setup>General setup>Bone conductor placement**, you can see how your system is calibrated. Ensure you place the bone conductor accordingly when performing bone conduction measurements.

3.1.4 Masking

In cases where a symmetrical hearing loss is detected, traditional audiometry without masking is usually sufficient. However, be aware that in cases of asymmetrical hearing loss, one cannot be certain that the test ear is the one detecting the sound. For example, when measuring an audiogram on a patient with hearing within the normal range on one ear but a moderate to severe hearing loss on the other, there is a potential risk that the better ear is the one responding, even if it is not the ear being tested. That is because the sound vibration may travel through the head and be heard by the opposite ear when the vibrations of the signal are of sufficient magnitude. Therefore, you are measuring the thresholds from the wrong ear.

To prevent this phenomenon in causing an erroneous measurement, masking noise can be used to occupy the better ear (non-test ear) while testing the other one (Stach 1998, Katz 2002 and British Society of Audiology 2004). Masking can be applied to air conduction, bone conduction and speech audiometry. The need to mask the better hearing ear is linked to the interaural attenuation which equals the amount of attenuation the sound is exposed to on its way through the skull. Even though the interaural attenuation is very individual and varies with frequency it can, on average be estimated to a minimum of 40 dB for supra-aural headphones and 55 dB for inserts. Regarding bone conduction, the interaural attenuation is a minimum of 0 dB which means that crossing over of the stimulus may occur all the time.

Required items:

- The Equinox Evo hardware
- Licensed AC440 Audiometry module
- Calibrated Headphones or insert phones
- A calibrated bone conductor
- A patient response button

Test procedure:

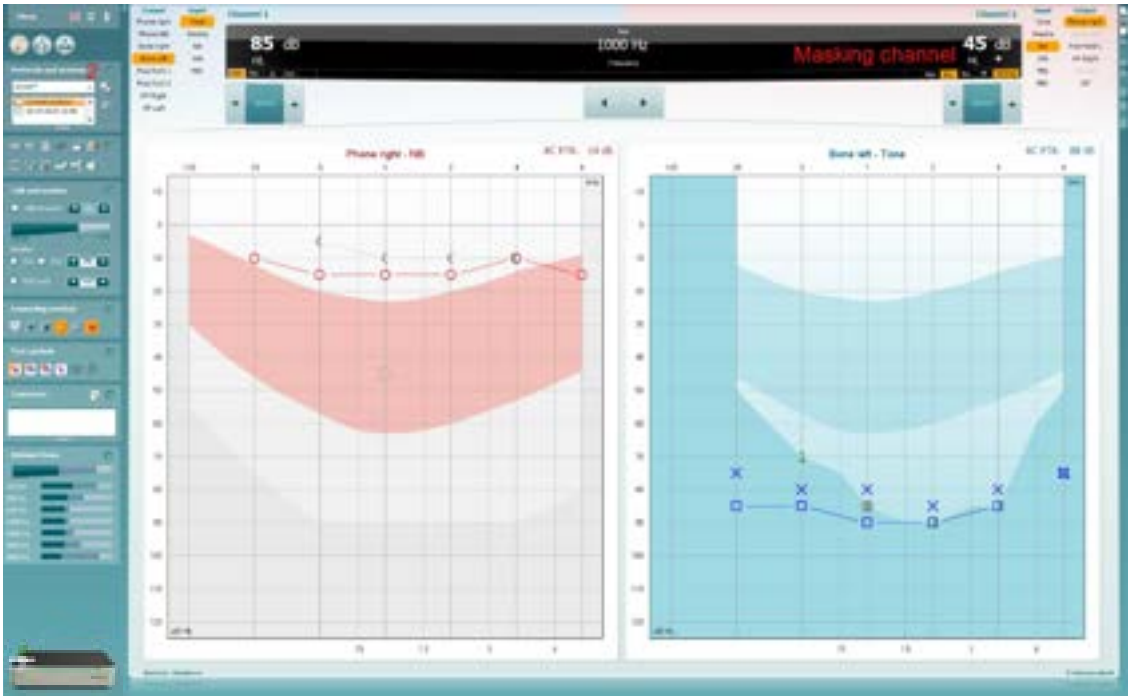
1) Open the AC440 module through Noah or OtoAccess®.

2) Select a test protocol in the list of **Protocols and sessions** if needed.

3) Perform the *Air conduction audiometry* as described in section 3.1. If the difference between left and right air conduction thresholds at any frequency are 40 dB (headphones) or 55 dB (inserts) and higher then masking is required.

4) Perform *Bone conduction audiometry* as described in section 3.1.3.

5) If the difference between the air conduction threshold of the worse ear and the bone conduction threshold of the better ear exceeds 10 dB, masking is needed.



There are many ways of applying clinical masking. Which method to use; is your decision. Regardless of the masking method **channel 2** is used to occupy the better ear. In the example above channel 2 should be set to *Right* (non-test ear) using the preferred masking stimulus preferred (usually Narrowband *NB*). Ensure that *Rev* is ticked making the masking noise continuous. **Channel 1** should be set to *Left* (test ear) using the preferred stimulus (usually *Tone*). You can set the masking and tone level using the buttons on the screen, the PC keyboard, or the dedicated keyboard. While trying to establish the true threshold of the left ear the right ear is now distracted with noise.

When storing a threshold while the masking is enabled, the used masking level is stored in the masking table under the ear that is being tested. The terms ‘Effective masking’ in this situation refers to the narrow band noise level that was loud enough to effectively mask a pure tone of the indicated level heard by the unmasked ear.

3.1.5 Weber

Originally the Weber test distinguished between conductive and sensorineural hearing loss through use of a tuning fork. The fork was softly struck and placed in the middle of the patient's forehead. If the patient heard the tone better in the poorer ear the hearing loss was conductive, and if the tone was heard better in the better ear the hearing loss was sensorineural at the given frequency. Today the Weber is most often performed using a bone conductor because the tuning fork method only allows testing at one frequency unless you have multiple tuning forks. The bone conduction oscillator is placed in the midline and as a stimulus is mostly a signal of 250, 500, and 1000 Hz chosen which should be clearly audible to the patient.
Using an audiometer together with a bone conductor to do the Weber is more reliable and flexible than the tuning fork method and has therefore become widespread.

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- A bone conductor (B81)

Test procedure:

1) Open the AC440 and enter the Weber screen by selecting **Menu > Tests > Weber**
2) Input and Output selections for **channel 1/channel 2** are fixed *Tone* and *Bone*.
3) Place the bone conductor on the patient's forehead and instruct them to tell you if the tones presented are heard better to the *Right, Left, Centre* or if it is *Not heard* at all.
4) Present a tone at a level of 10 dB above the worst BC threshold using the **dB HL Decrease/Increase** buttons or the PC keyboard. You can select whether you want a **Tone** or **Warble** stimulus.
5) Await response from the patient and click on the corresponding button above the graph.

If the patient hears the tone better in the poorer ear the hearing loss is conductive, and the tone is heard better in the better ear the hearing loss is sensorineural at the given frequency.

6) During the testing the frequency and intensity can be adjusted manually (see illustration).
7) Save the Weber test by clicking **Save**  .

3.1.6 Stenger test

The Stenger test is based on the **Stenger Principle**, which states that when two identical tones are presented simultaneously to both ears, only the louder tone will be perceived. This principle helps determine if a hearing loss is genuine or nonorganic.

How Does It Work?

1. Test Setup:
    - The test is performed when there is at least a 20 dB difference between the thresholds of the two ears.
    - Headphones or insert earphones are used to present the tones.
2. Procedure:
    - **Better Ear**: Present a tone 10 dB above the threshold of the better ear.
    - **Poorer Ear**: Present a tone 10 dB below the threshold of the poorer ear.
    - Both tones are presented simultaneously.

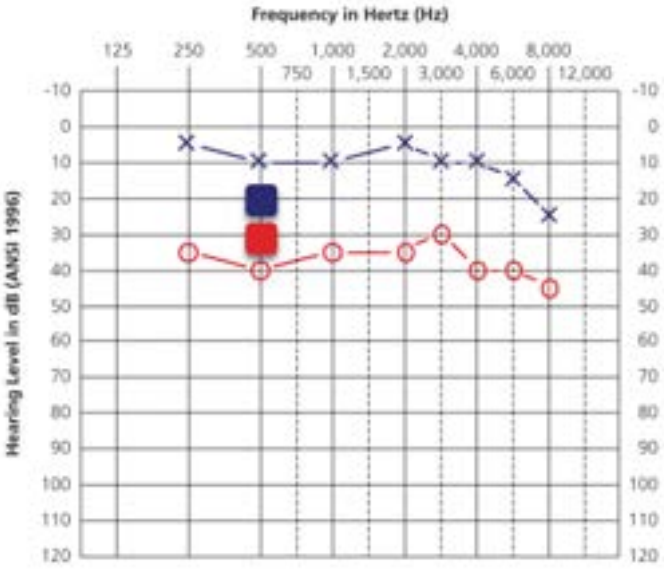


Figure above: Example of audiogram suitable for Stenger test. At 500 Hz, the intensity level for the left ear is set to 10 dB above threshold (blue square) and for the rigth ear the intensity level is set to 10 dB below the claimed threshold (red square)**.**

3. Interpreting Results:
    - **Negative Stenger**: If the patient responds, it means they are hearing the tone in the better ear, indicating that the hearing loss in the poorer ear is likely genuine.
    - **Positive Stenger**: If the patient does not respond, it suggests they are hearing the tone in the poorer ear but are not responding because they perceive it as softer than their claimed threshold. This indicates a nonorganic hearing loss.

Why is it Important?

The Stenger test is important because it helps audiologists identify cases of nonorganic hearing loss, ensuring accurate diagnosis and appropriate management of hearing conditions.

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- Calibrated Headphones or insert phones
- A patient response button

Test procedure for Stenger:

1) Open the AC440 module.

2) Choose settings for Stenger using the input and output for **channel 1** and **channel 2** as illustrated below:

Note: Man (Manual) and if preferred **Multi Pulse** should be selected for channel 1 and **Sim** (Simultaneous) for channel 2.

3) Typically, the instruction to the patient is not different than with normal audiometry. The patient does not need to be informed that stimuli are presented at both ears simultaneously.

4) Use **channel 2** for presenting tones to the better ear and set the intensity level to 10 dB above the threshold.

5) Use **channel 1** for the poorer ear and set the intensity level 10 dB below the level of the good ear.

6) Present the tones to both ears simultaneously. Keep the intensity level of the better ear fixed and increase the intensity for the worse ear in 5 dB steps. If the hearing loss in the worse ear is genuine the patient will keep responding to the signal presented to the better ear (*Negative Stenger*). If the patient is feigning the hearing impairment he will stop responding when the level of the worse ear exceeds the signal presented to the good ear (*Positive Stenger*).

7) Use the arrow buttons on the PC keyboard or an audiometry keyboard to set the frequency and intensity. If preferred choose **Mouse operated audiometry**  and perform the test using only the mouse. Left click to stimulate and right click to store the threshold.

The speech Stenger test is identical, but with the use of speech material instead.

3.1.7 TEN test[16]

The TEN test is designed to identify cochlear dead regions by measuring pure tone thresholds in the presence of a special masking noise called Threshold Equalizing Noise (TEN). The TEN Masking noise is a type of noise that is used to mask the hearing of pure tones. It is designed so that the threshold for detecting a tone in the noise is approximately the same across a wide range of frequencies for people with normal hearing. In a cochlear dead region, the inner hair cells (IHCs) and/or neurons are non-functioning. When a pure tone is presented in a dead region, it cannot be detected by the neurons in that region. Instead, the tone may be detected by neurons in adjacent regions where the IHCs are still functioning. This is known as “off-frequency listening. Because the tone is detected by neurons tuned to different frequencies, the amount of basilar membrane vibration needed to detect the tone is greater. This results in a higher threshold for detecting the tone in the presence of TEN noise. A dead region is indicated if the masked threshold is at least 10 dB above both the absolute threshold and the level of the TEN noise.

[16] TEN test requires an additional license.

When to Use

- Severe to profound hearing loss
- Absolute threshold at a specific frequency is 70 dB HL or greater
- Steeply sloping hearing loss
- Complaints of distortion
- Extremely poor speech discrimination

Test Procedure

1. **Setup:**
   a. Launch the Equinox Suite from your patient management system.
   b. Ensure you are in the AUD module.
   c. Select the TEN test from the Protocols and Sessions drop-down menu.
   d. Choose the desired transducer and ensure the stimulus is directed to the same ear in both channels.
   e. Set the stimulus/input: Tone for Channel 1 and TEN for Channel 2.
   f. Set the masking to “Rev” for a continuous masking signal.

2. **Intensity Levels:**
   a. For hearing loss up to 60 dB HL: Set the TEN level to 70 dB.
   b. For hearing loss 70 dB or more: Set the TEN level 10 dB above the audiometric threshold at that frequency.
   c. If the TEN is too loud or the maximum level of 90 dB HL is reached, set the TEN level equal to the audiometric threshold.

3. **Conducting the Test:**
   a. Perform a threshold search using the traditional method for air conduction.
   b. Repeat for each frequency where a dead region is suspected.

4. **Positive TEN Test Indicators:**
   a. A masked threshold at least 10 dB above the level of the TEN.
   b. A masked threshold at least 10 dB above the non-masked threshold.

Clinical Value

- Helps in counseling patients and managing expectations regarding hearing aids.
- Assists in choosing the type of hearing aid.
- Determines if a patient is a good candidate for cochlear implants.

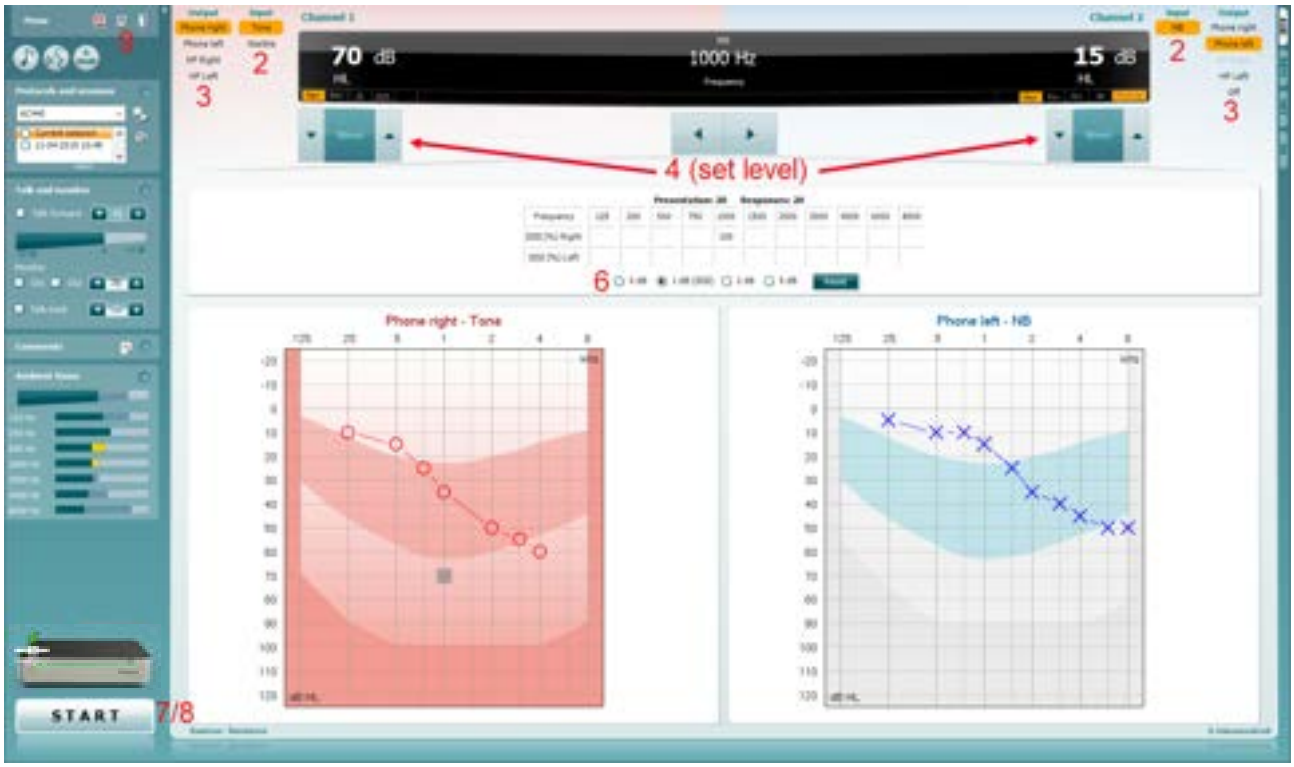
3.1.8 SISI[17]

Short Increment Sensitivity Index (SISI) is designed to test the ability to recognize 1 dB increase in intensity during a series of bursts of pure tones presented 20 dB above the pure tone threshold for the test frequency. It can be used to differentiate between cochlear and retro cochlear disorders as a patient with a cochlear disorder will be able to perceive the increments of 1 dB, as where a patient with a retro cochlear disorder will not.

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- Calibrated Headphones or insert phones
- A patient response button

Test procedure:



1) Open the AC440 and enter the SISI screen by selecting **Menu > Tests > SISI.**

[17] SISI requires an additional software license.

2) Select Tone or Warble Tone in the **channel 1** input list. If needed masking can be selected in the **channel 2** input dropdown list.

3) Select headphones or inserts in the **channel 1/channel 2** output lists

4) Set the input level to 20 dB above threshold using the **dB HL Decrease/Increase channel 1/channel 2** buttons or **arrow keys** on the PC keyboard.

5) Explain to the patient that they will now hear a series of tones. If suddenly one tone seems louder that the other ones the response button should immediately be pushed.

6) Select the preferred type of SISI test. Setting the system to *1 dB* increments is the classical SISI. If the patient can hear these increments and scores high, cochlea damage is likely. You may also choose 0 dB, 2 dB, or 5 dB increments.

   If the patient does to get a high score on the SISI test, this could indicate of retro-cochlear damage.

7) Start the test by pressing **START**. During the testing the frequency and intensity can be adjusted manually (see illustration). The system will automatically count the number of reactions from the patient. Note that the system needs 20 presentations to calculate a SISI score.

8) Press **STOP** to end the test.

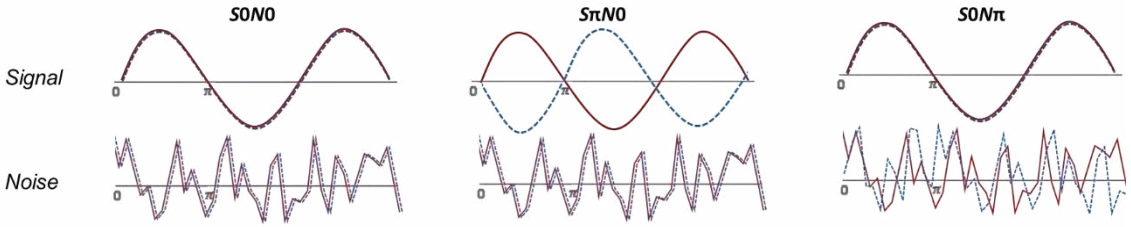
9) Save the SISI test by clicking **Save** 

3.1.9 MLD

The Masking Level Difference (MLD) test is used to evaluate binaural listening advantage, which is a central auditory function. Specifically, it asseses the brainstem's ability to process sounds.

What is the MLD Test?

The MLD test measures the improvement in detecting a tone or speech in noise when the phase of the tone or the noise is reversed by 180 degrees betweeen the two ears. This test is sensitive to brainstem lesions and can also be affected by peripheral hearing loss.



How does it work?

1. Test conditions:
   - Homophasic Condition (S0N0): Both the signal (tone or speech) and the noise are in phase when reaching both ears.
   - Antiphasic Condition (SπN0 or S0Nπ): Either the signal or the noise is out of phase when reaching the ears.
2. Procedure:
   - A low-frequency tone (usually 250 Hz or 500 Hz) is presented along with narrowband noise.
   - The test starts by finding the threshold for the homophasic condition (S0N0).
   - Then, the threshold is measured again for the antiphasic condition (SπN0 or S0Nπ).
   - The difference in thresholds between these conditions is the MLD.
3. Interpreting results:
   - A normal MLD is typically around 12 dB.

- An MLD of less than 7 dB may indicate a problem with the brainstem or binaural interaction.

Why is it Important?

The MLD test helps in diagnosing central auditory processing disorders and can be particularly useful in identifying brainstem lesions. It is a valuable tool for audiologists to understand how well the auditory system can separate sounds in noisy environments.

The MLD test on the Equinox Evo

1. Go to **Menu > Tests > MLD**.
2. Before placing the headphones on the patient, explain that they will hear tones (similar to those from air conduction audiometry) and noise through the headphones. Emphasize that they should focus only on the tones and press the response button whenever they hear a tone.
3. Select the frequency you want to test; starting with 250 Hz or 500 Hz is recommended.
4. Select **S0N0** and set the intensity level for both channels. The Masking Level Difference (MLD) test is typically performed at an intensity level of around 50 to 60 dB SPL, ensuring it is at a comfortable listening level.
5. Press **Start**.
6. **S0N0**: The signal will be presented to both ears in phase (S0N0), with narrowband noise also presented at a fixed level. Conduct a masked threshold search using the default 2 dB decibel step size. The threshold will typically match the noise level in the S0N0 condition.
7. Click **Store** on the Touch Keyboard or the PC Keyboard once you have established a threshold.
8. **SπN0**: The Suite will automatically switch to the **SπN0** antiphasic condition, while keeping the narrowband noise intensity level unchanged. The pulsed tone detection threshold should decrease significantly.
9. Click **Store** on the Touch Keyboard or the PC Keyboard once you have established a threshold.
10. **S0Nπ**: The Suite will automatically switch to the **S0Nπ** antiphasic condition. You can skip this condition by selecting another frequency.
11. The MLD is the difference between the homophasic and one of the antiphasic conditions. The largest MLD is found between the S0N0 threshold and the SπN0 threshold.
12. Press **Stop** to end the test.

3.1.10 ABLB/Fowler

ABLB (Alternate Binaural Loudness Balancing) is a test to detect perceived loudness differences between the ears designed for people with unilateral hearing loss. It serves as a possible test for recruitment.

The test is performed at frequencies where recruitment is presumed. The same tone is presented alternatively to both ears. The intensity is fixed in the impaired ear (20 dB above pure tone threshold). The task of the patient is to adjust the level of the better ear until the signal in the two ears is of equal intensity. Note however that the test may also be performed by fixing the intensity in the normal hearing ear and having the patient set the tone for the impaired ear.

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- Calibrated Headphones or insert phones
- A patient response button

Test procedure:

1) Open the AC440 module through your patient management system, Noah or OtoAccess®.
2) Choose settings for ABLB/Fowler using the input and output for **channel 1** and **channel 2** as illustrated below:

Note: Man (Manual) and **Multi Pulse** should be selected for channel 1 and **Alt** (Alternate) for channel 2.

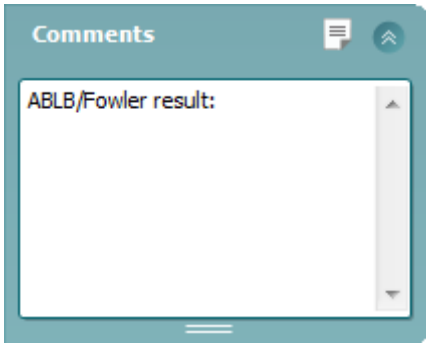
3) Clarify the test procedure to the patient. Explain that he/she will now hear tones in both ears. The assignment is to determine when the two tones sound equal in intensity/loudness

4) The ABLB is performed at frequencies where recruitment is assumed. Set the intensity level on the impaired ear to 20 dB above the pure tone threshold using **channel 2**.

5) Adjust the intensity level in the better ear until the perceived loudness is identical to the impaired ear using **channel 1**.

6) Use the arrow buttons on the PC keyboard or an audiometry keyboard to set the frequency and intensity. If preferred choose **Mouse operated audiometry**  and perform the test using only the mouse. Left click to stimulate and right click to store the threshold.

7) The ABLB/Fowler test cannot be saved. Results must therefore be noted manually. The reporting/ comment function in the AC440 software may also be of help.



3.1.11 Tone decay[18]

This is a test to help identify the adaptation of the auditory system (Carhart, 1957). It involves measuring the perceptual reduction in a continuous tone over time. This can indicate a cochlear or neural cause of deafness.

The test involves looking at the patient's response to the onset of a supra-threshold sound and then their continuous response to this as it continues over time. For example, in Meniere's disease this is detected correctly on onset but rapidly deteriorates due to dysfunctional hair cells (Carhart, 1957). A normal response should be maintained for a minute of stimulation, should a patient not be able to maintain this then the stimulus intensity is increased until a minute is achieved. This is only increased up to a maximum 30 dB supra-threshold.

[18] Tone decay requires an additional license

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- Calibrated Headphones or insert phones

Test procedure

1) Obtain the patient's tone audiogram.

2) The patient is then instructed to continuously respond to the tone if they hear it and not respond as the signal fades/is absent.

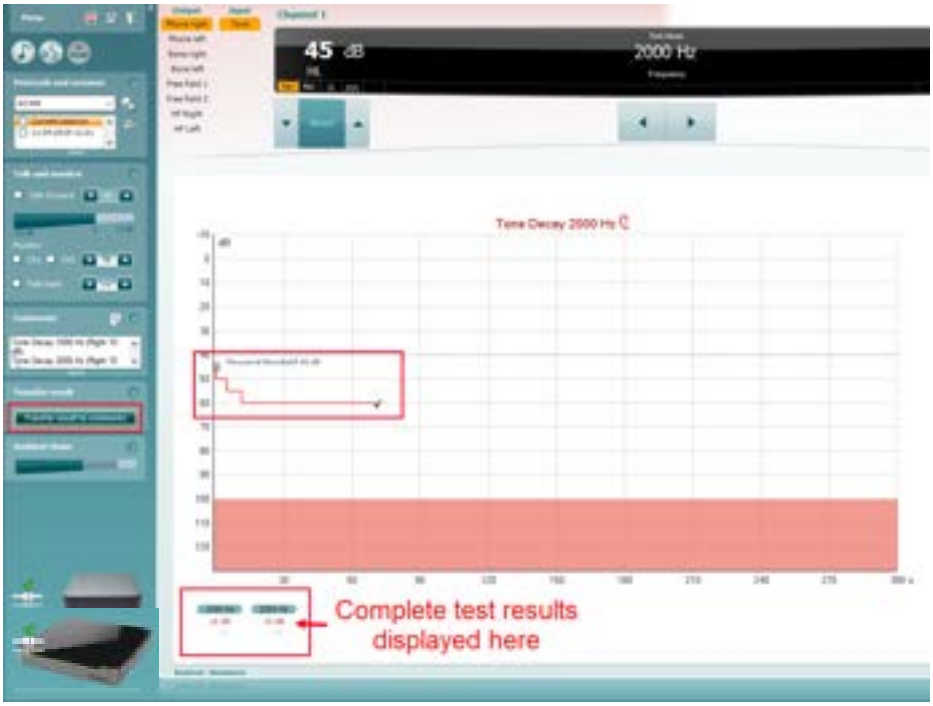
3) The test is administered with a pure tone 5 dB below the subject's established threshold and then ascended in 5 dB steps without interruption until the subject responds. As soon as the subject responds, the system will begin timing (this is shown in the image below). If the tone is heard for a full one minute, then the test is stopped.

4) But if the subject indicates that they no longer hear the tone before the minute criteria is reached, then the intensity of tone is increased by 5 dB without interrupting the tone, but the timing at the top of the screen is reset.

5) The tone is continued to be raised in 5 dB steps until an intensity is reached that allows the subject to perceive the tone for full minute. The amount of decay occurring at each level suggests/indicates the amount of decay the subject is showing.

6) As a time saving measure, Carhart (1957) suggested that the test should be terminated when the subject fails to respond 30 dB above threshold.

Once this measurement has been finished the data can be documented as a comment to the session by the ‘Transfer result to comments’ on the left of the screen. Alternatively, it can be saved via the disk or door icon in the top left for review later.



3.1.12 The Audible Contract Threshold (ACT™) Test

What is the ACT test?

The ACT diagnostic test is an above-threshold, non-language specific test that quantifies a person's real-world ability to hear in noise.

The test applies the shape and levels of the audiogram to ensure the correct stimulus intensity is applied.

When we get an audiogram, it allows us to objectively map out a person's hearing thresholds. ACT then applies this person's audiogram to deliver an above-threshold stimulus (a siren-like sound) to objectively map their hearing-in-noise ability.

In other words, where the audiogram measures the quantity of hearing, ACT measures the quality of hearing. This way, we have a robust assessment that reflects a person's real-world hearing abilities.

Once you have obtained the ACT value, you can use it to counsel your client on their speech-in-noise ability. It also provides you with advice on how best to support your client to hear better in noisy environments.

ACT is performed unaided. However, due to the test being conducted at above-threshold intensity, you can get a clearer understanding of how well your client will perform with hearing aids when in noisy situations.

There is also the possibility to prescribe help in noise in selected hearing aids.

The ACT value is denoted as dB nCL which stands for 'normalized Contrast Level.' This is a novel scale developed by the research team at the Interacoustics Research Unit (IRU). In brief, the background definition of nCL stands for:

- **n** (normalized): the scale is normalized based on normative data acquired from young, normally hearing people
- **C** (contrast): clients are detecting a contrast in the modulation of a signal
- **L** (level): this is a dB measure and is denoted as such

Pre-test counselling guidance

You can perform ACT on any adult client that you deem suitable to perform pure tone audiometry. It may be useful to counsel the client on the reason for performing ACT. Here, you will find an example script.

"We will perform a test called ACT. The result from this test will clarify your abilities to hear in background noise. This can be challenging, particularly if you have a hearing loss. So, performing this test will help me to know to what degree this is also a challenge for you."

Required equipment

To perform an ACT test, you will need:

- Equinox Evo
- Patient response button
- Connected PC and keyboard
- Headphones or insert earphones
- Licensed AC440 software
- ACT license

Points to note

It is recommended that you listen to the acoustic stimuli over monitor headphones during the test. This will help you to present the target stimuli in an unpredictable manner.

To perform ACT, you must complete an audiogram for air conduction at the following frequencies:

- 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz

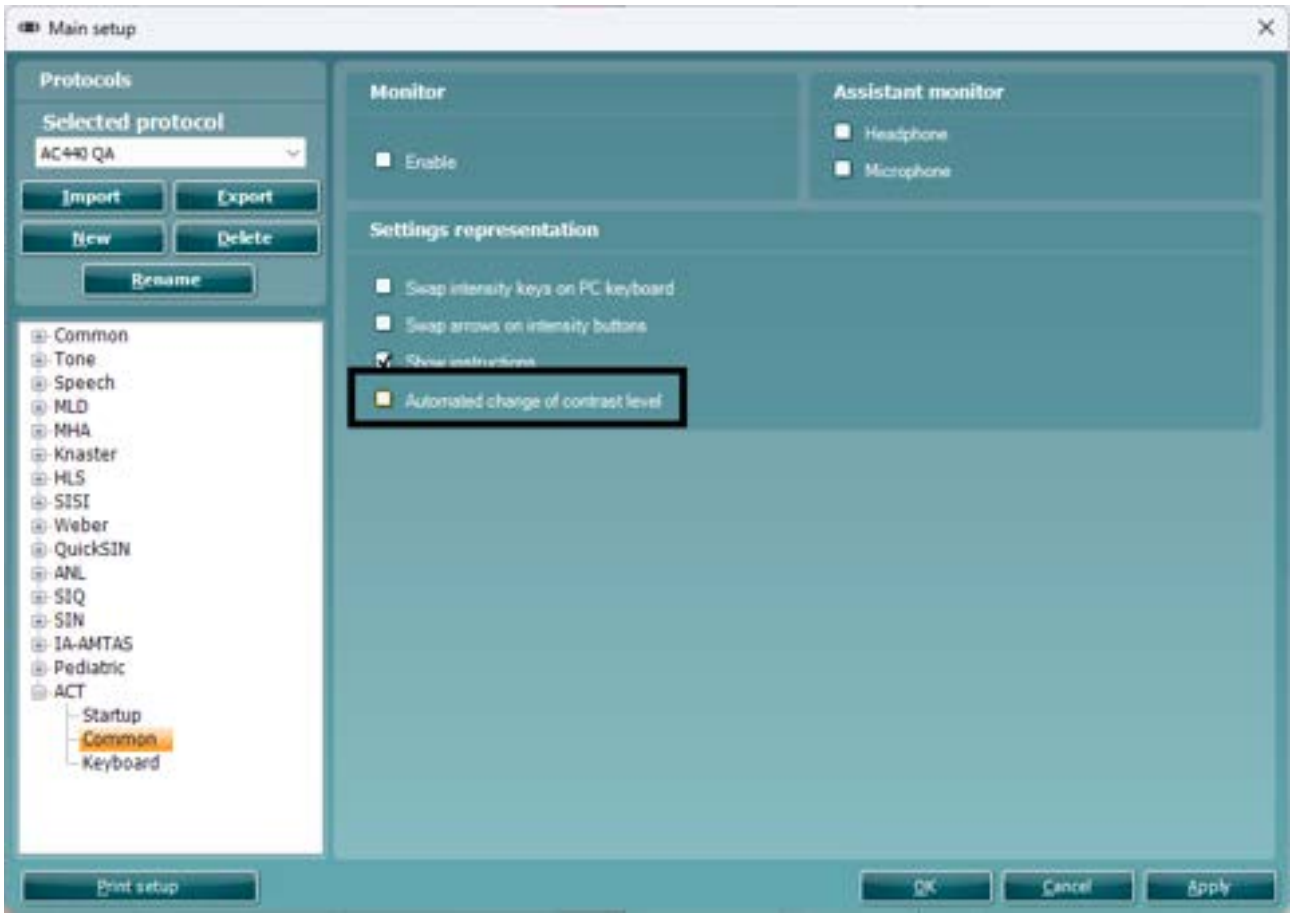
- Inter-octave frequencies will be considered in ACT testing if they have been completed.

Should the following notification appear: *'Insufficient data to complete the test*', please ensure all mandatory thresholds have been stored for both ears. A 'no response' will be factored into the ACT test, but a 'Could not test' or 'Did not test' will be excluded and you will not be able to complete the ACT test.

When in simulation mode of the suite, it is only possible to view historical data.

Setup

In the ACT settings within the Equinox Suite, you have the option to enable automated contrast level change in the ACT test.

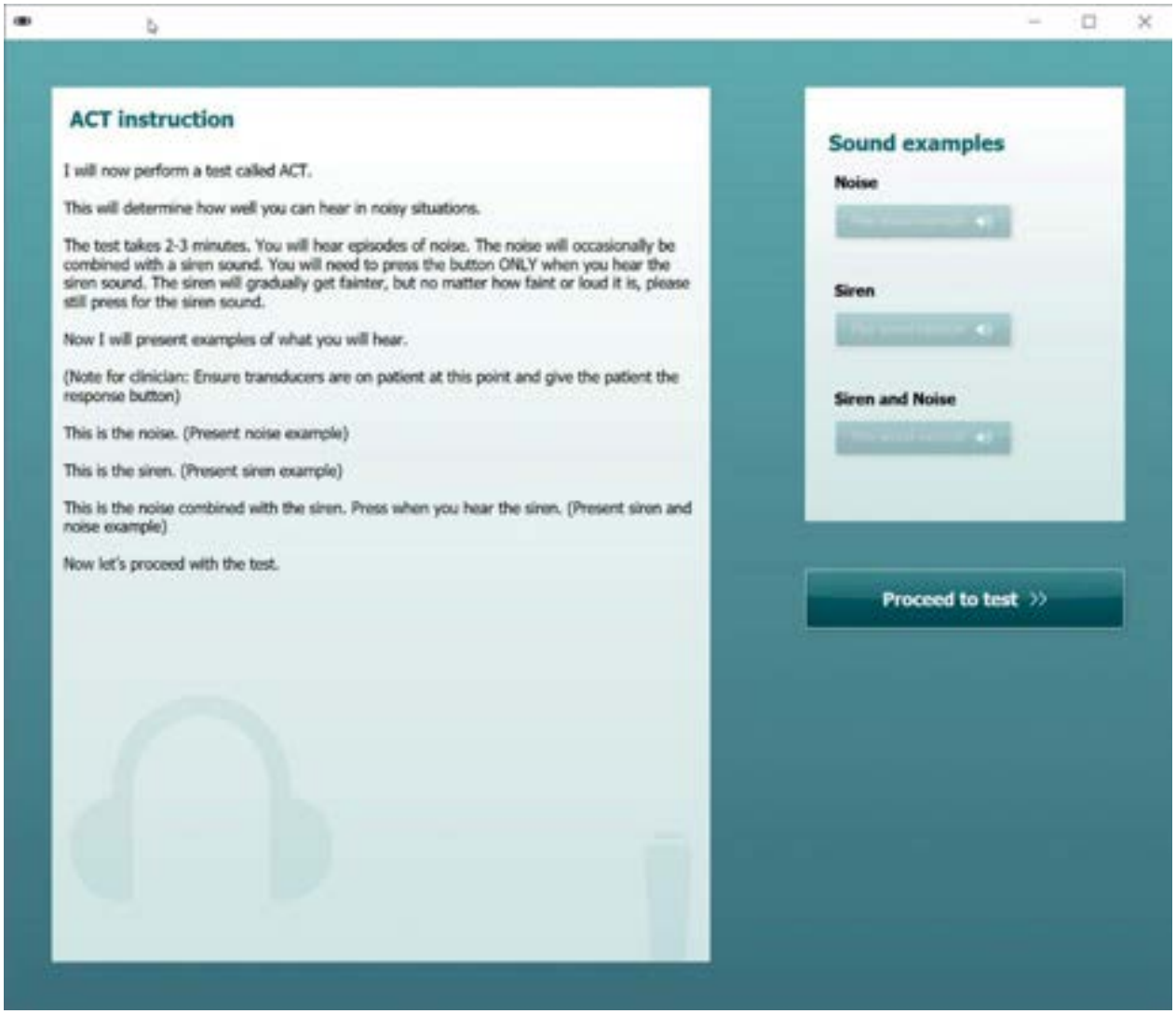


This feature allows the contrast of the ACT stimuli to adjust automatically based on the patient's responses, which are registered through the patient response button.

The adjustments of the contrast level follow the Hughson-Westlake method, ensuring a reliable approach to determining the appropriate contrast level for each patient.

ACT test procedure

1) Launch your Equinox suite into AUD mode.
2) Ensure there is an audiogram inserted into the current session.
3) Click on ‘Menu’.
4) Click on ‘Test.’
5) Select ACT.
6) The ACT instructions will pop up in a separate window.
7) Read the instructions to the client.
8) Use the 'sound examples' to demonstrate and explain the test procedure. You can play these sound examples as many times as is necessary to familiarize the client.
9) Once you are confident that the client has understood the test, click 'Proceed to test'.



ACT instruction

If you wish to read instructions again at any point, click on ‘i’ in the left-hand menu.

Show instruction screen

10) Press START.

a. A sequence of noise episodes will start.

b. You perform the test in the same way as pure tone audiometry using the Hughson-Westlake adaptive method (2 down, 1 up) with a 3 out of 5 criteria, as described in the ACT flowchart.

c. Present the stimulus by clicking once on your chosen presentation key. If you press ‘spacebar’ to present a stimulus, press this once. DO NOT press and hold.

d. A black dot appears automatically when the client correctly hears the target stimulus.

e. A white dot appears automatically when the client has not heard the stimulus or has not responded in the viable time frame.

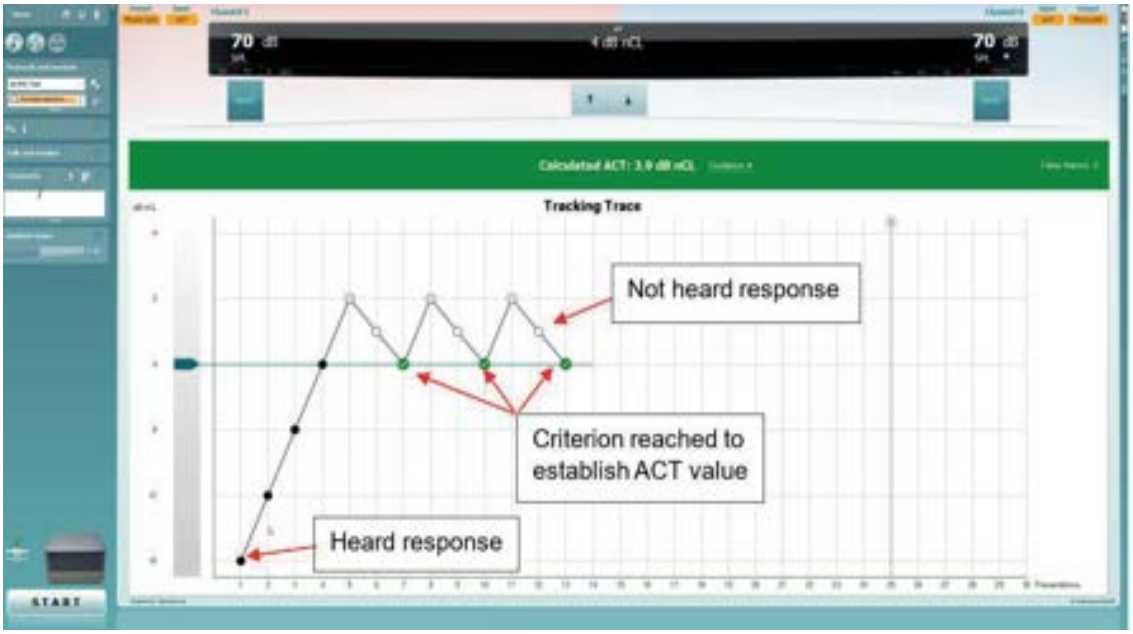
OPTIONAL: If you are not confident that your client knows when to respond after presenting the sound examples within the instruction box, try starting the test and perform 3 presentations at 16 dB nCL. Then continue as in step 10.

11) Once the required number of thresholds has been reached to produce an ACT value, the test will automatically stop. The calculated ACT value is then stored in the middle of the green band across the screen.

Points to consider:

- You can stop the test at any point by pressing the ‘STOP’ button.
- If the test exceeds 25 presentations (indicated as a line on the trace), there is a higher risk of client fatigue.

Please refer to scenario 3 below for guidance on how to address this.



Example traces

Example traces

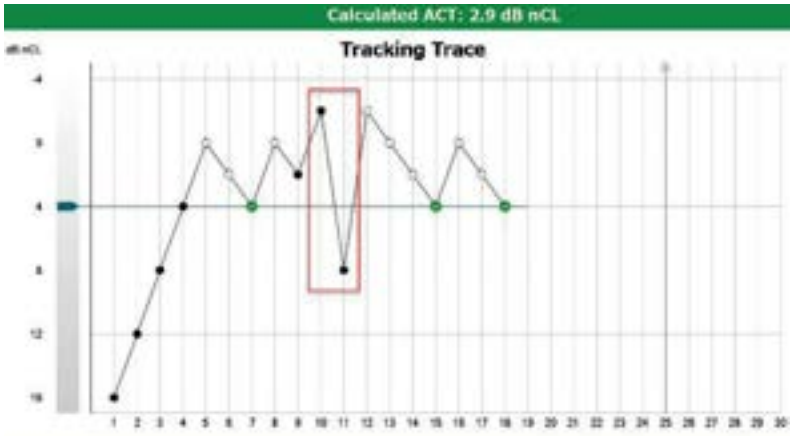
Scenarios

Guidance on what to do in case of inconsistent responses during the test

Every client is different and may not follow normative patterns when conducting ACT. The following pages show some examples on what you can do based on irregular responses

Scenario 1: Client keeps pressing response button despite no stimulus

The client has many false positives (responds at the right time but has not heard the signal) or presses the button too often. To solve this, increase the nCL to 4 dB nCL above the expected threshold (or even higher) to remind the client what to listen for and return to the previous level.

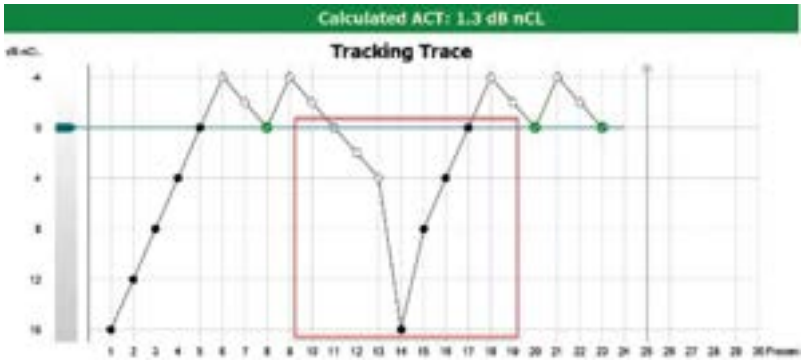


nCL increase 4 dB

Scenario 2: Client is losing concentration

The client is close to obtaining a threshold but loses concentration and fails to respond at levels previously detected.

To solve this, increase the nCL to a clearly detectable level (e.g. 16 dB nCL) to remind the client what to listen for.



nCL increase 16 dB

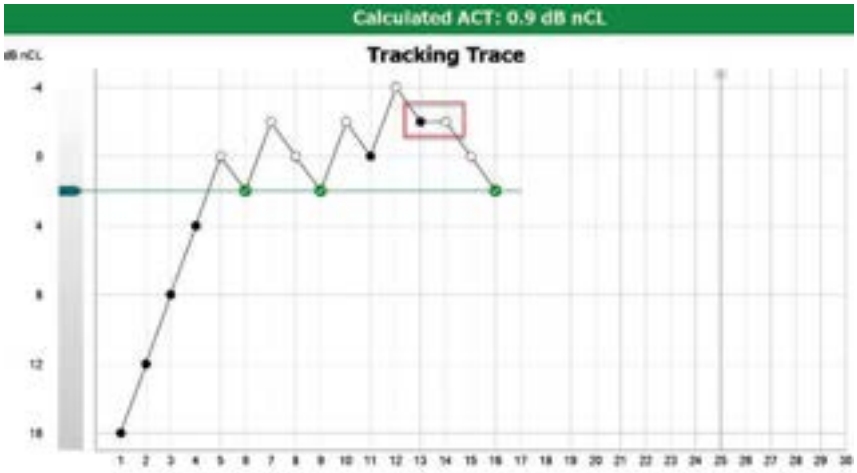
Scenario 3: The run exceeds 25 presentations

The run reaches 25 presentations and there is no threshold in sight. There is a higher risk of client fatigue at this point. To solve this, give the client a break, and re-iterate the instructions if needed. You can also perform ACT in a separate appointment, as long as the client's audiogram is present.

No threshold in sight

Scenario 4: Client responds unexpectedly

An otherwise reliable client responds against your expectation. To solve this, present the stimulus again at the same dB nCL to make sure the first response was not a coincidence.

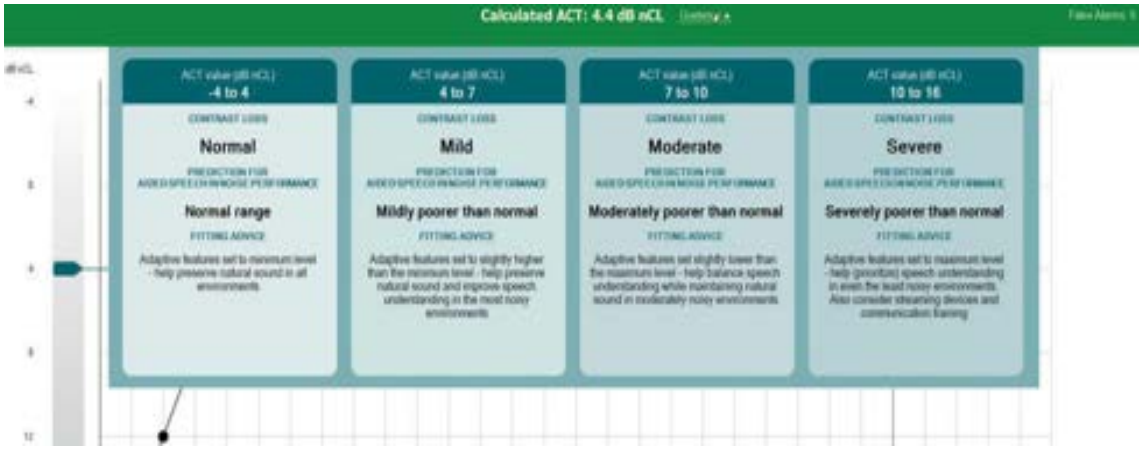


Present stimulus again at same dB nCL

Post-test counselling guidance

To access the post-test counselling guidance, click the ‘Guidance’ drop box in the middle of the screen. This will reveal the ACT severity categories with accompanying fitting advice.

Guidance drop box



Fitting guidance based on ACT value

Now that you have obtained your ACT value, you can use this in many ways, such as:

- Recommend assistive listening devices
- Set the adaptive features in all hearing aids
- Focus on rehabilitation and communication strategies
- Use selected hearing aids to automatically prescribe adaptive features
- Counsel clients on the prediction of how well they will cope in noisy situations.

Automatic hearing aid adaptive feature adjustments using the ACT value

The most effective way to use the ACT value is within the hearing aid fitting software itself. This will automatically optimize the adaptive features of a hearing aid such as noise reduction and directionality. This option is available in selected hearing aid brands only.

Manual adjustments to hearing aid adaptive features using the ACT value

If the hearing aid does not have an option to directly input the ACT value, then you can do adjustments based on the ACT value manually.

Hearing aids usually prescribe adaptive features such as noise reduction and directionality based on the client's audiogram as well as other data put into to the fitting software such as questionnaires and listening preferences.

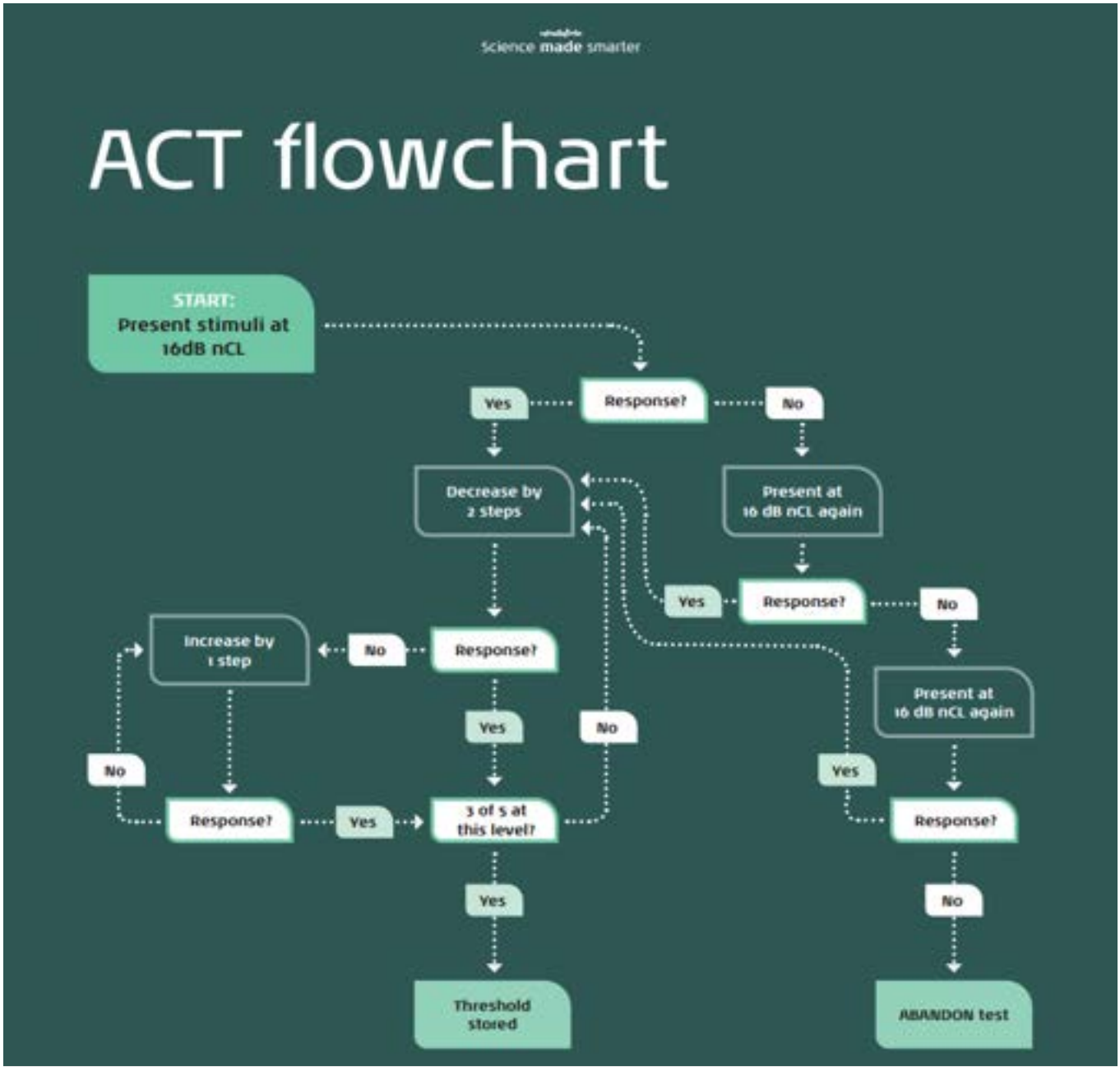
The ACT value allows for a more objective method of predicting the optimal starting point for these features to activate. Before making manual changes to the hearing device, it is important to understand how adaptive settings are programmed in the device you are fitting.

Further counselling advice

Below is an example script you may want to consider when counselling your client on their ACT value. This advice should be termed appropriately to consider both new and existing users of hearing aids.

"I have now completed the ACT test which tells me about your ability to hear and separate speech from noise in your daily life. Your ACT value today is x, corresponding to within the normal range (or), a mild/moderate/severe contrast loss. A contrast loss means that you need speech and background noise to be separated more to understand what is being said. In other words, you need greater contrast between speech and noise. The higher the value, the more contrast you will need. To help you create this contrast, we need to look at the options available to you to support you in the best way possible. This can be through hearing aid technology level, assistive devices, streaming devices, and communication strategies."

ACT flowchart



3.1.13 Pediatric Screen

What is the Pediatric Screen?

The Pediatric screen is designed for patients with a developmental age between 7 months and around 3 years. These patients cannot yet sit still, concentrate on listening to tones, and push a response button when a tone is heard.

Instead, they may be offered a broader range of sounds tailored to their individual interests. This approach keeps their attention, so they respond to the sounds when they hear them.

Young children demonstrate a head-turning response, and a Visual Reinforcement Audiometry (VRA) system conditions and strengthen this behavior to establish whether a sound is heard. When the child turns their head toward a sound, they receive a reward, teaching them that something interesting happens when a

sound is detected. The ‘something interesting’ can be a puppet that starts moving (analogue VRA) or an animation on a screen (digital VRA).

The Pediatric screen supports analogue VRA systems (connected to the VRA socket on the Equinox Evo) or a digital VRA system, but only one system at a time. The digital VRA option integrates the Interacoustics VRA Pure software within the Suite, supporting two screens connected to the PC (not to the Equinox Evo).

The Tick Sheet in Visual Reinforcement Audiology (VRA)

In Visual Reinforcement Audiology (VRA), a tick sheet is used to systematically record a child’s responses to auditory stimuli. This sheet helps audiologists track which sounds the child responds to and the consistency of these responses. Each time the child turns their head towards a sound and receives a visual reward, this is recorded on the tick sheet. This documentation is crucial for assessing the child’s hearing abilities and ensuring accurate and reliable results.

In the Pediatric screen, the tick sheet is automatically populated.

Using the Pediatric Screen

1) The VRA controls window is only visible if the Equinox Evo is set up with a VRA system. Go to **Menu > Setup > General setup > VRA** to choose an analogue VRA system, like the Interacoustics VRA201 (‘analogVRA’) or the Interacoustics VRA Pure (‘Digital (VRA Pure)’). The VRA Pure is separate software that must be opened before entering the Pediatric Screen to integrate successfully. Ensure also that VRA is activated on the device in **Menu > Setup > AC440 setup > Pediatric > Add-ons > VRA Settings**.

2) Select auditory stimuli. Saved audiometric thresholds for Tone, Warble, NB, and PED are also visible in the Tone test screen.

3) When Wavefile 1 is selected, alternative symbols are used in the audiogram because these stimuli do not comply with the standards for tone audiometry. Thresholds obtained with Wavefile 1 are saved in the Pediatric screen only and can be viewed there, including for historic sessions, but they are not saved as audiometric thresholds. The symbols used are blue for the left ear, red for the right ear, and black for both ears.

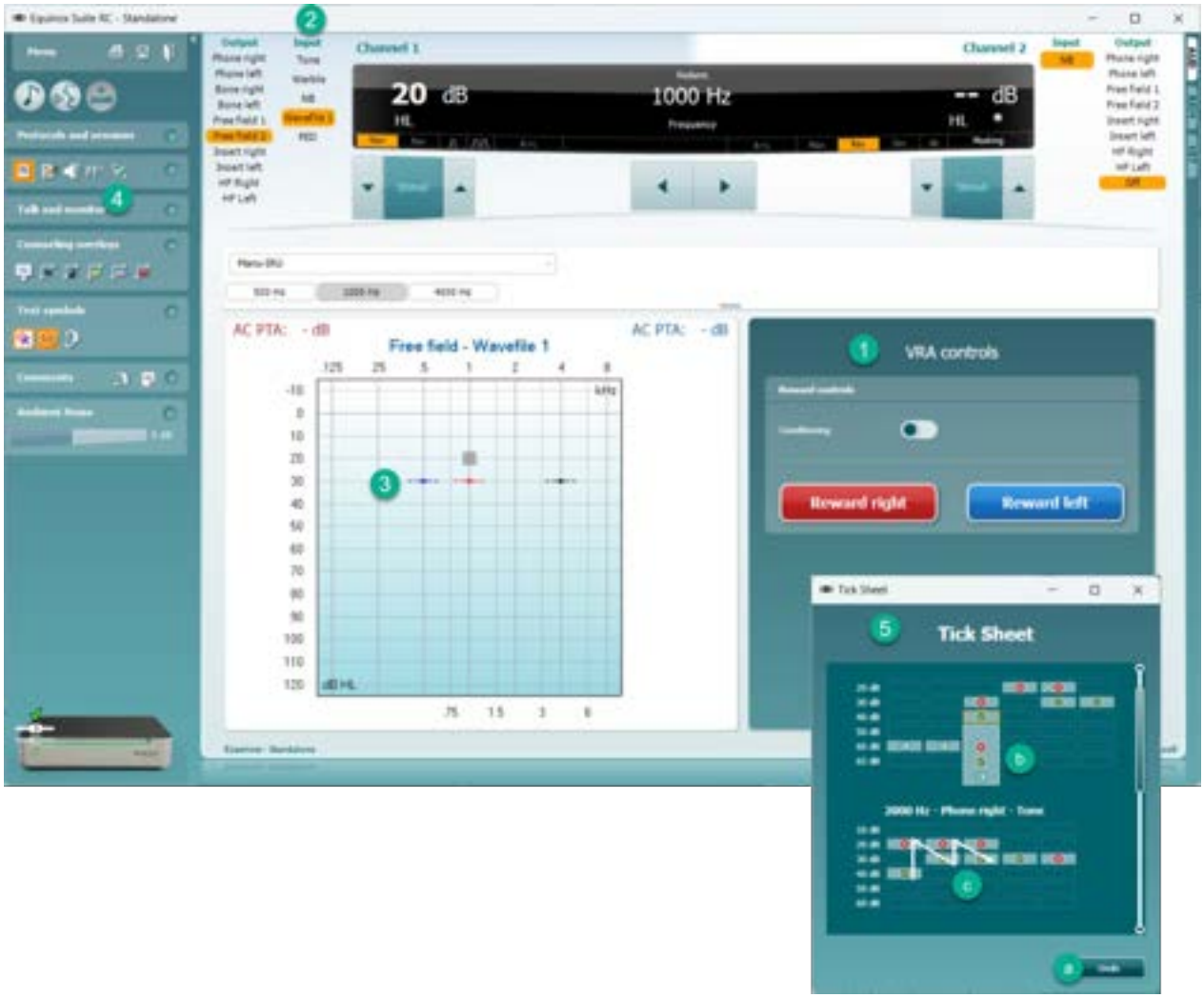
4) Click the icon to view the Tick Sheet in on-top mode.

5) The Tick Sheet is automatically populated and contains stimulus details such as frequency, transducer, ear side, and sound source. The table shows the intensity level of the presentation and the response to it. Ticks used in the Tick Sheet are ‘c’ for an adequate response to a conditioning trial, ‘x’ in red for no response, and ‘v’ in green for an adequate response to a stimulus. The default response window is 4 seconds. Go to **Menu > Setup > AC440 setup > Pediatric > Add-ons > VRA Settings** to adjust the response window between 1 and 10 seconds.

   a. The ‘undo’ button will delete the tick in the bottom right corner, which is chronologically the newest tick.

   b. Right-clicking the mouse allows you to either delete or change the tick.

   c. To follow the chronological presentation of the stimuli, read the table from top to bottom and across.



3.1.14 IA-AMTAS test

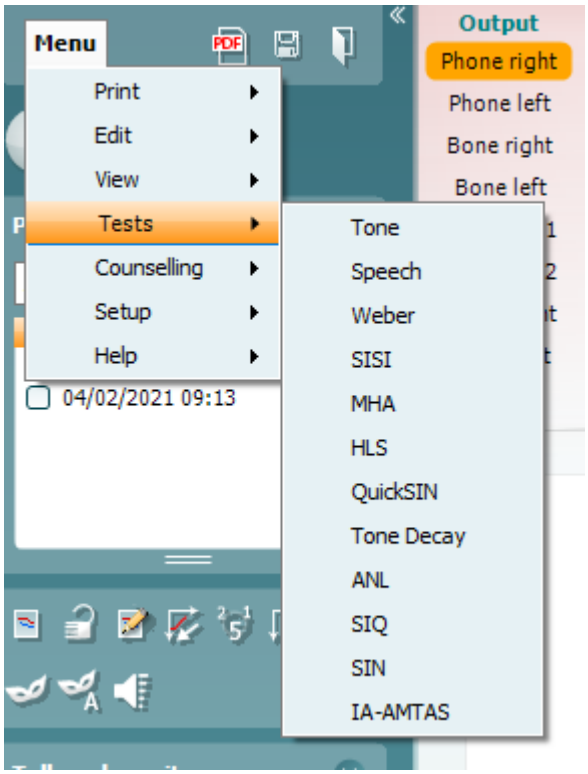
IA-AMTAS is a special test within the Equinox Suite that provides an automated method for obtaining a diagnostic hearing test; including air and bone conduction thresholds with masking applied to the non-test ear. IA-AMTAS also provides automated tests of speech reception, both Speech Recognition Threshold (SRT) and Word Recognition Scores (WRS) may be obtained.

IA-AMTAS was developed through a partnership between Audiology Incorporated and three research institutions, the University of Minnesota, the University of Utah, and the James H. Quillen Veterans Administration Medical Centre. The development was funded by the National Institutes of Health Small Business Technology Transfer (STTR) Program.

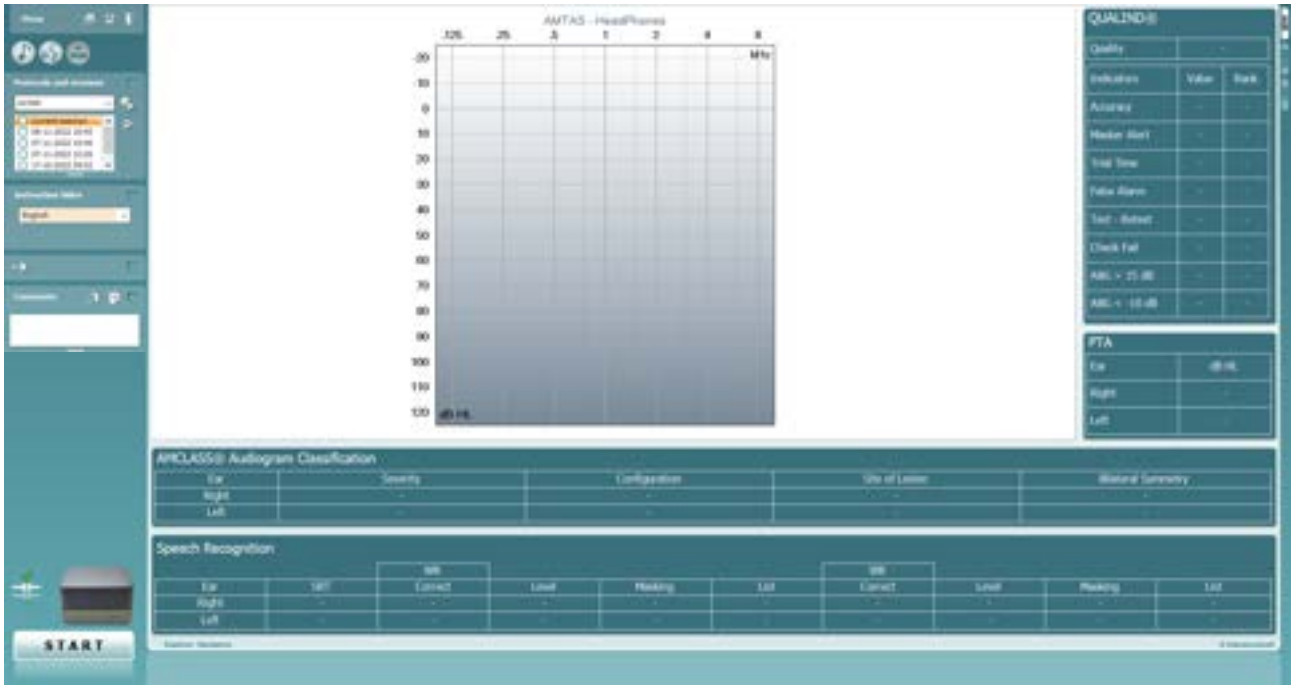
IA-AMTAS is based on a psychophysical procedure that uses the patient's responses to determine signal levels needed to find auditory thresholds. Once the transducers are placed on the patient, the test is self-administered. The test is self-paced so that patients proceed at the rate that is comfortable for them. Feedback is provided to the patient that helps them distinguish between test tones and other auditory sensations. IA-AMTAS was designed to provide the same test results that would be obtained by an expert audiologist with a psychophysical procedure that has advantages over the commonly used clinical ("Hughson-Westlake") method.

Quality indicators provide information about the validity of results. Air conduction audiograms are classified based on configuration, severity, and symmetry. The program generates a report and interfaces with Equinox Suite and the data may be transferred to other software programs.

The IA-AMTAS process



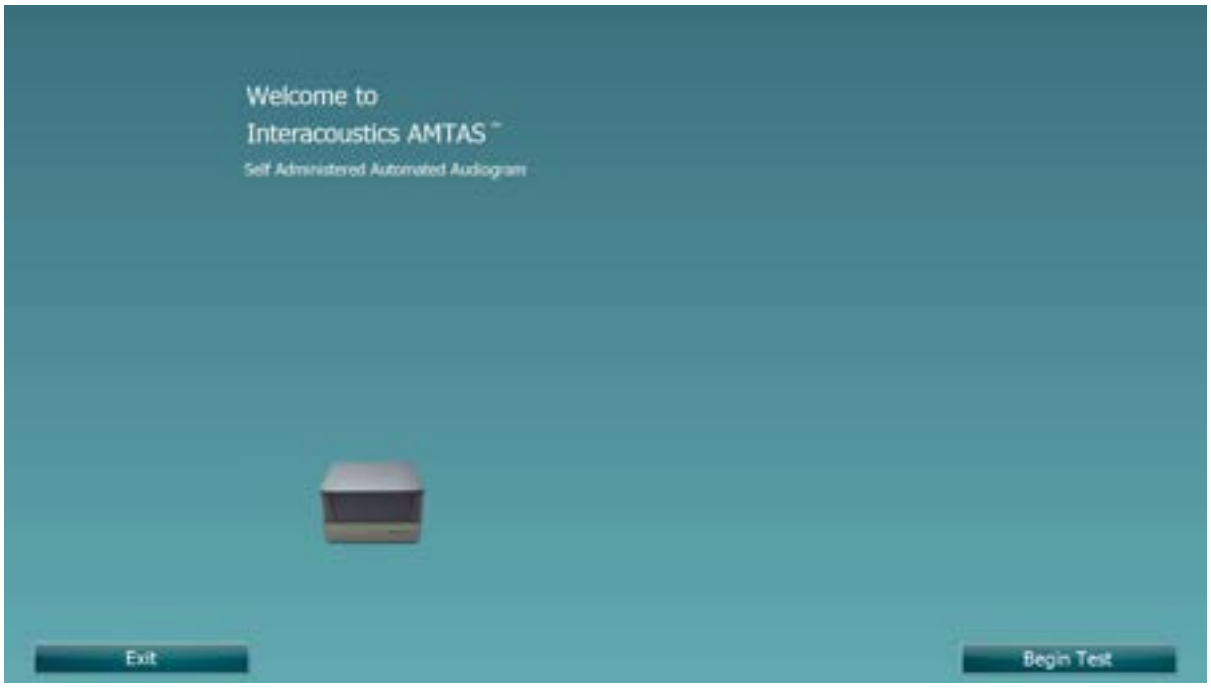
In your Equinox Suite go to **Menu** then **Tests** and click on **IA-AMTAS**. On doing this you will be brought into the screen below.



As no data exists you will not see anything in the graphs shown on the screen.

Choose the preferred language for the instructional video in the left hand menu

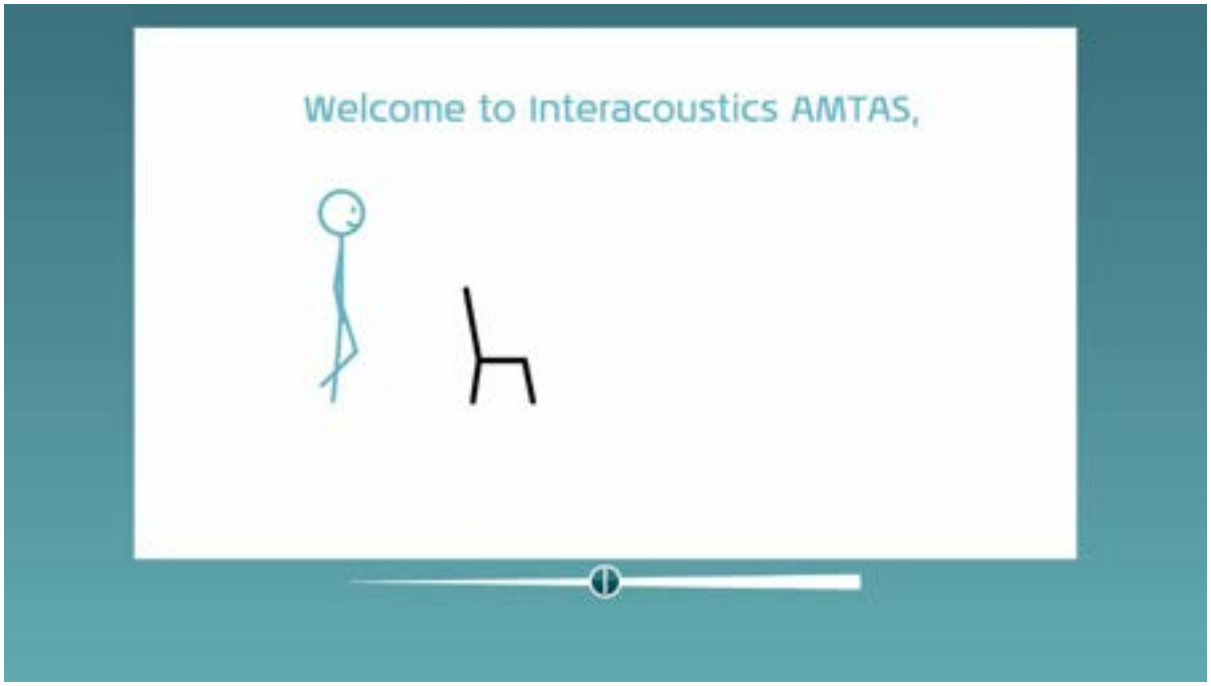
Click ‘Start’ to begin the test, this will bring you into a new screen as shown below



Press on the ‘Begin Test’ Button to proceed.

In this screen you will be shown the patients criteria, this is locked in circumstances where it can read from your database.

Click to continue. Where you will be shown an instruction video, below this is a volume slider to increase or decrease the volume of the instructions.

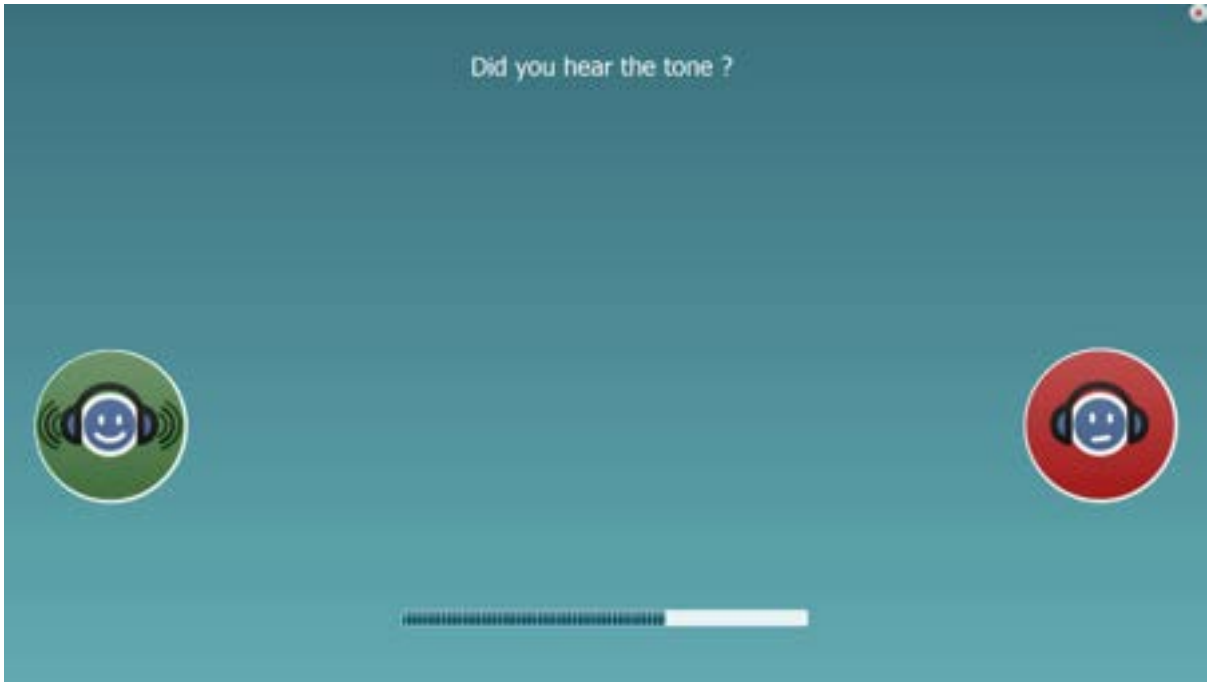


Once the video has completed the test will begin.

The patient is required to wear the headphone and bone transducer and respond via mouse or touch screen via the screen below.

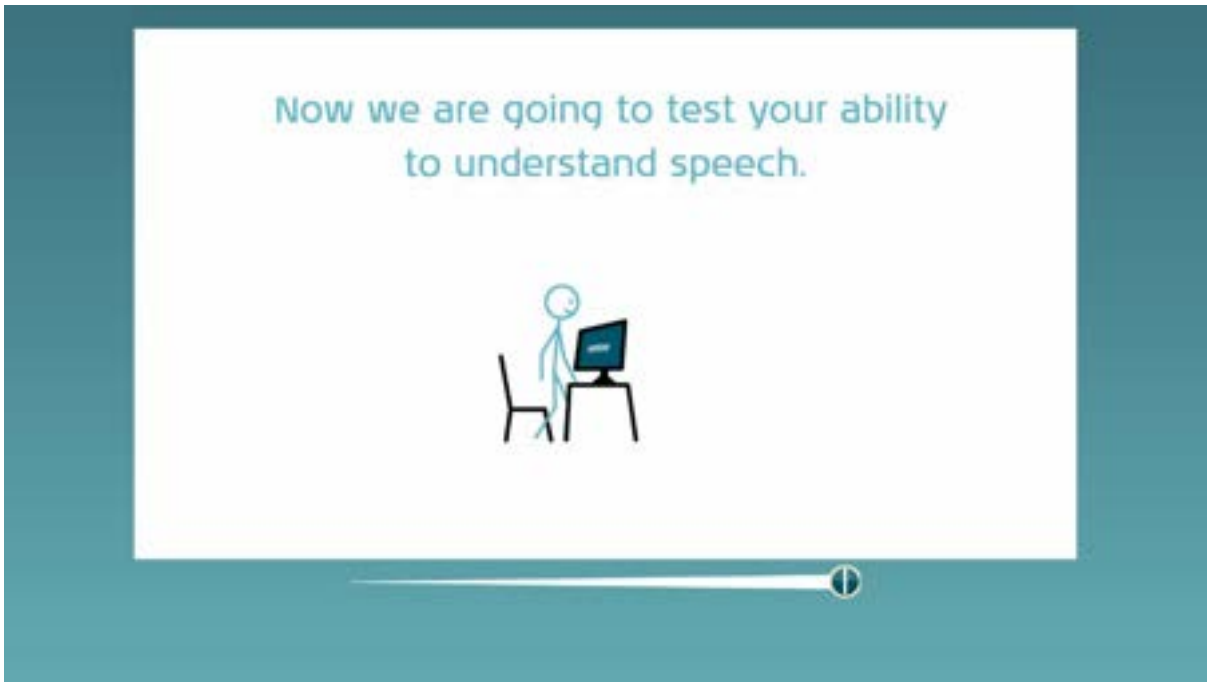
Masking will be automatically applied depending on the status of the test. The patient is advised to ignore this when testing.

Throughout all the IA-AMTAS test the process can be stopped by clicking on the cross in the top right corner.



There is a progress bar to indicate how far they are through the test.

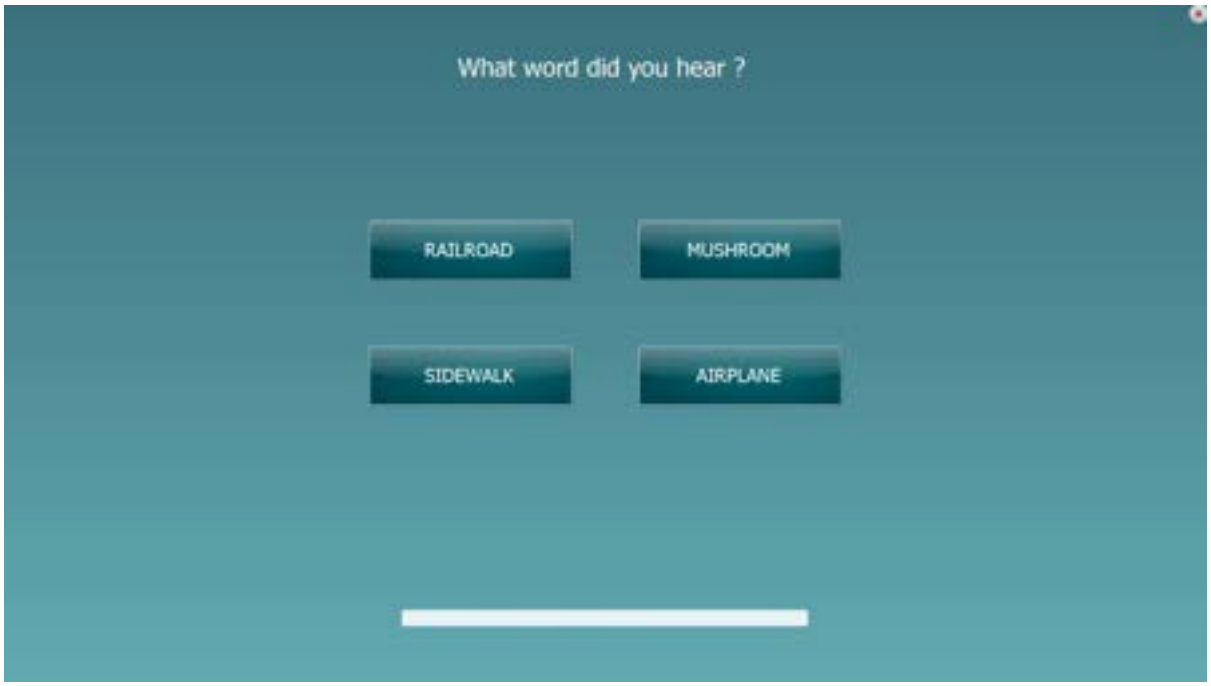
Once completed the test will swap to a speech test to acquire the Word Recognition and Speech Recognition Threshold. A video is shown to explain how this test proceeds and how to respond.



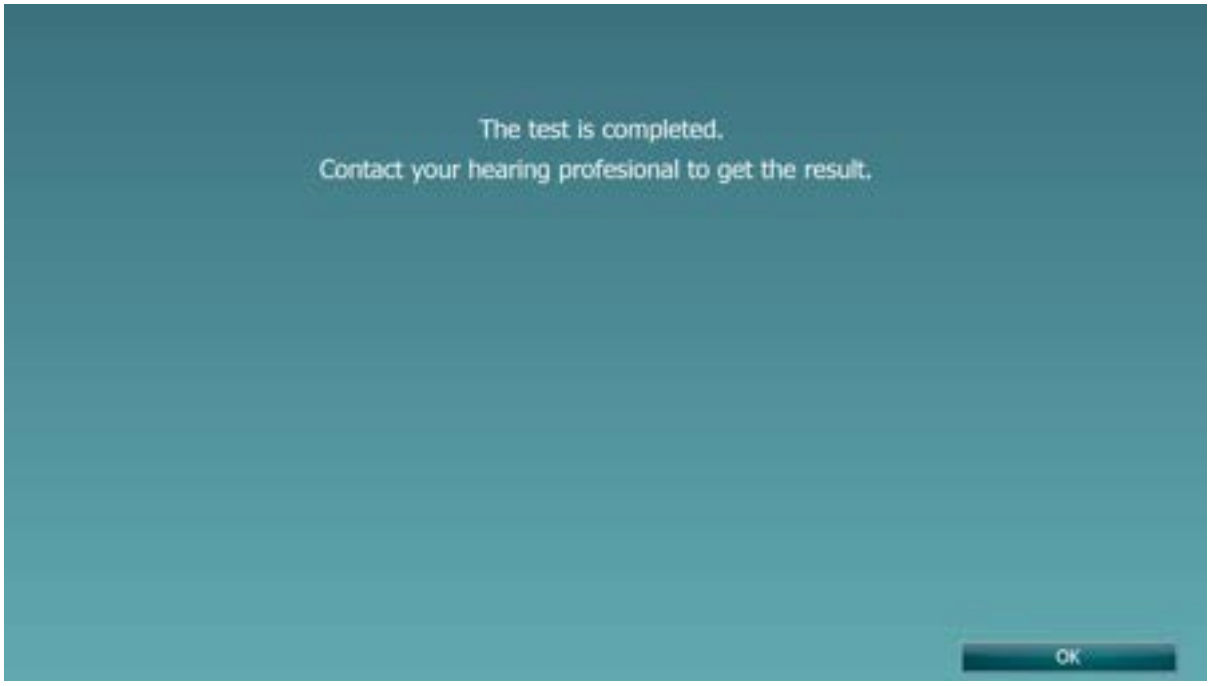
Once the video has finished the test will continue.

The below screens will show during testing both to indicate the response options and the status of the test.


Listen for a WORD

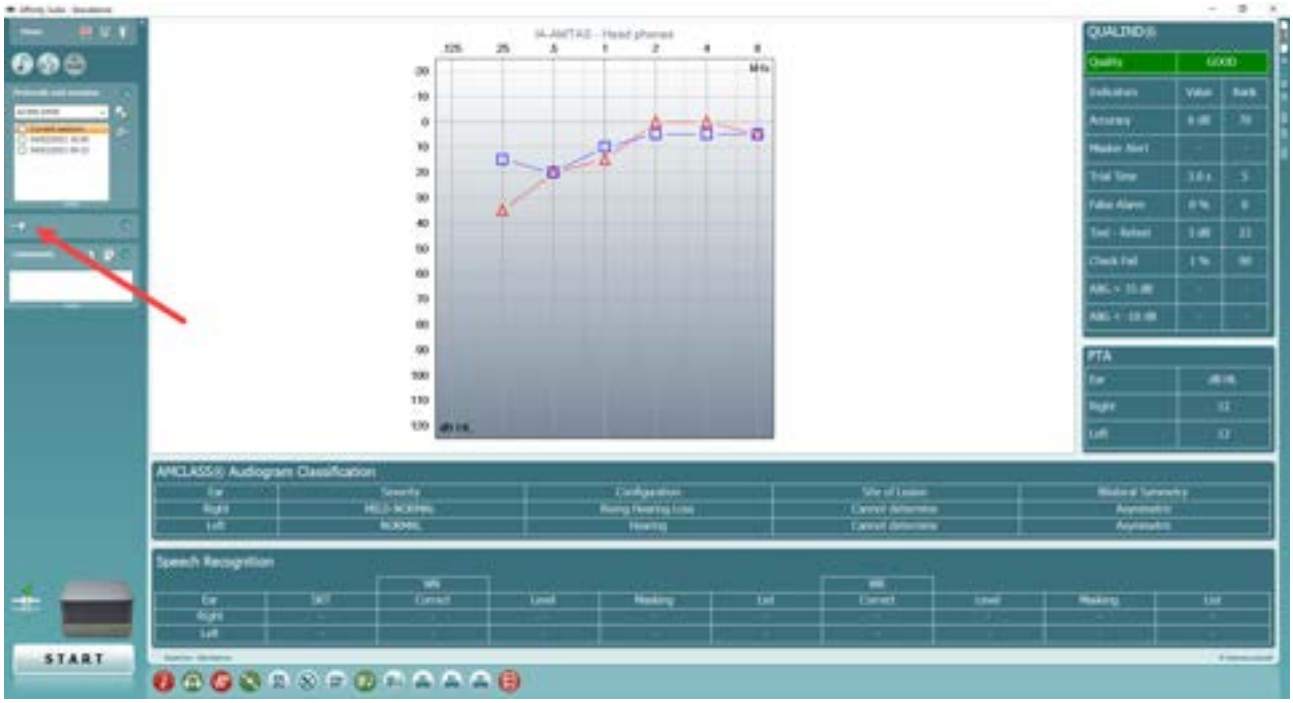

What word did you hear ?
RAILROAD
MUSHROOM
SIDEWALK
AIRPLANE

Once the test has completed you will see the following screen.

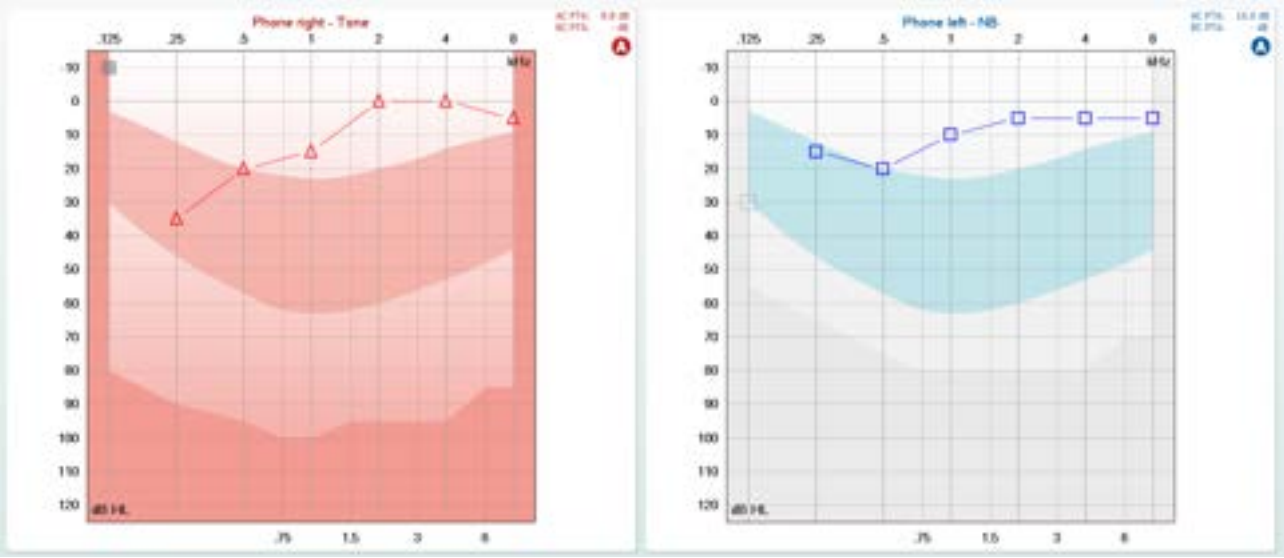


Once you have populated an audiogram using IA-AMTAS you can transfer your audiogram back into the standard Tone Audiometry screen of the Audiometry module.

To do this you should press on the arrow shown in the below screen.



The audiogram which is transferred back will be labelled with an ‘A’, indicating it was created in an automated manner.



3.2 Speech audiometry

Most people acquire hearing aids because they or their relatives report that they have trouble hearing speech. Speech audiometry has the advantage of utilising speech signals and is used to quantify the patient's ability to understand everyday communication. It examines the patient's processing ability in relation to their degree and type of hearing loss which can vary greatly between patients with the same hearing loss configuration.

Speech audiometry can be performed using several tests. For example, SRT (Speech Reception Threshold) refers to the level at which the patient can repeat 50% of the presented words correctly. It serves as confirmation of the pure tone audiogram, gives an index of hearing sensitivity for speech, and helps determine the starting point for other supra-threshold measures such as WR (Word Recognition). WR is sometimes also referred to as SDS (Speech Discrimination Scores) and represents the number of words correctly repeated, then expressed as a percentage.

Note that there is a predictable relationship between the patient's pure tone threshold and speech reception threshold. Speech audiometry may therefore be useful as a cross-check of the pure tone audiogram.

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- Headphones, insert phones, or free field speakers
- A microphone, CD player or wave files

Test procedure:

Before performing speech audiometry, you may wish to complete tone audiometry. This provides valuable predictive information useful in speech testing. Furthermore, the PTA level (Pure Tone Average) gives you a basis for calculating the starting point for speech testing.

1) Open the AC440 module in the Equinox Suite through your patient management software, Noah or OtoAccess®
2) Go to speech testing by pressing the **Speech Screen** quick access button
3) If needed select a test protocol in the **List of Protocols**.
4) Select the input and output stimuli and intensity levels for **channel 1**.
   If masking is needed, configure **channel 2** also.
5) Explain to the patient that he/she will now hear some words/numbers/sentences though the ear phones/free field speakers. Instruct him/her to repeat what is said even though it may be very faint. Patients may also be encouraged to guess if they are unsure about the word/number/sentence. If performing the speech test in noise do not forget to instruct the patient not to focus on the noise but on the speech.
6) Start presenting the words, numbers, or sentences. Depending on the setup for speech testing (see section 1.10.5) the test can be scored using the following buttons:

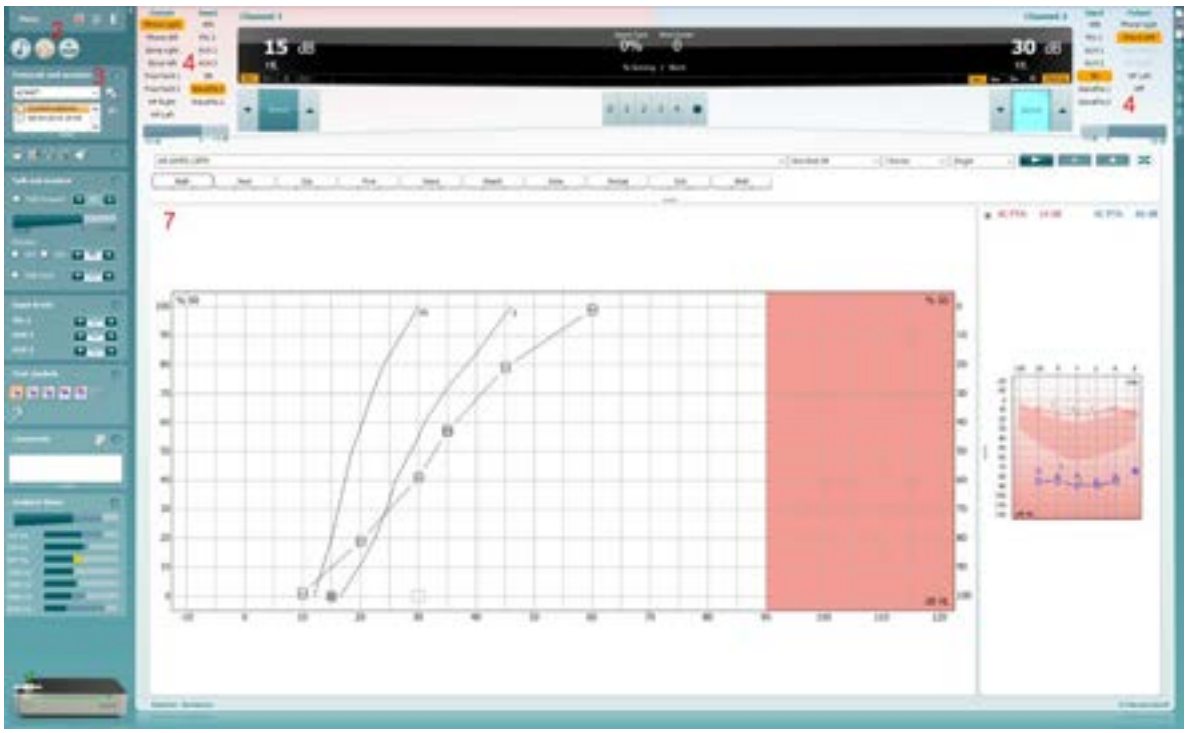
   Correct, Incorrect, and Store

   Number of correct phonemes and store

The speech score will be displayed in the black bar:



In case of mistakes during the test you can right click on the threshold which will prompt a menu with edit options. Besides deleting single thresholds or whole curves it also provides the option to **Add no response, Add masked threshold** and **Add masked-no response threshold**.

Note: If performing speech audiometry in free field and calibration is done at one location, please be aware that free field calibration values are likely to be incorrect at other locations because of acoustical circumstances. The differences can easily differ up to 10 dB.

Note: Due to vast amounts of speech material from different countries and regions there may be specific methodology and logic for you to carry out your speech test. Please refer to local guidance regarding how your speech material should be used and scored when using such materials.

3.2.1 Speech reception threshold (SRT) in table mode

The SRT examines at which level 50% of the speech material (usually numbers or spondaic words) is repeated correctly. The SRT can be used as a cross check of the air conduction audiometry and should closely agree with the PTA (Pure Tone Average). The PTA can be calculated in different ways but is usually the average of thresholds obtained at 500, 1000, 2000 and 4000 Hz. It is generally accepted that if the PTA and the SRT is within ± 6 dB of each other the accordance is good, if it is ±7 to 12 dB it is adequate, and if it ±13 or more it is poor.

1) Perform *air and bone conduction audiometry* as described in section 3.1 and 3.1.3 to obtain the PTA.

2) Open the **Speech Screen**

3) Ensure that the **SRT** test is active. This is shown by the SRT label being orange

4) Choose the input for **channel 1** (microphone, CD, or wave file). In case of wave files, check if the preferred material, and wordlist are selected.

Note: In case of **microphone/AUX** the speech material can be calibrated by speaking into the microphone/playing the calibration track. Adjust the corresponding arrow keys to 0 VU (see details in section 3.2)

3.2.2 Speech testing with a microphone

1) Start with the better hearing ear according to the audiogram and set the intensity to 15 dB above Pure Tone Average.
2) Begin presenting the speech material and reducing the intensity in 5 dB steps for every correctly repeated word. Use the **Store button** to store the SRT.
3) Upon changing *Transducer, Masking*, and/or *Aided* and re-testing an additional SRT entry will appear in the SRT table (see illustration above). This allows for multiple SRT measurements to be shown in the SRT table.

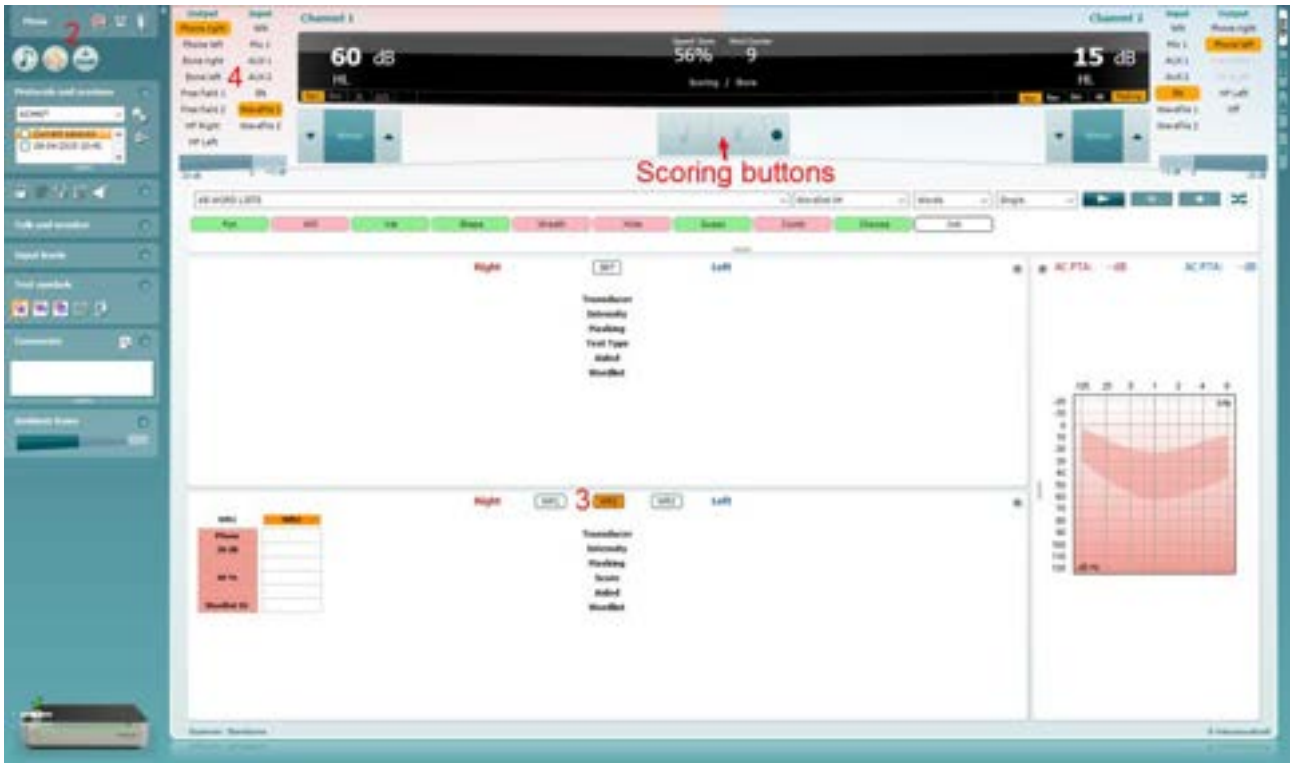
If the SRT is not in accordance with the air conduction thresholds, the air conduction audiogram should be checked, and the procedure repeated (Nielsen & Carver 1997; Katz 2002).

Note: MCL and UCL speech testing can be conducted by selecting MCL or UCL

3.2.3 Word recognition (WR) in table mode

The Word Recognition score determines the patient's discrimination ability expressed in a percentage. It provides information about what phonemes the patient has difficulty hearing at a particular intensity level. This is helpful for counselling and rehabilitation purposes. The diagnostic value has shown to be low, but it is generally accepted that word and sentence recognition are least affected by conductive and most affected by neural loss.

There are numerous ways of performing the WR. The procedure described below is a suggestion.



1) Perform *air and bone conduction audiometry* as described in section 3.1 and 3.1.3 to obtain the PTA.

2) Open the **Speech Screen**

3) Ensure that WR test is active.

   In table mode, this is shown by the corresponding WR label being orange

4) Choose the input for **channel 1** (Microphone, CD, or wave file). In case of wave files, select the preferred material and wordlist (see below). Note that calibration is the same for SRT

   a) Start in the better hearing ear according to the audiogram and set the intensity to approximately 30 or 40 dB above PTA (minimum 55 dB). In cases where recruitment is present start lower at about 20 dB above PTA and ask the patient if the level is comfortable after 2-3 words.

3) Begin presenting the speech material. Use the scoring buttons to score and store the results. The current score (in percent) will appear in the black bar.

4) Upon changing *Transducer, Masking*, and/or *Aided* re-testing an additional WR entry will appear in the WR table. This allows for multiple WR measurements to be shown in the WR table

5) If you have other speech audiograms on the patient saved in Noah or OtoAccess® you can compare the new audiogram to a previous one using the session list. This is done by using the checkboxes of the historic sessions that you like to overlay.

To save the audiogram press **Save** or **Save and Exit** .

3.2.4 Speech testing with a microphone

1) Connect the microphone to the Mic1.-Talk F(6) input on the hardware.

2) Open the AC440 software, go to the Speech screen

3) Choose *Mic1* in the input **channel 1** list.

4) Adjust the input level for the *Mic1* until you reach an average of approximately 0 dB VU on the VU meter while speaking into the microphone at a normal conversation level.

5) When the VU meter is adjusted the microphone input is ready for use. Perform the speech audiometry as described in section 3.2.

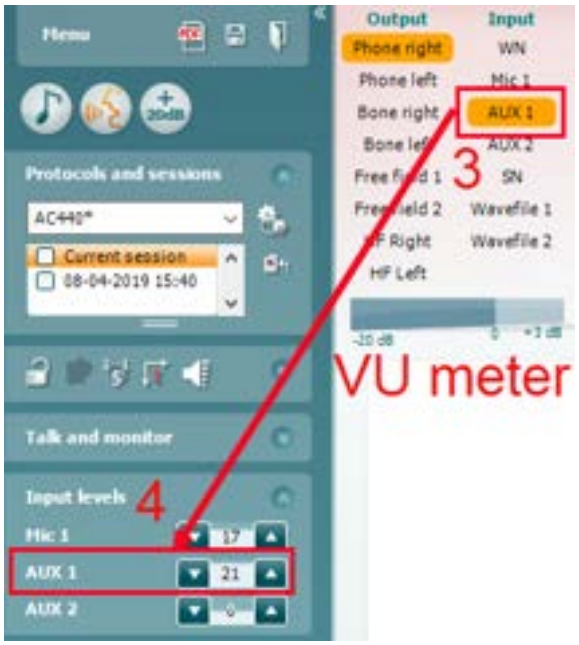
3.2.5 Speech testing with an external sound source

1) Connect the sound source to the AUX input (8) of the device.

2) Open the AC440 software, go to the Speech screen .

3) Choose *AUX1* or *AUX2* in the **channel 1** list.

4) Play the calibration tone for your material through the sound source. Then adjust the input levels for the *AUX1* or *AUX2* until you reach an average of approximately 0 dB VU on the VU meter[19]. You may also use the sound source's volume control to adjust the VU meter, should the control in the Suite not be sufficient.



5) When the VU meter is adjusted the AUX input is ready for use. Perform the speech audiometry as described in section 3.2.

[19] This function ensures that the VU meter is not adjusted by accident.

3.2.6 Speech testing with wave files[20]

The AC440 also allows for testing with wave files if installed on the PC. The default speech material can be selected in the AC440 setup (see section 1.9).

1) To use wave files choose them in the **channel 1** list.

2) The speech material can be selected from the four dropdown lists.

3) **Play, Stop, or Pause** the speech test on the three buttons on the right side.

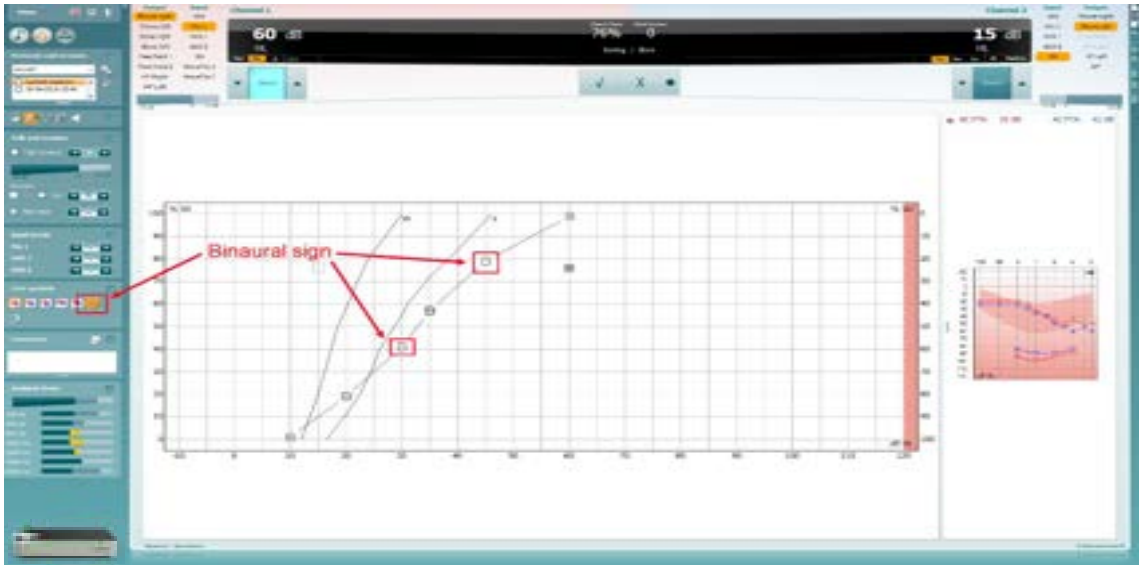
4) By clicking the button indicated in the image below, you can randomise the order in which your materials are presented. **Note:** this setting will be reflected when the play button is pushed as the word order will then shuffle.

5) Should you wish to edit your speech score after it has been assigned you can right click on the word, and it will allow you to re-score it as shown below. This feature can be used during testing or after the test has completed.

6) Should you wish to choose where to begin your speech testing then you can click on the designated wavefile ahead of starting the test. Clicking on it will highlight it with a bolder outline. The material will then play from her on clicking the 'play' icon.

[20] Speech audiometry with wave files requires an additional software license.

3.2.7 Binaural speech



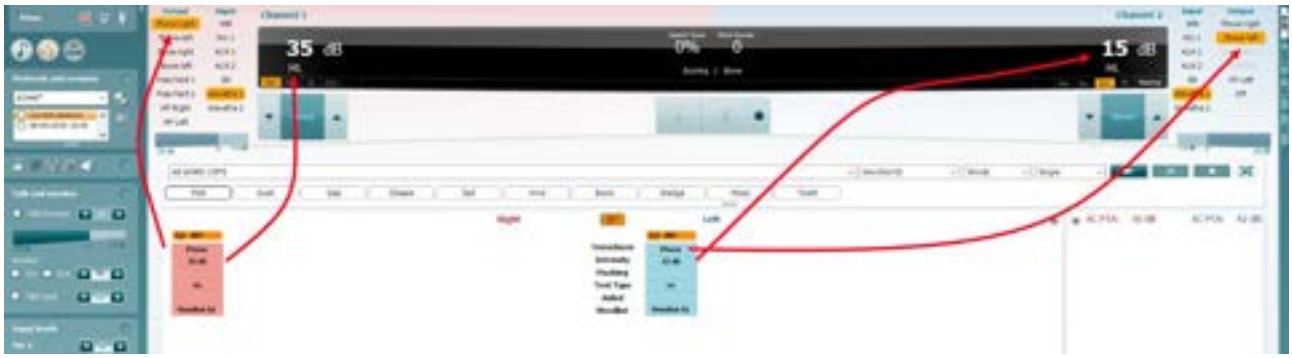
It is only possible to test Speech binaurally in the Speech audiometry screen. This can be done if channel 1 and channel 2 are using the same air conduction transducer and only when a different output is chosen. E.g., right ear in channel 1 and left ear in channel 2 or vice versa.

When the binaural mode is activated 

in graph mode the stored symbol will be shown as a “B”.

When the binaural mode is activated 

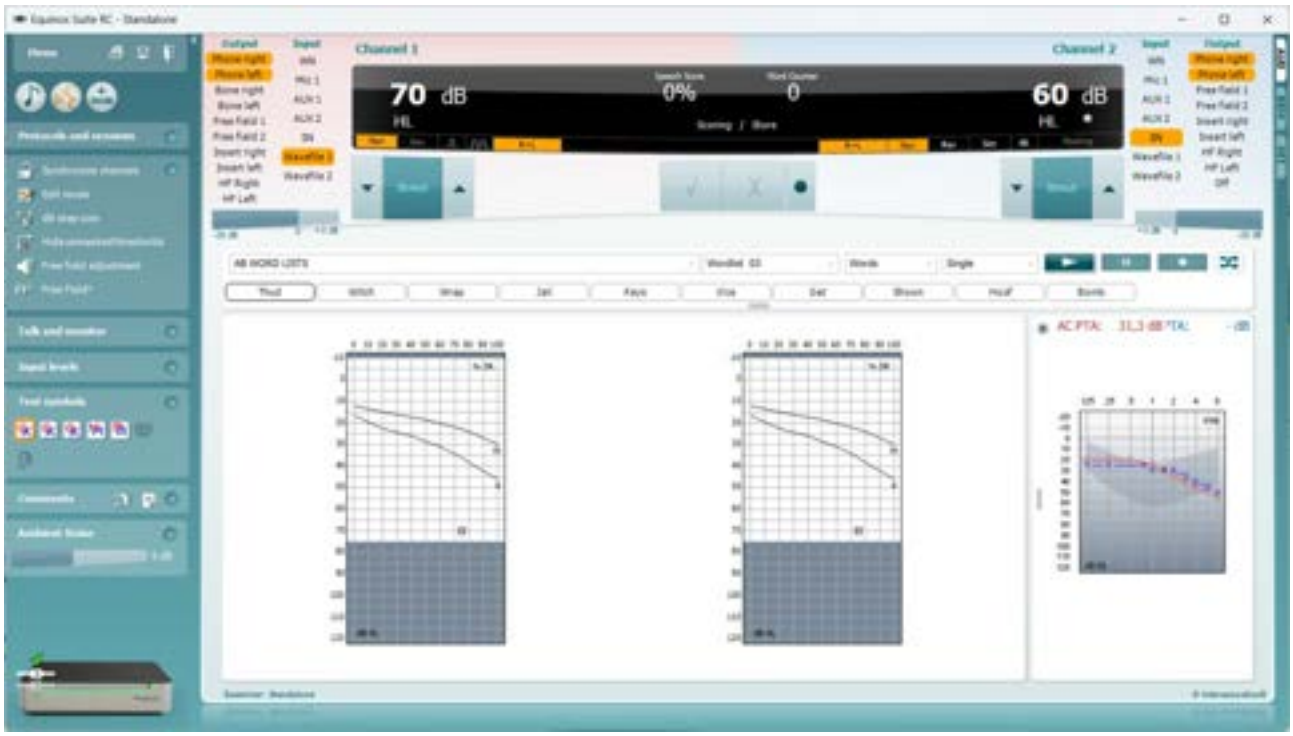
in table both results will be stored even if the level is different. This means when this is stored it will store the channel 2 level and display the results as well as channel 1. See below:



In ‘Binaural mode’ the Pure Tone Average (PTA) calculations will be calculated monaurally only, although the value will be displayed above each Audiogram.

3.2.8 Four channel speech with R+L function

Four channel speech allows speech and noise to be presented in both channels at the same time, in order to test speech in noise abilities. The function is enabled via the R+L function for each channel.



If the R+L is chosen in channel 1, the intensity level from channel 1 will apply to both earsides and both audiograms will appear grey. The stored symbol is shown as a ‘B’.

When the R+L is activated in the speech section and displayed via the table mode results from both channel 1 and channel 2 will be stored even if the level is different. This is shown by the table screen split up in two, see figure below: 1= channel 1, 2= channel 2.

3.2.9 QuickSIN[21]

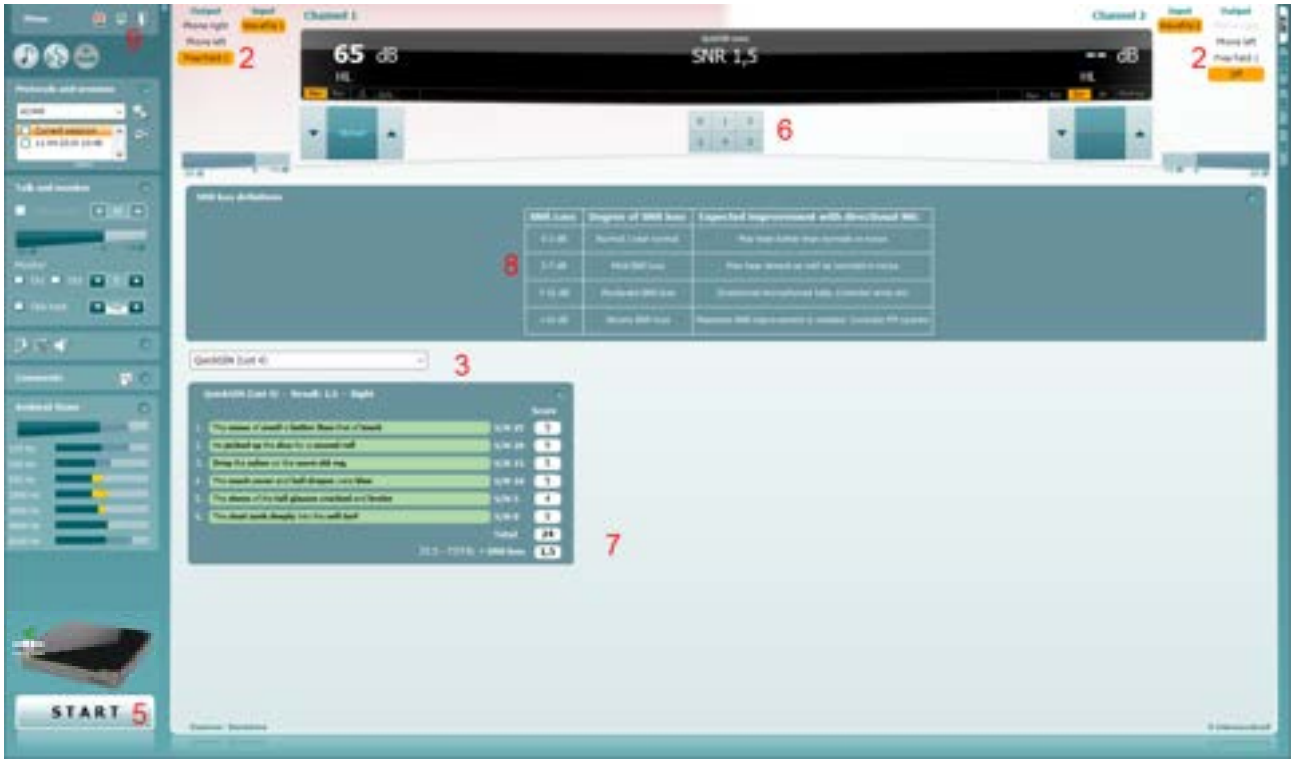
Difficulty with hearing in background noise is a common complaint among hearing aid users. Therefore, the measurement of SNR loss (signal-to-noise ratio loss) is important because a person's ability to understand speech in noise cannot be reliably predicted from the pure tone audiogram. The QuickSIN test was developed to provide a quick estimate of SNR loss. A list of six sentences with five key words per sentence is presented in four-talker babble noise. The sentences are presented at pre-recorded signal-to-noise ratios which decrease in 5-dB steps from 25 (very easy) to 0 (extremely difficult). The SNRs used are: 25, 20, 15, 10, 5 and 0, encompassing normal to severely impaired performance in noise. For more information, please refer to QuickSIN manual on the Interacoustics webpage.

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- Calibrated Headphones, insert phones or Free-Field Speakers

[21] QuickSIN requires an additional license.

Test procedure



1) Open the AC440 and enter the QuickSIN screen by selecting **Menu > Tests > QuickSIN**
2) Select the output level. For most of the tracks the channels are synchronised to ensure that the correct SNR level is achieved. Note: the ‘Speech and Babble’ Lists are not synchronised and will require the user to manually alter these to ensure the correct SNR setting for the test.
3) Select a list in the corresponding dropdown. e.g., “QuickSIN (List 2)”.
4) Instruct the patient to repeat the sentences and try to ignore the noise that they will also hear through the headphones.
5) Press **START** to begin the test
6) The number of words in bold the patient repeats correctly should be scored by clicking on the score buttons.
7) When 6 sentences are scored a total score will be calculated.

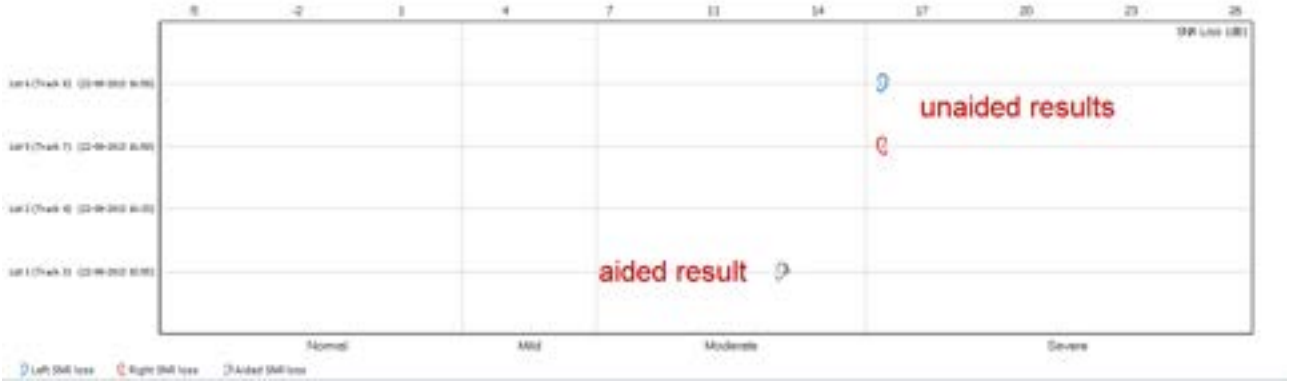
   Note that if you press **Stop** before the 6 sentences of the list have been played and scored, no total score will be calculated.
8) The total score can be compared to the “SNR loss definitions”.
9) Save the QuickSIN test by clicking **Save** 

Comparing aided and unaided QuickSIN scores over time:

Clinicians are now able to compare the Unaided and Aided SNR scores.

To view the scores in a graph view, click on the graph icon 

To view the scores in a graph view, but using the patient monitor, click on Patient Monitor 



The QuickSIN is performed according to the methods described in the QuickSIN manual.

3.2.10 SIQ test

The Speech in Quiet (SIQ) test is a method of testing a patient's functional hearing in the absence of any competing sound. The objective of this is to identify their functional hearing ability (Schoepflin, 2012). The outcome of this investigation will give a Speech Recognition Threshold (SRT).

This type of testing is different from Tone Audiometry as it involves higher areas of the Auditory pathway as the information needs to be heard, processed, and repeated to give a correct response (National Research Council (US), 2004).

The SIQ test is designed to be performed via loudspeaker as it is a free field test. However, it can be configured to perform monaurally via selection of headphones and routing the signal to the relevant ear-side.

The SIQ test is very similar to Speech Audiometry and can use any of the materials you have already ripped into your Interacoustics Suite software. However, the Stimulus intensity is maintained automatically by the software following a correct or incorrect response to the stimulus, this helps to speed up the test time.

When should I perform the SIQ test?

It is normal to perform this following Tone Audiometry as it gives a good indicator of the patient s performance for speech, it can also be a good indicator of the accuracy of your audiogram (Mehta & Singh, 2000). It can also be used before and after the provision of hearing aids to give an identification of the benefit achieved through amplification.

Test procedure

1) Launch the Equinox Suite from Noah or OtoAccess®.
2) Click on the **AUD** tab on the upper right-hand side of the screen. Ensure that your Audiometry has been performed ahead of advancing into the SIN test as this determines the start level for the test.
3) Click on **Menu**, **Tests** and then select **SIQ**.

4) Once in the SIQ test screen, the stimuli levels should be set for you. These are based on the patient audiogram and the PTA score.

5) Ensure that your speech material is correct, and the relevant list has been chosen.

6) Instruct the patient to respond by repeating the words that they hear. Press the play icon to begin the test.

7) On the patients' response, score the words correct or incorrect according to their response. The system will automatically increase the next stimulus intensity for an incorrect response and decrease the next stimulus intensity for a correct response.

8) Repeat this procedure until your word list has completed. The system will automatically store on completion of your word list.

3.2.11 SIN test

The Speech in Noise (SIN) test is a method of testing a patient's functional hearing in the presence of competing sound (Taylor, 2003). The objective of this is to identify their functional hearing ability and higher processing which allows them to sort between useful (speech/signal) and irrelevant (noise/masking) information (Taylor, 2003). The outcome of this investigation will give a Speech Recognition Threshold (SRT) for a varying Signal to Noise Ratio (SNR).

This type of testing is different from Tone Audiometry as it involves higher areas of the Auditory pathway as the information needs to be heard, sorted, and understood to determine if it is useful or not (Marrone et al., 2008).

The SIN test is designed to be performed via loudspeaker as it is a free field test. However, it can be configured to perform monaurally via selection of headphones and routing the masking to the same output.

The SIN test is very similar to Speech Audiometry and can use any of the materials you have already ripped into your Interacoustics Suite software. However, the Signal-to-Noise Ratio is maintained automatically by the software following a correct or incorrect response to the stimulus, this helps to speed up the test time.

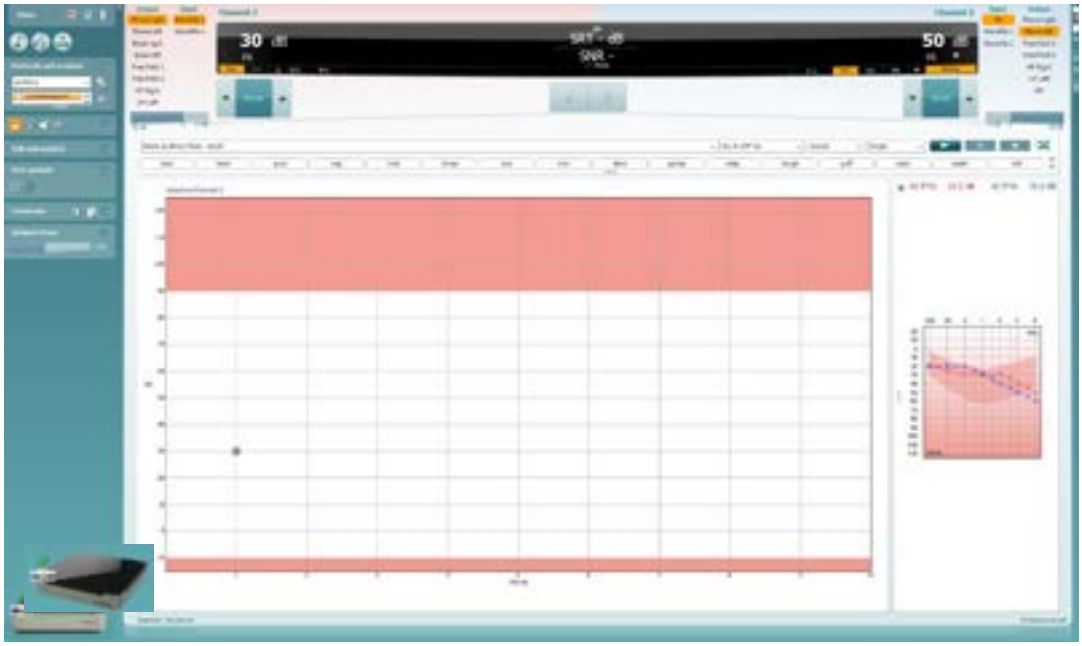
When should I perform the SIN test?

It is normal to perform this following Tone Audiometry as it gives a good indicator of the patient s performance for speech in noise. It can also be used before and after the provision of hearing aids to give an identification of the benefit achieved through amplification (Marrone, Mason and Kidd, 2008).

Test procedure

1) Launch the Equinox Suite from Noah or OtoAccess®.
2) Click on the **AUD** tab on the upper right-hand side of the screen. Ensure that your Audiometry has been performed ahead of advancing into the SIN test as this determines the start level for the test.
3) Click on **Menu**, **Tests** and then select **SIN**.

4) Once in the SIN test screen, the stimuli levels should be set for you. These are based on the patient audiogram and the PTA score.



5) Ensure that your speech material is correct, and the relevant list has been chosen.

6) Turn on the masking in Channel 2 by clicking from **Man** to **Rev**. The masking will need to be turned on manually, this is because you may want to perform an initial familiarization test with the patient without the noise to begin.

7) Instruct the patient to respond by repeating the words that they hear. Press the play icon to begin the test.

8) On the patients' response, score the words correct or incorrect according to their response. The system will automatically increase the next stimulus intensity for an incorrect response and decrease the next stimulus intensity for a correct response.

9) Repeat this procedure until your word list is completed. The system will automatically store on the completion of your word list.

3.2.12 ANL test[22]

The Acceptable Noise Level (ANL) Test is a method of determining how much noise the patient can tolerate whilst listening to a target signal/speaker (Nabalek et al., 1991). It is used as a predictor for how well a patient will cope with amplification when receiving a hearing aid (Nabalek et al., 2006).

The ANL test is designed to be performed via loudspeaker as it is a free field test. However, it can be configured to perform monaurally via selection of headphones and routing the signal to the relevant ear-side.

The ANL Test can use any of the materials you have already ripped into your Interacoustics Suite software.

When should I perform the ANL test?

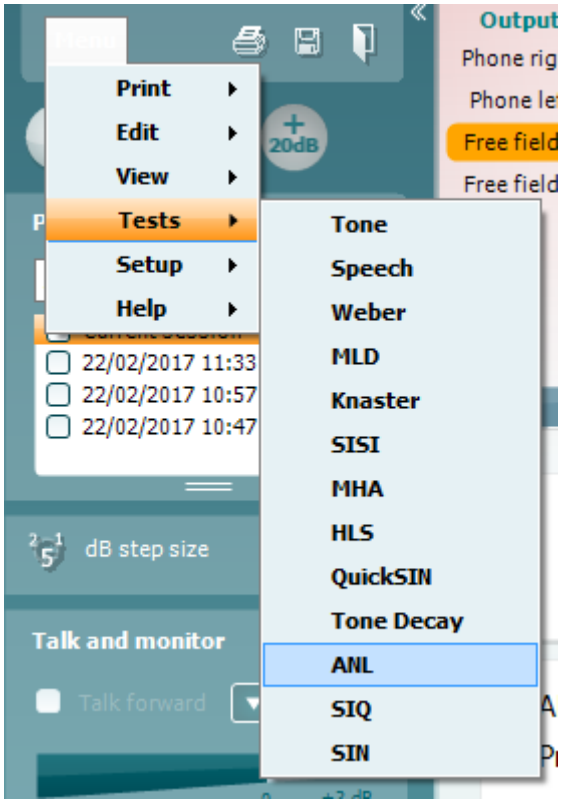
The ANL test is typically performed before the patient is given any form of amplification as a rehabilitative action for their hearing loss.

Test procedure

1) Launch the Equinox Suite from Noah or OtoAccess®.

2) Click on the **AUD** tab on the upper right-hand side of the screen. Ensure that your Audiometry has been performed ahead of advancing into the SIN test as this determines the start level for the test.

3) Click on **Menu > Tests > ANL**



4) Once in the ANL test screen, you will see that there are 4 different conditions which you can choose to measure.

   MCL High – This is the loudest comfortable level the patient can listen to without any competing noise

   MCL Low – This is the lowest comfortable level the patient can listen to without any competing noise

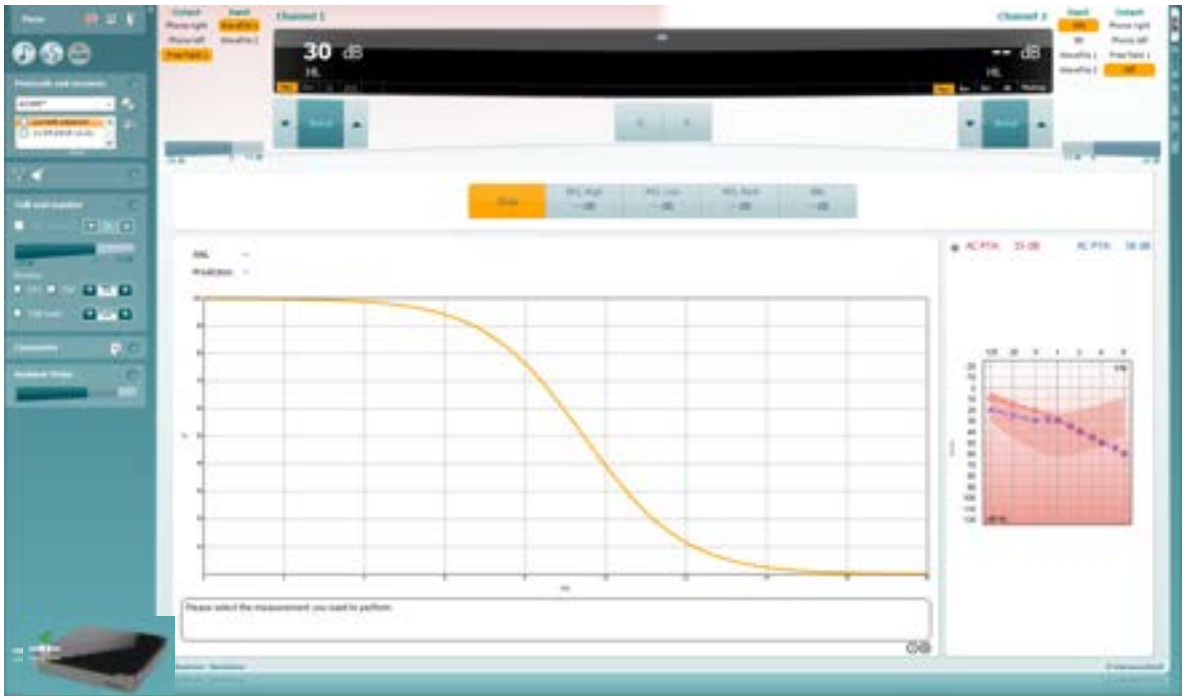
[22] The ANL Test requires an additional license.

MCL Real – This is the patient most comfortable level without any competing noise

BNL – This is the actual ANL test where the MCL Real is presented, and the competing noise is manipulated to find an ANL value

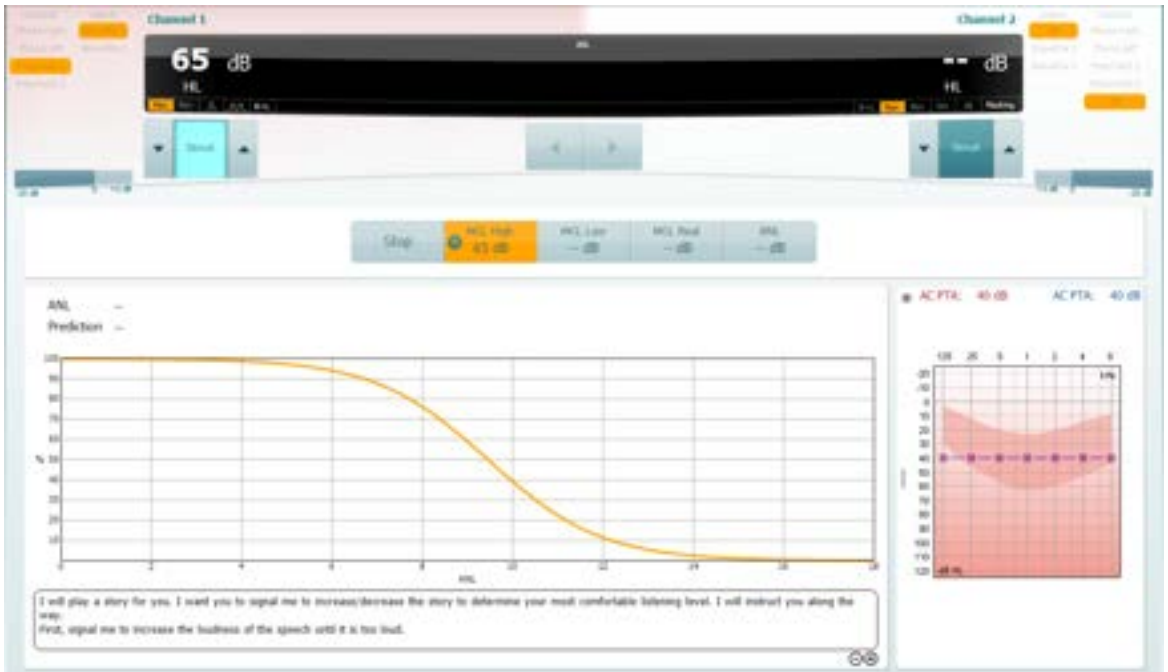
It is not essential to perform MCL High and MCL Low for the ANL test, but these are also good indicators of the patients' comfortable hearing range.

Instructions for the patient will always be displayed at the bottom of the screen.



5) MCL High

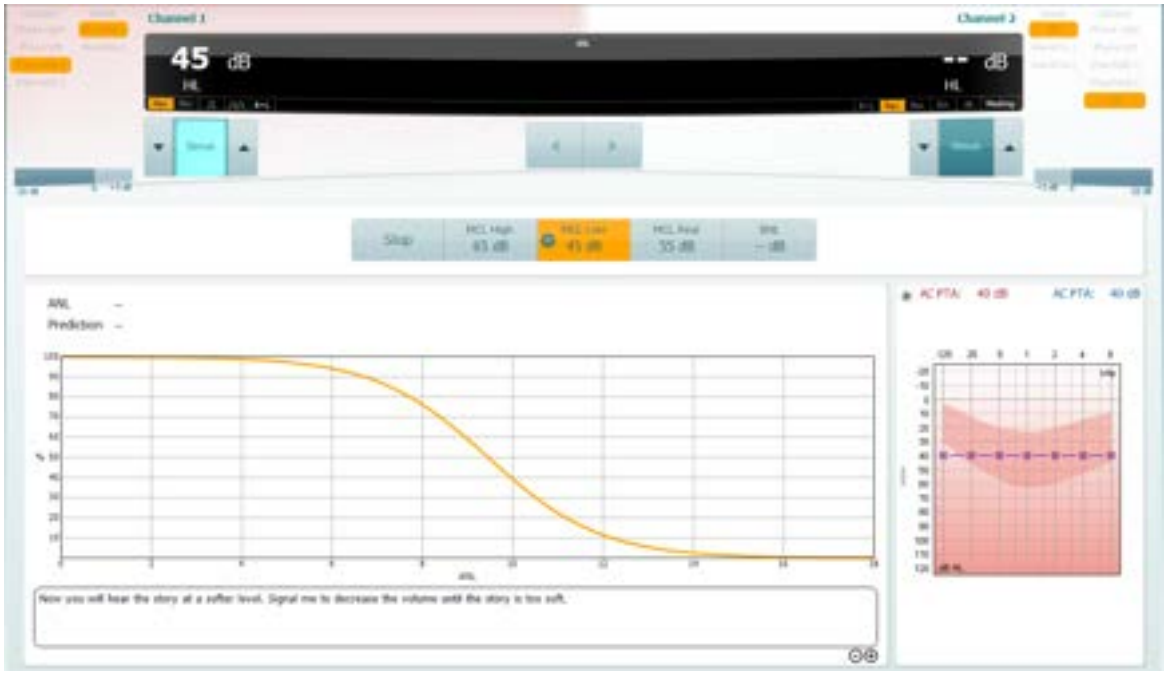
Click on the MCL High Icon and click play. This will loop your speech material.



Increase and decrease the stimulus intensity to match the patient's loudest MCL. There will be no other change in the display to represent this, only the level in the MCL High icon box.

6) MCL Low

Click on the MCL Low Icon and click play. This will loop your speech material.



Increase and decrease the stimulus intensity to match the patient's lowest MCL. The display will change within the icon but also a predicted MCL Real will be generated as a midpoint between the MCL High and MCL Low.

7) MCL Real

Click on the MCL Real Icon and click play. This will loop your speech material. If you have performed the MCL High and MCL low, you should already have a predicted MCL value here. If not, then increase/decrease the intensity to find a suitable level for the patients MCL.

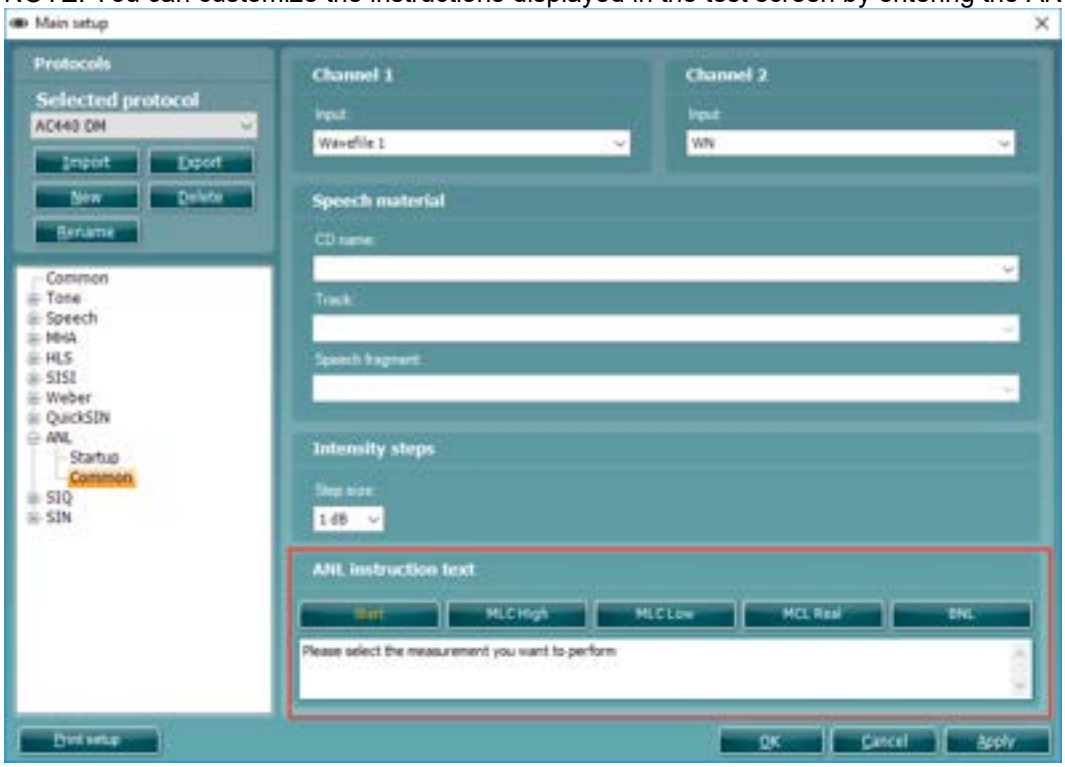
Again, the display will not change, other than inside the icon for your test condition.

8) BNL

Click on the BNL Icon and click Play. This will loop the same speech material but also introduce the background masking noise.

Increase/decrease Channel 2 to find a level of competing noise which the patient would be comfortable to listen to alongside their target material. Whilst doing this you will notice the display will change to reflect the patient's ANL value and the prediction percentage of how well they will perform with amplification.

NOTE: You can customize the instructions displayed in the test screen by entering the ANL setup.



What does my ANL value mean?

On performing the ANL test you will obtain an ANL value (in dB) and a percentage. The percentage gives a likelihood of success with amplification (Nabalek et al., 2006) and the ANL value is the outcome of the following calculation:

ANL = MCL -BNL

For response categories the following outcome criteria was determined as an effect of the Nabalek et al. (2006) investigation into ANL outcomes in relation to amplification:

ANL Score 7 dB or less: These individuals have a great prognosis for regular use and acceptance of hearing aids; may not need as much follow-up counseling and guidance as the average patient.

ANL Score 8-12 dB: These are your more common patients and have a good (8) or bad (12) prognosis for regular use and acceptance of hearing aids. These patients may need more follow-up counseling and are excellent candidates for noise reduction technologies.

ANL Score 13 dB or more: These patients are “at risk” for reduced utilization of hearing aids and may need additional post-fitting counseling, guidance, and require noise reduction technologies.

3.3 Counseling

3.3.1 Master hearing aid (MHA)[23]

MHA is a hearing aid fitting procedure consisting of three hearing aid simulated high pass filters of -6 dB, -12 dB, -18 dB per octave and a HFE filter (High Frequency Emphasis) equivalent to -24 dB per octave through the audiometric headphones. This gives a rough sense of the benefits of a hearing aid and what could eventually be gained by getting properly fitted hearing aids. The filters can be activated individually on both channels enabling the audiometer to serve as a 2-channel master hearing aid.

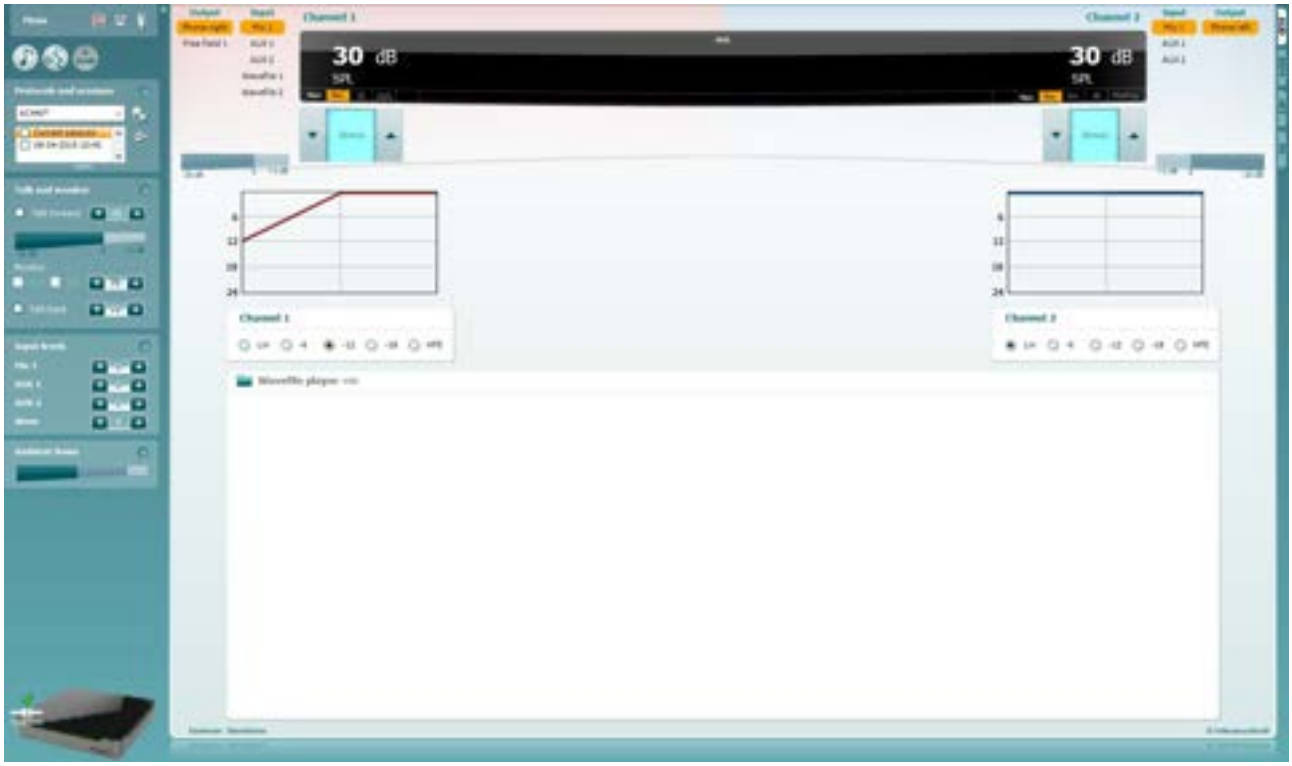
Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- MHA license
- Headphones or insert phones
- A microphone, external sound source or wave files

Test procedure:

When having performed the hearing assessment you may want to start discussing a possible hearing aid solution. However, there is no guarantee that the patient is positive towards such a solution. He/she might not even have acknowledged their hearing impairment and may therefore not be motivated or prepared for this prospect. In this situation, MHA may be useful.

[23] MHA requires an additional software license

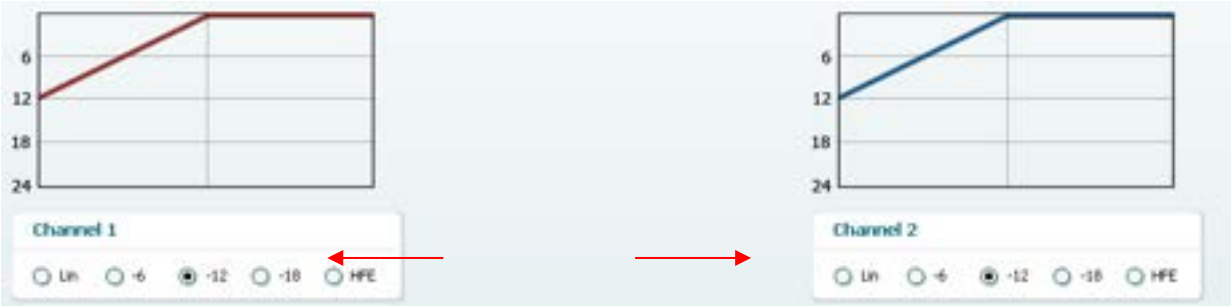


1) Open the AC440 and enter the MHA screen by selecting **Menu > Tests > MHA**.

2) Select headphones or inserts in the **channel 1** output list.

3) Select *AUX, Microphone* or *Wavefile* **in the channel 1** input list.

   If using AUX press *play* on the external sound source, and if using wave files, you can *Browse* and play them at the bottom of the screen.



   In this example the simulation starts in the *-12 dB* filter. It may, however, be advisable to start in *Lin* (no filtering) as listing to the input signal with one's own hearing for a moment is likely to have a strong effect when having to compare with the filtered input. The procedure is, however, up to you and the defaults can be set up in the AC440 setup.

4) Before mounting the headsets on the patient describe to them that this tool can give an impression of what a hearing aid might sound like. Perhaps let him or her listen to the signal with their natural hearing as it is (without manipulating the sound). Explain that they are now listening to the CD, wave file or live voice with their own natural hearing. In a minute, though, the sound will be changed trying to give them an impression of what it could sound like if they acquired hearing aids. Note that it may be necessary to point out that a hearing aid will sound even better than what they are about to hear which is an approximation. A hearing aid will be fitted more accurately based on the individual hearing loss. The MHA is meant to give them an idea as to how the amplification can provide them with much more audibility and thereby improve their quality of life significantly.

5) The selected MHA filter can be visualized in the graph. Toggle between the filters and see the effect.

6) During the simulation it is possible to adjust the volume of the signal using the **dB HL Decrease/Increase channel 1/channel 2** buttons.

3.3.2 Hearing loss simulation (HLS)[24]

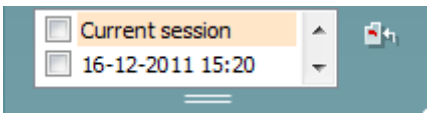
The HLS offers a simulation of the hearing loss through the audiometric headphones or the high frequency headset and is primarily aimed at the family members of the hearing impaired. It is a valuable tool as a hearing loss in many families may result in frustrations and misunderstandings. Knowing what the hearing loss sounds like gives an impression of what the hearing impaired goes through every day.

Required items:

- The Equinox Evo hardware
- Licensed AC440 software
- HLS license
- Headphones or a free field speaker
- A microphone, external sound source, or wave files

Test procedure:

1) Open the AC440. To perform the HLS counselling, an audiogram is needed. You should therefore start by performing *Air Conduction Audiometry* (as described in section 3.1) or retrieving an old audiogram in the **List of historical sessions**.



2) When an audiogram is present, enter the HLS screen by selecting **Menu > Tests > HLS.**

3) Select headphones or inserts in the **channel 1** output dropdown list.

4) Select *AUX, Microphone* or *Wave files* in the **channel 1** input dropdown list.

   If using AUX press *play* on the external sound source, and if using wave files, you can *Browse* and play them in the bottom of the screen.

5) Before mounting the headset on the friend or relative explain the audiogram. Use examples of what the hearing impaired may not be able to hear anymore such as some speech sounds and other sounds that are likely to occur in everyday surroundings.

6) It may be advisable to start the simulation session by letting the relative listen to the input signal with his or her natural hearing for a moment. This is likely to have a strong effect when having to compare with the simulation. The procedure is, however, up to you and the defaults can be set up in the AC440 setup (see section 1.9).

[24] HLS requires an additional software license.

Start simulating by clicking the **Right** and/or **Left** buttons corresponding to the ear to be simulated. The text above each button will then change from *Normal* to *ON.*

During the simulation it is possible to adjust the volume of the signal using the **dB HL Decrease/Increase channel 1/channel 2** buttons.

Patient monitor text with HLS

Now clinicians can input text in the patient monitor, which can then be read out loud while simulating the hearing loss. This is to help with counselling and adding text which can be read out loud can make it easier than asking someone to spontaneously say something. Please see section 1.9 for more information on how to set up the Patient Monitor.

3.3.3 Counselling with Sound Studio[25]

The Sound Studio is a counselling tool which allows you to recreate sound environments to simulate real-life situations for use during hearing aid fitting and counselling.

To find this please go to the Menu icon in the top left corner and select Counselling.

[25] Requires additional software

Please contact your local distributor for more information and the additional software.

4 Printing and making reports

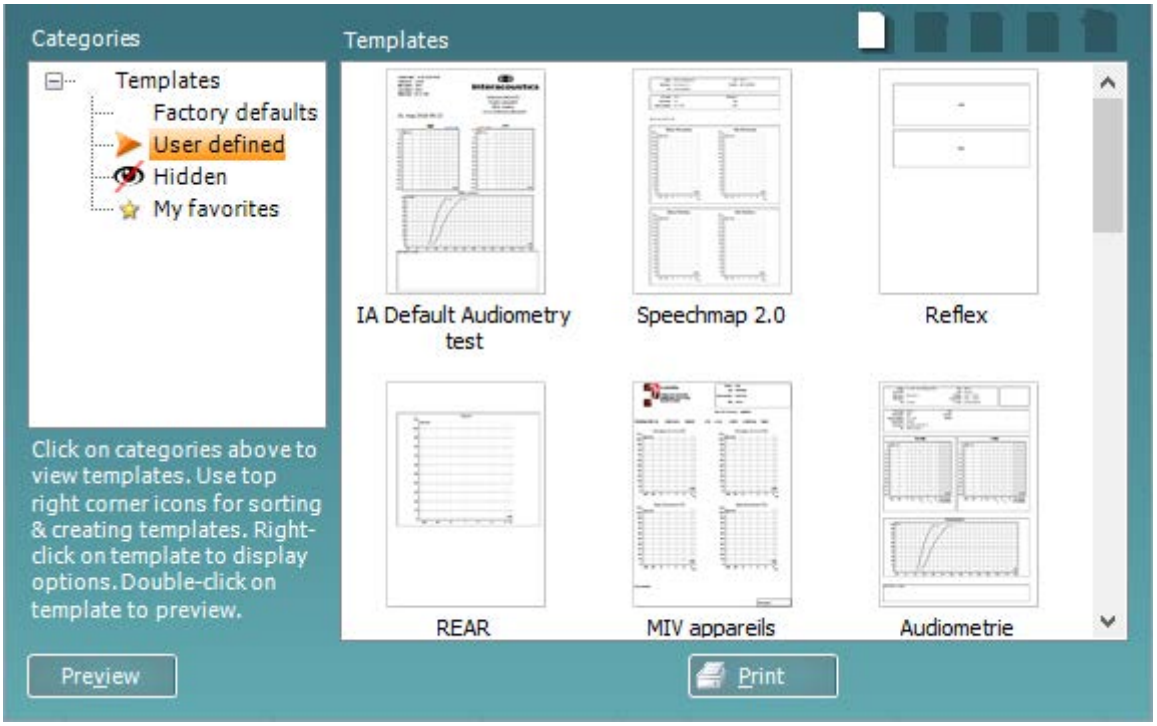
4.1 The Print Wizard

In the Print Wizard you have the option to create customized print templates which can be linked to individual protocols for quick printing. The Print Wizard can be accessed in two ways.

a. If you want to make a template for general use, or select an existing one for printing: Go to **Menu> File>Print Layout…** in any of the Affinity Suite tabs (AUD, REM or HIT)

b. If you want to make a template or select an existing one to link to a specific protocol: Go to Module tab (AUD, REM, or HIT) relating to the specific protocol and select **Menu>Setup>AC440 setup, Menu>Setup>REM440 setup,** or **Menu>Setup HIT440 setup**. Select the specific protocol from the drop-down menu and select **Print Wizard** at the bottom of the window.

Now the **Print Wizard** window opens and shows the following information and functionalities:



1) Underneath **Categories** you can select

- **Templates** to show all available templates
- **Factory defaults** to show only standard templates
- **User defined** to show only custom templates
- **Hidden** to show hidden templates
- **My favourites** to show only templates marked as a favourite

2) Available templates from the selected category are shown in the **Templates** viewing area.

   Factory default templates are recognized by the lock icon. They ensure that you always have a standard template and do not need to create a customized one. However, they cannot be edited according to personal preferences without resaving with a new name. **User defined**/created templates can be set to **Read-only** (showing the lock icon), by right clicking on the template and selecting **Read-only** from the drop-down list. **Read-only** status can also be removed from **User defined** templates by following the same steps.

3) Templates added to **My favourites** are marked with a star. Adding templates to **My favourites** allow quick viewing of your most used templates.

4) The template that is attached to the selected protocol when entering the print wizard via the **AC440, REM440** or **HIT440** window is recognized by a checkmark.

5) Press the **New Template** button to open a new empty template.

6) Select one of the existing templates and press the **Edit Template** button to modify the selected layout.

7) Select one of the existing templates and press the **Delete Template** button to delete the selected template. You will be prompted to confirm that you want to delete the template.

8) Select one of the existing templates and press the **Hide Template** button to hide the selected template. The template will now be visible only when **Hidden** is selected under **Categories**. To unhide the template, select **Hidden** under **Categories**, right click on the desired template, and select **View**/**Show**.

9) Select one of the existing templates and press the **My Favourites** button to mark the template as a favourite. The template can now be quickly found when **My Favourites** is selected under **Categories**. To remove a template marked with a star from My Favourites, select the template and press the **My Favourites** button.

10) Select one of the templates and press the **Preview** button to print preview the template on screen.

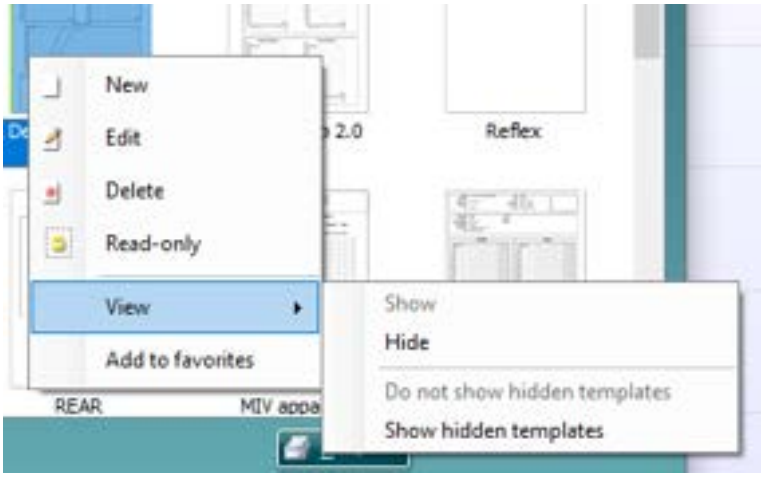
11) Depending how you reached the Print Wizard, you will have the option to press

    a. **Print** for using the selected template for printing or press

    b. **Select** for dedicating the selected template to the protocol from which you got into the Print Wizard.

12) To leave the Print Wizard without selecting or changing a template press **Cancel**.

Right clicking on a specific template provides a drop-down menu offering an alternative method for performing the options as described above:



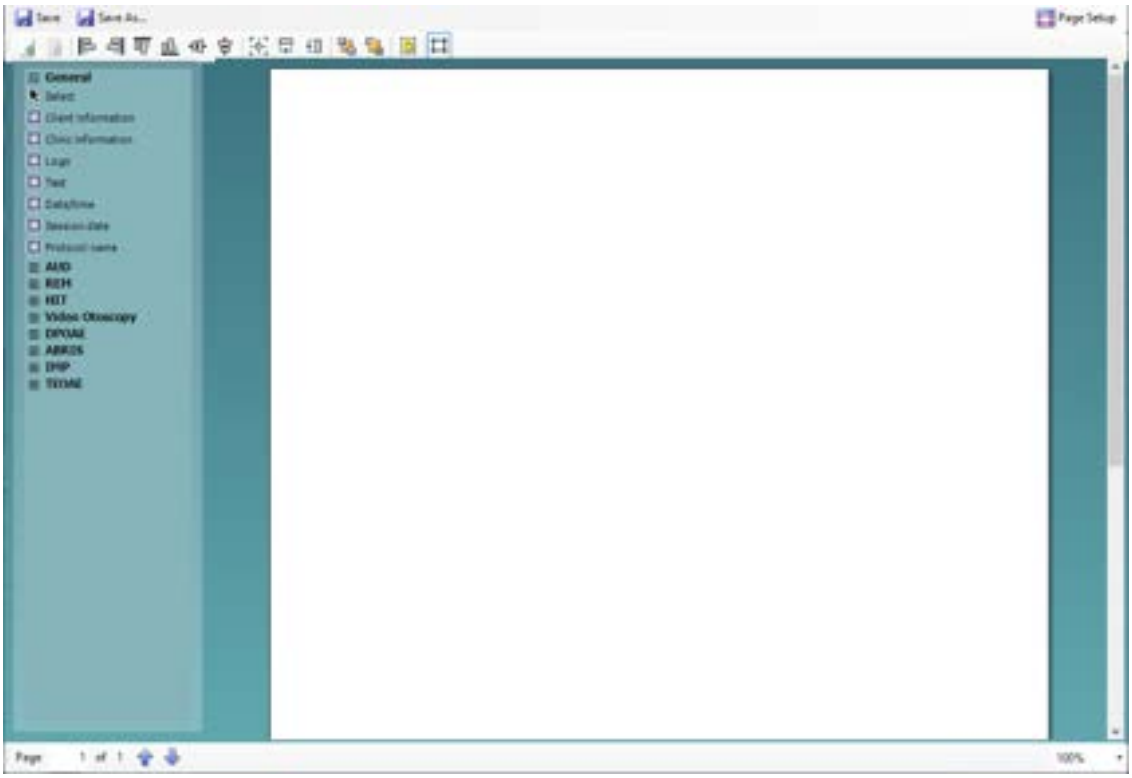
4.1.1 Designing a customized print template

After clicking on the **New Template** (or **Edit Template**) button the design window shows as below.

1) Upon opening, a short description about how to create a template will show on the screen. Press **Close** to close the message box. Uncheck the **Show hints** checkbox if you do not want it to appear next time.

2) This list shows the elements which can be dragged onto the blank template. When **General** is selected, the general elements are listed. Template elements for each module will be listed when selecting the relevant module name, for example **AUD, REM, HIT**. If other suites are installed, such as the Titan suite, the relevant suites will also be displayed.

   The handling and options for all elements are discussed in a separate section below.



3) The taskbar includes numerous icons for customizing the elements that are dragged onto the blank template page. These are described below in a separate section.

4) Press **Save** to save the print template and go back to the **Print Wizard** window. If you have created a new template, you are prompted to give it a name. Press **Save As…** if you have modified an existing template and want to save under a different name.

5) Pressing the **Page Setup** button opens the **Page Setup** window where you can choose the paper size, source, margins, and setup the paper orientation.

6) If the template has more than one page, use the up and down arrows,  , to scroll through the different pages. You can also type in the page number that you would like to view and/or edit.

7) The **Zoom** drop down menu allows you to change the viewing size of the template on screen.

4.1.2 Design elements

Template elements are added to the template page using the select, drag, and drop function.

Click on the desired element and drag it onto the template page. The element will appear as a small box in the upper left-hand corner. Resize the element to the desired size and drag it to an appropriate location.

The following elements are available for the **AUD**, **REM**, **HIT** and **Video Otoscopy** modules. The section below describes the options available within each element once dragged onto the template. Right clicking on any element will list its options for customization.

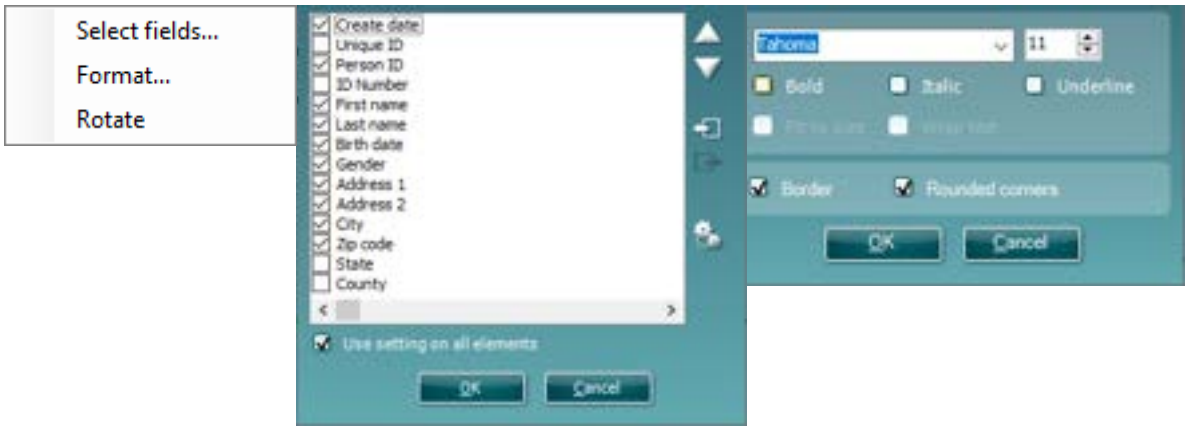
4.1.3 General elements

1. Client information

a. **Select fields** opens the **Select fields** window where you select which items are to be shown in the client information element. You can change the order of the items by selecting one and pressing the up or down arrows. Pressing will create a new empty field that can be named and shown in the template. Change a field's name by selecting it, waiting for 1 sec, and then left clicking on the name. Pressing will remove user created fields when selected. Press to restore the manufacturers' default fields.

b. **Format…** opens the **Format Client** window. Here you can change the font, font size and formatting, and the appearance (borders) of the **Client information** area.

c. Selecting **Rotate** makes the element rotate 90.



2 **Clinic information**.

a. **Select fields** pops up the **Select fields** window where you select which items are to be shown in the clinic information element. You can change the order of the items by selecting one and pressing the up or down arrows. Pressing will create a new empty field that can be named and shown in the template. Change a field's name by selecting it, waiting for 1 sec, and then left clicking on the name. Pressing will remove user created fields when selected.

   a. Press to restore the manufacturers' default fields.

b. **Enter clinic info…** opens the **Clinic info editor** window. Here you can type and save the clinic information specifically for the selected print template. The **Create date** item cannot be changed as it will always show the current date and time.

c. **Format…** Here you can change the the font, font size and formatting, and the appearance (borders) of the **Clinic information** area.

d. By selecting **Show labels**, the **Clinic information** fields can be toggled on and off.

e. Selecting **Rotate** makes the element rotate 90 degrees clockwise.

3. **Logo**.

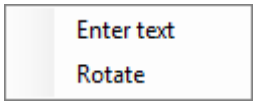
a. **Select image** opens a window from where you can browse to find the image stored on your PC that you want to include in the template.

b. Selecting **Rotate** makes the element rotate 90 degrees clockwise.

4. **Text**. This element allows you to add additional text, e.g., footnotes on your template.

a. **Enter text** opens the **Enter Text** window. Here you can type in text and choose the font type, size and formatting.

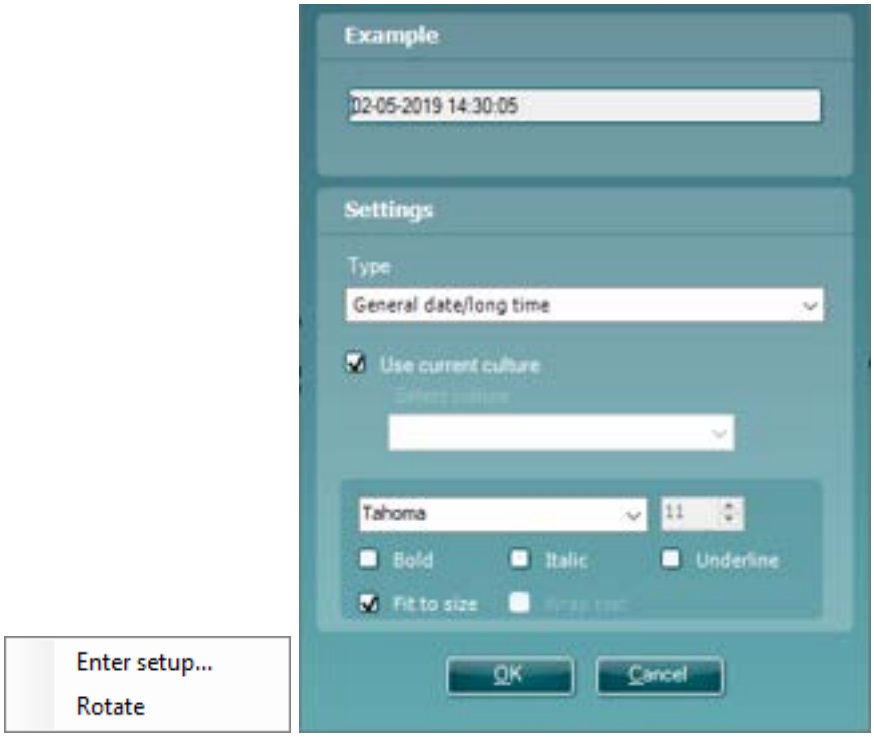
b. Selecting **Rotate** makes the element rotate 90 degrees clockwise.



5. **Date Time**. This element allows you to put in a stamp on the template showing date and/or time of printing.

a. **Enter setup…**opens the **Date Time setup** window. Here you choose the format in which the date and/or time appears in the template. You can also choose the font type, size and formatting.

b. Selecting **Rotate** makes the element rotate 90 degrees clockwise.



6. **Session date**. This element allows you to put in a stamp on the template showing date and/or time that the measurements were recorded.

a. **Enter setup…** opens the **Date Time setup** window, exactly as in 5a. Here you choose the format in which the date and/or time appears in the template. You can also choose the font type, size and formatting.

b. Selecting **Modules** gives the opportunity to define which modules' session dates will be shown. On the printout you can combine measurements from both the Equinox Suite and Titan Suite.

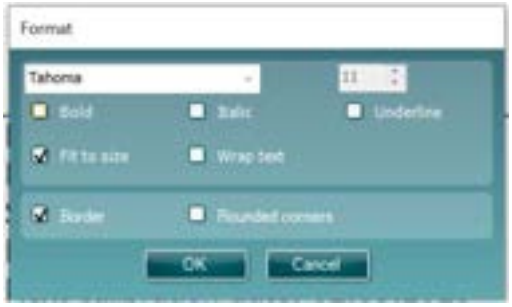
c. **Toggle borders** allow you to disable or enable the border around the **Session date** element.

d. Selecting **Rotate** makes the element rotate 90 degrees clockwise.

7. **Protocol name**
   a. Selecting modules gives the opportunity to select the protocol names for each module
   b. **Toggle borders** allow you to disable or enable the border around the **Protocol name** element
   c. Selecting **Rotate** makes the element rotate 90 degrees clockwise.

8. **Hardware –** Here you can include information about the hardware such as Hardware name, modules used, version number, serial number, last calibration date and next calibration due.

   a. **Select fields** pops up the **Select fields** window where you select which items are to be shown in the Hardware element. You can change the order of the items by selecting one and pressing the up or down arrows. Press to restore the manufacturers' default fields.



b. **Format…** Here you can change the font, font size and formatting, and the appearance (borders) of the **Hardware** area.
c. Selecting **Modules** gives the opportunity to define which modules' session dates will be shown.
d. Selecting **Rotate** makes the element rotate 90 degrees clockwise.

4.1.4 Taskbar

1. **Add page** to make a template of more than one page.
2. **Remove page**. You will be prompted if you are sure you want to delete the page and all its contents.
3. **Align left**. If you select two or more elements (using the shift button on the keyboard) this button will align those elements on their left sides.
4. **Align right**. If you select two or more elements (using the shift button on the keyboard) this button will align those elements on their right sides.
5. **Align top**. If you select two or more elements (using the shift button on the keyboard) this button will align those elements on their top sides.
6. **Align bottom**. If you select two or more elements (using the shift button on the keyboard) this button will align those elements on their bottom sides.
7. **Align horizontal**. If you select two or more elements (using the shift button on the keyboard) this button will align those elements on their horizontal central axis.
8. **Align vertical**. If you select two or more elements (using the shift button on the keyboard) this button will align those elements on their vertical central axis.
9. **Make equal size**. If you select two or more elements (using the shift button on the keyboard) this button will make all sizes equal to the element that was placed on the page first.
10. **Same width**. If you select two or more elements (using the shift button on the keyboard) this button will make all widths equal to the width of the element that was placed on the page first.
11. **Same height**. If you select two or more elements (using the shift button on the keyboard) this button will make all heights equal to the height of the element that was placed on the page first.
12. **Send to back**. This button sends the selected element(s) to the back.
13. **Send to front**. This button sends the selected element(s) to the front.
14. **Lock element** locks (or unlocks) the selected element(s). This means that the position and size of the element is locked. When one of the taskbar functions is used on a locked element it will automatically unlock.
15. **Display margins** toggles between showing and not showing the print margins as a broken line.

4.2 Creating reports

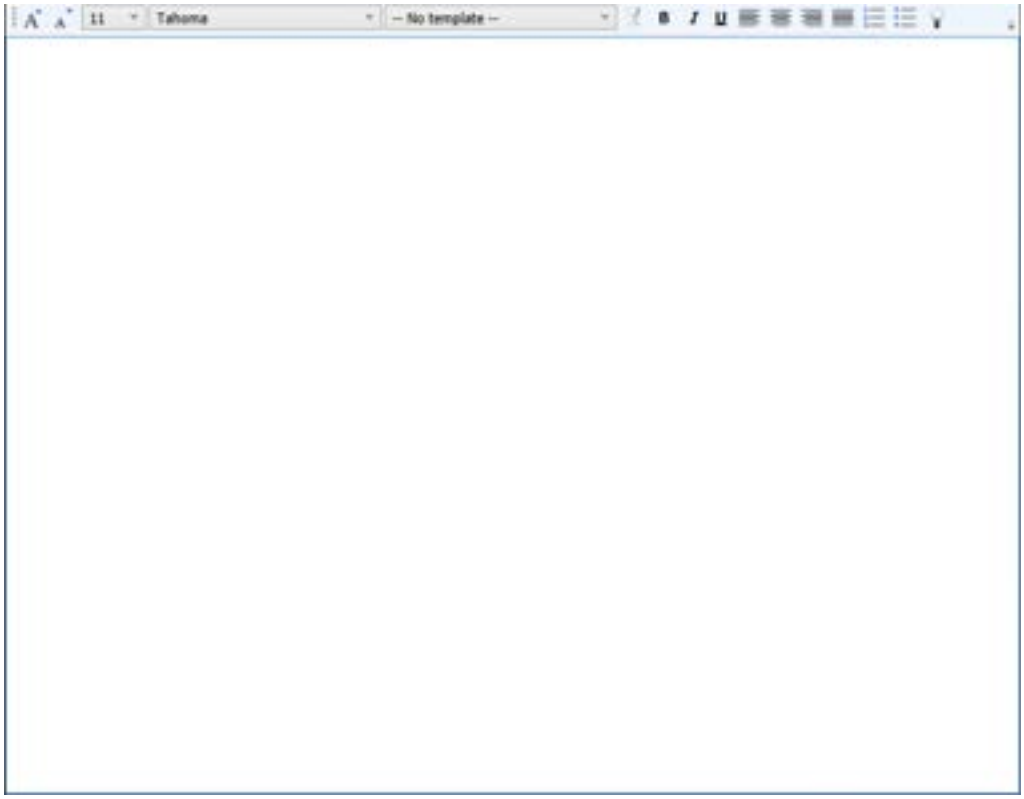
The Affinity/Equinox Suite allows electronically generated reports through the **Report editor**. This allows reports to be saved in the module for each session and they can be retrieved at any time. The reports can also be implemented in the patient's printout, which gives you the opportunity to have all the relevant test information in one customized piece of paper. The report function also includes the possibility to make **Report templates** which gives you the option to have different templates e.g., for different client groups or for use by different clinicians.

Note: You must enter the report whilst in the current client session. It is not possible to enter a report for a previous session unless you transfer it to the current session first and re-save it.

4.2.1 Operation of the report editor

To open the **Report editor** to make a report on the current patient you need to press  in the **AUD**, **REM,** or **HIT** screen.

4.2.2 The report editor

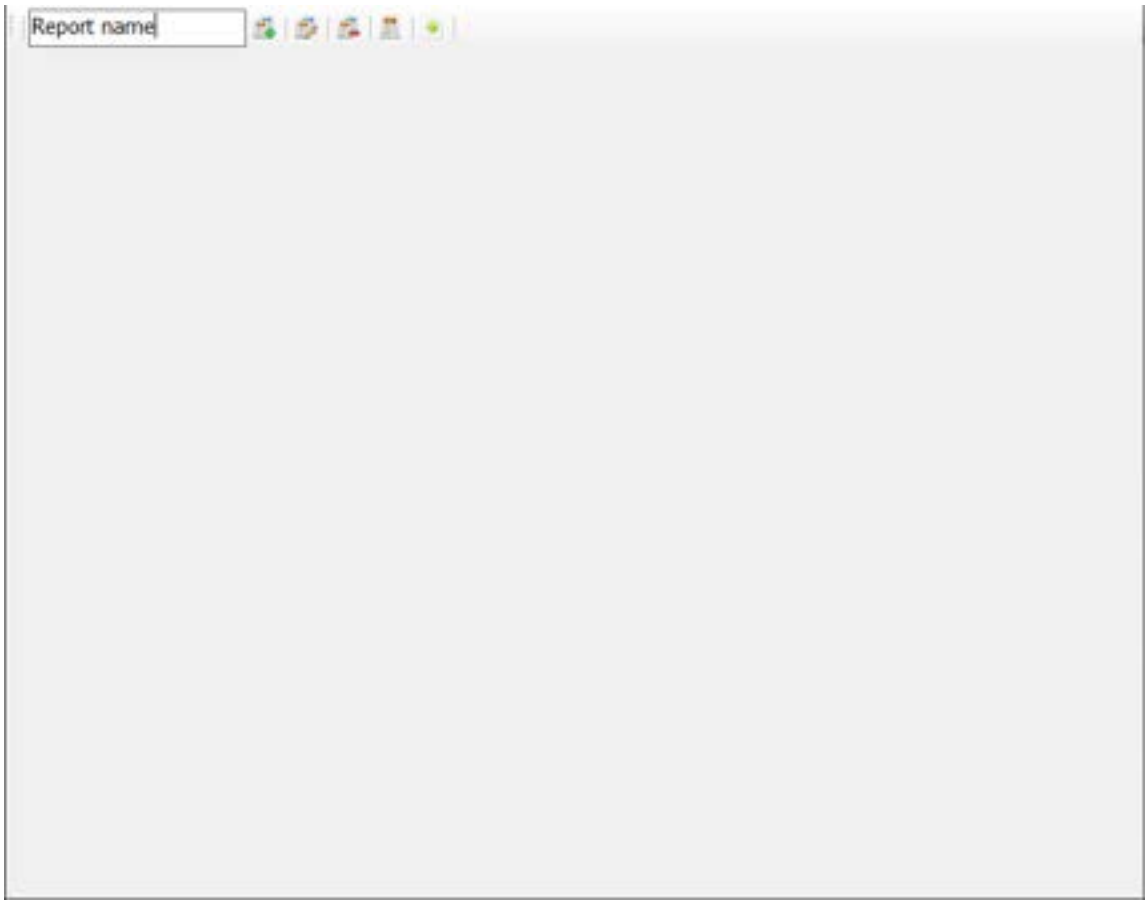


- Write your reports and observations in the report page.
- Increase the **Font size** of the current selection.
- Decrease **Font size** of the current selection.
- Change the **Font size** of the current selection.
- Change the **Font type** of the current selection.
- Select a **Template** from one of the existing templates in the drop-down menu and insert it in the current report.

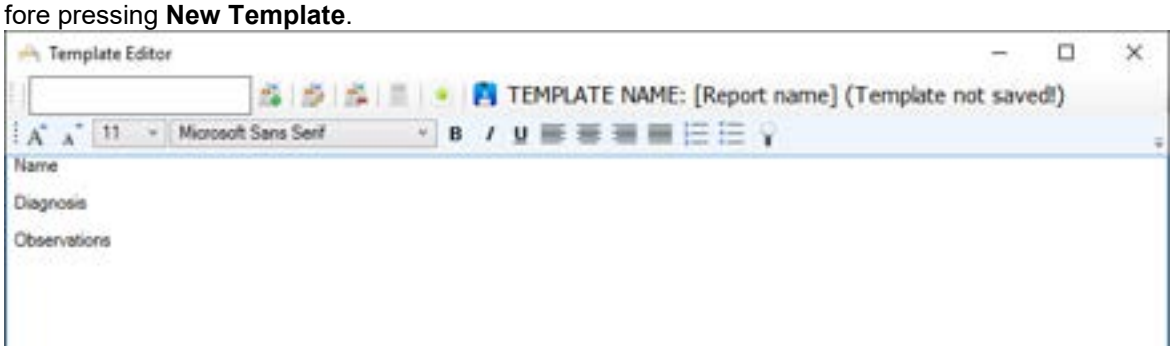
- **Template Editor** allows you to create a new template, edit an existing template, or set a preferred template to be default template (see section 4.1.1).
- Change the font of the current selection to be **Bold**.
- Change the font of the current selection to be **Italic**.
- Change the font of the current selection to be **Underlined**.
- Change the alignment of the selection to **Align left**.
- Change the alignment of the selection to **Centre**.
- Change the alignment of the selection to **Align right**.
- Change the alignment of the selection to **Justify**.
- Insert **Numbering**
- Insert **Bulleting**.
- **Import Image** allows you to browse for a picture on your PC (e.g., a clinic logo).

4.2.3 The template editor

To enter the **Template editor** press  .



1) **New Template** enables you to create a new customized report template. Enter a template name before pressing **New Template**.



The name of the template will then appear on the tool bar, and you can type in your report template details like in the example below.

Remember to press the **Save** icon to save the template when finished .

2) **Edit Template** allows you to edit an existing template. Press the button and select which of the saved templates you wish to adjust.
3) **Delete Template** allows you to remove an existing template. Press the button and select which of the saved templates you wish to delete.
4) **Set as Default Template** will cause the currently open template always to be inserted when the report editor is opened for the first time during a session.
5) Press the red cross to return to the Report Editor .

5 Recovery manager

In the unlikely event that your software is not shut down properly, the recovery manager will ensure that no data is lost. During testing each threshold or measurement that is stored on screen is also saved in a log file on your PC. When you enter one of the modules of the Equinox/Equinox Suite it checks if this log file contains data that may need recovery.

The audiometry module will show the following screen in which you can indicate which of the test results need recovering.

In the REM and HIT module the recovery manager shows the following screen which allows you to recover all available measurements.

Note that in case the current selected patient is different from the patient on which earlier measurements took place, the recovery manager will warn you.

6 References

British Society of Audiology Recommended Procedure: Pure tone air and bone conduction threshold audiometry with and without masking and determination of uncomfortable loudness levels (2004). Uploaded from www.thebsa.org.uk/docs/bsapta.doc

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