MADSEN Astera²

Reference Manual

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otometrics

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2015-02-04

Technical support
Please contact your supplier.

Table of Contents

1 Introduction to MADSEN Astera²

The two-channel MADSEN Astera² features two separate and fully independent channels ("true" two-channel circuitry). This permits different stimuli to be freely routed in any combination of ears (including binaural). "True" two-channel circuitry can be used to perform dichotic listening tests or to present two different stimuli to the same ear simultaneously.

With MADSEN Astera² you can perform all standard audiometric tests, tone and speech audiometry and special tests.

- You can operate MADSEN Astera² from the PC's keyboard/mouse, or from the MADSEN Astera² Audiometer Control Panel (ACP) with the OTOsuite Audiometry Software Module acting as the display.
- From the OTOsuite Audiometry Software Module, which is NOAH compatible, you can monitor test results, create User Tests, store and export data, and print reports.

  Test intensities and frequencies as well as the current test settings and other information are shown on the PC monitor.

1.1 MADSEN Astera²

MADSEN Astera² is a Type-1, 2-channel, PC-based audiometer for testing patient hearing.

MADSEN Astera² can be used only in connection with the OTOsuite Audiometry Module for online operation, monitoring of test results, data export and storage, printing and NOAH compatibility. When used with the OTOsuite Audiometry Module, MADSEN Astera² is capable of performing all standard audiometric tests, tone and speech audiometry and special tests.

MADSEN Astera² can be desktop or wall-mounted.

Operation

MADSEN Astera² is operated from the PC's keyboard/mouse, or from the the MADSEN Astera² Audiometer Control Panel (ACP), with the OTOsuite Audiometry Module acting as the display showing the intensity, frequency as well as current settings and other information on the PC monitor.

Speech input signals can be taken from audio files on the PC hard drive, CD-ROM, external line-in devices such as CD player or tape recorder, or live-voice from a microphone.

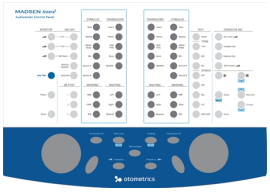
Outputs

MADSEN Astera² supports

- 3 sets of air conduction transducers
  - TDH39 headphones
  - HDA 200 headphones for high-frequency audiometry (calibration can be stored to test 125 to 20,000 Hz)
  - Insert Phones.
- Bone oscillator (calibration can be stored for mastoid and forehead placement),

- 1 set of sound field speakers (2 to 5, more than 2 is optional). The speakers can use either the power amplifier built into MADSEN Astera² or external power amplifiers through the balanced line outputs.

1.2 The MADSEN Astera² Audiometer Control Panel (ACP)



The MADSEN Astera² ACP is used as a supplementary user interface connected to MADSEN Astera², and via a USB connection to a PC with theOTOsuite Audiometry Module.

When connected to MADSEN Astera² and the PC with the OTOsuite Audiometry Module started, the ACP can be used for performing all standard audiometric tests, tone and speech audiometry and special tests.

Operation

The ACP provides the controls for operating MADSEN Astera² with the OTOsuite Audiometry Module acting as the display showing the current settings, as well as intensity, frequency and other information on the PC monitor.

Input and output options

The ACP connects both to MADSEN Astera² and the PC.

From MADSEN Astera² to the ACP

- Desktop microphone socket
- Operator headset socket
- Operator boom microphone socket
- Built-in monitor speaker

From the ACP to accessories

- Desktop microphone socket
- Headset socket
- Boom microphone socket

From the PC to the ACP

- USB socket (if needed, through externally powered USB hub)

1.3 The OTOsuite Audiometry Module

OTOsuite

OTOsuite is a software tool that integrates a suite of audiological tests with result review and reporting capabilities into a single powerful PC application.

OTOsuite integrates closely with the latest generation of Otometrics test devices by offering real time presentation of test results and full test control directly from a PC with a comprehensive user interface and NOAH compatibility.

The OTOsuite Audiometry Module is designed to operate with MADSEN Astera² as the test device.

The OTOsuite Audiometry Module

The OTOsuite Audiometry Module provides you with comprehensive control and overview of the current stimulus and masking choices both numerically and graphically in the displayed audiogram when you test with a connected Otometrics audiometer.

As the module is part of OTOsuite, audiograms can be used directly in other OTOsuite modules such as the PMM and Immittance modules for an optimized workflow independent of NOAH, and for combined reporting.

The Audiometry Module provides you with a wide range of features:

Testing

- Testing, using the Audiometry Module as a handy control panel while you follow stimulus settings and test progress on your PC display
- Tone testing
- Speech testing
- A wide range of special tests
- Controlling play-back of speech test material
- Using the Masking Assistant to prompt when masking is recommended
- Creating complete User Tests for specific audiometric tasks, including selecting specific speech lists, viewing preferences, activating operator monitoring peripherals, etc.
- Entering tester details and test date entry for manually entered audiograms
- Entering special test and tuning fork test results

Viewing and printing

- Viewing and printing test results
- Viewing the progression of a range of tests online
- Viewing historic audiometry results from NOAH or XML
- Viewing online audiometry results during testing
- Viewing masking level indicator in audiogram
- Viewing audiogram overlays

1.3.1 NOAH

OTOsuite integrates with:

- NOAH systems
- NOAH for ENT
- NOAH-compatible Office Management systems.

The NOAH System is a HIMSA product for managing clients, launching hearing test applications and fitting software, and storing audiological test results. OTOsuite stores test results using NOAH.

> ***Note** • Whenever reference in this manual is made to NOAH, this reference should also apply to NOAH compatible systems.*

1.4 Intended use

MADSEN Astera² and the Audiometry module

Users: audiologists, ENTs and other health care professionals in testing the hearing of their patients.

Use: diagnostic and clinical audiometric testing.

The MADSEN Astera² Audiometer Control Panel (ACP)

The ACP is intended as a supplementary user interface connected to MADSEN Astera².

1.5 About this manual

This is your guide to installing, calibrating and using MADSEN Astera² and the MADSEN Astera² ACP, and to using the OTOsuite Audiometry Module. It also introduces you to the key features of the device and the software, as well as to working scenarios for performing tests and viewing and printing test results.

We strongly recommend that you read this manual carefully before using MADSEN Astera² and the OTOsuite Audiometry Module for the first time.

Note • *If you are using the Audiometry Module with NOAH, we recommend that you are familiar with the screens and functions provided in NOAH.*

1.5.1 Safety

This manual contains information and warnings which must be followed to ensure the safe performance of MADSEN Astera², the ACP, and the OTOsuite Audiometry Module.

Warning • *Local government rules and regulations, if applicable, should be followed at all times.*

Safety information is stated where it is relevant, and general safety aspects are described in Standards and safety ▶ 157.

- Standards and safety ▶ 157 gives you an overview of device labeling and standards.
- General warning notes ▶ 158 contains relevant warning notes.
- Connector warning notes ▶ 157 contains connector warning notes.

1.6 Typographical conventions

The use of Warning, Caution and Note

To draw your attention to information regarding safe and appropriate use of the device or software, the manual uses pre-cautionary statements as follows:

Warning • *Indicates that there is a risk of death or serious injury to the user or patient.*

Caution • *Indicates that there is a risk of injury to the user or patient or risk of damage to data or the device.*

Note • *Indicates that you should take special notice.*

1.6.1 Navigation

Menus, icons and functions to select are shown in bold type, as for instance in:

- Click the **Set options** icon on the toolbar or select **Tools > Options...**

2 Getting started

Training

We recommend that you read this manual and make yourself familiar with the MADSEN Astera², and if needed the Audiometer Control Panel (ACP), and how they operate with the OTOsuite Audiometry Module.

Safety

For safety information, see

- Standards and safety ► 157

Installation

- To install the new system, see Unpacking and installing ► 131.

Connecting to MADSEN Astera²

- See Communicating with the device ► 151

Configuring the OTOsuite Audiometry Module

- See see Configuring the Audiometry Module ► 147.

Preparing for testing

Before you receive the client and start the session of testing and explaining test results, your time is well spent preparing for the session.

- Test preparations are described in Preparing for testing ► 115.

Descriptions and testing

In order for you to feel well prepared and confident before you receive clients for testing using the Audiometry Module, see the test screen descriptions. They provide you with examples on how to view the test results.

- The basic OTOsuite functions are described in the OTOsuite User Guide.
- The test screens are described in Navigating in the OTOsuite Audiometry Module ► 15.
- Useful information on how to test may be found in Examples of audiometric testing ► 119.

Printing

- See the OTOsuite User Guide.

3 Navigating in the OTOsuite Audiometry Module

The general functions for navigating in the main window are described in the OTOsuite manual.

You will find descriptions of the Audiometry test screens in:

- The Tone test screen ▶ 34
- The Speech test screen ▶ 43

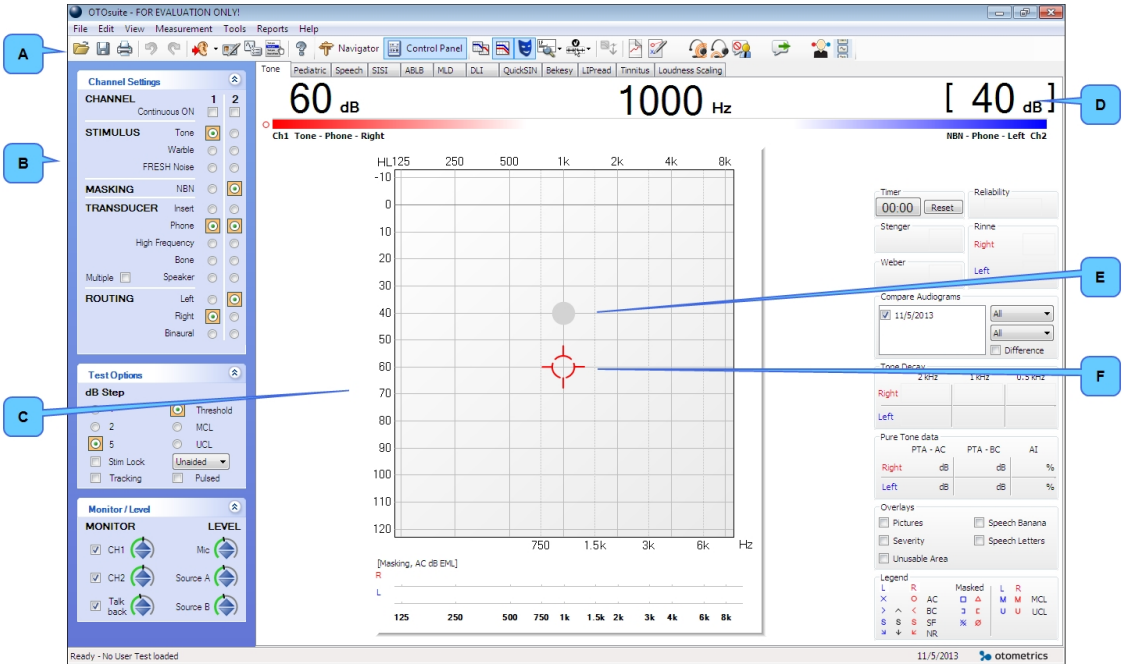
Special tests are described in:

- Special tests ▶ 65

3.1 The Audiometry Module main window

The basic OTOsuite functions are described in the OTOsuite User Guide.

Audiometry elements



A. Audiometry toolbar
B. Control Panel
C. Work area
D. Stimulus bar
E. Masking level indicator
F. Stimulus marker

3.2 Menus and toolbar icons

General icons

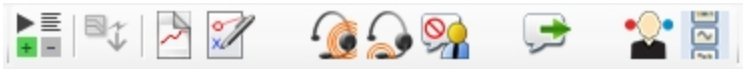
See the OTOsuite User Guide.

Audiometry icons and menu selections

The icons and menu selections that are unique to Audiometry functionality depend on the test functions included in OTOsuite and/or whether a test device is connected.

Tone audiometry

Speech audiometry



3.2.1 File menu

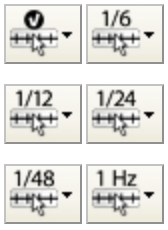
Menu item	Icon	Description
New Audiogram		Select new audiogram. You will be prompted to save or cancel current data.

3.2.2 Edit menu

Menu item	Icon	Shortcut	Description
Audiometric properties...		**Ctrl+U**	Click to enter Tester name, Test Date, and air conduction transducer for a manually entered audiogram. ***Note*** *• The air conduction transducer is stored when you have selected it in the transducer section of the Control Panel (or with device controls, if applicable) and data points are entered on the audiogram.*

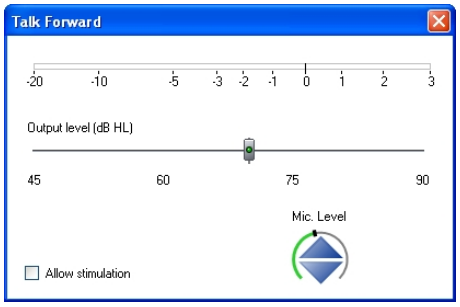
3.2.3 View menu

Menu item	Icon	Description
Masking Assistant		Enable or disable the Masking Assistant. The Masking Assistant causes an unmasked threshold to flash repeatedly if masking is recommended. • See The Masking Assistant ► 20.
Overlays		Enables or disables the overlays. Overlays display • pictures • severity • speech banana, • speech letters, • unusable area on the audiogram. Overlays can also be displayed by selecting them from the overlays box below or next to the audiogram. To view/hide the overlays box, select **Tools > Options > General**. • See Tone feature boxes ► 39.
Combined Audiogram		Click to toggle between viewing both ears in a single audiogram (combined audiogram) or both a left and a right audiogram on your screen.
	 	**Combined View** • Click to view both ears in a single audiogram. **Split View** • Click to view separate audiograms for each ear.
Left - Right		Click to display the left ear audiogram on the left side of the window and the right ear audiogram on the right side of the window (when **Dual Graph View** is enabled in **Options > Audiometry > Tone > Misc**).
Right - Left		Click to display the right ear audiogram on the left side of the window and the left ear audiogram on the right side of the window (when **Dual Graph View** is enabled in **Options > Audiometry > Tone > Misc**).
Audiogram Legend		Click to enable or disable the display of the audiogram legend. The legend contains the most commonly used symbols for the audiogram. It is not configurable.

Menu item	Icon	Description
Standard / All / High frequencies		The graph shows up to 20,000 Hz. MADSEN Astera² presents stimulus up to 12,500 Hz. • Click to choose between viewing:
		**Standard Frequencies** Displays the audiogram from 125 to 8000 Hz.
		**All Frequencies** Displays the audiogram from 125 to 20,000 Hz.
		**High Frequencies** Displays the audiogram from 8000 to 20,000 Hz.
Frequency resolution		The options for frequency resolutions are 1/6, 1/12, 1/24 and 1/48 octave as well as 1 Hz. Select the different tone stimulus resolutions from the toolbar or from **Tools** > **Options** > **Audiometry** > **General**. You can store up to 24 points for each audiometry curve. You will be prompted if you try to store more than the maximum number of points.

3.2.4 Measurement menu

Menu item	Icon	Description
Monitoring		Enables or disables the monitor speaker for monitoring stimuli presented to the patient from the **Stimulus** or **Masking** channel. I.e. Channel 1 or Channel 2.
Desktop/Headset Microphone		**Toggle microphone types** Click to toggle between the operator headset boom microphones and desktop microphone used to communicate with the patient and/or the assistant. The one displayed is the one currently active.
Talk to Assistant		Click to enable or disable talking to another party (usually a second tester) in the booth.

Menu item	Icon	Description
Talk Forward		Enables communicating with the patient in the sound booth. This will display the **Talk Forward** dialog box, where you can control the talk forward microphone sensitivity and the output level (in dB HL) to the patient.  When enabled, the monitor speaker will be disabled. When the **Allow stimulation** checkbox is checked, you can present stimuli while leaving **Talk Forward** on. This is useful when you wish to present stimuli and verbally reinforce the patient quickly, as for instance during pediatric testing. ***Note** • Be aware that background noise must not be present if **Allow stimulation** is checked.*
Select Orientation		Click to select the perspective of the patient's ears as presented on the screen for graph and table views.
Sunshine Panel		Click to select the Sunshine Panel in **Tone** or **Speech** testing, or in some of the special tests. See The Sunshine Panel.
Scoring and Playing		See Selecting word or phoneme scoring ► 44.
Ambient Noise Assessor		See Ambient Noise Assessor ► 100.

3.2.5 Tools menu

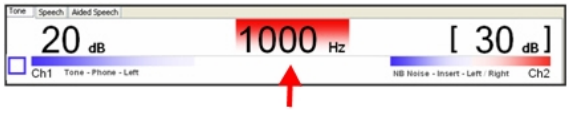
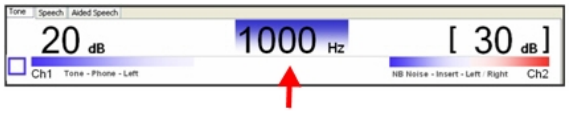
Menu item	Icon	Description
Curves and Symbols		Click to select the **Curves and Symbols** dialog box. This dialog box and its related function are specific to configuring the curves and symbols to be displayed on the audiogram or speech graph during testing. See Curves and symbols selection ► 37.

3.3 The Patient Responder indicator

When the patient presses the Patient Responder this is shown on the Stimulus bar, and a sound signal from the PC is heard through the Monitor Speaker or Operator Headset. The sound signal is optional (**Tools > Options > Audiometry > General > Monitoring and Levels > Audible patient response**).

Use the Configuration Wizard to select Single Responder or Dual Responder setup. See Configuring the Audiometry Module ► 147.

Single Responder setup	
• **Green** Indicates that the patient is pressing the Patient Responder.	

Dual Responder setup	
• **Red** Indicates that the patient is pressing the right response button.	
• **Blue** Indicates that the patient is pressing the left response button.	
• **Red and blue** Indicates that the patient is pressing both response buttons.	

3.4 The Masking Assistant

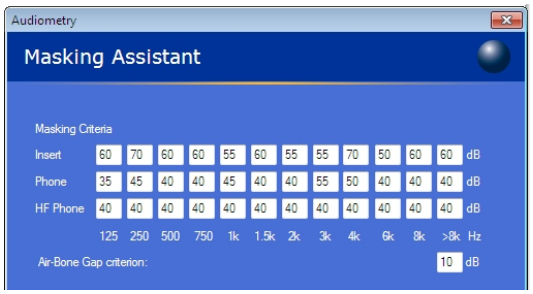
If the Masking Assistant is enabled, it will at all times check for frequencies that may require testing with masking. This also applies to old audiograms imported from NOAH or XML as long as a supported transducer was stored with the data.

The Masking Assistant is a tool provided to help you with an indication that there may be frequencies where testing with masking[1] is recommended.

- The audiogram symbol will flash at the specific frequencies where contralateral masking may be recommended[2].

- The masking criteria are configurable so that you can set them up to match your local recommendations for masking. You can for instance choose either frequency specific criteria, which increases the efficacy of your work, or the traditional "one-level-fits-all" criteria.

  Select the **Tools > Configuration Wizard > Configure... Audiometry > Masking Assistant** to set up the masking criteria.



How does the Masking Assistant work?

Terminology	
AC	AC test ear
ACc	AC contra
BC	BC
BCc	BC contra
Min IA	Minimum inter-aural attenuation.

When is masking required?		
Masking is recommended when the following conditions are met:		
AC		AC > ACc + Min IA
	or	AC > BCc + Min IA
BC		BC < AC - x* dB

Only stored thresholds measured without masking are checked. Levels which did not evoke a response are excluded from the check. This means that as soon as a masked threshold has been stored, the flashing stops for that frequency.

[1] **(Katz, J., Lezynski, J. (2002). Clinical Masking. In J. Katz, ed.,** *Handbook of Clinical Audiology*, **Williams and Wilkins, Baltimore.)**

[2] **Based on criteria described in** *Clinical Masking, Essentials of Audiology, Stanley A. Gelfand, Thieme 1997*, **and** *Measurement of Pure Tone Hearing Thresholds, Audiologists' Desk Reference - Vol 1, James W. Hall III, H. Gustav Mueller III, Singular Publishing Group 1997*. **and** *Munro K.J., Agnew N. A comparison of inter-aural attenuation with the Etymotic ER-3A insert earphone and the Telephonics TDH-39 supra-aural earphone. Br J Audiol 1999; 33: 259-262*.

* denotes configurable Air/Bone gap criterion (**Tools > Configuration Wizard > Configure... Audiometry > Masking Assistant**).

Min IA is frequency specific

These are the Min IA tables for TDH-39 and Otometrics Inserts used in the Masking Assistant [1].

Min IA (supraaural phone: TDH-39), frequency specific

Hz	dB	
125	35	Katz & Lezynski, (2002)
250	48	Munro & Agnew, BJA (1999)
500	44	Munro & Agnew, BJA (1999)
750	40	N/A - fulfill traditional approach
1000	48	Munro & Agnew, BJA (1999)
1500	40	N/A - fulfill traditional approach
2000	44	Munro & Agnew, BJA (1999)
3000	56	Hall J.W. III & Mueller G.H. III / Munro & Agnew, BJA (1999)
4000	50	Katz J / Munro & Agnew, BJA (1999)
6000	44	Hall J.W. III & Mueller G.H. III / Munro & Agnew, BJA (1999)
8000	42	Katz J / Munro & Agnew, BJA (1999)

Min IA insert phone

Hz	dB	
125	60	N/A - traditional value
250	72	Munro & Agnew, BJA (1999)
500	64	Munro & Agnew, BJA (1999)
750	60	N/A - traditional value
1000	58	Munro & Agnew, BJA (1999)
1500	60	N/A - traditional value
2000	56	Munro & Agnew, BJA (1999)

[1] **Katz, J., Lezynski, J. (2002). Clinical Masking. In J. Katz, ed.,** *Handbook of Clinical Audiology*, **Williams and Wilkins, Baltimore. Munro, K.J., Agnew,** *N. A comparison of inter-aural attenuation with the Etymotic ER-3A insert earphone and the Telephonics TDH-39 supra-aural earphone*. **Br J Audiol 1999; 33: 259-262. Hall, JW., MUELLER, HG. (1997).** *The audiologists' desk reference*, **Volume I., Singular Publishing Group, San Diego.**

Hz	dB	
3000	58	Munro & Agnew, BJA (1999)
4000	72	Munro & Agnew, BJA (1999)
6000	54	Munro & Agnew, BJA (1999)
8000	62	Munro & Agnew, BJA (1999)

3.5 The Control Panels

Click the **Control Panel** icon in the toolbar to activate the Control Panel.

***Note** • If you are using the MADSEN Astera² ACP, you may choose not to display the Control Panel. Select **Tools > Configuration Wizard... >** and click **Next** until the **Preferences** screen is displayed. The checkbox **Activate control panel** must be disabled.*

Click the Sunshine icon to select or deselect the Sunshine Panel in either **Tone** or **Speech** testing. The Sunshine Panel is also available in a range of special tests.

The Sunshine Panel

Use the Sunshine Panel to quickly select the main settings for testing.

See The Sunshine Panel ► 23.

The Classic Control Panel

Use the Classic Control Panel to select more advanced settings for testing.

See The Classic Control Panel ► 26.

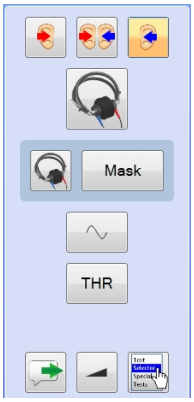
3.5.1 The Sunshine Panel

Use the Sunshine Panel to quickly select the main settings for testing.

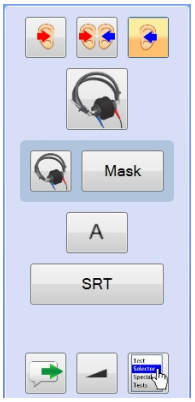
Click the **Control Panel** icon in the toolbar to activate the Control Panel.

Click the **Sunshine** icon in the toolbar to select the Sunshine Panel in **Tone** or **Speech** testing, or in some of the special tests.

Tone



Speech



In the Sunshine Panel you can quickly select test ear, transducer, masking, and test type.

You can control the monitor level, activate the **Talk Forward** dialog, and select the **Test Selector** for quickly selecting the relevant user test.

Your selections are shown in the **Stimulus** bar and as symbols in the audiogram.

Customizing the Sunshine Panel

You can customize the Sunshine Panel to display one or several buttons for some of the functions. For instance, you can display one or more of the **Curve Selection** buttons on the panel.

When the right-click menu for a button includes the selection **Add / Remove Buttons** you can customize the setup.

1. Enable/disable the button(s) you wish to display.
2. Click to disable the selection **Use Single Button**. The enabled buttons are displayed immediately in the panel.

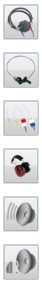
Unusual settings

Non-default settings that you can select only in the right-click menus are shown as shortcut links in the Sunshine Panel. Click the link to deselect or change the setting.

Panel description

Click on the buttons to toggle the selection or right-click on a button to select a combination of functions.

Function	Icon	Description
Test ear selection		Click to select test ear: • **Right** • **Left** • **Binaural**

Function	Icon	Description
Transducer selection for test ear		Click to select the transducer used for the test ear: • **Phones** (standard headphones) • **Bone** (oscillator) • **Insert** (earphones) • **High Frequency** (headphones) • **SF Unaided** (Sound Field speaker, unaided) • **SF Aided 1** and **SF Aided 2** (Sound field speaker - Aided 1 and 2)
Transducer selection for masked ear		Click to select the transducer used for the masked ear: • **Phones** (standard headphones) • **Bone** (oscillator) • **Insert** (earphones) • **High Frequency** (headphones) • **SF** (Sound Field speaker) • **SF Aided 1** and **SF Aided 2** (Sound field speaker - Aided 1 and 2)
Masking on/off	**Mask**	Click to enable or disable masking.
Stimulus selection		Click to select stimulus type. • Tone (Tone testing) • Warble (Tone testing) • FRESH noise (Tone testing) • Pre-recorded stimulus (Speech) • Microphone to present live speech stimulus (Speech)
		From the right-click menu of the **Stimulus selection** button you can also select • Int. CD (internal CD ROM built into the PC) (Speech) • File (stored on hard drive) (Speech) • Line In (external medium connected to the PC) (Speech) • Pulsed stimulus (Tone) • Stim Lock (presents stimulus and masker simultaneously) • Tracking (increases stimulus and masker intensity by the same number of dB) • 1, 2 or 5 dB step

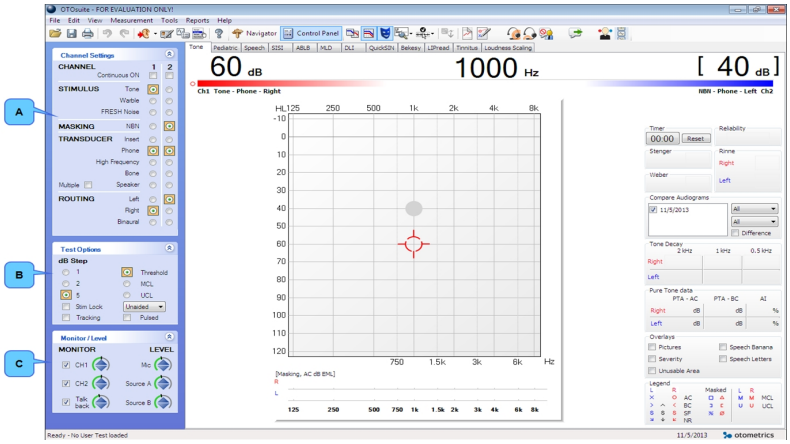
Function	Icon	Description
Curve selection		Click to select the curve type: • **THR** (Threshold level) (Tone) • **MCL** (Most Comfortable Loudness level) • **UCL** (Uncomfortable Loudness level) • **SDT** (Speech Detection Threshold) (Speech) • **SRT** (Speech Recognition Threshold) (Speech) • **WRS/SRS** (Word Recognition Score/Sentence Recognition Score) (Speech)
Opens the Monitor and Level dialog		For a description of the **Monitor and Level** dialog, see Monitor and Level ► 31.
Opens the Talk Forward dialog		For a description of the **Talk Forward** dialog, see Measurement menu ► 18.
Opens the Test Selector dialog		The **Test Selector** dialog is described in the OTOsuite User Guide.

3.5.2 The Classic Control Panel

Click the **Control Panel** icon in the toolbar to activate the Control Panel.

> ***Note*** • *If you are using the MADSEN Astera² ACP, you may choose not to display the Control Panel. Select* ***Tools > Configuration Wizard... >*** *and click* ***Next*** *until the* ***Preferences*** *screen is displayed. The checkbox* ***Activate control panel*** *must be disabled.*

The Classic Control Panel is divided into the following main sections, where you can view and change various settings depending on the selected test type.



A. Channel Settings ▶ 27
B. Test Options ▶ 29
C. Monitor and Level ▶ 31

3.5.2.1 Channel Settings

Channel	
Continuous ON	The stimulus is continuously on and turns off when you present the stimulus.

Stimulus (Tone)	
Tone	Presents a pure tone as the stimulus type. • 125 Hz to 12,500 Hz is standard, • 12,500 to 20,000 Hz is optional.
Warble	Presents a warbled pure tone as the stimulus type. This stimulus type should be used for sound field testing to avoid any standing waves.
FRESH Noise	Presents the customized FRESH noise as the stimulus type.[ab] FRESH stands for FREquency Specific Hearing assessment noise.

Stimulus (Speech)	
Mic.	The microphone (operator headset boom microphone or desktop microphone) delivers the speech stimulus using live voice.
Source A	Delivers recorded speech material from source A.
Source B	Delivers recorded speech material from source B.

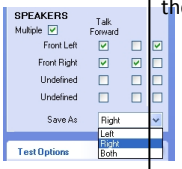
[a]The FRESH noise is implemented according to specifications of "Stimuli for Sound Field Audiometry: A Response to Lippmann and Adams", G. Walker and H. Dillon, 1984 in Journal of Speech and Hearing Disorders, p 219, and H. Dillon (2008), personal communication.

[b]For more information read: "Narrow Band Noise Audiometry: The Effect of Filter Slope", Daneil J. Orchik and Nancy L. Mosher, 1975 in The Journal of American Audiology Society, Vol. 1, No. 2, p. 50-53.

Stimulus (Speech)	
Speech material source (drop down list)	Determines the input to Source A and Source B. The options are: • Int. File (stored on hard drive), • Int. CD (internal CD ROM built into the PC), • Line In (external medium connected to the PC).

Masking	
In **Tools > Options > Audiometry > Tone > Measurement > Switch off Masking on Store**, you can set up whether the masking signal should automatically switch off when you store a data point or whether it should be manually controlled.	
NBN	**Tone** Presents a Narrow Band Noise as the masking type. If selected under the masking parameters it should only be used as a masker (not a stimulus) because it is calibrated in effective masking level. NBN is the default.
WN	**Tone and Speech** Presents a White Noise as the masking type. ***Note*** • *Select* ***WN*** *in* ***Tools > Options > Tone*** *or* ***Tools > Options > Speech****.*
SWN	**Speech** Presents a Speech Weighted Noise as the masking type. SWN is the default.

Transducer	
Insert	Presents the stimulus or masker through the insert earphones.
Phone	Presents the stimulus or masker through the supra-aural headphones.
High Frequency	Presents the stimulus or masker through the high frequency headphones.
Bone	Presents the stimulus or masker through the bone oscillator.
Speaker	Presents the stimulus or masker through the soundfield speakers. • If you are using only 2 speakers, the routing is determined by the routing controls **Left**, **Right**, **Binaural**. • If you are using only 2 speakers, you can set up a channel to provide stimulus/masking via a different transducer (i.e. when providing masking to one ear and stimulating the other ear using the soundfield speakers).

Transducer	
Multiple 	Enables multiple speaker routing options. This routing setup is only available if you have purchased the multiple speaker package. – If 4 speakers are used you can determine which stimulus will be presented from an individual speaker or from a combination of speakers. – You can determine which speaker(s) will be used for talk forward. – When 2 speakers and a masking noise are selected in a channel, the noise can be non-correlated between the speakers if non-correlated noise is enabled in **Tools > Options > General**. – Alternate transducers cannot be used in combination with a multiple speaker setup.
	Save As **Left**: Stores the left symbol on the left audiogram. **Right**: Stores the right symbol on the right audiogram. **Binaural**: Stores the binaural symbol on both audiograms (or once on the combined audiogram).

Routing	
Left	Stimulus is routed to the left transducer.
Right	Stimulus is routed to the right transducer.
Binaural	Stimulus is routed to both the left and right transducer.

3.5.2.2 Test Options

Test options	
dB Step	Defines the intensity of the stimulus and masker used to record the audiogram.
Stim Lock	The stimulus/masker from both channels will be presented simultaneously if this option is enabled.
Tracking	When the intensity of the stimulus/masker for a channel is increased/decreased by x dB the intensity of the stimulus/masker for the other channel will also increase/decrease by the same x dB if this option is enabled.
Threshold	**Tone**: The audiometric symbols for air conduction or bone conduction thresholds (masked or unmasked) will display on the graph when data points are stored.

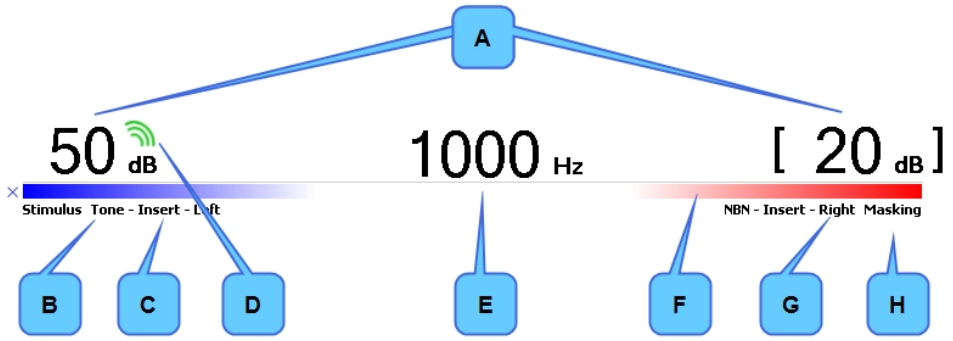
Test options	
SDT	**Speech**: The data will be stored as a Speech Detection Threshold. This is the lowest level at which the patient responds to speech at least 50% of the time (also known as SAT - Speech Awareness Threshold).
SRT	**Speech**: The data will be stored as a Speech Reception Threshold. This is the lowest level at which the patient repeats at least 50% of spondaic words correctly.
MCL	**Tone** and **Speech**: The **M**ost **C**omfortable **L**oudness level symbols will display on the graph when data points are stored.
UCL	**Tone** and **Speech**: The **U**n**C**omfortable **L**oudness level symbols will display on the graph when data points are stored.
Unaided/Aided 1/ Aided 2	**Tone** only: Select to display unaided or aided symbols on the graph. To change the symbol sets for **Unaided/Aided 1/Aided 2**, select **Tools > Curves and Symbols**.
Pulsed	**Tone** only:The stimulus pulses 200ms on and 200ms off if this option is enabled.The pulse duration is configurable: **Select Tools > Options... > Audiometry > Tone > Measurement > Pulsed**.
WRS/SRS	**Speech**: The data will be stored as a **W**ord **R**ecognition **S**core or **S**entence **R**ecognition **S**core. This test requires monosyllabic words to be presented at the patient's MCL level or above. The patient is instructed to repeat the words he or she hears.
SNR	**Speech**: Check **SNR** to report a Signal to Noise Ratio in the **SNR** column in the Speech test table. • **Manual** Uses the fixed predefined SNR level. • **Automatic** Calculates the SNR based on the channel level.
SNR in dB	Set the difference in dB between the signal and the noise. If noise is louder in intensity than the signal, use a negative number.

3.5.2.3 Monitor and Level

Monitor	
The signal level changes in 3 dB steps with each click of the arrow up or arrow down buttons.To change the signal level by more than one click at a time, use the mouse scroll wheel.The check boxes are used for enabling/disabling of monitoring. You can also define this in **Tools > Options > Audiometry > General > Measurement > Monitor**.	
Ch1, **Ch2**	Click to enable monitoring of Channel 1 or Channel 2. The indicator displays the level of the signal.
Talk back	Talkback can be monitored if this option is enabled. The indicator displays the level of the signal.

Level	
The signal level changes in 1 dB steps with each click of the arrow up or arrow down buttons. • To change the signal level by more than one click at a time, use the mouse scroll wheel.	
Mic	For adjusting the sensitivity of the test microphone reflected on the VU meter (only used for Speech testing).
Source A, **Source B**	For adjusting the sensitivity of the signal coming from **Source A** or **Source B** reflected on the VU meter (only used for Speech testing).

3.6 The stimulus bar



A. Intensity
B. Stimulus indicator
C. Transducer indicator
D. Stimulus being presented
E. Frequency
F. Stimulus bar color
G. Routing indicator
H. Masking on

Intensity
Indicated by the dB level above the channel status bars. • Masking is denoted by square brackets around the level (calibrated in effective masking level). • The green triple wave symbol above the level indicates that the stimulus is currently being presented.

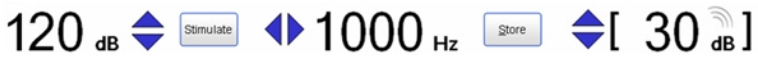
Stimulus bar color
Indicates the routing for each channel: • Blue = left ear • Red = right ear • Blue/Red = binaural • Gray = unspecified

Stimulus, transducer and routing indicators
The stimulus/masking type, the transducer and the routing for each channel.

3.6.1 Test controls

Test controls provide a means of operating the audiometer if you use the mouse and on-screen options to perform tests.

- To enable test controls, select **Tools**> **Options**> **Audiometry**> **General**> **On-screen controls** > **Show**> **On**.



Up and down arrows	
	Tone and Speech. Stimulus and Masking • The Arrow Up and the Arrow Down buttons change the stimulus level depending on the setting in **Tools > Options > Audiometry > Tone > Misc. > Level Direction of Arrow Keys**.

Left and right arrows	
	Tone. Stimulus and Masking • Arrow left decreases the stimulus frequency. • Arrow right increases the stimulus frequency.

Stimulate button	
Present	**Tone** • Presents stimulus. • If **Continuous ON** is enabled, activating the button interrupts the stimulus.

Store button	
Store	**Tone and Speech** • Stores the data point on the audiogram(s) or in the Speech screen.

Silence Mode

Silence Mode allows you to control tone levels and presentation by hovering the mouse cursor over the respective on-screen controls. This is particularly useful when the operator of the audiometer and the person being tested are in the same room.

- To enable silence mode, select **Tools** > **Options** > **Audiometry** > **General** > **On-screen controls** > **Silence Mode** > **On**.
- To change the level and frequency by more than one click at a time, use the mouse scroll wheel.

3.6.2 The Tone stimulus bar

A. Symbol **B.** Frequency

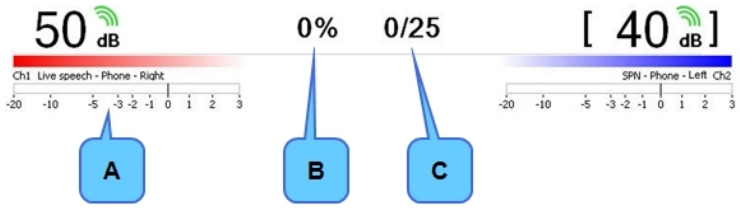
During online testing, the stimulus bar shows:

Symbol
• Indicates the symbol that will be displayed on the audiogram(s) when a data point is stored. The symbol shown reflects the current audiometer measurement settings.

See also Curves and symbols selection ► 37.

Frequency
• Indicated by the Hz value in the center of the stimulus bar.

3.6.3 The Speech stimulus bar



A. VU meter
B. Speech score
C. Word count

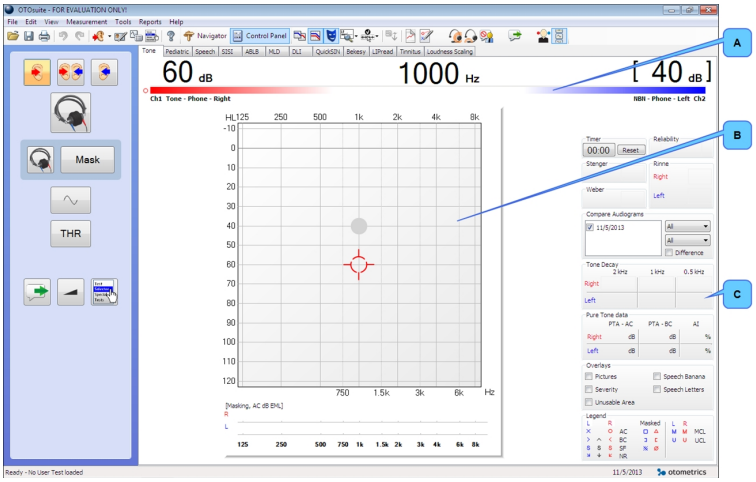
During online testing, the stimulus bar shows:

Speech Score/Word Count
• Displays the percentage correct/incorrect and the amount of words correct/incorrect out of a given number of words. You can display speech score and word count either as "% Correct" or as "% Incorrect". To set your preference, select **Tools > Options > Speech > Misc. > Score Presentation**. **% Correct** is the default setting.

VU Meter
• Displays the level (in volume units) of the test microphone or speech material from Source A or Source B. Speech should always be delivered at 0 dB on the VU meter so that the dB level on the stimulus intensity bar represents the level actually being delivered to the patient.

3.7 The Tone test screen

During online testing, the screen reflects the test done by the audiometer as it progresses.



A. Stimulus bar
B. Work area
C. Feature boxes

3.7.1 The work area in the Tone screen

The Tone test work area consists of a range of elements for viewing and selecting various features:

- The audiogram ► 35

  With a description of audiogram elements, how to view single or dual graphs, and how to view the intensity levels used for masking.

- Tone feature boxes ► 39

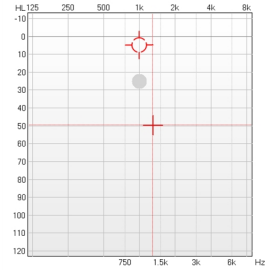
  With a description of result boxes for special tests, utilities such as a timer and an overlays selector, and instructions for how to view/hide the feature boxes.

3.7.2 The audiogram

Audiogram elements

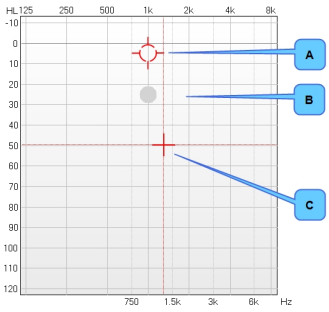
Cross hatch	
	Indicates your current stimulus level and frequency. The color indicates the routing: • Blue = left • Red = right • Black = binaural

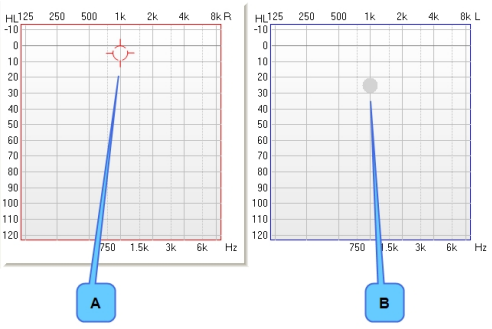
Mouse cursor	
	Indicates where you place the mouse. The color indicates the routing: • Blue = left • Red = right • Black = binaural

Audiogram	
	• Intensity is shown to the left of the audiogram in dB HL. • Octave frequencies are shown below the audiogram in Hz. • Interoctave frequencies are shown above the audiogram in Hz.

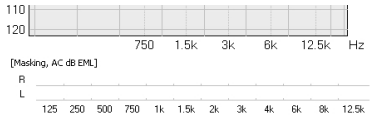
Viewing the audiogram

You can choose between:

Single graph view	
A. Stimulus marker (ear color) **B.** Masking level indicator **C.** Mouse cursor (ear color)	

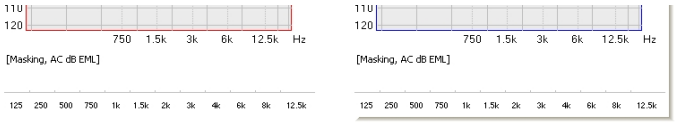
Dual graph view	
When you use the dual graph viewing option, the graph that corresponds with the stimulus ear will have a gray outline to denote the active audiogram. You can switch the position of the right and left graphs to correspond to your viewing preference. 1. Select **Tools > Options > Tone > Misc. > Dual Graph View** or in the menu bar under **View**. **A.** Stimulus marker (ear color) **B.** Masking level indicator	

Viewing masking levels

Masking levels
Below the audiogram, the intensity levels used for masking can be displayed. It is an option to display the masking levels. Select **Tools > Options > Tone > View > Misc. > Masking Levels**.
• In combined view, the non-test ear masking levels are shown below the graph. 

Masking levels

- In **Dual Graph View**, the masking level used for masking the non-test ear will be displayed under the graph for the test ear. The masking level can be set to be displayed either under the test ear or under the non-test ear: select **Tools > Options > Tone > View > Misc > Masking Table Placement**.



3.7.3 Curves and symbols selection

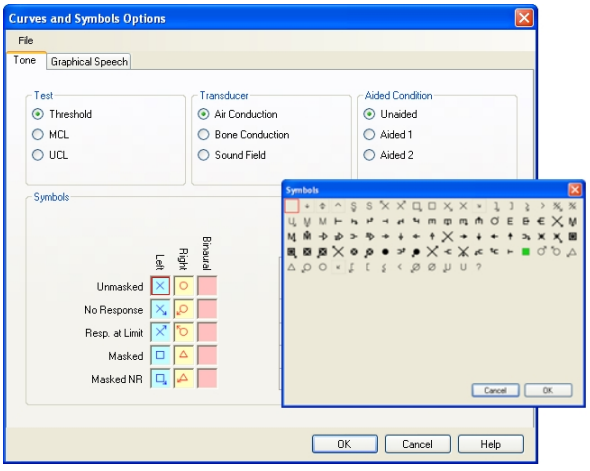
You can select a symbol and/or a curve style for a specific measurement and you can create new symbols.

3.7.3.1 Selecting a symbol or curve

You can select a symbol and/or a curve style for a specific measurement.

1. Select **Tools > Curves and Symbols...**
2. Click on the selections that apply to your measurement under **Test**, **Transducer**, and **Aided Condition**. The current symbols and line style are shown.
3. Double-click on the symbol you wish to change. The **Symbols** selection dialog box is shown.
4. Double-click on the symbol you wish to use.
5. To change the line style of the curve, select from the **Line Style** drop-down list.
6. To change the color, double-click on the current **Color** square. Select a new color or click on **Define custom colors>>** to select a color not shown. Click **OK**.
7. To optimize viewing of the audiogram, you can offset the symbols in relation to the audiogram grid in the fields **Horizontal Offset** and **Vertical Offset**.

   You can superimpose symbols on the audiogram where two different points share the same value (i.e. air and bone threshold). In order to see both superimposed symbols, you can define an offset direction for each individual symbol.



3.7.3.2 Creating new symbols

1. Use Microsoft Powerpoint to create graphics that can be saved in Enhanced Meta Files (*.emf) format.
2. The outer size of the EMF file must be less than or equal to 1 x 1 inches (2.5 x 2.5 cm).

> ***Note*** • *If the symbols are created larger, this may severely compromise the performance of OTOsuite.*

   The standard symbols are drawn within a centered inner frame of 1.5 x 1.5 cm (0.6 x 0.6 inches).

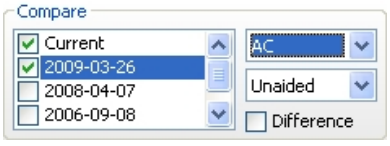
   The area between the inner and outer frames is used for additions to the main symbol, such as arrows for **No Response** or **Response at Limit**, and designators for **Aided Left** or **Aided Right**.
3. Before you store the new graphic, make sure that the outer and inner frames are invisible: Select the frame, and set the line color to **No Line**. Repeat this for each frame.
4. To save as an *.emf graphics file, select all elements in the drawing (including the invisible outer frame as well as the symbol itself centered within the frame). Right-click and select **Save as picture...**
5. Name the file and select the file type *.emf.
6. Save it in **C:\Program Files\GN Otometrics\OTOsuite\AudSymbols**.
7. Launch the OTOsuite Audiometry Module and select **Tools > Curves and Symbols**.

   The new symbol should appear on the list of symbol options.

   In this dialog box, you also have options for setting the color, line type, and horizontal and vertical offsets that will apply when you use the new symbol.

3.7.4 Compare audiograms

Make sure the feature box for **Compare Audiograms** is visible in the OTOsuite main view area (if not, set **Tools > Options > Tone > View > Show Compare Audiograms** to **On**).

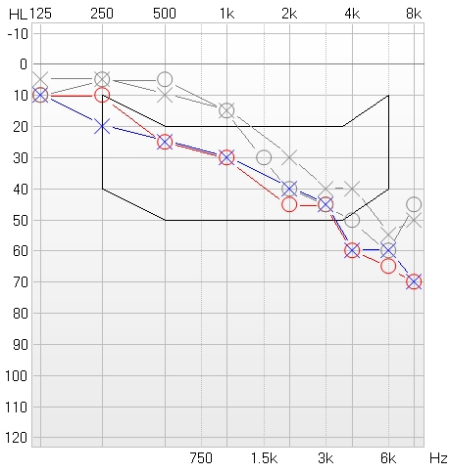


OTOsuite under NOAH

All sessions relating to the selected client, and containing audiometry data are automatically loaded into the **Compare Audiograms** feature box.

Compare current and historical audiograms

1. In the **Compare Audiograms** feature box, single-click to select the audiograms you wish to view from the list of historical audiograms. Any selected historical audiogram will appear with grey curves in the audiogram graph.
2. All curves of the selected audiograms are viewed and compared simultaneously unless you explicitly select a curve type from the feature box drop-down lists. The lists let you define the test type and aided condition that you wish to view and compare.
3. You can enhance the compare view by enabling the **Difference** view. This is done by checking the **Difference** option in the feature box. The **Difference** view highlights any difference between the most recent and any older audiogram curves selected in the list.



4. If you decide to make a new audiogram, then a new **Current** audiogram is generated in the **Compare Audiograms** feature box list, and what was previously the current audiogram consequently becomes a historical one, displayed with measurement date.
5. If you deselect the viewing of a **Current** audiogram so that it is no longer shown, then it will instantly be reselected if you try to edit a curve.
6. You can keep any previously collected audiogram visible in the graph while collecting the current audiogram simply by keeping it selected in the **Compare Audiograms** feature box while measuring.

3.7.5 Tone feature boxes

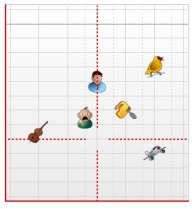
You can access a number of Tone view options directly from the **Tone** main screen.

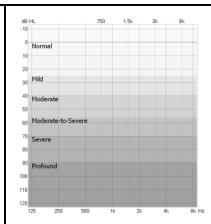
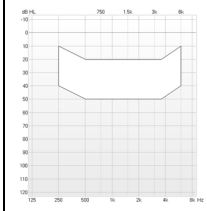
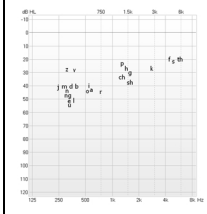
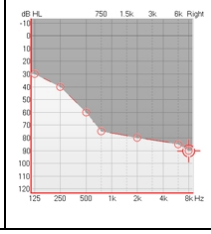
The view options can be turned on/off. To do so, select **Tools > Options > Tone**.

Feature boxes

Weber	**Single Frequency Weber** Displays the results of a single frequency (500 Hz) Weber test. • Lateralization options are: Uncertain patient response (question mark), Left (L), Right (R), Center (arrow up), Blank (no result).

	**Multi Frequency Weber** Displays the results of the Weber test when performed at the standard audiometric frequencies (250 to 4000 Hz). • Lateralization options are: Uncertain patient response (question mark), Left (L), Right (R), Center (arrow up), Blank (no result).
Stenger	Displays the results of a pure tone Stenger test. • Scoring options are positive (+) or negative (-).
Rinne	Displays the results of a Rinne tuning fork test. • Scoring options are positive (+) or negative (-).
Reliability	Displays the reliability of the patient's responses (good, fair, poor).
Timer	Allows you to time the length of a tone presentation (e.g. during **Tone Decay** testing). • The arrow starts the timer. • The square stops the timer. • The **Reset** button resets the timer to 00:00.
Pure Tone Data	Displays the pure tone average (PTA) for air conduction and bone conduction as well as the articulation index (AI). • The AI is calculated according to the “Count-the-dot” method. • To configure PTA calculation, select **Tools > Options > General > Misc > PTA Frequency Multipliers AC/BC**.
Tone Decay	Displays the results of the tone decay test. Scoring options are: • Rosenberg Method (Normal, Mild, Moderate, Marked) or • Jerger STAT Method (Negative, Positive).

Overlays	Select the overlay to be displayed on the audiogram. These overlays assist in the counseling process. • Select **Tools > Options > Audiometry > Tone > Overlay Selection Box**. The overlay options are:	
		**Pictures** Displays pictures representing common environmental sounds at their approximate dB level (e.g. bird, plane).

		**Severity** Displays the audiometric severity levels (normal, mild, moderate, moderate-to-severe, severe, profound).
		**Speech Banana** Displays the speech banana of a listener with normal hearing.
		**Speech Letters** Displays speech sounds at their approximate dB level.
		**Unusable area** Shades the area which is outside the patient's dynamic range of hearing.

3.7.6 Tone editing options

When you right-click on the main screen in **Tone** mode, the following options appear:

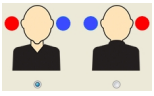
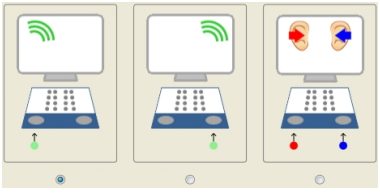
Tone editing options	
Selected Point (e.g. Left AC threshold, 1kHz)	If more than one symbol is at the same intensity/frequency, select the data point of interest from the drop-down list.
Delete Point	• Deletes a selected data point.
Delete Curve	• Deletes a selected data curve.
Insert "No Response"	• Inserts a "no response" symbol (default: symbol with arrow downward) on the audiogram. You can also access the "no response" symbol by holding down the "S" key on the keyboard.
Insert "Response at Limit"	• Inserts a "response at limit" symbol (default: symbol with arrow upward) on the audiogram.

3.8 Work-flow related features

3.8.1 Selecting orientation

Select graph, table and control layout

Click **Select Orientation** on the toolbar to see the following dialog:

Graphs and Tables 	Click to select the way you view the patient in relation to your monitor.
Control 	Click to select the position of the stimulus channel on the screen.

3.8.2 Channel-specific Storing

You can measure and store the results for one ear by using **Ch 1**, and for the other ear by using **Ch 2**.

1. Select **Dual Graph View**.
2. Assign **Ch 1** and **Ch 2** routings to match the view order of the graphs. To do so, assign a stimulus to each channel (No Masking), one test ear to **Ch 1**, and the other to **Ch 2**.

> ***Note • Frequency Shift on Store*** *is disabled when you use this feature.*

ACP

- Use the dials and the control buttons to control the frequency, levels and stimulus.
- To store **Ch 1** results press the **Store** button on the left-hand side.
  To store **Ch 2** results press the **Store** button on the right-hand side.

3.8.3 Automatic frequency/level shift when storing

When you use the **Wrap** or **Butterfly** method for testing, this feature enables you to speed up the test process by automatically shifting frequency (and level) when you store a point in the audiogram. To do so, select **Tools > Options > Tone > Measurement > Auto Freq./Level Shift**.

> ***Note •*** *Masking is always switched off when the frequency is changed automatically.*

You can set up the definitions for each of the test types THR/MCL and UCL individually:

Options	
Included AC/BC/SF Frequencies	Defines which frequencies to exclude from the automatic frequency shift. The actual available frequency range is defined by the selected transducer. ***Note** • You can always select any frequency manually.*
Level Shift when Storing	You can choose whether the new level should be referenced to the previous data point or be set to a fixed level. If a data point already exists at the new frequency, this will be used as a reference point. ***Note** • The automatically selected level never exceeds 80 dB HL for reasons of safety.*
Frequency Shift when Storing (None, Wrap, Butterfly)	• **Wrap**: Automatically selects the next, higher frequency. When it reaches the highest available frequency, it wraps around to the lowest frequency. • **Butterfly**: Automatically selects the next, higher frequency. When it reaches the highest available frequency, it goes to 1000 Hz and automatically selects the next, lower frequency. When it reaches the lowest frequency, it automatically goes to 1000 Hz. The direction depends on whether the previous data point was stored at a higher or lower frequency.

3.8.4 Stimulus duration

You can set a fixed duration of the presentation of the tone stimulus. To do so, select **Tools > Options > Tone > Measurement > Stimulus Duration.**

3.8.5 Ear shift frequency and level setting

When you change test ear, you can define that the frequency and level should be set to 1000 Hz at 20 dB HL. To do so, select **Tools > Options > Tone > Measurement > Ear Shift Frequency and Level.** Check **Ear Shift Frequency and Level**.

3.8.6 Saving non-stimulus channel as masking

If you use an external masking signal (non-audiometer masking noise) for speech masking, you can choose to store the presentation level of the non-stimulus channel as a masking level.

To do so, set **Tools > Options > Speech > Measurement > Use Non-Stimulus Channel as Masking** to *Yes*.

3.9 The Speech test screen

Selecting the work area in the Speech screen

You can perform tests and view the speech test results in the work area. The work area can be shown in two modes:

- Speech testing - tabular view ► 56.

- Speech testing - graph view ► 60.

Selecting word or phoneme scoring

- See Selecting word or phoneme scoring ► 44

Scoring and playing speech material

There are some basic differences in how the settings for **Scoring and Playing** are applied and relate to each other in word or phoneme scoring, and in whether you use integrated OTOsuite Speech Material or speech recordings from other sources. These differences are described in detail in the following sections.

- Set up the **Control Panel** and select the speech material. See Selecting speech material ► 48

Word scoring

- Scoring words using integrated OTOsuite Speech Material ► 50
- Scoring words using external sound source ► 52

Phoneme scoring

- Scoring phonemes using integrated OTOsuite speech material ► 53
- Scoring phonemes using external sound source ► 54

Editing options

- Speech editing options - tabular view ► 59
- Speech editing options - graph view ► 62

Storing speech data

You can store the current data as the result either by clicking with the mouse on the highlighted field, or by pressing the **Store** shortcut key on the keyboard (S).

See also

- Storing SNR for Speech testing ► 59

3.9.1 Selecting word or phoneme scoring

Scoring and Playing is a control where you can configure how to play back recordings and score the results. The control contains four different columns as listed and described below. These columns present various controls, which you can combine to define how to run the test.

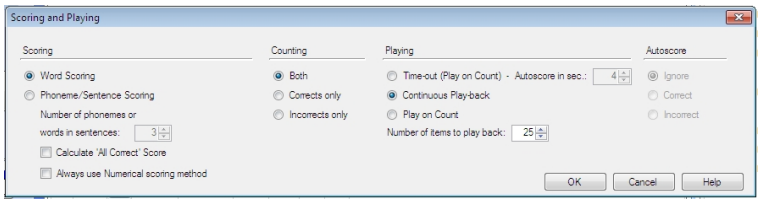
To set up word or phoneme scoring,

- click 

or

- select **Tools > Options > Speech > Scoring and Playing** and click the pop-up button.

The **Scoring and Playing** dialog is shown.



The Scoring and Playing dialog

Word scoring

In word scoring you score either correct or incorrect responses using + or - in the Speech Player Panel.

Numerical phoneme/sentence scoring

In numerical scoring you click the numbered buttons in the Speech Player Panel to score the number of correct phonemes in phoneme scoring or words in sentence scoring. The maximum score in a single presentation is either determined as a fixed value (1 to 9 in the **Scoring and Playing** dialog) or automatically as determined by the integrated word list.

Specific phoneme/sentence scoring

Some speech materials support specific scoring. This means that you can click the scorable items directly in the speech list. Scorable items can be either individual phonemes in phoneme scoring or individual words in sentence scoring.

You can use the **All Correct** button when the patient responds correctly to a presentation.

When you use specific phoneme scoring, you can keep your focus on the speech list by using the **Play** button next to the item in the speech list.

Scoring	
Scoring	**Word scoring** Enable **Word Scoring**. **Phoneme/Sentence scoring** Enable **Phoneme/Sentence Scoring**.
Number of phonemes or words in sentence	**Word scoring** Does not apply to word scoring. **Phoneme/Sentence scoring** Defines the total number of phonemes in the word. The default is 3 phonemes intended for monosyllabic words. The corresponding number of buttons is enabled in the **Speech Player Panel**, and on the Numerical pad of the PC keyboard.
Calculate 'All Correct' Score	**Word scoring** Does not apply to word scoring. **Phoneme/Sentence scoring** Calculates all correctly scored phonemes or items based on

Scoring	
Always use Numerical scoring method	**Word scoring** Does not apply to word scoring. **Phoneme/Sentence scoring** Select this if you use lists using specific phoneme/sentence scoring, but prefer to score the test items numerically.

Counting	
Defines how you want to score words (**Both**, **Corrects only** and **Incorrects only**).	
• **Both**	**Word scoring** You manually score correct and incorrect words. The word counter is updated accordingly.
	Phoneme/Sentence scoring Does not apply to phoneme scoring.
• **Corrects only**	**Word scoring** Software assumes the word is incorrect unless you manually score it as correct. *External speech material:* The percentage is calculated based on the total number of words you have defined in advance - **Tools > Options > Audiometry > Speech > Scoring and Playing > Number of items to play back**.
	Phoneme/Sentence scoring Score the number of correct phonemes using the corresponding numbers in the **Counter**. *External speech material:* Always enter a score for each word. This will update the counter accordingly.
• **Incorrects only**	**Word scoring** Software assumes word is correct unless you manually score it as incorrect. *External speech material:* The percentage is calculated based on the total number of words you have defined in advance - **Tools > Options > Audiometry > Speech > Scoring and Playing > Number of items to play back**.
	Phoneme/Sentence scoring Does not apply to phoneme scoring.

Playing	
Playing	***Note*** *• This feature applies to the playback of integrated word lists from the OTOsuite Speech Material. It contains the following options:*
• **Time out (Play on Count)**	**Word scoring** Next word is presented every x seconds based on the value set in the **Autoscore in sec** box. If the word is scored, the next word will be presented without pausing. If the current word times out, the **Autoscore** is applied. *External speech material:* Does not apply to external sound source speech material.
	Phoneme/Sentence scoring Does not apply to phoneme scoring.
• **Continuous Playback**	**Word scoring** The word list is presented exactly as the original recording without pausing. *External speech material:* Does not apply to external sound source speech material.
	Phoneme/Sentence scoring The word list is presented exactly as the original recording without pausing. If a word is presented without any phonemes being counted, the **Autoscore** is applied. *External speech material:* Does not apply to external sound source speech material.
• **Play on Count**	**Word scoring** Next word plays after previous word is scored. To enable this option, select the value **Both** under **Counting**. *External speech material:* Does not apply to external sound source speech material.
	Phoneme/Sentence scoring When the number of correct phonemes has been scored for a word, the next word is presented. *External speech material:* Does not apply to external sound source speech material.

Playing	
• **Number of items to play back**	**Word scoring** Defines the number of words to be presented from the integrated/external word list. *Integrated speech material:* The player pauses after presenting the defined number of words. Press **Play** to continue playing the rest of the list. *External speech material:* This is the total number on which the percentage should be based when counting **Corrects only** or **Incorrects only**.
	Phoneme/Sentence scoring Defines the number of words to be presented from the integrated word list. The player pauses after presenting the defined number of words. Press **Play** to continue playing the rest of the list. *External speech material:* Does not apply to external sound source speech material.

Autoscore	
Autoscore	**Word scoring** When you score words, **Autoscore** is defined by the combinations of the settings in the columns **Counting** and **Playing**. If a word is not manually scored before **Time-out** or before the next word is presented by **Continuous Play-back**, the scoring is set automatically. *External speech material:* Does not apply to external sound source speech material.
	Phoneme/Sentence scoring When you score phonemes, you can define **Autoscore** manually to either ignore the entire word, or count it as fully correct or incorrect. If phonemes are not manually scored before **Time-out** or before the next word is presented by **Continuous Play-back**, the scoring is set automatically. *External speech material:* Does not apply to external sound source speech material.

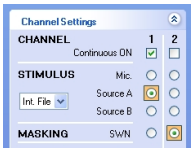
3.9.2 Selecting speech material

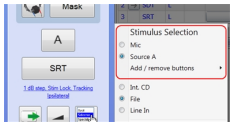
Caution *• Only speech material supplied on the OTOsuite Speech material CD is precalibrated according to the description supplied with the original speech material.*

If you use any other speech material, make sure that it is calibrated correctly.

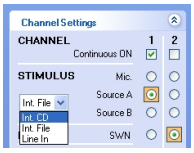
Classic Panel **Sunshine Panel**

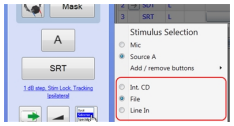
1. Activate **Source A** or **Source B** in the **STIMULUS** section of the **Control Panel**.



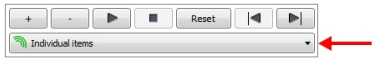


2. Select speech input from pre-recorded input sources for **Source A** or **Source B** from the list in the **STIMULUS** section of the **Control Panel**.
   - **Int.CD** (CD material in CD/DVD drive)
   - **Int.File** (integrated OTOsuite Speech Material or regular sound files)
   - **Line In** (analog input from external sound players, eg. CD, MD, MP3 or cassette recorders connected to the audiometer via the **Line in** input).





3. You can find the speech material files in the **File/track/list selection** drop-down list.



Speech list files (provided by Otometrics)

When you use integrated OTOsuite Speech Material, you can choose between speech lists in the **File/track/list selection** drop-down list.

- Select **Int.File** in the **Control Panel**, and browse to the folder where your speech material is installed (default location: **c:\ Program Files\GN Otometrics\OTOsuite\Wordlists\...**).

Regular sound files (files not supplied on the OTOsuite Speech Material CD)

You can use any sound file stored on your PC hard drive:

- Select **Int.File** in the **Control Panel**, and browse to the folder where your recordings are stored.

CD material

You can use any type of CD sound recordings of your choice.

- Select **Int.CD** in the **Control Panel**, and browse to the drive you wish to use.

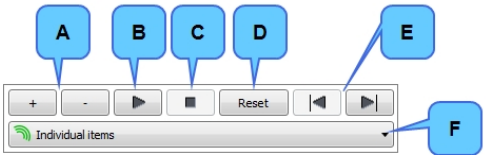
  These files are shown as CD track numbers in the **File/track/list selection** drop-down list.

Line In

When **Line In** is selected, only the **Counter** of the **Player Panel** is activated.

3.9.3 Scoring words using integrated OTOsuite Speech Material

The Speech Player Panel

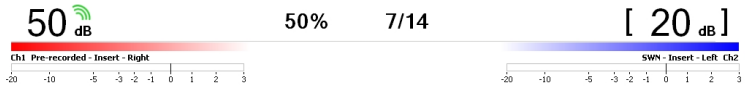


A. Word score counter buttons:
Correct (+)
Incorrect (-)
B. Play/Pause
C. Stop
D. Reset word score
E. Previous/next list
F. File/track/list selection

Setting up for Scoring and Playing

To set up for scoring and playing, see Selecting word or phoneme scoring ► 44.

The Stimulus bar - word score

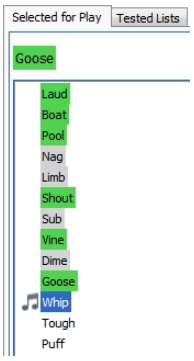


Scoring Panel

The score percentage and the **Correct** or **Incorrect** scores relating to the number of words played are shown at the top of the screen.

When you use integrated word lists, the Scoring Panel is either initialized to "0% 0/0" or to “100% 0/0”, depending on the setting in **Tools > Options > Audiometry > Speech > View > Score Presentation**.

- Click on the relevant Word score counter button to record the response of the client.

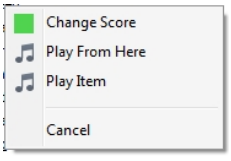
The Word List box	
	The Word List box consists of a tab showing the list **Selected for Play**, and **Tested Lists**. **Selected for Play** The **Word List** is shown automatically in the **Selected for Play** tab, when you select an integrated word list. You can view the selected OTOsuite Speech Material in the **Word List**, and use it to review and edit scoring during the test. **Scoring** You can always click on any word to change the score. The word that has just been played is also shown above the list so that you can easily score it. • **Specific scoring:** Click on the word to toggle between **Correct**, **Incorrect**. or **Not Scored,** or • **Numerical scoring:** Use the traditional score controls (+/- for word scoring, or 0, 1, 2, 3... for phoneme and sentence scoring) in the Player Panel. **Tested Lists** After you have scored the integrated word lists they will appear in the **Tested Lists** tab. The **Tested Lists** tab will show the list belonging to the test currently selected in the Speech Results table (tabular) or Speech legend (graphical). The tested lists are also available for printing.

	When you mouse over an item in the speech list, a Play button appears to the left of the item. Click the **Play** button to present the item to the patient.

	The word currently playing is indicated by a musical note and highlighted in blue in the list.

	A word that was correctly repeated is highlighted in green in the list.

	A word that was incorrectly repeated is highlighted in gray in the list.

	• You can right-click on a word to change the score or control the play-back of the word list. • You can either play back a single item or select a place in the list where you want to start the play-back.

Using word lists with monitored live voice testing

When you have loaded an integrated OTOsuite Speech Material, you can use the word list to read from using **Mic.** stimulus, for live voice testing.

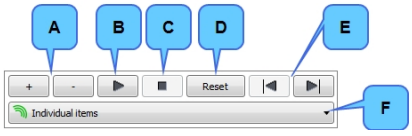
Store the word scores

See Storing speech data ► 44.

3.9.4 Scoring words using external sound source

> ***Note*** • *Using an external sound source includes the use of all types of sound sources such as CDs, MP3 players, cassette recorders, and sound files on the PC hard drive except for the integrated OTOsuite Speech Material.*

The Speech Player Panel

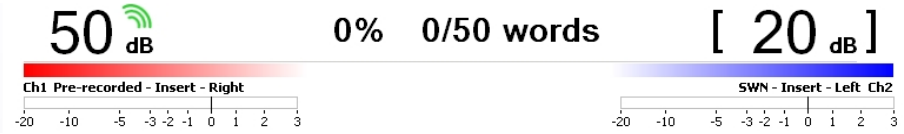


A. Word score counter buttons:
Correct (+)
Incorrect (-)
B. Play/Pause
C. Stop
D. Reset word score
E. Previous/next list
F. File/track/list selection
(disabled when Line In is selected)

Setting up for Scoring and Playing

To set up for scoring and playing, see Selecting word or phoneme scoring ► 44.

The Stimulus bar - word score



Scoring Panel

The score percentage and the **Correct** or **Incorrect** scores relating to the number of words played are shown at the top of the screen.

When you use external word lists, the Scoring Panel is either initialized to "0% 0/n" or to “100% n/n”, depending on the setting in **Tools > Options > Audiometry > Speech > View > Score Presentation**.

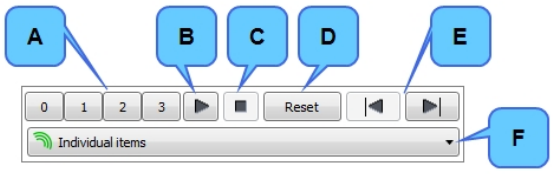
- Click on the relevant Word score counter button to record the response of the client.

Store the word scores

See Storing speech data ► 44

3.9.5 Scoring phonemes using integrated OTOsuite speech material

The Speech Player Panel



- **A.** Phoneme score counter buttons:
  No correct phonemes (0)
  1 phoneme correct (1)
  2 phonemes correct (2)
  All 3 phonemes correct (3)
- **B.** Play/Pause
- **C.** Stop
- **D.** Reset Counter scoring and Player
- **E.** Previous/next list
- **F.** File/track/list selection

In the Speech Player Panel example shown above, the **Number of phonemes** setting in the **Scoring and Playing** dialog box is set to *3*.

Configurable number of phonemes

The integrated speech materials dictate the number of phonemes and provide the appropriate number of scoring buttons automatically. This can be configured specifically for each item in the integrated Speech material. Please contact your supplier for further information.

Setting up for Scoring and Playing

To set up for scoring and playing, see Selecting word or phoneme scoring ► 44.

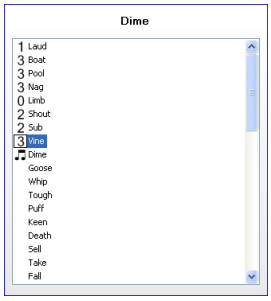
The Stimulus bar - phoneme score

Scoring Panel

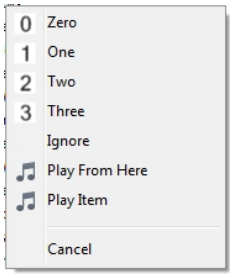
The score percentage and the number of words played are shown at the top of the screen.

The Scoring Panel is either initialized to "0% 0 words" or to “100% 0 words”, depending on the setting in **Tools > Options > Audiometry > Speech > View > Score Presentation**.

- Click on the relevant phoneme score counter button to record the response of the client.

The Word List	
	The Word List is shown automatically when you select an integrated word list. You can view the currently selected integrated OTOsuite Speech Material in the **Word List**, and use it to review and edit scoring during the test. You can also see the word currently being played back for monitoring purposes. The number of correct phonemes repeated is marked with the corresponding number to the left of the word in the list.

	The word currently playing is indicated by a musical note and highlighted in blue in the list.

	• You can right-click on a word to change the score or control the play-back of the word list. • You can either play back a single item or select a place in the list where you want to start the play-back.

Using word lists with monitored live voice testing

When you have loaded an integrated OTOsuite Speech Material, you can use the word list to read from using **Mic.** stimulus, for live voice testing.

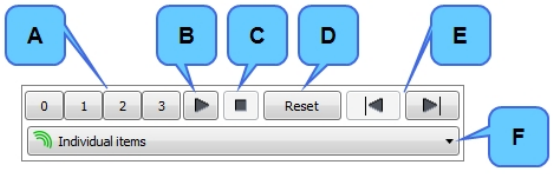
Store the phoneme score results

See Selecting the work area in the Speech screen ► 43

3.9.6 Scoring phonemes using external sound source

***Note** • Using an external sound source includes the use of all types of sound sources such as CDs, MP3 players, cassette recorders, and sound files on the PC hard drive except for the integrated OTOsuite Speech Material.*

The Speech Player Panel



A. Phoneme score counter buttons:
No correct phonemes (0)
1 phoneme correct (1)
2 phonemes correct (2)
All 3 phonemes correct (3)
B. Play/Pause
C. Stop
D. Reset Counter scoring and Player
E. Previous/next list
F. File/track/list selection
(disabled when Line In is selected)

In the Speech Player Panel example shown above, the **Number of phonemes** setting in the **Scoring and Playing** dialog box is set to *3*.

Setting up for Scoring and Playing

To set up for scoring and playing, see Selecting word or phoneme scoring ► 44.

The Stimulus bar - phoneme score

Scoring Panel

The score percentage and the number of words played are shown at the top of the screen.

The Scoring Panel is either initialized to "0% 0 words" or to “100% 0 words”, depending on the setting in **Tools > Options > Audiometry > Speech > View > Score Presentation**.

- Click on the relevant phoneme score counter button to record the response of the client.

Store the phoneme score results

See Selecting the work area in the Speech screen ► 43.

3.9.7 Saving source levels for speech material

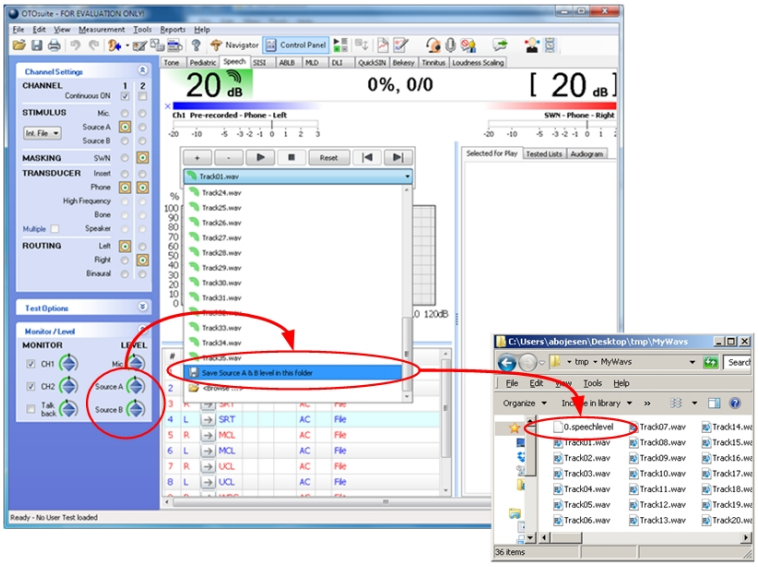
***Note** • This feature applies to sound files on the PC hard drive except for the integrated OTOsuite Speech Material.*

If you have a folder on the PC containing WAVE (.wav) files, eg. from a CD, you can calibrate these files by adjusting the **Source A** and **Source B** levels in the **Monitor and Level** section of the control panel. The next time you browse to this folder (or create a user test) the **Source A** and **Source B** level settings will automatically be set to the saved level.

Procedure

1. Browse to the folder containing the WAVE (.wav) file or files you wish to adjust to a specific level.
2. Play the file from the Speech player.
3. Use the dials in the **Monitor and Level** section of the control panel to adjust the levels to zero, as seen on the VU meter.
4. Open the Play list in the Speech player and click Save Source A & B level in this folder.
5. A file called "0.speechlevel" is created in this folder.

   The next time you play any file from this folder, it will be calibrated to the level set in the "0.speechlevel" file.



3.10 Speech testing - tabular view

Selecting tabular or graphical view

In the Speech test screen of the OTOsuite Audiometry module you can use either tabular view or graphical view.

1. To select the view you wish to use, select **Tools > Options > Audiometry > Speech > Speech View Mode > Tabular View** or **Graphical View**.

General description

The tabular speech view consists of a table showing the measurement conditions for testing and displaying the speech data. The rows are color coded according to their respective routing.

The table adapts to the tests and adds a row for each measurement you make. You can also pin tests so that they are readily available for future testing.

Adaptive rows

The rows in the adaptive table always show the current measurement settings and the measurements you have made. A new row will be added to the table every time you make a new measurement.

Example

#		Test	Ear	Score	dB	SNR			Info
1	→	SRT	L				AC		File

The Speech table showing the current measurement settings. Data has not been stored at this point.

#		Test	Ear	Score	dB	SNR			Info
1	→	SRT	R		30		AC		Live
2	→	SRT	L		30		AC		Live
3	→	WRS	R	75%	75 [35]		AC		NU-6 List 1A
4		WRS	L				AC		NU-6 List 1A

The Speech table showing the three first measurements followed by a blank row with the current measurement settings ready to be stored.

Pinned rows

#		Test	Ear	Score	dB	SNR			Info
1	→	SRT	R				AC		Live
2	→	SRT	L				AC		Live
3	→	MCL	R				AC		Rainbow Passage
4	→	MCL	L				AC		Rainbow Passage
5	→	WRS	R				AC		NU-6 List 1A
6	→	WRS	L				AC		NU-6 List 2A
7									

You can pin a row to make it available in advance in order to reflect the measurements usually performed in your clinic. A table with pinned rows will always look the same when you start testing a new patient.

This customized layout provides you with a consistent work environment and makes it easy to see what to do next, or if any measurement has been deliberately left out.

A measurement that is not pinned to the table is added automatically below the pinned rows.

Click 'n' Get (loading settings)

The Click 'n' Get feature allows you to perform a test from the predefined table simply by clicking the **Apply Settings** arrow button in the second column of the table. Click 'n' Get loads all the relevant settings including the integrated speech files.

Pinning a test

You can pin one test per measurement condition.

> ***Note** • You can pin a test to the table, if you have not already pinned an identical test. To edit a pinned test, make sure that User Tests are not write protected in the Configuration Wizard.*

To pin a row, simply select the row, right-click and select **Pinned Tests > Pin Test**. Here you can also rearrange pinned rows by moving them up or down in the table.

Modifying Click 'n' Get for a pinned test

You can assign a different speech stimulus and/or transducer to a pinned test. This will load the desired word list, transducer, etc., when you use the Click 'n' Get feature.

Changing assigned speech stimulus for a pinned test

1. Select the speech stimulus, such as a specific integrated word list, or internal CD or line-in device, in the Control Panel and/or speech player.
2. Right-click on the **Apply Settings** button in the pinned test row, and select **Assign Selected Stimulus**.

Changing an assigned transducer for a pinned test

1. Select the transducer in the Control Panel.
2. Right-click on the **Apply Settings** button in the pinned test row, and select **Assign Selected Transducer**.

***Note** • When you use Click 'n' Get to apply settings, the AC transducer as well as the speech stimulus are loaded as your preferred starting point. You can always adjust them in the Control Panel or in the Speech Player panel.*

Example 1:
You typically use insert phones but you have a patient with an ear infection and you wish to use supra-aural headphones. Use Click 'n' Get to load the desired test, and simply switch to Phone in the Control Panel before you start the test.

Example 2:
You typically wish to start the Speech test by familiarizing the patient with a specific word list before starting the actual test with a different word list.. Use Click 'n' Get to load the desired starting point, and simply switch to any word list you wish to use after the familiarization.

Storing data in a row

To store data in a row, click the **dB** field in the relevant row or press **S** on your keyboard.

The Info field

The **Info** field provides additional information such as a stimulus source (e.g. CD, Live, File, or specific speech material), as well as noise condition, and your own comments if desired. To add your own comments, right-click the **Info** field.

Editing a row

Click on the data you wish to edit and use the right-click menu to change the value.

Deleting a row

Right-click on the field you wish to delete and select **Delete Measurement**.

Sorting the tabular speech data

You can sort your data either by ear or by its sequential number depending on your needs. Usually, the sequential sorting is preferred during data collection when you perform one test type at a time. Sorting by ear is sometimes preferred when you compare the ears when analyzing the complete results.

- To sort data by their sequential number, click the number field in the table header (marked with the #symbol).
- To sort data by ear, click the ear field in the table header.

Pure Tone Data
These fields contain the tone test results. They display the pure tone average (PTA) for air conduction (AC), bone conduction (BC), and the calculated Articulation Index (AI) for that ear. The PTA and AI are automatically calculated from the tone audiogram. • To configure pure tone average (PTA) calculation, select **Tools > Options > Audiometry > General > Misc. > PTA Frequency AC/BC**.

3.10.1 Speech editing options - tabular view

When you right-click any of the rows in tabular view, the following options appear:

Options	
Store	Stores the dB level(s) currently displayed to the field that is highlighted.
Insert No Response	NR will replace the stimulus level for the selected speech test.
Insert Did Not Test	DNT will replace the stimulus level for the selected speech test.
Insert Could Not Test	CNT will replace the stimulus level for the selected speech test.
Delete Measurement	Deletes an existing measurement.
Entry fields	Enables you to enter results in the selected field. • When you have typed in the desired data, confirm by pressing **Enter** or cancel by pressing **Esc**.

Pinned Rows	Select to define a row as pinned. See also Speech testing - tabular view ► 56.

3.10.2 Storing SNR for Speech testing

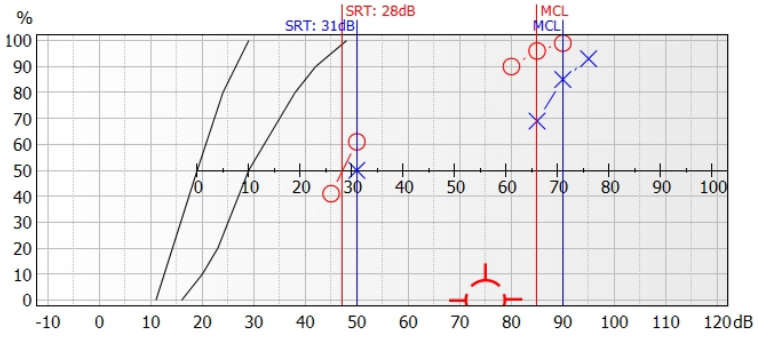
Word and Sentence Recognition tests can be performed in noise. The Signal to Noise Ratio can be stored with the data regardless of whether the noise comes from the recording or is generated in the audiometer.

You can enter an SNR manually or set it to be calculated automatically based on the difference between the Stimulus and the noise channel levels.

- *Manual:*
  is useful when signal and noise are mixed together in the speech recording.
- *Automatic:*
  is useful when you mix speech and noise from the two audiometer channels.

3.11 Speech testing - graph view

General description



The Speech Graph screen displays the speech graph which includes SDT, MCL, UCL noted by a line (blue = left, red = right) at the corresponding dB level.

For SRT and WRS/SRS, or WRS/SRS with noise, symbols will be shown based on the location corresponding to the dB level of presentation and the percentage of correct responses.

The graphical speech legend

The graphical speech legend shows the measurement conditions for testing and displays the corresponding symbols from the graph. The legend rows are color coded according to their respective routing.

The legend adapts to the tests and adds a row for each measurement you make. You can also pin tests so that they are readily available for future testing.

Adaptive rows

The rows in the adaptive legend always show the current measurement settings and the measurements you have made. A new row will be added to the legend every time you make a new test.

Example

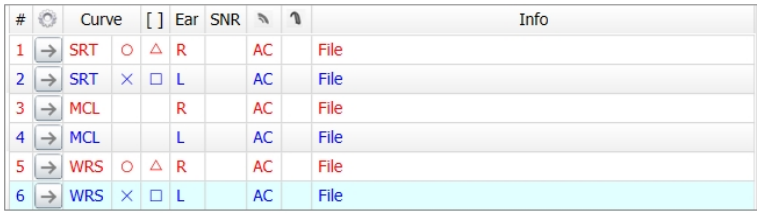
#	Curve	[ ]	Ear	SNR			Info
1	SRT	×	□	L		AC	File

The adaptive Speech legend showing the current measurement settings. Data has not been stored at this point.

#	Curve	[ ]	Ear	SNR			Info
1	SRT	×	□	L		AC	File
2	SRT	○	△	R		AC	File
3	WRS	○	△	R		AC	File
4	WRS	×	□	L		AC	File

The adaptive Speech legend showing the three first measurements followed by a blank row with the current measurement settings ready to be stored.

Pinned rows



#	Curve	[ ]	Ear	SNR			Info
1	SRT	○	△	R		AC		File
2	SRT	×	□	L		AC		File
3	MCL			R		AC		File
4	MCL			L		AC		File
5	WRS	○	△	R		AC		File
6	WRS	×	□	L		AC		File

You can pin a row to make it available in advance in order to reflect the measurements usually performed in your clinic. A legend with pinned rows will always look the same when you start testing a new patient.

This customized layout provides you with a consistent work environment and makes it easy to see what to do next, or if any test has been deliberately left out.

A test that is not pinned to the legend is added automatically below the pinned rows.

Click 'n' Get

The Click 'n' Get feature allows you to perform a test from the predefined legend simply by clicking the **Apply Settings** arrow button in the second column of the legend. Click 'n' Get loads all the relevant settings including the integrated speech files.

Pinning a test

You can pin one test per measurement condition.

> ***Note*** • *You can pin a test to the legend, if you have not already pinned an identical test. To edit a pinned test, make sure that User Tests are not write protected in the Configuration Wizard.*

To pin a row, simply select the row, right-click and select **Pinned Tests> Pin Test**. Here you can also rearrange pinned rows by moving them up or down in the legend.

Modifying Click 'n' Get for a pinned test

You can assign a different speech stimulus and/or transducer to a pinned test. This will load the desired word list, transducer, etc., when you use the Click 'n' Get feature.

Changing assigned speech stimulus for a pinned test

1. Select the speech stimulus, such as a specific integrated word list, or internal CD or line-in device, in the Control Panel and/or speech player.
2. Right-click on the **Apply Settings** button in the pinned test row, and select **Assign Selected Stimulus**.

Changing an assigned transducer for a pinned test

1. Select the transducer in the Control Panel.
2. Right-click on the **Apply Settings** button in the pinned test row, and select **Assign Selected Transducer**.

***Note** • When you use Click 'n' Get to apply settings, the AC transducer as well as the speech stimulus are loaded as your preferred starting point. You can always adjust them in the Control Panel or in the Speech Player panel.*

Example 1:
You typically use insert phones but you have a patient with an ear infection and you wish to use supra-aural headphones. Use Click 'n' Get to load the desired test, and simply switch to Phone in the Control Panel before you start the test.

Example 2:
You typically wish to start the Speech test by familiarizing the patient with a specific word list before starting the actual test with a different word list. Use Click 'n' Get to load the desired starting point, and simply switch to any word list you wish to use after the familiarization.

Storing data in a row

To store data in a row, click the **dB** field in the relevant row or press **S** on your keyboard.

The Info field

The **Info** field provides additional information such as a stimulus source (e.g. CD, Live, File, or specific speech material), as well as noise condition, and your own comments if desired. To add your own comments, right-click the **Info** field.

Editing a row

Click on the data you wish to edit and use the right-click menu to change the value.

Deleting a row

Right-click on the field you wish to delete and select **Delete Measurement**.

3.11.1 Speech editing options - graph view

When you right-click on a measurement in the graph, the following options appear:

Options	
Selected Point (e.g. WRS, Left, Live, AC)	If more than one symbol is at the same %/intensity, select the data point of interest from the drop down.
Delete Point	Deletes a selected data point.
Delete Curve	Deletes a selected data curve.
Insert No Response	This will overwrite the current symbol with a No Response symbol.
%	If needed, change the score.
All Correct score	Is shown if **Calculate 'All Correct' score** is enabled in the **Scoring and Playing** dialog.
Level	If needed, change the level.

Options	
Masking/Level2	Displays the effective masking level of the measurement point (dB EML).
Curve SNR	Displays the Signal to Noise ratio used for the entire curve (SNR).

When you right-click on a row in the graph legend, the following options appear:

Options	
Selected Point (e.g. WRS, Left, Live, AC)	Identifies the curve in the graph that you wish to edit.
Info	If needed, enter information of your choice.

3.12 Speech feature boxes

You can access a number of speech display options directly from the **Speech** main screen.

The display options can be turned on/off. To do so, select **Tools > Options > Speech**.

Feature boxes	
Pure Tone data	Displays the pure tone average for air conduction and bone conduction as well as the articulation index. The AI is calculated according to the "Count-the-dot" method.
Stenger	Displays the results of a speech Stenger test. • Scoring options are positive (+) or negative (-).

3.13 Terms and abbreviations used in Speech testing

SDT	Speech Detection Threshold
SRT	Speech Recognition Threshold
MCL	Most Comfortable Loudness Level
UCL	UnComfortable Loudness Level
WRS/SRS	Word Recognition Score/Sentence Recognition Score
	• **Score** Percentage of correct/incorrect words.
	• **Level** dB level at which the words were presented.
	• **[Msk]** Effective masking level (dB EML) used for contralateral masking.
	• **SNR** Signal-to-Noise Ratio.

PTA	Pure Tone Average
	• **PTA - AC** Pure Tone Average for Air Conduction thresholds.
	• **PTA - BC** Pure Tone Average for Bone Conduction thresholds.
AI	Articulation Index (%), based on the Count-the-dot method.

3.14 Special tests

3.14.1 Locally available special tests

Some special tests such as the QuickSIN and HörTech tests may be specific to language or local test protocols and are not included in OTOsuite but are available for adding to the OTOsuite Audiometry module. Contact your local supplier for further information.

3.14.2 Pediatric testing

The Pediatric test in the OTOsuite Audiometry Module is a tool that complements the regular Tone test in order to facilitate hearing testing on young children. The Pediatric test features built-in VRA control, combinations of Tone and Speech stimuli, as well as collecting the child's response to each stimulus presentation.

You can combine the unique Pediatric features with traditional MADSEN Astera² functionality such as FRESH noise, Talk to Assistant, and flexible control options to efficiently test this difficult-to-test age group.

Pediatric testing using VRA (Visual Reinforcement Audiometry) is aimed at testing children from approximately 7 months to 2½ years of age. You can perform testing either as a Tone test, a Speech test, or a combination of both, switching between the two types at your convenience to keep the child's attention.

When you present a stimulus, the child will turn its eyes or entire head towards the sound source. You can reward the child by activating a lighted mechanical toy placed near the sound source.

The purpose of the test is to estimate frequency- and ear-specific hearing sensitivity and hearing loss type with the result being an estimation of hearing thresholds based on minimum response levels (MRSLs) that are closely connected to perceptual thresholds.

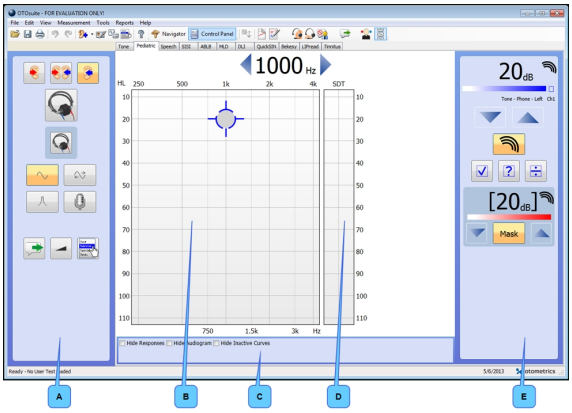
In order not to overly challenge the attention span of the child to be tested, it is extremely important that you have prepared software and equipment in advance. Also, it is important that you have a clear objective for the testing.

3.14.2.1 Navigating in the Pediatric test

Setting up for Pediatric testing

You can enable/disable a range of features, including VRA tools, for use in Pediatric testing. To do so, select **Tools > Configuration Wizard... > Configure... Audiometry**, and click next until the **Pediatric** configuration screen is shown. See Configuring the Audiometry Module ► 147.

The main screen



A. The control panel, where you adjust the settings required for testing. The **Pediatric** test screen has two main types of panels: The Control Panel and the Test Panel. See The Control and Test Panels ► 66

B. The audiogram area. See The audiogram area ► 68.

C. Curve Selection box with Graph Control buttons. See The Curve Selection box ► 69.

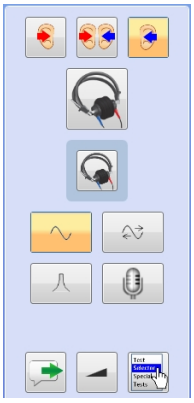
D. SDT results (Speech Detection Thresholds). See The audiogram area ► 68.

E. The Pediatric Test Panel, where you control the actual test. See The Control and Test Panels ► 66.

3.14.2.2 The Control and Test Panels

The Control Panel

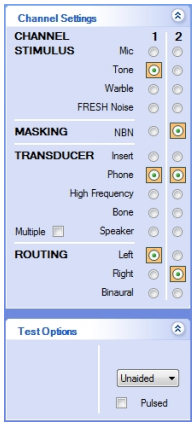
The Sunshine Panel without VRA



Use the Sunshine Panel to quickly select the main settings for testing.

See also The Sunshine Panel ▶ 23.

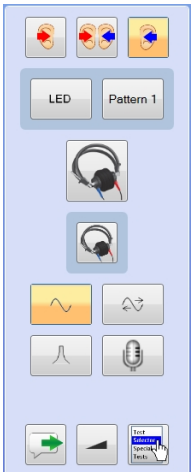
The Classic Control Panel without VRA



Use the Classic Control Panel to select more advanced settings for testing.

See also The Classic Control Panel ▶ 26.

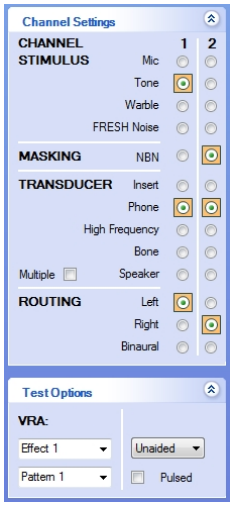
The Sunshine Panel with VRA



Click the buttons to toggle between selections.

> ***Note*** • *This example does not apply if you are using VRA with video reinforcement.*

The Classic Control Panel with VRA

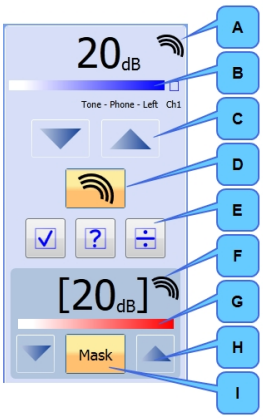


Select from the VRA drop-down lists in the **Test Options** panel.

The Test Panel

This is where you control the Pediatric test.

Without VRA



Stimulus control

A. Stimulus indicator (shows the stimulus being presented)

B. Stimulus bar (shows stimulus type, transducer, routing, test ear color)

C. Decrease or increase frequency

D. Enable or disable stimulus

Tracking response

E. Buttons for tracking responses: **Response**, **Questionable Response**, and **No Response**.

Masking

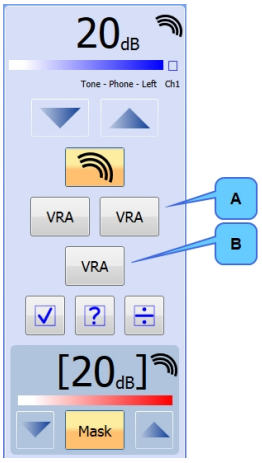
F. Masking indicator

G. Masking ear indicator

H. Decrease or increase masking level

I. Enable or disable masking

With VRA



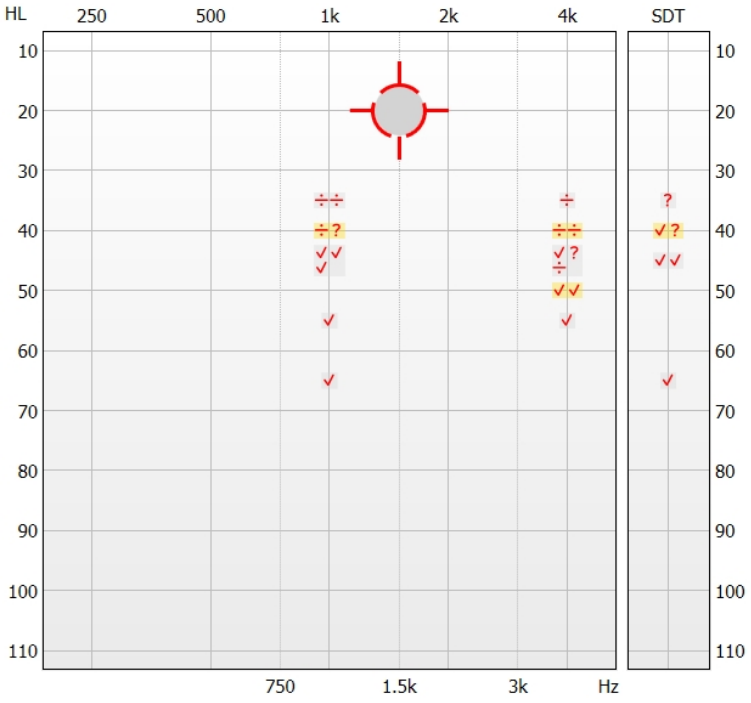
VRA controls

See Controlling and using VRA ► 68.

A. Activate/deactivate left or right VRA

B. Activate/deactivate center VRA

3.14.2.3 The audiogram area



The audiogram is tailored to accomodate tracking of responses with respect to the dB range and the frequency range shown.

The gray and yellow highlights serve to distinguish between the different 5 dB steps.

Editing and managing curves

Right-click on the symbols in the graph to edit responses and curves.

You can manage your curves in the curve selection box.

Configuring the audiogram area

You can configure the audiogram area:

- to increase the audiogram area to 6 kHz,
- to include the Speech Detection Thresholds.

See Configuring the Audiometry Module ► 147to set up these features.

3.14.2.4 Controlling and using VRA

The MADSEN Astera² supports specific VRA systems so that you can control them from the Audiometry Module. For further information please contact your supplier.

To enable using VRA, select **Tools > Configuration Wizard... > Configure... Audiometry**, and click next until the **Pediatric** configuration screen is shown. See also Configuring the Audiometry Module ► 147.

You can control the VRA functions from OTOsuite, from the keyboard, or from the ACP.

1. If needed, select the VRA reinforcement types in the **Control Panel**.
2. Use the on-screen VRA buttons in the Test Panel to activate/deactivate visual reinforcement.

3.14.2.5 The Curve Selection box

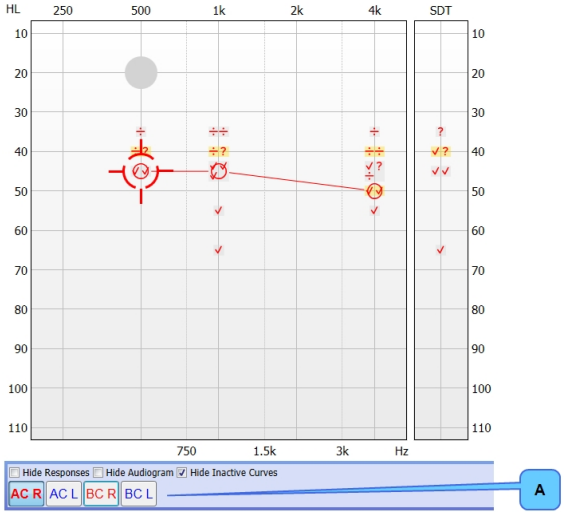
You can manage your curves in the Curve Selection box.

Response views

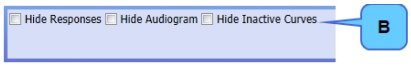
Every measurement condition, such as AC, BC, SF, ear side, etc., has its own response view in the audiogram. This prevents the audiogram from cluttering up, and allows you to analyze the progress of the test or to plot minimum responses as an audiogram curve.

A new response view is created automatically when you change measurement conditions.

In the example you can see the right ear AC responses, as well as the plotted curve.



A. Response views



B. Graph control buttons

Graph control buttons

The graph control buttons beneath the graph can be used to switch between the measurement conditions that were used during testing. The buttons select the view and set up the controls for the applicable measurement conditions so that you can quickly switch between the conditions used.

Measurements that are stored as binaural or non-ear specific are represented by both right and left graph control buttons.

You can hide or display the different symbols and curves depending on your current needs, e.g. during testing or post-analysis.

Graph Control buttons	
Hide Responses	Lets you view the audiogram curves more clearly without showing the responses.
Hide Audiogram	Lets you view the responses more clearly. This is particularly useful during post-analysis of the test progress.

Graph Control buttons	
Hide Inactive Curves	This is particularly useful when you want to focus on one test condition at a time.

3.14.3 SISI (Short Increment Sensitivity Index)

The SISI Test was developed by Jerger and co-workers (Jerger, Shedd, and Harford, 1959) and was introduced as a procedure that was reliable and reasonably objective.

The test consists of superimposing brief bursts of 1 dB intensity increments on a sustained tone presented monaurally through earphones at a sensation level of 20 dB at each tested frequency.

The patient is instructed to report any jumps in loudness detected while listening to the sustained tone for a period of about two minutes.

3.14.3.1 Navigating in SISI

The Control Panel

Channel	
Continuous ON	When checked, the stimulus will be continuously on and will turn off when you press the stimulus button.

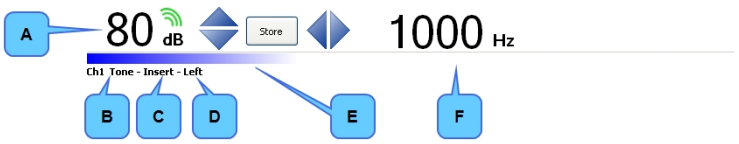
Transducer	
Insert	Presents the stimulus through the insert earphones.
Phone	Presents the stimulus through the headphones.
High Frequency	Presents the stimulus through the high frequency headphones.

Routing	
Left	Stimulus is routed to the left transducer.
Right	Stimulus is routed to the right transducer.

Test Options - SISI

Transducer	
dB Step	This determines the dB step size for the intensity of the stimulus when presenting the tone manually. Options are 1, 2, and 5.
SISI dB Step	This determines the dB step size for the intensity of the stimulus when presenting the tone automatically using the play button. Options are 1 (should be used for testing), 2, and 5.

SISI Stimulus Bar



A. Intensity
B. Stimulus indicator
C. Transducer indicator
D. Routing indicator
E. Stimulus bar color
F. Frequency

Intensity
Indicated by the dB level above the channel status bars. • The green wave symbol above the level indicates with two waves that the stimulus carrier tone is currently being presented, and with three waves that the increment is applied.

Stimulus bar color
Indicates the routing for the channel: • Blue = left ear • Red = right ear

Stimulus, transducer and routing indicators
Indicates the stimulus type, the transducer and the routing for each channel.

Test controls

Test controls provide a means of operating the audiometer if you use the mouse and on-screen options to perform tests.

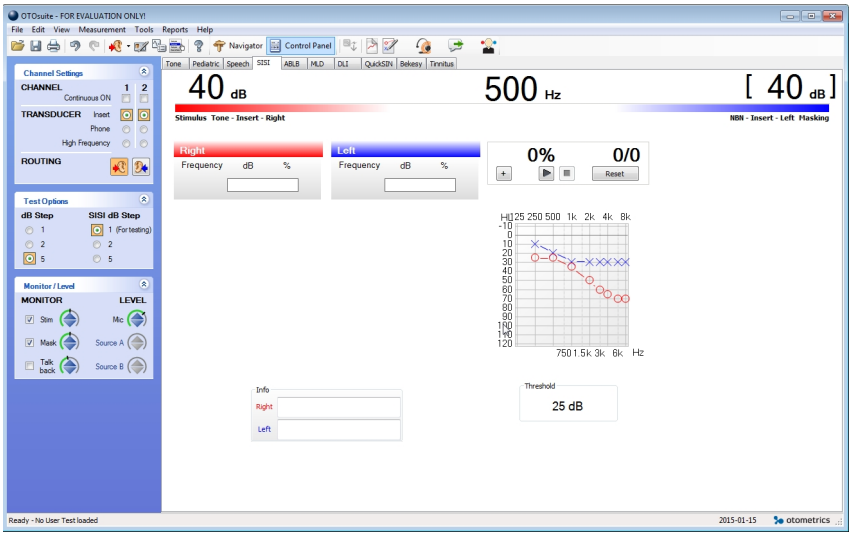
- To enable test controls, select **Tools > Options > Audiometry > General > On-screen controls**.

Controlling intensity and frequency, and storing data	
	• The **Arrow Up** button increases the intensity. • The **Arrow Down** button decreases the intensity.
	• The **Arrow Left** button decreases the stimulus frequency. • The **Arrow Right** button increases the stimulus frequency.
Store	• Stores the data point.

Scoring Level Intensity Change Recognition	
	• Click the **+** button each time the patient acknowledges that a change in intensity was heard
	• **Play** button Starts the test.

Scoring Level Intensity Change Recognition	
	• **Stop** button Stops the test.
Reset	• **Reset** button Resets the score to 0% and 0/0.
	The score box tracks the number of 1 dB intensity changes presented and the number of 1 dB intensity changes the patient heard. The percentage is a ratio of the number of intensity changes heard compared to the number of intensity changes presented.

SISI data



Data display in SISI screen	
Frequency	• The frequency which was presented.
dB	• The intensity.
%	• The score.
Audiogram	• Displays pure tone audiogram.
Threshold	• Displays pure tone average.

SISI editing options

Editing options	
Delete	• Deletes the data for a particular frequency for a particular ear.
Delete all	• Deletes the data for all the frequencies for a particular ear.

3.14.3.2 The test process

The audiometer produces an intensity increment every 5 seconds. Each increment has a rise time of 50 msec, a duration at full strength of 200 msec, and a decay time of 50 msec. The size of the increment can be varied from 0 to 5 dB in 1 dB steps (selected on-screen from the Increment box), although the test is scored only on the percentage of 1 dB increments correctly identified by the patient. Twenty 1 dB increments are presented during the test. If the subject responds 10 times out of the 20 1 dB increments, the sensitivity index is 50%.

Before starting the test

Before starting the test, present five 5 dB increments to give the patient a noticeably intense increment to respond to.

3.14.4 ABLB (Alternate Binaural Loudness Balance)

This test was first described by Fowler (1928).

Hearing levels at which a pure tone sounds equally loud to both ears of a subject are compared.

The test is applicable when there is a difference in hearing loss of at least 20 dB between the two ears at the pure-tone test frequency.

3.14.4.1 Navigating in ABLB

The Control Panel

Channel	
Continuous ON	When checked, the stimulus will be continuously on and will turn off when you press the stimulus button.

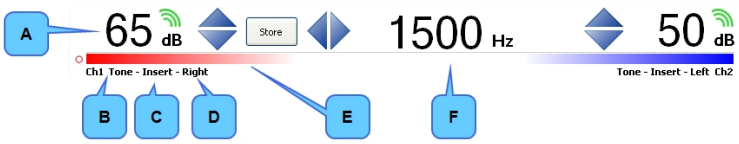
Transducer	
Insert	Presents the stimulus through the insert earphones.
Phone	Presents the stimulus through the headphones.
High Frequency	Presents the stimulus through the high frequency headphones.

Routing	
Left	Left transducer is considered the ABLB test ear.
Right	Right transducer is considered the ABLB test ear.

Test Options - ABLB

Transducer	
dB Step	This determines the dB step size for the intensity of the reference stimulus tone. Options are 1, 2, and 5.
ABLB dB Step	This determines the dB step size for the intensity of the ABLB test stimulus. Options are 1 (should be used for testing), 2, and 5.

ABLB Stimulus Bar



A. Intensity
B. Stimulus indicator
C. Transducer indicator
D. Routing indicator
E. Stimulus bar color
F. Frequency

Intensity
Indicated by the dB level above the channel status bars. • The green triple wave symbol above the level indicates that the stimulus is currently being presented.

Stimulus bar color
Indicates the routing for the channel: • Blue = left ear • Red = right ear

Stimulus, transducer and routing indicators
Indicates the stimulus type, the transducer and the routing for each channel.

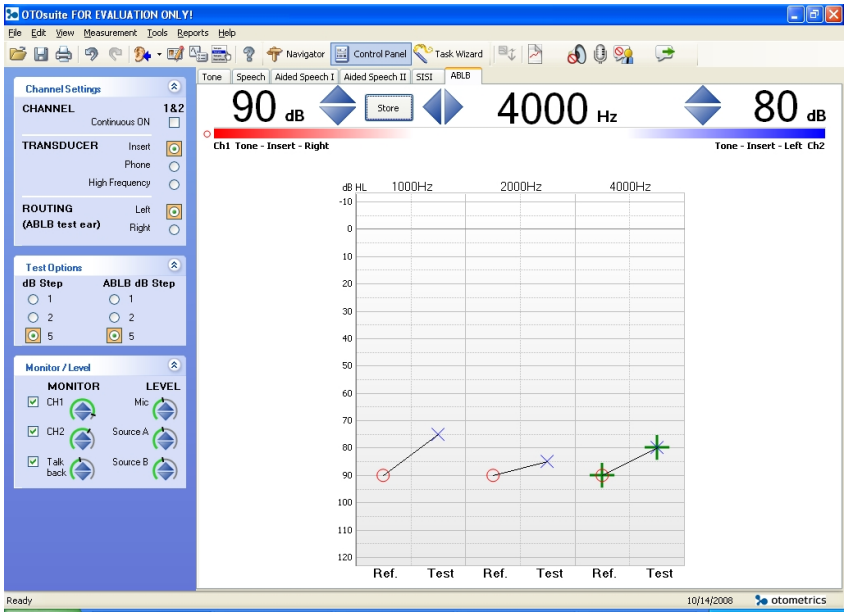
Test controls

Test controls provide a means of operating the audiometer if you use the mouse and on-screen options to perform tests.

- To enable test controls, select **Tools > Options > Audiometry > General > On-screen controls**.

Controlling intensity and frequency, and storing data	
	• **Arrow up** increases the intensity. • **Arrow down** decreases the intensity.
	• **Arrow left** decreases the stimulus frequency. • **Arrow right** increases the stimulus frequency.
Store	• Stores the data point.

ABLB data

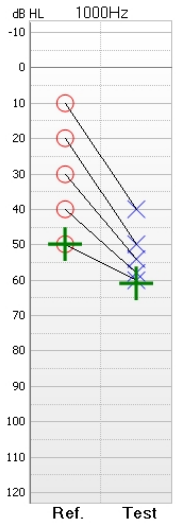


Data display in ABLB screen	
Frequency column	• Each frequency displays low to high intensity from top to bottom.
Ref	• The ear that is considered to be the reference ear. A steady tone at a particular intensity is presented to this ear.
Test	• The ear that is considered the test ear. A steady tone with adjustable intensity is presented to this ear until equal loudness with the reference ear is determined.

ABLB editing options

Editing options	
Selected point	• e.g. 1000 Hz (90/75) dB
Delete Selected measurement	• Deletes the data for the frequency that is currently displayed.
Delete all at x (e.g. 1000) Hz	• Deletes the data for that particular column when the frequency is currently set differently from that column.

3.14.4.2 The test process



Tones are presented alternately to both ears, and the patient is asked to make an equal loudness judgment.

3.14.5 MLD (Masking Level Difference)

The MLD test is a measure of the masking needed to completely mask the test tone when the tone and the masking noise is in phase between both ears (SONO), compared with a condition when either the tone is 180 degrees out of phase between the ears (SπNO) or the masking noise is (SONπ).

The difference in MLD threshold is automatically calculated when the necessary data for the different conditions are stored.

3.14.5.1 Navigating in MLD

In the MLD Control Panel you can start and stop the stimulus with **Continuously On**, select air conduction transducer with the **Insert**, **Phone** or **High Frequency** selections, set the stimulus increment size with **dB Step** and **Pulse** lets you choose whether to pulse the tone signal.

You can also select the MLD test conditions SONO, SπNO or SONπ.

The section for **Monitor / Level** is common for all the audiometer test types.

The Control Panel

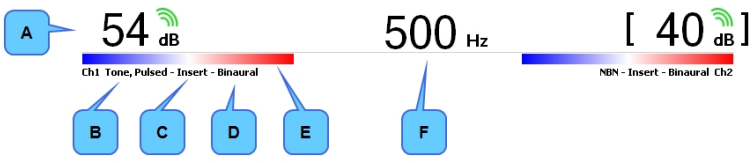
Channel	
Continuous ON	When checked, the stimulus will be continuously on and will turn off when you press the stimulus button (the **Continuous on** buttons on the ACP, the N(Ch1) and M (Ch2) keys on the keyboard).

Transducer	
Insert	Presents the stimulus through the insert earphones.
Phone	Presents the stimulus through the headphones.
High Frequency	Presents the stimulus through the high frequency headphones.

Test Options - MLD

Test Options - MLD	
Signal (Ch1) dB Step	This determines the dB step size for the intensity of the tone signal. Options are 1, 2, and 5.
Noise (Ch2) dB Step	This determines the dB step size for the intensity of the noise signal. Options are 1, 2, and 5.
Presentation	This determines the MLD test condition: SONO, SπNO or SONπ. Toggles to the next condition, when you store data.
Pulsed	This determines whether you pulse the tone signal.

MLD Stimulus Bar



A. Intensity
B. Stimulus indicator
C. Transducer indicator
D. Routing indicator
E. Stimulus bar color
F. Frequency

Intensity
Indicated by the dB level above the channel status bars. • The green triple wave symbol above the level indicates that the signal is currently being presented.

Stimulus bar color
Indicates the routing for the channel: • Blue/Red = Binaural

Stimulus, transducer and routing indicators
Indicates the stimulus type, the transducer and the routing for each channel.

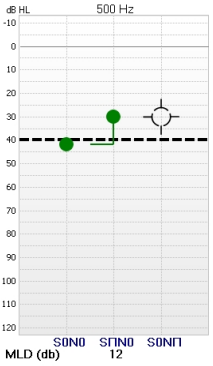
Test Controls

Test controls provide a means of operating the audiometer if you use the mouse and on-screen options to perform tests.

- To enable test controls, select **Tools > Options > Audiometry > General > On-screen controls**.

Controlling intensity and frequency, and presenting and storing data	
	• **Arrow up** increases the intensity. • **Arrow down** decreases the intensity.
	• **Arrow left** decreases the stimulus frequency. • **Arrow right** increases the stimulus frequency.
Present	• Presents the signal.
Store	• Stores the data point.

The MLD graph



MLD editing options

Editing options	
Delete selected measurement	• Deletes the selected data point.
Delete all at xx Hz	• Deletes all data for the currently selected frequency.
Cancel	• Closes the window.

3.14.5.2 The test process

1. Establish and store the hearing threshold with the SONO condition.
2. Maintain the noise level and re-establish the threshold using either the SπNO or SONπ condition.
3. The MLD is calculated automatically.

3.14.6 DLI (Difference Limen Intensity)

This DLI test was developed by Zwislocki and Lüscher (1949) and was introduced as a procedure for establishing the test subject's capability of detecting small variations of intensity in a tone signal.

The test consists of superimposing brief bursts of 0.2 to 5 dB intensity increments (DeltaL) on a sustained tone presented monaurally through earphones at a sensation level of 20 dB at each tested frequency.

The patient is instructed to report any variations in loudness detected while listening to the continuous tone. The intensity increments should be changed every 3 seconds, and the result of the test is the smallest dB increment that could be detected.

3.14.6.1 Navigating in DLI

The Control Panel

Channel	
Continuous ON	When checked, the stimulus will be continuously on and will turn off when you press the stimulus button (the **Continuous on** button on the ACP, the N (Ch1) or M (Ch2) key on the keyboard).

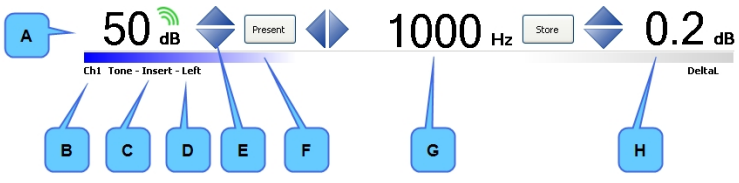
Transducer	
Insert	Presents the stimulus through the insert earphones.
Phone	Presents the stimulus through the headphones.
High Frequency	Presents the stimulus through the high frequency headphones.

Routing	
Left	Stimulus is routed to the left transducer.
Right	Stimulus is routed to the right transducer.

Test Options - DLI

Transducer	
dB Step	This determines the dB step size for the intensity of the stimulus when presenting the tone manually. Options are 1, 2, and 5.
DeltaL	This determines the dB step size for the intensity of the stimulus when presenting the tone automatically using the **Play** button. Options are 0, 0.2, 0.4, 0.6, 0.8, 1, 2, 3, 4 and 5. Use the right **Attenuator** knob on the ACP, or use Shift+Arrows Up/Down on the keyboard to set the DeltaL.

DLI Stimulus Bar



A. Intensity
B. Stimulus indicator
C. Transducer indicator
D. Routing indicator
E. Test level
F. Stimulus bar color
G. Frequency
H. DeltaL

Intensity
Indicated by the dB level above the channel status bars. • The green wave symbol above the level indicates with two waves that the stimulus carrier tone is currently being presented, and with three waves that the increment is applied.

Stimulus bar color
Indicates the routing for the channel: • Blue = left ear • Red = right ear

Stimulus, transducer and routing indicators
Indicates the stimulus type, the transducer and the routing for each channel.

Test Controls

Test controls provide a means of operating the audiometer if you use the mouse and on-screen options to perform tests.

- To enable test controls, select **Tools > Options > Audiometry > General > On-screen controls**.

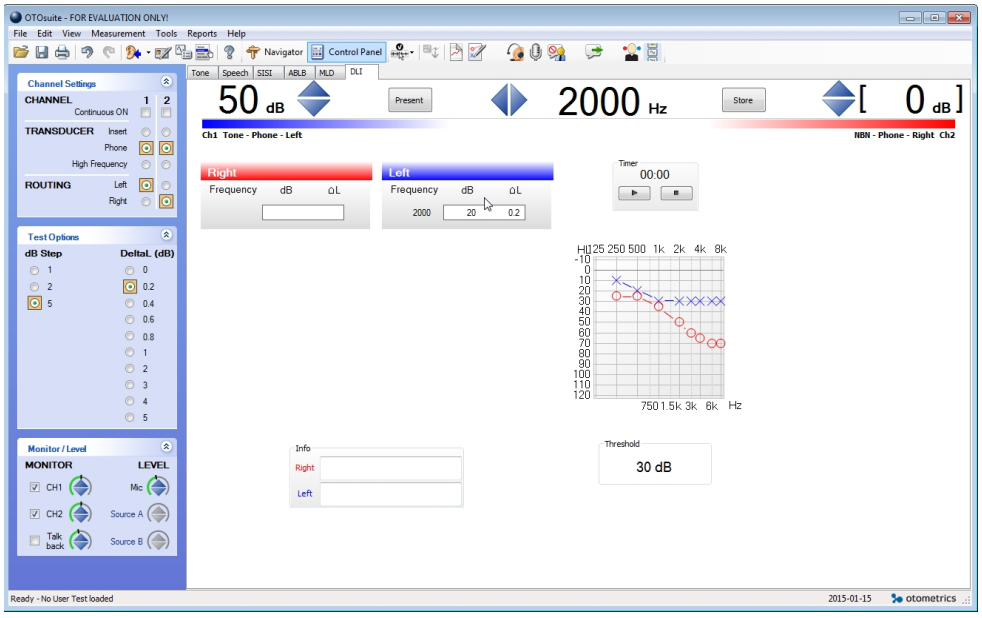
Controlling intensity and frequency, and storing data	
	• The **Up arrow** increases the base line intensity. • The **Down arrow** decreases the base line intensity.
	• The **Arrow left** decreases the stimulus frequency. • The **Arrow right** increases the stimulus frequency.
Store	• Stores the data point.

DeltaL up and down arrows	
	• The **Up arrow** increases the DeltaL modulation size. • The **Down arrow** decreases the DeltaL modulation size.

Scoring Level Intensity Change Recognition	
	**Player/Timer box** • The timer is used for keeping track of when to change the **DeltaL**.
	• **Play button** Starts the test and the timing.

Scoring Level Intensity Change Recognition	
	• **Stop button** Stops the test and the timing.
	• **Reset button** Resets the timer.

DLI data



Data display in DLI screen	
Frequency	• The frequency which was presented.
dB	• The level/intensity.
ΔL	• DeltaL - the result.
Audiogram	• Displays puretone audiogram.
Threshold	• Displays puretone average.

DLI editing options

Editing options	
Delete	• Deletes the data for a particular frequency for a particular ear.
Delete all	• Deletes the data for all the frequencies for a particular ear.
Cancel	• Closes the window.

3.14.6.2 The test process

The audiometer produces four intensity increments per second. Each increment has a rise time of 50 msec, a duration of 75 msec, and a decay time of 50 msec. The size of the increment (DeltaL) can be varied from 0 to 5 dB in steps (selected e.g. on-screen from the **DeltaL (dB)** selection list in the **Test Options** box).

During the test the **DeltaL** is decreased every 3 seconds until the patient no longer hears any changes in the signal, and the last registered **DeltaL** is stored as the result. The procedure should be repeated in order to verify the result.

3.14.7 Békésy (OTOsuite Bekesy audiometry)

Purpose of the test

Bekesy audiometry is a type of self-recording audiometry. The patient is presented with a stimulus, which decreases while the patient keeps the button pressed, and increases when the patient releases the button. The patient's threshold will be established as located between the points where the patient presses and releases the button.

The test uses both pulsed and steady tones.

Results may suggest middle-ear, cochlear, or eighth nerve lesions.

Description of the test

In OTOsuite you can carry out Bekesy testing in two different modes. Each mode has its own test screen and you can use the toolbar button to switch screens. The applicable screen is automatically selected when you start a test.

- Sweep frequency

  This is the traditional method where the response tracings resulting from a pulsed and a steady stimulus can be compared for differential diagnostics. (The Jerger Method.)

- Fixed frequency

  The level is increased and decreased without changing the frequency until the predefined number of level cycles is reached.

  An average threshold level is calculated and plotted in an HL audiogram and can be stored as a regular audiogram.

References

Békésy G v, 1947. A new audiometer. *Acta Otolaryngol* (Stockholm) 35, p 411-422

Jerger J, 1960. Békésy audiometry in analysis of auditory disorders. *J Speech Hear Res 3*, p 275-287.

3.14.7.1 The test process

Preparing the patient

Instruct the patient in how the test progresses:

- The patient will hear a soft tone that is either pulsed or steady.
- The patient must keep the responder button pressed for as long as the tone can be heard.
- The patient must release the button immediately when the tone cannot be heard any longer.
- The patient must press the button as soon as the tone can be heard again.
- The stimulus can change to the other ear.

Carrying out the test

Start the test either by clicking the **Test All Frequencies** button or the **Test Single Frequency** button in the **Control Panel**.

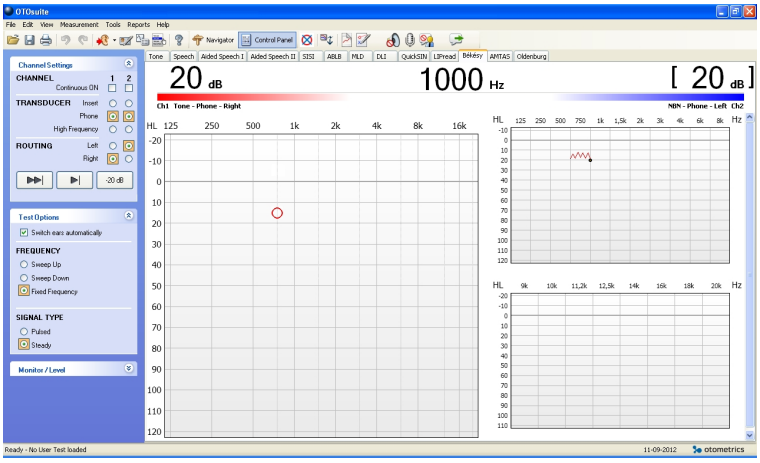
Test functions	
	Test All Frequencies button Runs a complete test including all the test frequencies selected in the **Options** dialog.
	Test Single Frequency button Runs a limited test covering the currently selected audiometer frequency. This can be used e.g. for retesting a certain portion of the test, if needed.
	Drop 20 dB button Use the **-20 dB** button to instantly drop the level. This can be used if there is suspicion of malingering or psychogenic hearing loss. When you drop the level by 20 dB, the patient should stop responding instantly since the tone is presumably inaudible. The level will then gradually increase again and the test sequence will be resumed as soon as the patient starts responding again.
	**Talk Forward icon** Use the **Talk Forward** function to instantly stop the test. Disable the **Talk Forward** function to continue the test.

3.14.7.2 The test result

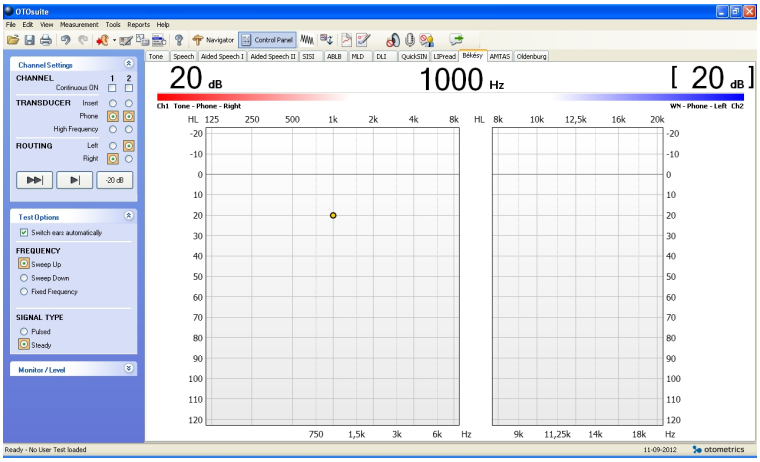
Test results are shown as plotted results.

Fixed Frequency results

For the Fixed Frequency test the results will be stored as an HL audiogram when you save the results.



Sweep Frequency results



3.14.8 LIPread

The OTOsuite LIPread speech test is designed to integrate multi-modal speech tests for playback in the OTOsuite software.

The purpose of the LIPread test is to test a person's ability to understand speech with and without visual cues and noise.

The test consists of video presentations where the patient is prompted to repeat as much as possible of the sentences presented. The test can be presented with and without sound or video so that lipreading ability can be assessed for rehabilitation purposes.

When OTOsuite is used as a NOAH module, all historical LIPread data is always available on the screen and in reports so that the patient's progress can be followed over time.

Intended use

The OTOsuite LIPread speech test is intended for use in connection with hearing habilitation/rehabilitation performed by audiologists, speech therapists and other trained personnel.

System overview

- Testing in OTOsuite is supported by MADSEN Astera².
- OTOsuite with the module for performing the LIPread test is supplied on the OTOsuite Installation disk
- The LIPread speech material is supplied on a separate disk.

Installation

For instructions on installing OTOsuite, see the OTOsuite Installation Guide which is inserted in the OTOsuite Installation box, and the OTOsuite Reference Manual.

Whether you install OTOsuite or the LIPread speech material first is of no consequence.

1. When you have installed OTOsuite and the LIPread speech material, enter the LIPread license key in the OTOsuite Configuration Wizard. Select **Tools > Configuration Wizard...** and click the **Configure** button next to **Audiometry**.
2. Click **Next** until you reach the screen for entering license keys and enter the license key.
3. If the **LIPread** tab is not shown in OTOsuite, enable viewing the tab in the **Configuration Wizard**.

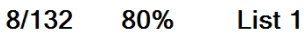
3.14.8.1 Navigating in LIPread

For general information about navigating in the test screen, see also the OTOsuite User Guide.

The main screen consists of

- a **Scoring Counter** at the top of the screen. See The LIPread Scoring Counter ► 85
- a **Player Panel** for selecting speech lists and controlling the test. See The LIPread Player Panel ► 85
- a **List View** for viewing and scoring in the selected list during presentation. See The LIPread List View ► 86.
- a **Results Table** for viewing and comparing the results. See The LIPread Results Table ► 87.

3.14.8.2 The LIPread Scoring Counter



During playback and scoring, the **Scoring Counter** at the top of the screen shows

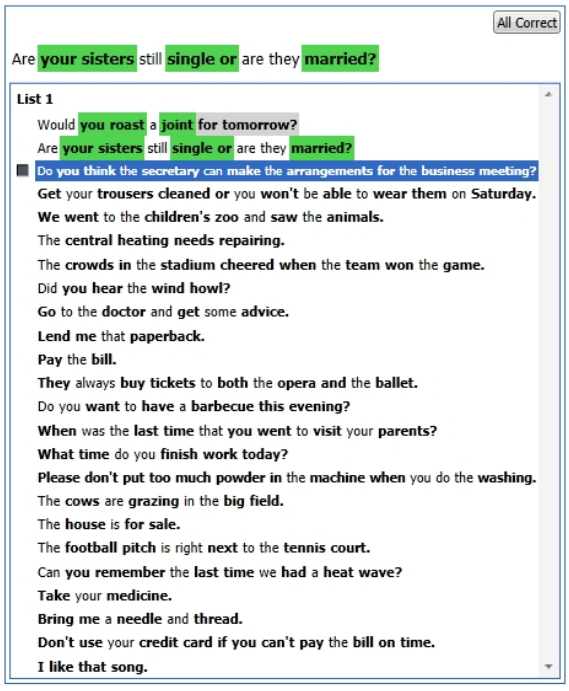
- the number of words in the list scored correctly of the total number of words in the list
- the percentage of correctly scored words
- the list currently being presented.

3.14.8.3 The LIPread Player Panel

The **Player Panel** is a group of buttons enabling you to control the test. You can select the speech list for the test, and you can play, pause, resume, and stop the test.

Player Panel	
	• **Play** During the test: – the **List View** shows only the speech list that has been selected for the current test. – you can click on any sentence to jump freely in the selected speech list. – click the **Play** button to play back the selected sentence.
	• **Stop** Stops play-back of the current sentence.
	• **Store** Terminates the test and stores the result.
	• **Reset** Terminates the test without storing any results.
	• **List selection** drop-down list Click the drop-down to select which speech list to use in the test.

3.14.8.4 The LIPread List View



When you start play-back of the selected speech list, the **List View** shows the selected lists.

Each sentence in a list has a number of highlighted key words that can be scored as **Correct** or **Incorrect**.

Words that can be scored are displayed in **bold type**.

The sentence being presented is shown at the top of the list. This is where you score correctly repeated words by clicking on them.

- When you score a word as **Correct**, it is highlighted in green.
- When you score a word as **Incorrect**, it is highlighted in grey.

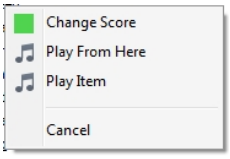
Practice List

For practicing the test flow so that the client is familiar with the procedure before the actual test starts. Results from a practice list cannot be stored.

During play-back

An icon to the left of the sentence that is being presented shows the status.

Editing



- You can right-click on a word to change the score or control the play-back of the word list.
- You can either play back a single item or select a place in the list where you want to start the play-back.

Scoring

The key words are scored after play-back of each sentence. The key words to be scored are shown in **BOLD** type.

To score a word, click on it.

You can change a previous score by right-clicking the word and selecting **Change Score**.

3.14.8.5 The LIPread Results Table

During review (when the Player is in idle mode), the **List View** shows all lists that have been included in the **Results** table.

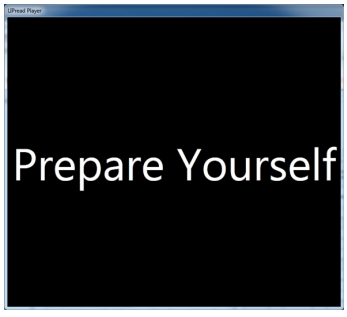
You can add a comment of your own choice next to each test.

Results Table	
Ear	Shows which ear was tested.
%	Indicates the correct score.
dB	Shows the stimulus and masking levels used in the test.
List	Shows the number of the tested list.
Info	Displays the test conditions, for example whether sound was muted or video was included, etc.
Date and Comments	Displays the date of the test and any comments you may have entered.

3.14.8.6 Preparing for LIPread testing

Preparing OTOsuite

1. Click on the **LIPread** tab in the **Audiometry** module.
2. Set up the test to suit your purposes: select **Tools > Options > Audiometry**.
   - You can select whether to play the video instantly, or whether to briefly display specific screens in order to prepare the patient for the next presentation or present a topic cue for the next presentation.



– You can disable sound in order to assess the patient's ability to lipread.

3. Select the speech list.

   The list can be presented either through earphones or sound field loudspeakers.

4. Click the **List Selection** button to expand and select the list you wish to include in the test.

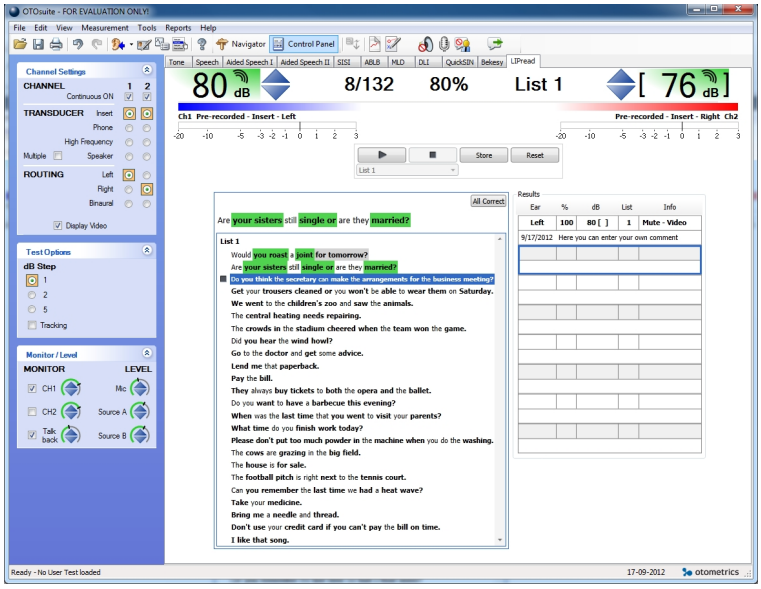
5. Test monaurally or binaurally. Insert earphones are recommended for monaural testing. Their high interaural attenuation typically makes masking of the non-test ear unnecessary.

Preparing the patient

You can use a practice lists to familiarize the patient with the test protocol.

1. Instruct the patient to repeat the sentences that are presented during the test.

3.14.8.7 The test process



1. Select the desired test list in the player.
2. Present the test with earphones or in a sound field.
3. Instruct the patient in how to respond to the presented material.
4. Score the key words highlighted in each sentence by clicking the words on the screen. You can also enter a full sentence score by clicking the **All Correct** button.
5. You can store results in the **Results Table** by clicking the **Store** button.
6. Click the table to review scoring data.

3.14.9 Tinnitus

3.14.9.1 Navigating in Tinnitus

The Control Panel

Channel Settings	Description
Continuous ON	The stimulus is continuously on and turns off when you present the stimulus.
SIGNAL	
• **Tone**	Presents a pure tone as the stimulus type. • 125 Hz to 12,500 Hz is standard, • 12,500 to 20,000 Hz is optional.
• **Warble**	Presents a warbled pure tone as the stimulus type. This stimulus type should be used for sound field testing to avoid any standing waves.
• **FRESH Noise**	Presents the customized FRESH noise as the stimulus type.[ab] FRESH stands for FREquency Specific Hearing assessment noise.
• **NBN**	Presents Narrow Band Noise as the stimulus type.
• **WN**	Presents White Noise as the stimulus type.
TRANSDUCER	
• **Insert**	Presents the stimulus through the insert earphones.
• **Phone**	Presents the stimulus through the headphones.
• **High Frequency**	Presents the stimulus through the high frequency headphones.
ROUTING	
• **Left**	Stimulus is routed to the left transducer.
• **Right**	Stimulus is routed to the right transducer.
• **Binaural**	Stimulus is routed to both right and left transducer.

Test Options	Function
• **dB Step**	This determines the dB step size for the intensity of the stimulus when presenting the tone manually.
• **Pulsed**	Presents the stimulus as a pulsed tone.

[a] The FRESH noise is implemented according to specifications of "Stimuli for Sound Field Audiometry: A Response to Lippmann and Adams", G. Walker and H. Dillon, 1984 in Journal of Speech and Hearing Disorders, p 219, and H. Dillon (2008), personal communication.

[b] For more information read: "Narrow Band Noise Audiometry: The Effect of Filter Slope", Daneil J. Orchik and Nancy L. Mosher, 1975 in The Journal of American Audiology Society, Vol. 1, No. 2, p. 50-53.

Test Options	Function
• **Hz Step**	This determines the dB step size for the intensity of the stimulus when presenting the tone automatically using the Play button.
Residual Inhibition Player - Noise: 1 m	The amount of time the tinnitus is absent after 60 seconds of noise stimulation at Minimum Masking Level + 10 dB.

Tinnitus Stimulus Bar

A. Intensity
B. Stimulus indicator
C. Transducer indicator
D. Routing indicator
E. Stimulus bar color
F. Frequency
G. +/- 1 octave buttons

Function	Description
A. Intensity	Indicated by the dB level above the channel status bars. • The green wave symbol above the level indicates with two waves that the stimulus carrier tone is currently being presented, and with three waves that the increment is applied.
B. Stimulus indicator	Indicates the stimulus type for the channel.
C. Transducer indicator	Indicates the transducer for the channel.
D. Routing indicator	Indicates the routing for the channel.
E. Stimulus bar color	Indicates the routing for the channel: • Blue = left ear • Red = right ear.
F. Frequency	Indicates the current frequency.
G. +/- 1 octave buttons	Allows octave confusion testing without having to manually find the frequency.

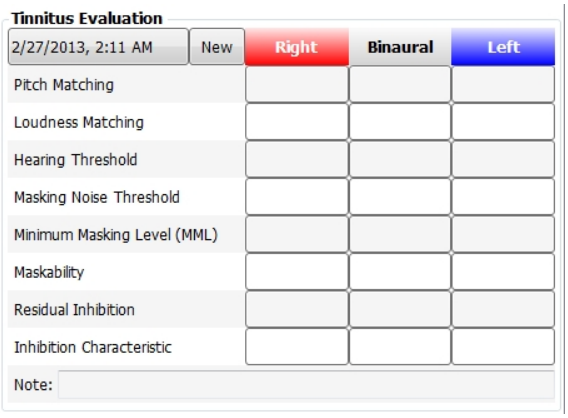
The audiogram

The audiogram shows the patient's most current audiogram at the time of the evaluation.

Pitch and loudness data is plotted with a T symbol at the applicable level and frequency. This symbol also shows in the Tone test audiogram and is included in Tone audiogram reports.

Tinnitus Evaluation table

The Tinnitus Evaluation table always shows the most recent data as default. You can also click the button showing evaluation date and time to review historical data.



Data display in Tinnitus screen	
Evaluation date and time	Click to see a list of historical Tinnitus evaluations for the selected patient.
New	Clears the Tinnitus Evaluation table and creates a new table.
Pitch Matching	The patient compares the pitch of the tinnitus with the pitch of a presented signal. The signal is adjusted up or down in frequency until the patient reports a match between them. The signal frequency (Hz) is reported as the result.
Loudness Matching	The patient compares the loudness of the tinnitus with the loudness of the presented signal. The signal is adjusted up or down in level until the patient reports a match between them. The signal level (dB) is reported as the result.
Hearing Threshold	Tinnitus matched to non-audiometric frequency does not have corresponding hearing threshold in the audiogram. Here you can measure and enter the patient's perceived hearing threshold for the tinnitus frequency. This threshold allows for displaying the tinnitus loudness in dB SL (sensation level).
Masking Noise Threshold	The minimum level at which the patient can detect the masking noise signal.
Min. Masking Level (MML)	The mimimum level where the masking noise masks the tinnitus.
Maskability	Descriptor of the perceived degree of masking.
Residual Inhibition	The amount of time the tinnitus is absent after 60 seconds of noise stimulation at Minimum Masking Level + 10 dB
Inhibition Characteristic	Descriptor of perceived residual inhibition.
Note	Enter you comments or notes such as hyper-acusis, fluctuating, etc.

Tinnitus editing options

Right-click values in the Tinnitus Evaluation table for measurement information. Here you can also delete the data.

Tinnitus Questionnaires

See Tinnitus questionnaires ► 92.

3.14.9.2 Tinnitus questionnaires

Standardized tinnitus questionnaires are used to obtain a global index score of a patient's perceived tinnitus severity, and many questionnaires are available for this purpose (C. W. Newman & Sandridge, 2004). A tinnitus-severity index score from a tinnitus questionnaire, however, should not be relied on as the sole indicator of the degree to which tinnitus affects a patient's life.

A tinnitus questionnaire provides a standardized baseline of the patient's perceived problem due to tinnitus, and it is essential to acquire this baseline prior to any testing or counseling.

Types of questionnaires

The Tinnitus questionnaires are available in a number of languages.

- **THI (Tinnitus Handicap Inventory)**

  The purpose of the THI questionnaire is to establish the severity of the patient's Tinnitus problems.

  The Tinnitus Handicap Inventory (C. W. Newman et al., 1996) is one of the most widely used and best documented of the tinnitus questionnaires that currently are available.

  The THI can serve as the primary outcome instrument. Patients should complete the THI to assess outcomes at intervals (e.g., every 3 months) during ongoing intervention, and prior to terminating intervention.

  The THI contains 25 statements, and response choices are "no" (0 points), "sometimes" (2 points), and "yes" (4 points). The index score ranges from 0 to 100. Handicap severity can be categorized based on the THI index score as follows (Handscomb, 2006):

  – Severe (58–100)
  – Moderate (38–56)
  – Mild (18–36)
  – No handicap (0–16)

  A change in the total index score of at least 20 points has been reported to indicate a statistically and clinically significant change in self-perceived tinnitus handicap (C. W. Newman & Sandridge, 2004).

  The THI would be helpful in selecting those patients with tinnitus most in need of intervention.

  – *References THI*

    Newman, C.W., Jacobson, G.P., & Spitzer, J.B. (1996). Development of the Tinnitus Handicap Inventory. Archives of Otolaryngology, 122, 143-148.

    Newman, C.W., Sandridge, S.A., Jacobson, G.P. (1998). Psychometric adequacy of the Tinnitus Handicap Inventory (THI) for evaluating treatment outcome. Journal of the American Academy of Audiology, 9, 153-160.

- **TFI (Tinnitus Functional Index)**

  The Tinnitus Functional Index (TFI) has documented validity both for scaling the severity and negative impact of tinnitus for use in intake assessment and for measuring treatment-related changes in tinnitus (responsiveness). It provides comprehensive coverage of multiple tinnitus severity domains.

  – *References TFI*

    Meikle MB, Henry JA, Griest SE, Stewart BJ, Abrams HB, McArdle R, Myers PJ, Newman CW, Sandridge S, Turk DC, Folmer RL, Frederick EJ, House JW, Jacobson GP, Kinney SE, Martin WH, Nagler SM, Reich GE, Searchfield G, Sweetow R, Vernon JA. (2012). The tinnitus functional index: development of a new clinical measure for chronic, intrusive tinnitus. Ear Hear. Mar-Apr;33(2):153-76.

    http://www.ohsu.edu/xd/health/services/ent/services/tinnitus-clinic/tinnitus-functional-index.cfm

- **THS (Tinnitus and Hearing Survey)**

  The Tinnitus and Hearing Survey is a brief questionnaire designed specifically to assist patients and clinicians in determining how much of a patient's reported problem is due to tinnitus and how much is due to hearing problems. The survey also contains two items that screen for sound tolerance problems.

  The THS is not a validated outcome instrument, and therefore should not be used as a primary measure of outcome of intervention. The THS was designed to differentiate tinnitus-specific versus hearing-specific problems.

  The THS contains three sections.

  – Section A includes four statements that address tinnitus-specific problems unrelated to hearing problems.

  – Section B contains four statements that focus on common hearing problems. The Section B statements are phrased to minimize any perceived effects of tinnitus on hearing function. Higher scores for Section A indicate a tinnitus-specific problem, whereas higher scores for Section B indicate a hearing problem. Results of this survey, along with results of the hearing evaluation, provide the clinician with the information needed to differentiate tinnitus- specific problems from hearing problems.

  – Section C asks patients if they have sound tolerance problems. Affirmative responses to Section C should be discussed with patients to determine the potential need to focus on treating the sound tolerance problem before continuing with Tinnitus management counceling.

  After completing the THS, patients should understand that the problems listed in Section A are problems that can be addressed with tinnitus management. Section B problems can be addressed with intervention specific to hearing, regardless of the cause of the hearing problem. Section C addresses possible sound tolerance problems.

  – *References THS*
    http://www.ncrar.research.va.gov/Education/Documents/TinnitusDocuments/Index.asp.

Using questionnaires

1. Click one of the **Questionnaires** buttons to access a questionnaire. To access a different one, right-click on the questionnaire button and select from the right-click menu.

   When you select a questionnaire from one of the lists, the name of that questionnaire is then shown as the new name of the button.

   A questionnaire viewer opens and displays the questionnaire.

   All relevant patient and tester data is entered automatically at the top of the questionnaire.
2. Click the relevant selections. The selections will be circled in green.
3. When the selections have been made, the score with a description of the severity is shown at the end of the questionnaire.
4. To save and close the questionnaire click the red X-button in the top right corner.

   The questionnaire is now listed in the **Questionnaire** field.

Reviewing or editing a questionnaire

- If you wish to review or edit the questionnaire, click the relevant row in the **Questionnaire** field to open the questionnaire viewer. If needed, you can change any values.

Selecting a new questionnaire

- To select another questionnaire, right-click on the button and select a new one from the list.

Deleting a questionnaire

- To delete a questionnaire, right-click on the relevant row in the **Questionnaire** field and select **Delete**.

Printing a questionnaire

- To print a questionnaire, click the **Print** icon in the top left corner of the questionnaire viewer.

3.14.10 TEN (Threshold-Equalizing Noise)

Purpose of the test

The TEN test is a tool for identifying dead regions (regions with no functioning inner hair cells and/or neurones) in the cochlea. Dead regions can be difficult to determine with standard pure-tone audiometry. Persons with dead regions may not benefit from hearing instrument amplification in those regions, and amplification may even reduce speech intelligibility. However, people with high-frequency dead regions may have some benefit from amplification for frequencies up to approximately 70% higher than the "edge frequency" of a dead region.

When the pure-tone signal frequency falls in a dead region, the signal will only be detected when it produces sufficient basilar membrane vibration at a remote region in the cochlea where there are surviving inner hair cells and neurons. The amount of vibration produced by the tone at this remote region will be less than in the dead region, and so the noise will be very effective in masking it. Thus, the signal threshold is expected to be markedly higher than normal.

Procedure

1. Select **Tone** in the Audiometry Module.
2. Perform a pure-tone test to register a pure-tone audiogram.
3. In **Tone**, select **TEN** as masking noise, and route it ipsi-laterally so that both the tone and noise are presented in the test ear.

   The stimulus for each frequency of the pure-tone signal is presented at a level 10 dB above the established threshold.

   For frequencies where the hearing loss is less than or equal to 60 dBHL, set the TEN level to 70 dBHL. This is not unpleasantly loud for most people, and it leads to a definitive result.

   When the hearing loss is 70 dBHL or more at a given frequency, set the TEN level 10 dB above the audiometric threshold at that frequency. For example, if the audiometric threshold is 75 dBHL, set the TEN level to 85 dBHL.
4. If the TEN is found to be unpleasantly loud, or if the maximum TEN level of 90 dBHL is reached, you can set the TEN level equal to the audiometric threshold. This should still produce a definitive result.

It typically takes about 4 minutes per ear to perform the TEN(HL) test for all test frequencies.

Interpretation of the test result

The criteria for diagnosing a dead region at a specific frequency are:

- The threshold of the test tone in the TEN is 10 dB or more above the TEN level.
- The threshold of the test tone in the TEN is 10 dB or more above the audiometric (absolute) threshold.

Sources

Web site: hearing.psychol.cam.ac.uk

3.14.11 Loudness Scaling

Purpose of the test

The OTOsuite Loudness Scaling test complies with the ISO 16832 standard for Acoustics - Loudness scaling by means of categories.

Loudness Scaling is a tool for acquiring reliable knowledge about the user's loudness perception of auditory stimuli for different presentation levels and frequencies. This information can be used for diagnostic and rehabilitative purposes particularly with regard to hearing instrument selection, fitting and verification.

The Loudness Scaling test in the OTOsuite Audiometry module offers an interactive and self-explanatory user interface for:

- a simple and time-efficient procedure to ensure general use in clinical environments,
- high reliability and straightforward interpretation of test results.

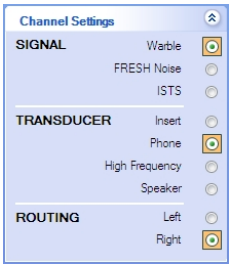
Description of the test

The patient uses a mouse or a touch screen as the patient responder connected to the PC running OTOsuite.

The test uses a single step loudness scaling procedure using either a 7-category or 11-category scale (not audible, very soft, ... , very loud, uncomfortably loud). The results are registered on the PC screen either as level loudness functions ("loudness growth curves") or as equal loudness contours.

3.14.11.1 Navigating in Loudness Scaling

The Control Panel

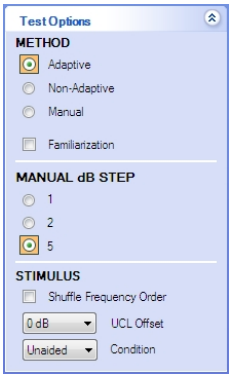


Channel Settings	
SIGNAL	
• **Warble**	Presents a warbled pure tone as the stimulus type. This stimulus type should be used for sound field testing to avoid any standing waves.
• **FRESH Noise**	Presents the customized FRESH noise as the stimulus type.[ab] FRESH stands for FREquency Specific Hearing assessment noise.
• **ISTS**	Presents filtered ISTS (International Speech Test Signal) as the stimulus type. To configure the bandwidth of the stimulus, click the **ISTS** button in the toolbar or select **Tools > ISTS Bandwidth**. You can set the width for each test frequency.
TRANSDUCER	

[a] The FRESH noise is implemented according to specifications of "Stimuli for Sound Field Audiometry: A Response to Lippmann and Adams", G. Walker and H. Dillon, 1984 in Journal of Speech and Hearing Disorders, p 219, and H. Dillon (2008), personal communication.

[b] For more information read: "Narrow Band Noise Audiometry: The Effect of Filter Slope", Daneil J. Orchik and Nancy L. Mosher, 1975 in The Journal of American Audiology Society, Vol. 1, No. 2, p. 50-53.

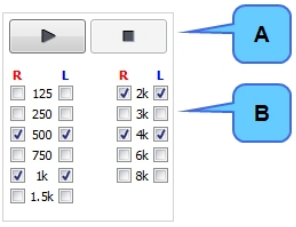
Channel Settings	
• **Insert**	Presents the stimulus through the insert earphones.
• **Phone**	Presents the stimulus through the headphones.
• **High Frequency**	Presents the stimulus through the high frequency headphones.
• **Speaker**	Presents the stimulus through the connected speaker.
ROUTING	
• **Left**	Stimulus is routed to the left transducer.
• **Right**	Stimulus is routed to the right transducer.



Test Options	
METHOD	
• **Adaptive**	Selects the adaptive mode where the patient is tested in two phases. • In the first phase, the dynamic range is roughly estimated. • In the second phase, the dynamic max level is calculated based on the presentation of stimulus as the max level presented in the first phase plus 5 dB.
• **Non-Adaptive**	Selects the non-adaptive mode where the patient is tested in two phases. • In the first phase, the patient is instructed to respond to the softest sound (the threshold) which the patient can hear. The level is then increased, and the patient is instructed to respond when the stimulus reaches the UCL. • In the second phase, the threshold and the UCL from phase one are used as reference points for the rest of the test.
• **Manual**	Selects manual mode, where you use the regular audiometer controls to perform Loudness Scaling testing.

Test Options	
• **Familiarization**	You can run a predefined number of presentations in the test in order to familiarize the patient with the test process. The patient's responses will not be collected. The number of presentations used to familiarize the patient can be set in **Tools > Options > Familiarization Presentation Count**. You can click the **Skip** button to interrupt the familiarization phase and start the actual test where the patient's responses will be collected.
MANUAL dB STEP	
• **1, 2, 5**	Defines the intensity of the stimulus used.
STIMULUS	
• **Shuffle Frequency Order**	Jumps between frequencies during the test instead of completing an entire frequency before going to the next frequency.
• **UCL Offset**	Defines the max level of the Loudness Scaling testing in relation to the UCL level from the Tone audiogram.
• **Condition**	Aided or unaided.

The Player Panel



A. **Play/Pause** and **Stop** buttons. **Play** opens the Patient Responder.
B. Select the frequencies at which you wish to perform the test for one or both ears.

3.14.11.2 The test process

The Patient Responder

The patient's response is entered using the Patient Responder window. Entering the response can be done either by the patient or by the operator by selecting the category bar corresponding best to the patient's perception of loudness. Even bars with no text can be clicked.

The Patient Responder window opens up on the screen where it was last used when the test is started.

Some patients may find the 7-category responder easier to use. This can be set in **Tools > Options > Number of Categories**.

Preparing the patient

Instruct the patient in how the test progresses:

- The patient will hear stimulus signals.
- When the signal is presented, the patient must select the category bar on the responder corresponding to the patient's perception of loudness.

- Explain the loudness categories. The rating scale consisting of the response alternatives will be presented to the patient during the test. The patient responder contains category bars.

Minimum and Maximum stimulus levels

The effective maximum level is the lowest level of Tone UCL + Offset and maximum level as set in **Options**.

The effective minimum level is the highest level of Tone THR and minimum level as set in **Options**.

The effective test range is shown as the light area between the shaded areas of the Loudness Contour graph.

Carrying out an automatic test

1. Start the test by clicking the **Play** button.
2. Monitor the patient during the automated test. You can pause and resume the test if necessary, and Talk Forward can be used at any time. The automatic test always repeats the last stimulus when resuming testing after a pause.
3. Some stimuli will be perceived as extremely loud.
4. The test automatically closes the Patient Responder window when the test is completed.
5. An automatic test can be supplemented with manual testing, if necessary.

Carrying out a manual test

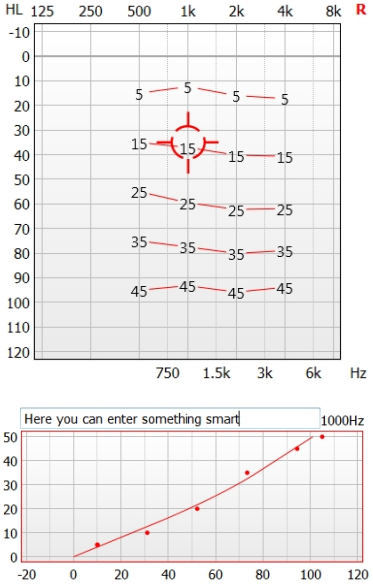
1. When you use the manual test method, stimuli are presented the same way as in Tone audiometry.
2. Start the test by clicking **Play**. This will open the Patient Responder window.
3. The manual test can supplement an automatic test, whereas an automatic test cannot supplement a manual test.

Carrying out several tests

You can make one or more tests. They are displayed in dedicated view tabs at the bottom of the screen. A new tab is created whenever a new test setting is selected.

3.14.11.3 The test result

Equal loudness contours and level loudness function at 1000 Hz for the right ear.



The test view tab

If you make one or more tests, they are displayed in dedicated view tabs at the bottom of the screen. A new tab is created whenever a new test setting is selected.

Any historic Loudness Scaling tests will appear when you load the patient data in OTOsuite. Historical data cannot be deleted in OTOsuite, but must be done in the source file (e.g. NOAH session).

The name of the test view tabs contain the measurement settings and test date.

Editing test results

Right-click options in the function graph	
Include selected point	If you have excluded a point from being calculated, you can include it in the calculations.
Delete selected point	
Exclude selected point	You can exclude a data point from being included in the calculations.
Delete all points for this frequency	
Delete all points for this ear	

Right-click options in the test view tab	
New Loudness Scaling	Select this item to make several Loudness Scalings using identical settings.
Delete this test tab	Select to delete from current view.

3.14.12 Oldenburg

The OTOsuite Oldenburg module is a module designed to interface with the Oldenburg Test software.

From the OTOsuite Oldenburg module you can

- launch the Oldenburg test software to perform tests,
- open, view, and delete Oldenburg test records,
- resume Oldenburg tests.

System overview

- The MADSEN Astera² audiometer
- OTOsuite
- The Oldenburg Test software

Installation

1. Install the Oldenburg Test software (not supplied by Otometrics).
2. Insert the Oldenburg license dongle in the PC (not supplied by Otometrics).
3. Calibrate MADSEN Astera² (see the MADSEN Astera² Service Manual).

4. Calibrate the Oldenburg Test software, if needed.

3.14.12.1 Using the Oldenburg module

Getting started

1. Launch OTOsuite.
2. Click the **Navigation Panel** and select **Oldenburg** in the **Audiometry** module.
   - The **Oldenburg Measurement Panel** shows all installed tests.
   - The **Oldenburg Measurements** main window shows test records, if any, that relate to the selected patient.

Testing from the Oldenburg Test software

1. If needed, click on **Settings** in the **Oldenburg Measurement Panel**, and adjust test settings.
2. Click on the test you wish to perform in the **Oldenburg Measurement Panel**.

   A message indicates that OTOsuite becomes inactive and the Oldenburg Test software is launched.
3. Perform the test and save the results.
4. Exit the Oldenburg Test software. OTOsuite becomes active, and the **Oldenburg Measurements** main window shows the new test record.

   The test record lists the test name and a range of test-specific data for easy identification.

Viewing Oldenburg test records

1. Double-click on a test record in the **Oldenburg Measurements** main window.

   A message indicates that OTOsuite becomes inactive and the Oldenburg Test software is launched.
2. You can now view the test record.

Resuming Oldenburg tests

If needed, you can resume testing from the Oldenburg Test software, as long as the test record is from the current working day.

1. Double-click on a test record in the **Oldenburg Measurements** main window.

   A message indicates that OTOsuite becomes inactive and the Oldenburg Test software is launched.
2. You can now resume the test.
3. When you exit the Oldenburg Test software, a new test record is shown in the **Oldenburg Measurements** main window in OTOsuite.

Deleting Oldenburg tests

You can delete obsolete or incomplete test records as needed, as long as the test record is from the current working day.

1. Click on a test record in the **Oldenburg Measurements** main window.
2. Click the button **Delete Measurement**.

3.14.13 Ambient Noise Assessor

***Note** • The Ambient Noise Assessor feature is based on ANSI standard S3.1, and is available by special request only. If you are interested in this feature, please contact your local OTOsuite sales representative.*

With Ambient Noise Assessor, you can use AURICAL FreeFit to measure ambient noise levels during audiometric tests in the **Tone** screen and in the **Speech** screen in tabular view. The permissible noise level is calculated according to ANSI S3.1.

The **Ambient Noise Assessor** dialog indicates whether the current noise level is permissible for the current measurement according to ANSI S3.1. The permissible noise level depends on the frequency and level of the stimulus that is being tested, as well as other factors, such as the transducer type.

3.14.13.1 Selecting the FreeFit device in OTOsuite

You must select your FreeFit device in the configuration wizard before you can use FreeFit for the first time.

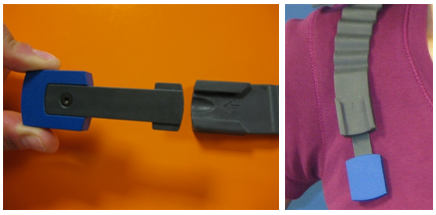
1. In OTOsuite, click **Tools** > **Configuration wizard...**, and then click the **Configure...** button for **PMM**.
2. On the **Select Your FreeFit** page, select your device.
   - If the device is not listed, turn on FreeFit by pressing the power button on the device. Check the **My device is turned on and ready to be found** check box, and then click **Search**.
3. Click **Finish** twice to close the configuration wizard.

For more information about connecting FreeFit, see the "Configuring PMM" chapter in the AURICAL FreeFit and the Probe Microphone Measurements Module Reference Manual.

3.14.13.2 Measuring Ambient Noise with FreeFit

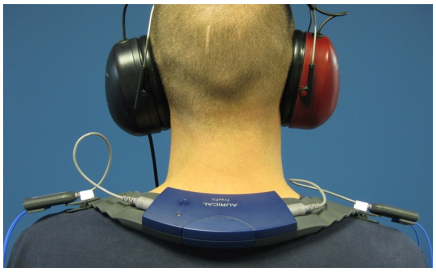
To use the Ambient Noise Assessor to monitor noise levels while performing Audiometry, follow this procedure:

1. Fit FreeFit with counterweights. (For detailed instructions, see the reference manual for FreeFit.)

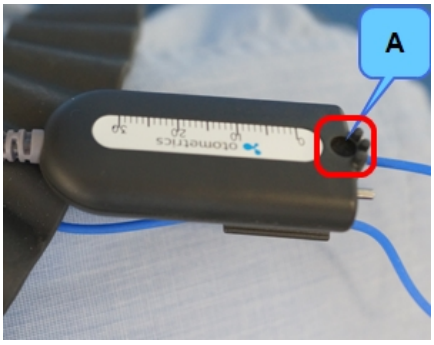


2. Slide the probe cable into place so it fits snugly in the cable holder on an Ambient Noise Assessor clip. Repeat with another clip for the second probe.

3. Place FreeFit on the patient's shoulders. Clip the probes to the FreeFit collar.
   - Position the probes so that they are above the patient's shoulders.



4. Adjust each probe carefully:
   - The reference microphone should face the ceiling.



A. Reference microphone

   - Ensure that the probe housing does not touch the patient's clothing and that the microphone is not covered by anything, such as clothing or hair.

5. Open the audiometry control panel.

If the **Ambient Noise Assessor** is not already open, click the button on the Audiometry toolbar.

6. Press the power button on FreeFit. If FreeFit does not connect, ensure that your FreeFit has been selected in the PMM configuration wizard. Also check the battery status of FreeFit. (See Charging, Powering and Connection Status in the reference manual for FreeFit.)

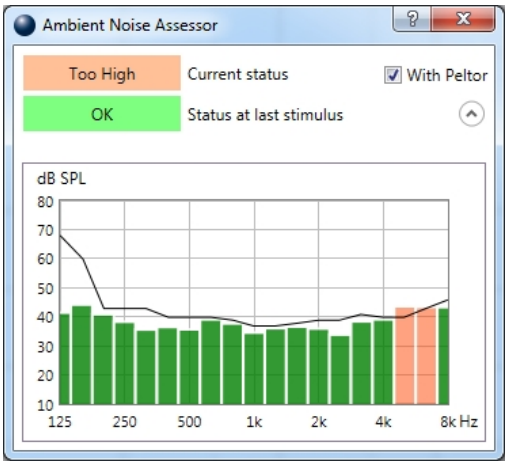
   The **Ambient Noise Assessor** dialog indicates the status of the noise level:

Ambient Noise Status	
OK	The measured ambient noise level is below the maximum permissible level for the stimulus that is currently selected.
Too High	The ambient noise level is above the maximum permissible level calculated by the standard. Reduce noise if possible.
Uncertain	The measured ambient noise level is above the maximum permissible noise level. However, the level is so low that it may be noise from FreeFit itself, rather than ambient noise.
Connect	A **Connect** button is displayed if FreeFit is not connected.
?	If you view the **Ambient Noise Assessor** dialog in an Audiometry test screen other than **Tone** or **Speech**, you can view the ambient noise bar graph, but no maximum permissible level is calculated, and therefore no status can be displayed. A question mark is also displayed if no audiometer is connected.

7. If you are using TDH39 headphones with Peltor noise reduction enclosure, select the **With Peltor** option.

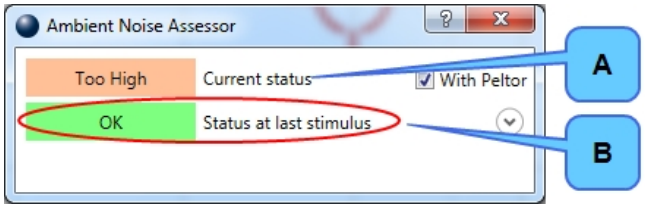
> ***Note*** • *The ANSI standard used to calculate the maximum permissible noise level is based on use of the TDH39 with Peltor noise reduction.*

8. To see a live graphical display of ambient noise, click the **Show Details** button .



- The curve shows the maximum permissible ambient noise level for the selected stimulus.
- The columns show the current measured noise for each 1/3 octave band between 125 Hz and 8 kHz. Each column is green, orange, or yellow, corresponding to the color symbols described above.
- If the measured noise exceeds the maximum permissible level 2 seconds before or 0.5 seconds after the stimulus is presented, a warning marker is displayed at the corresponding frequency. The warning marker will disappear if a new measurement is made when the ambient noise level is OK. The warning marker also disappears if you switch to a new test frequency.

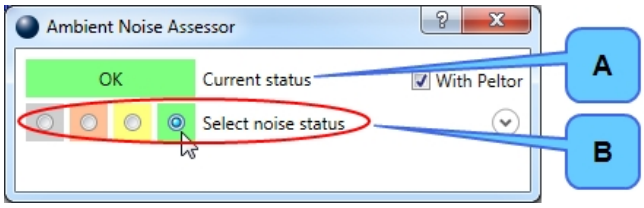
9. When the noise level is acceptable to you, you can store a point in the audiogram as you would normally.
   - In the **Tone** screen, when a point is stored, the noise level status from the last presentation of the stimulus is stored.



A. Current noise status

B. Noise status at last stimulus - *automatically selected by OTOsuite* - will be stored with audiogram point

   - In the **Speech** screen, the noise level status is not assigned automatically because OTOsuite cannot judge if noise registered after the stimulus is ambient noise or the patient's answer. You can use the **Ambient Noise Assessor** dialog to keep an eye on the current noise level, and then present the stimulus when the status is OK (Green). Then you can select the status in the dialog box before storing:



A. Current noise status

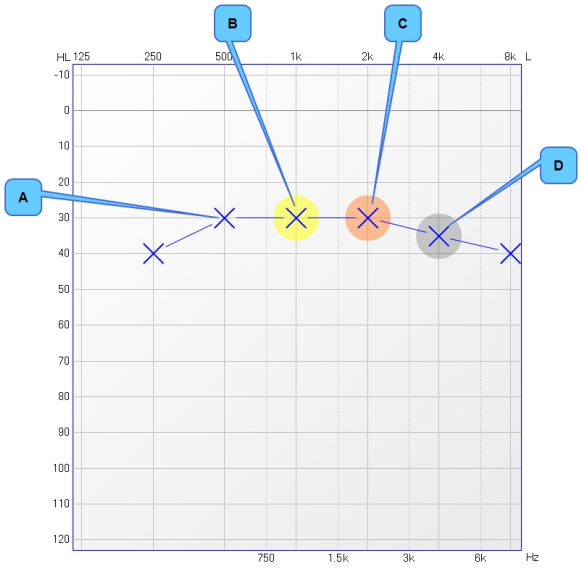
B. Noise status at last stimulus - *selected by user* - will be stored with audiogram point

The selected status will be stored when you store a point in the audiogram.

3.14.13.3 Noise level indicators in the audiogram

Tone audiometry

When you make an audiogram using the Ambient Noise Assessor, the background color behind each point in the audiogram indicates the following:



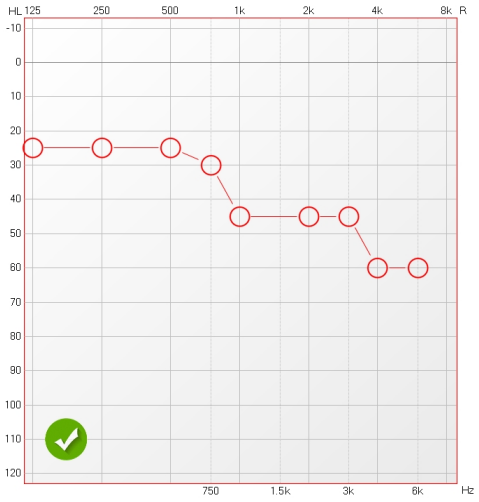
A. No background color: The noise level was below the maximum permissible level.

B. Yellow: The measured ambient noise level was above the maximum permissible noise level for the stimulus. However, the level is so low that it may be noise from the FreeFit itself, rather than ambient noise. (See Minimum HTL per transducer type ► 106.)

C. Orange: The measured ambient noise was above the maximum permissible noise level for the stimulus.

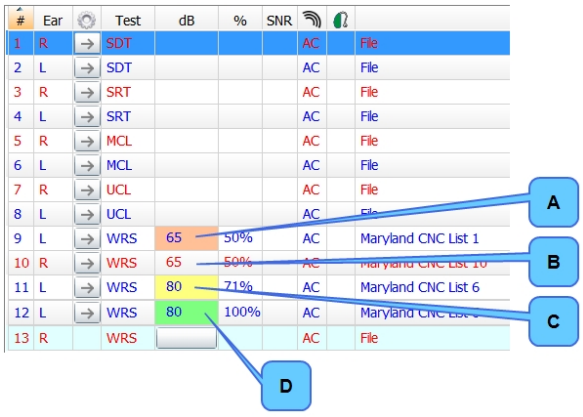
D. Gray: The status of ambient noise is unknown. Either FreeFit was not activated when the point was measured, or the frequency was stored without the signal having been presented.

These indicators are stored with the audiogram. If the noise level was measured and was below maximum permissible levels for all points in a stored audiogram, a check mark is displayed in the bottom-left corner of the audiogram:



Speech audiometry

When you perform a test in the Speech screen using tabular view, you manually select the status in the **Ambient Noise Assessor** dialog, and the selection appears as a background color behind each measurement in the table. The colors have the following meaning:



A. Orange: The measured ambient noise was above the maximum permissible noise level for the stimulus.

B. Gray: the status of ambient noise is unknown. Measurements stored with this status appear the same as measurements made without the Ambient Noise Assessor activated.

C. Yellow: The measured ambient noise level was above the maximum permissible noise level for the stimulus. However, the level is so low that it may be noise from the FreeFit itself, rather than ambient noise. (See Minimum HTL per transducer type ► 106.)

D. Green: The noise level was below the maximum permissible level.

3.14.13.4 Activating the Ambient Noise Assessor automatically

You can use the toolbar button to open the Ambient Noise Assessor when you need it, or you can set the feature to open automatically.

In **Options**> **Audiometry** > **General** > **Measurement**, **Misc.** you can set **Show Ambient Noise Assessor** to **Yes**. Then the **Ambient Noise Assessor** dialog will open automatically when you open the **Tone** or **Speech** tab in Audiometry.

3.14.13.5 Minimum HTL per transducer type

The following table describes the minimum HTLs for which the Ambient Noise Assessor can measure ambient noise, for various transducers. For stimuli below the given level, the Ambient Noise Assessor cannot distinguish between noise produced by the transducer and ambient noise. For stimuli below the minimum level, the ambient noise status indicator will be yellow.

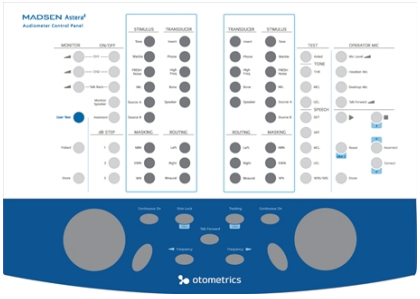
Transducer	Minimum HTL (dB HL)
Bone	30
Supra Aural, TDH 39/MX41	15
TDH39 with Peltor enclosure	0
Insert	-10

3.15 Test controls (ACP, keyboard, mouse)

The following sections describe ACP controls, PC keyboard controls and PC keyboard shortcuts for accessing all basic functions.

3.15.1 ACP front panel layout

When you use the ACP, you can show/hide the OTOsuite Control Panel: press **F12** on the keyboard.



You can access all basic functions directly by using the buttons and knobs on the MADSEN Astera² ACP front panel.

The button light indicators

Each button has its own function. Some buttons have a light to indicate whether the function is currently active. For the buttons to light up, launch the OTOsuite Audiometry Module.

Enable/disable buttons

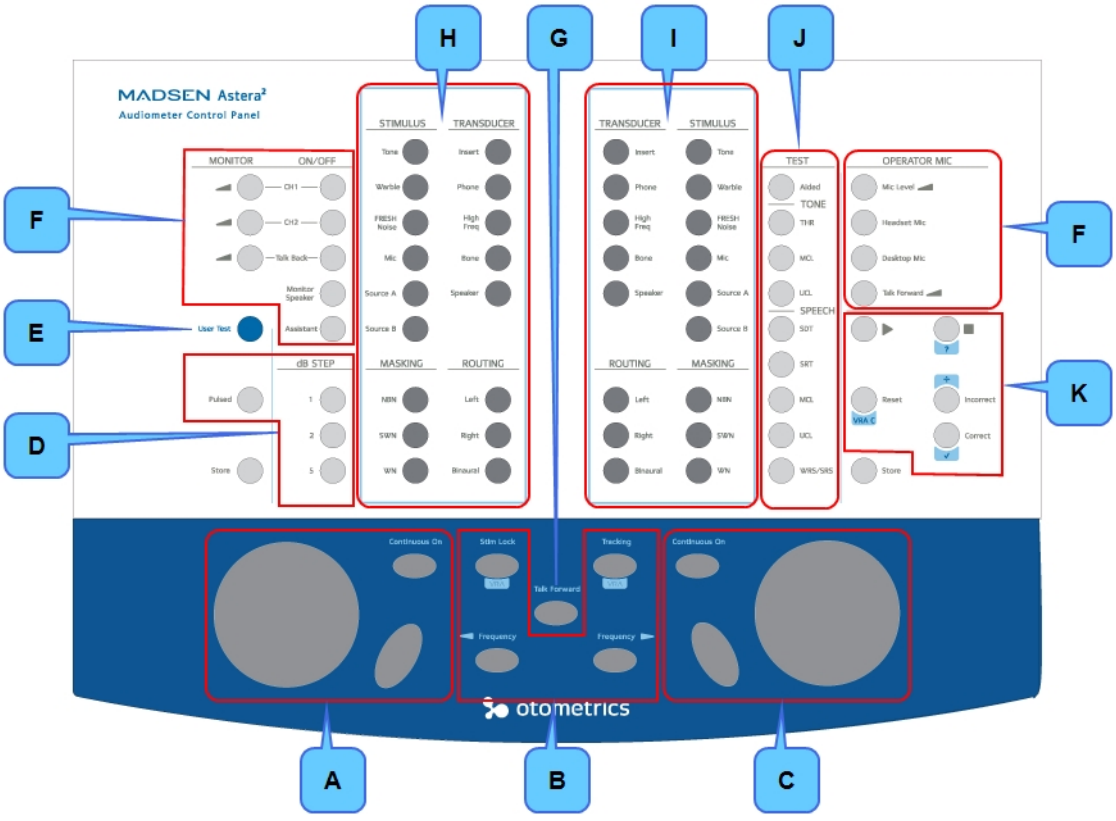
- Press the button to enable.
- Press the button again to disable.

Radio buttons

- Toggle function: Press the button to enable. Any corresponding button will automatically be disabled.

3.15.2 ACP front panel controls

The ACP buttons and controls are grouped according to their function and how frequently they are used. The buttons in the **Channel 1** and **Channel 2** columns reflect the **Control Panel** in the OTOsuite Audiometry Module.



Test controls ► 107

A. Channel 1 - Level and on/off controls

B. Common level and frequency controls

C. Channel 2 - Level and on/off controls

Test related controls ► 109

D. Common level step size, pulsed on/off

E. User Test selection

Monitoring controls ► 109

F. Monitoring - Selection and level, Operator monitoring and level

G. Talk forward

CH1 and CH2 controls ► 110

H. Channel 1 stimulus

I. Channel 2 stimulus

Test type controls ► 112

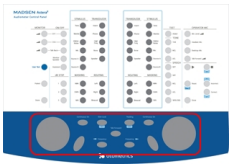
J. Test types

Speech test controls ► 113

K. Speech and Pediatric test controls

3.15.2.1 Test controls

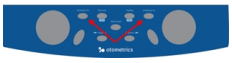
These test controls include the **HL attenuator** controls, **Frequency** controls, the **Continuous on**, **Stim. Lock**, **Tracking** and **Talk forward** buttons, and **VRA** activation buttons. The **Store** buttons are located just above these controls.



HL attenuator controls
For adjusting:

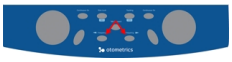
- the test signal intensity level,
- the masking intensity level,
- operator microphone level,
- monitoring levels,
- the talk-forward level.

Stimulus buttons
Presents the selected stimulus. To reverse this function, press the **Continuous On** button and press the **Stimulus** button to stop presentation of the selected stimulus.



Continuous On
When activated, the stimulus will be continuously on (the button is lit).

To disable continuous presentation, press the **Continuous On** button (the button is not lit). When the **Continuous On** button is disabled, the stimulus is only presented when you press the **Stimulus** button.

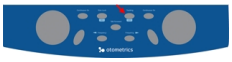


Frequency buttons
Press to select the frequency at which the stimulus is presented.

- The left **Frequency** button ◀ decreases the frequency,
- The right **Frequency** button ▶ increases the frequency.

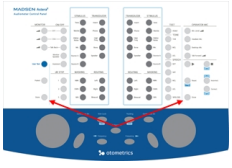
Stim. Lock
Presents the stimuli from both channels simultaneously, when you press one of the **Stimulus** buttons.

Activate VRA
Activates the Visual Reinforcement on your left-hand side during Pediatric testing.



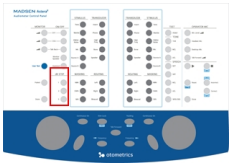
Tracking
Changes the level of the stimulus in each channel by the same amount.

Activate VRA
Activates the Visual Reinforcement on your right-hand side during Pediatric testing.

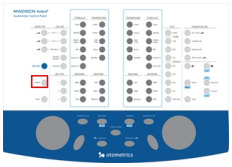


Store
Press to store data points in the OTOsuite Audiometry Module.

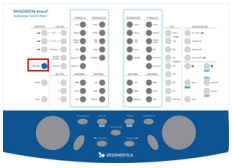
3.15.2.2 Test related controls



dB Step
Determines the dB step size for the intensity of the stimulus and masker. Options are 1, 2, and 5 dB.



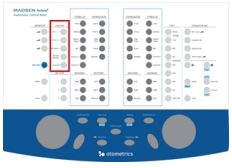
Pulsed
Pulses the stimulus 200ms on and 200ms off. The pulsing affects the Tone, Warble, and FRESH Noise stimulus.



User test
To select predefined test setups:

1. Press **User Test**. The **Test Selector** window appears on the PC screen.
2. Turn one of the **Attenuator** knobs to scroll through the list.
3. Press **User Test** again to select the highlighted user test.

3.15.2.3 Monitoring controls



Monitoring On/Off

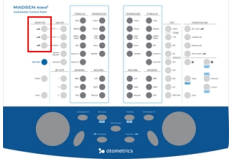
CH1
The **CH 1 On/Off** button enables/disables monitoring of Channel 1.

CH 2
The **CH 2 On/Off** button enables/disables monitoring of Channel 2.

Talk Back
The **Talk Back On/Off** button enables/disables monitoring of the patient's speech in the operator's monitor headset.

Monitor Speaker
The **Monitor speaker** button enables/disables the monitor speaker built into the ACP.

Assistant (microphone)
Enables/disables the **Assistant microphone**.



Monitoring level

CH1/CH2
You can monitor Channel 1/Channel 2.

1. Press and hold the **MONITOR** button next to **CH 1** or **CH 2** and turn one of the **Attenuator** knobs to determine the intensity of the signal.

   When you press and hold the **CH 1** or **CH 2** button, the level is displayed on the PC screen in the Control Panel. The level will be adjusted in 3 dB steps.

Talkback
You can monitor the talkback.

1. Press and hold the **Talkback Monitor** button and turn one of the **Attenuator** knobs to determine the intensity of the signal.

   When you press and hold the **Talkback** button, the level is displayed on the PC screen in the control panel. The level will be adjusted in 3 dB steps.

Operator microphones/monitoring transducer

Mic. Level
To set the microphone level, press and hold the **Mic. Level** button and turn one of the **Attenuator** knobs.

When you press and hold the **Mic. Level** button, the level is displayed on the PC screen in the control panel. The level will be adjusted in 1 dB steps.

Headset
Press to enable the operator headset boom microphone.
When you enable the headset microphone, you disable the desktop microphone.

Desktop
Press to enable the desktop microphone.
When you enable the desktop microphone, you disable the headset boom microphone.

Talk forward
Press to enable and speak directly to the patient. Press again to disable when done.

To set the microphone level, press the **Talk forward** button in the **Operator Mic.** column. The **Talk Forward** window will appear on the screen. While keeping the **Talk forward** button in the **Operator Mic.** column pressed, turn one of the **Attenuator** knobs to adjust the intensity of the signal.

3.15.2.4 CH1 and CH2 controls

The buttons in the **Channel 1** and **Channel 2** columns are identical, making it easy for you to activate the required functions for each channel.

Stimulus types

Tone
Presents a pure tone as the stimulus type.

Warble
Presents a warbled pure tone as the stimulus type. This stimulus type should be used for soundfield testing to avoid any standing waves.

FRESH Noise
Presents the customized FRESH noise as the stimulus type.[ab]
FRESH stands for FREquency Specific Hearing assessment noise.

When FRESH Noise is selected under the stimulus parameters it should only be used as a stimulus (not a masker) because it is calibrated as a stimulus.

Mic.
Present live voice as the stimulus type.

Source A
Delivers the speech material from Source A. The options are:

- Int CD (internal CD ROM built into the PC),
- Int File (stored on hard drive), or
- Line In (external medium connected to the PC).

Source B
Delivers the speech material from Source B. The options are:

- Int CD (internal CD ROM built into the PC),
- Int File (stored on hard drive), or
- Line In (external medium connected to the PC).

Masking type

NBN
Presents a narrowband noise as the masking type. When narrowband noise is selected under the masking parameters it should only be used as a masker (not a stimulus) because it is calibrated as an effective masker.

NBN is only available during tone testing.

SWN
Presents a Speech Weighted Noise (Speech Noise).
Speech weighted noise is only available during speech testing.

WN
Presents a white noise as the masking type.
White noise is available for both tone and speech testing.

Transducer

Insert
Presents the stimulus or masker through the insert earphones.

Phone
Presents the stimulus or masker through the supra-aural headphones.

[a]The FRESH noise is implemented according to specifications of "Stimuli for Sound Field Audiometry: A Response to Lippmann and Adams", G. Walker and H. Dillon, 1984 in Journal of Speech and Hearing Disorders, p 219, and H. Dillon (2008), personal communication.

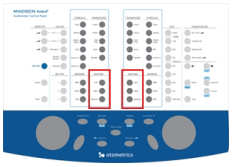
[b]For more information read: "Narrow Band Noise Audiometry: The Effect of Filter Slope", Daneil J. Orchik and Nancy L. Mosher, 1975 in The Journal of American Audiology Society, Vol. 1, No. 2, p. 50-53.

High Frequency
Presents the stimulus or masker through the high frequency headphones.

Bone
Presents the stimulus or masker through the bone oscillator.

Speaker
Presents the stimulus or masker through the soundfield speakers.

- If you are using only 2 speakers, the routing is selected with the routing controls (left, right, binaural).
- If you are using only 2 speakers, you can set up a channel to provide stimulus/masking via a different transducer (e.g. when providing masking to one ear and stimulating the other ear using the soundfield speakers).



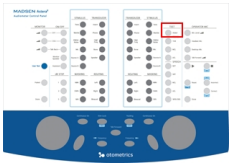
Routing

Left
The stimulus/masker will be presented to the left transducer.

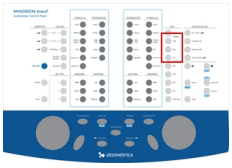
Right
The stimulus/masker will be presented to the right transducer.

Binaural
The stimulus/masker will be presented to both the left and right transducers.

3.15.2.5 Test type controls



Aided
Displays the aided symbols on the graph in the OTOsuite Audiometry Module when data points are stored.
Aided can be selected in combination with any other test type.

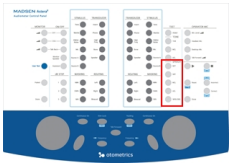


TONE

THR (Threshold)
Displays the typical audiometric symbols for air conduction, bone conduction (masked or unmasked) on the graph when data points are stored.

MCL
Displays the **M**ost **C**omfortable **L**oudness symbol on the graph when data points are stored.

UCL
Displays the **U**n**C**omfortable **L**oudness symbol on the graph when data points are stored.



SPEECH

SDT
The data will be stored as a **S**peech **D**etection **T**hreshold.

SRT
The data will be stored as a **S**peech **R**eception **T**hreshold.

MCL
The data will be stored as a **M**ost **C**omfortable **L**oudness level.

UCL
The data will be stored as an **U**n**C**omfortable **L**oudness level.

WRS/SRS
The data will be stored as a **W**ord **R**ecognition **S**core or **S**entence **R**ecognition **S**core.

3.15.2.6 Speech test controls

Speech material controls

Play/pause
The button toggles between **Play** and **Pause**.

- **Play**

  Press the play button ▶ to start the presentation of the word list.

- **Pause**

  During presentation of the word list, press the play button ▶ to pause the presentation. The button flashes when the test is paused.

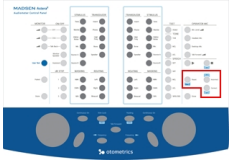
- **Continue play**

  Press the play button ▶ to continue presentation of the word list.

Stop

- **Stop**

  Press the stop button ■ to stop the presentation of the word list.



Speech counter controls

Incorrect/Correct

- **Word Counters**

  Press **Correct** to count correct responses and **Incorrect** to count incorrect responses.

  Reset will return the counter to 0/0.

  The next word will proceed when you have scored the word as correct or incorrect.

  See also Scoring words using integrated OTOsuite Speech Material ▶ 50 for more information.

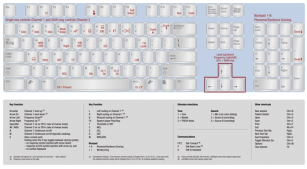
Pediatric

- **VRA C** 

  Press to activate the central Visual Reinforcement during Pediatric testing.
- **Score as uncertain** 

  Press to score the word as uncertain.
- **Score as incorrect** 
  Press to score the word as incorrect.
- **Score as correct** 
  Press to score the word as correct.

3.15.3 PC keyboard controls



For PC keyboard controls, see the "Documentation" folder on the OTOsuite installation medium (disk or memory stick).

4 Preparing for testing

It is important to prepare properly before making measurements with MADSEN Astera² and the OTOsuite software. It is time-saving for both you and the client if the environment, the client, the test device, and the software are ready for the test.

4.1 Preparing the test environment

Before you start testing, make sure that the test environment is conducive to testing.

- The test environment should be quiet, preferably in a sound proof booth, for accurate threshold results.
- The test room or sound booth should have a minimum of furniture and hard surfaced articles (i.e. filing cabinets, tables etc), as these can cause reverberation during sound field testing.Live voice examinations are best carried out when using a sound booth, so that the client/patient cannot hear the tester's voice directly. With tester and client/patient in the same room, especially of clients with normal or almost normal hearing, false results could be obtained.

Furniture

The test environment should include

- a comfortable chair for the client,
- a child-sized chair if testing pediatrics,
- a comfortable chair for the assistant.

The examiner should be able to see the client/patient. The client/patient should be seated so that it is not possible to see what the examiner is doing or how the equipment is being operated. This reduces the likelihood that the client/patient can anticipate when the stimulus will be presented.

For pediatric testing consider using a highchair, which is a familiar environment for most children and will place them closer to eye level with the visual reinforcement toys. Make sure if performing visual reinforcement audiometry that the reinforcing toys can be seen by the child. A child cannot look over and up at a toy until approximately 9 months of age.

Lighting

The lighting in the booth should be bright enough for the examiner to adequately see the client.

Toys

If testing pediatrics, several interesting toys are needed to center the child (obtain the child's attention toward the assistant or tester) prior to stimulus presentation. It is best if these toys do not produce sounds.

The child should be conditioned to respond to the sound of the stimulus only. Competing sounds from toys can confuse the child and reduce the reliability of the test.

Soft toys are needed to keep a young child's attention during behavioral observation or visual reinforcement audiometry. Younger children like to tap the toy on the highchair tray and therefore a toy that does not create much sound would be more appropriate during testing.

Blocks, buckets, puzzles are needed to keep a child's attention during play audiometry.

4.2 Preparing the test equipment

Accessories

Make sure that you have connected the required accessories to the audiometer:

- headphones

- insert phone(s)
- bone oscillator
- patient responder.

MADSEN Astera² and the Audiometry Module

- Make sure the cables of the test equipment are connected correctly.
- Launch OTOsuite and the Audiometry Module on the PC (see the OTOsuite User Manual).
- Make sure MADSEN Astera² is switched on.
- Make sure the connection between the Audiometry Module and MADSEN Astera² is enabled.

  See Configuring the Audiometry Module ▶ 147.

4.3 Listening check

Perform listening checks routinely to make sure that the equipment is functioning properly.

- Use a person who has auditory thresholds below 10 dB and make sure that he or she can hear a very faint sound for each stimulus type, frequency and for each transducer at 0 to 5 dB.
- If the person cannot hear the stimulus, contact the manufacturer or local representative to troubleshoot the system.
- It is recommended that the system be calibrated annually or according to the local requirements.

4.4 Preparing the client

4.4.1 Hygienic precautions

It is important that hygienic precautions are taken to protect the client from cross-infection. Be sure to follow any established infection control procedures for the setting in which you are working.

- *Headphones*

  Clean the headphones between patients, e.g. with a non-alcohol based antibacterial wipe, such as Audiowipes.
- *Insert earphones*

> ***Warning*** • *To prevent cross-infection, use new eartips when you test the next client.*

4.4.2 Inspecting the client's ear(s)

1. Position the client so that you can easily access the client's ear(s).
2. Grasp the pinna and gently pull it back and slightly up and away from the client's head.
3. Inspect the ear canal and make sure that you can see the ear drum.

   If you can see apparent narrowing of the ear canal, it may be blocked by vernix or debris, or it may not be straight.
4. If the ear canal is blocked, for instance by vernix or debris, the outcome of the procedures may be affected.

   Clean the ear canal if required.

4.5 Proper transducer placement

Headphones

1. Loosen the headband and place both the left and right side of the headphones simultaneously.
2. Make sure that the blue indicator is on the left ear and the red indicator is on the right ear. The center of the headphone diaphragm should be directly opposite the opening of the ear canal for the left and right side.

> ***Note •*** *If the headphones are not placed properly, there is risk of causing the ear canal to collapse which will result in elevated thresholds.*

3. Ask the patient if the headphones are comfortable.
4. Tighten the headband while holding the headphones in place with your thumbs.
5. Examine the placement of the headphones to make sure they are level, and properly positioned.

Insert Earphones

Young children tolerate insert earphones better than headphones.

The insert earphones are color-coded:

- the blue indicator for the left ear,
- the red indicator for the right ear.

1. Select the largest foam eartip that will fit into the patient's ear.

   If the eartip is too small the sound will leak out and the dB level will not be accurate at the eardrum.

   Insert earphones have greater attenuation between ears especially at the low frequencies; this reduces the need for masking.
2. It is best to clip the insert earphone transducers behind the child or on the back of their clothing and then fit the foam eartip into the child's ears.

   If the foam eartip is a little too large, consider cutting it down to make it a little smaller.

Bone Oscillator

> ***Note •*** *For unmasked bone thresholds, you can store binaural data by selecting Binaural bone in the routing section of the control panel.*

Mastoid placement

1. Move any hair covering the mastoid out of the way and place the flat round part of the bone oscillator securely on the boniest portion of the mastoid without any part of the transducer touching the external ear.
2. Make sure the bone oscillator is tight on the mastoid but still comfortable.
3. If you are going to perform masking with earphones, position the other end of the bone oscillator headband over the patient's temple on the opposite side of the head so that the headband of the earphones and bone oscillator fit on the patient's head.

Frontal bone placement

1. For frontal bone placement, place the flat round part of the bone oscillator securely on the middle of the forehead about an inch (2.5 cm) below the hairline.
2. Make sure the bone oscillator is tight on the forehead but still comfortable.

5 Examples of audiometric testing

5.1 Testing the older child or adult patient

5.1.1 Assessing pure tone threshold using the Hughson/Westlake procedure

Threshold

This is the lowest level at which the patient responds to the stimulus at least 50% of the time.

1. Talk to the patient while you walk him/her to the booth. This will give you some idea of how well he/she is hearing.
   - Ask him/her which ear is his/her better hearing ear.
2. Perform otoscopic inspection of the ear canals to make sure that the ears are free from occluding cerumen (earwax) or debris.
3. Optional: Perform tympanometry and reflexes prior to audiometric test.
4. Properly place the earphones. Begin the test with the air conduction transducer.
   - If you are planning to test high frequencies, use the HDA 200 earphones for all frequencies (if they have been calibrated for all frequencies).
5. Give the patient the responder(s).
6. Instruct the patient so that he/she knows what to expect: "You will hear various sounds from low pitches to high pitches. Push the button when you hear a sound, even if it is very soft."
7. If the patient reports having tinnitus, consider using a pulsed tone for testing.
8. Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing, sound level, and frequency. Make sure that threshold test (THR) is selected.
9. Begin the test in the ear reported as the better hearing ear.
   - Tell the patient in which ear the test will begin.
10. Start the testing at 1000 Hz.
11. Start presenting the tone at a sound level that should be clearly audible to the patient to confirm that instructions for responding were understood.
    - Present the tone for 1 to 2 seconds.
12. If the patient responds to the initial sound level presented, proceed with the test by decreasing the level in 10 dB steps until no response is obtained.
    - Increase the level in 5 dB steps until a response is obtained again.
    - Continue decreasing in 10 dB steps and increasing in 5 dB steps until you determine the lowest level at which the patient responds correctly to two of three trials. This is the threshold.
    - Once threshold is obtained, store the response.
13. Continue testing with this up/down procedure in the following frequency order: 2000, 4000, 8000, 500, 250, 125, and reconfirm the threshold at 1000 Hz.
    - If there is a 20 dB difference or greater between octaves, test the interoctave frequencies.
    - Talk to the patient occasionally. Encourage the patient to concentrate on the task. This will keep your patient from getting bored or becoming an unreliable responder.
14. Switch to the other ear and tell the patient to listen for the sounds in that ear.
15. Repeat steps 11 to 13.

16. If there is a difference of 40 dB or more between the test ear threshold and nontest ear threshold, the better ear must be masked to test the poorer ear. The Masking Assistant can assist you in determining which thresholds need to be masked.
17. To use masking noise in combination with the pure tone, either check **Stim Lock** to coordinate the presentation of two channels or check **Continuous On** to keep the masking channel presenting continuously.
18. After the air conduction thresholds are determined, bone conduction audiometry can be performed.
19. Properly place the bone oscillator.
20. Instruct the patient again to push the button in response to the tone even if the stimulus is very soft.
21. Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing, sound level, and frequency.
22. Repeat steps 9 to 13.
    - If there is a difference of 10 dB or greater between the bone conduction threshold and the air conduction threshold of the same ear, masking is needed. The Masking Assistant can assist you in determining which thresholds need to be masked.
23. When all air and bone conduction thresholds are determined, the pure tone average (PTA) for each will appear in the **PTA/AI** box. The Articulation Index (AI) and the overlay options can be used for counseling the patient.
24. Click in the **Reliability** box to report the reliability of the patient's responses during testing - **Good**, **Fair**, or **Poor**.

5.1.2 Assessing pure tone or speech most comfortable loudness level (MCL)

1. Properly place the earphones.
   - Begin the test with the air conduction transducer.
2. Instruct the patient that you are trying to find the level at which he/she is most comfortable listening to the sounds.
3. Make sure that the control panel of the OTOsuite software is set to the correct transducer, desired routing and sound level.
   - Make sure that most comfortable level test (MCL) is selected.
4. Start at a moderate level. Present the stimulus and ask the patient if the current level is comfortable or if he/she would prefer it louder or softer.
   - Increase and decrease the sound level until the patient's preferred level is determined. This is the MCL.
   - Once MCL is obtained, store the response.
5. Repeat steps 3 and 4 for each frequency if performing MCL testing for pure tones.
6. Switch to the other ear and tell the patient to listen for the sounds in that ear.
7. Repeat steps 3 and 4 for the opposite ear.

5.1.3 Assessing pure tone or speech uncomfortable loudness level (UCL)

1. Properly place the earphones.
   - Begin the test with the air conduction transducer.
2. Instruct the patient that you are trying to find the level at which the sound is uncomfortably loud. It should be tolerable and not painful.
3. Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing and sound level.
   - Make sure that uncomfortable loudness testing (UCL) is selected.

4. Start at a moderate level. Present the stimulus and then ask the patient if the current level is okay or uncomfortable. Increase the presentation level in 5 to 10 dB steps until the patient's uncomfortable loudness level is determined.
5. Repeat steps 3 and 4 for each frequency if performing UCL testing for pure tones.
6. Switch to the other ear and tell the patient to listen for the sounds in that ear.
7. Repeat steps 3 and 4 for the opposite ear.

5.1.4 Assessing speech reception threshold (SRT) using the Hughson/Westlake procedure

1. Properly place the earphones.
   - Begin the test with the air conduction transducer.
2. Instruct the patient so that he/she will know what to expect: "You will hear various words, like hotdog, ice cream, ect. When you hear a word, repeat it back to me even if the word is very soft. It is okay to guess if you are unsure of the word."
3. Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing and sound level.
   - Make sure that speech reception threshold (SRT) is selected.
4. Begin the test in the ear that has the lower PTA.
   - Inform the patient in which ear the test will begin.
5. Start presenting words at a level that should be clearly audible to the patient to confirm that the instructions for responding were understood.
6. It is best to use recorded speech to reduce variability.
   - If the automated presentation speed of the recorded speech is too fast for the patient, you can deliver the recorded words one at a time by double-clicking on the word in the word list.
   - You can also present the speech material using monitored live-voice.
7. If the patient responds to the initial sound level presented, proceed with the test by decreasing the level in 10 dB steps until no response is obtained.
   - Increase the level in 5 dB steps until a response is obtained again.
   - Continue decreasing in 10-dB steps and increasing in 5-dB steps until you determine the lowest level at which the patient responds correctly to two of three trials. This is the SRT.
   - Once the SRT is obtained, store the response.
8. If the SRT of the test ear and the SRT or PTA of the nontest ear differ by 45 dB or more, masking is needed.

   If the SRT of the test ear and the bone conduction PTA of the nontest ear differ by 45 dB or more, masking is needed.
9. Switch to the other ear and tell the patient to listen for the words in that ear.
10. Repeat steps 3 to 7.
11. The SRT will be ± 8 dB of the PTA for each ear if the data are reliable.

5.1.5 Assessing word recognition score

1. Properly place the earphones.
   - Begin the test with the air conduction transducer.
2. Instruct the patient so that he/she will know what to expect: "You will hear various words, like bird, dog, etc. When you hear a word, repeat it back to me. This time the words will all be loud enough to hear. It is okay to guess if you are unsure of the word."

3. Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing and sound level.
   - Make sure that word recognition score (WRS/SRS) is selected.
4. Begin the test in the ear with the lower PTA and/or SRT.
   - Tell the patient in which ear the test will begin.
5. It is best to use recorded speech to reduce variability.
   - If the automated presentation speed of the recorded speech is too fast for the patient, you can deliver the recorded words one at a time by double-clicking on the word in the word list.
   - You can also present the speech material using monitored live-voice.
6. Present the words at a sound level that is 30 to 40 dB higher than the SRT score.
   - Some examiners prefer to give the patient a couple of words to make sure that the response instructions are understood. These words should not be part of the test word list as familiarity can bias the test.
7. Score the responses using the +/- buttons. Typically, 25 or 50 words are presented in a list. Once all the words on the list have been presented, you have a percentage correct. This is the WRS.
   - Once the WRS is obtained, store the response.
8. Switch to the other ear and tell the patient to listen for the words in that ear.
9. Repeat steps 6 to 7.
10. Type any desired notes regarding the test (for example, "NU-6, word list 3A") in the box to the left of the scores (tabular view) or symbols (graphical view).

5.2 Testing the pediatric patient

5.2.1 Assessing speech detection threshold (SDT) using the Hughson/Westlake procedure

Threshold

This is the lowest level at which the patient responds to the stimulus at least 50% of the time. For very young children, often the responses obtained are above threshold. It may take several visits to obtain a complete audiogram.

1. Talk to the patient while you walk him/her to the booth. This will give you some idea of how well he/she is hearing.
   - Make the test sound exciting and fun. Tell the patient about the toys you have in the booth so that the patient is more comfortable with the testing.
   - Use the person accompanying the child as a resource for information about the patient's hearing, including which ear might be the better hearing ear.
2. Perform otoscopic inspection of the ear canals to make sure that the ears are free from occluding cerumen (earwax) or debris.
3. Optional: Perform tympanometry and reflexes prior to audiometric test.
4. Depending on the child's comfort level, you might decide to do testing in soundfield. However, if the child will allow it, properly place the earphones. Younger children will usually tolerate insert earphones better than supra-aural earphones. See Proper transducer placement ► 117 for more detail.
   - It is helpful to have an extra set of earphones for the person accompanying the child to wear to show the child that it is okay to wear the earphones.

5. For infants less than 6 months old, use monitored live-voice to present stimuli (like the patient's name) and observe the patient for behavioral responses.
   - For infants older than 6 months, use the head-orienting reflex for Visual Reinforcement Audiometry (VRA).
   - For toddlers, use social reinforcement for Conditioned Play Audiometry (CPA).
   - If the child is old enough, use a picture board depicting SRT words and ask the child point to the picture corresponding with the word heard. Use words with which the child is likely to be familiar.
   - All of the above are examples of Speech Detection Threshold (SDT).
6. If using play audiometry or a picture board, condition the patient to respond as desired before beginning the testing.
7. Make sure that the control panel of the OTOsuite software or the MADSEN Astera² ACP is set to the correct transducer and desired routing and sound level.
   - Make sure that speech detection threshold (SDT) is selected.
8. Begin the test in the ear suspected to be the better hearing ear.
9. It is recommended that children be tested using an ascending approach.
   - Start at 10 dB and increase the level of the speech stimulus until the child responds. This will ensure that you are not conditioning the child at a level that he/she cannot hear.
   - Once you identify a level that is clearly audible to the patient, confirm that the response instructions are understood by practicing the response task.
10. It is best to use recorded speech to reduce variability. However, younger children need constant reinforcement to keep their attention and therefore presenting the speech material using live-voice is most common.
11. If the patient responds to the initial stimulus level presented, proceed with the test by decreasing the level in 10 dB steps until no response is obtained.
    - Increase the level in 5 dB steps until a response is obtained again.
    - Continue decreasing in 10 dB steps and increasing in 5 dB steps until you determine the lowest level at which the patient responds correctly to two out of three trials. This is the SDT.
    - Once the SDT is obtained, store the response.
12. If the SDT of the test ear and the SDT or PTA of the nontest ear differ by 45 dB or greater, masking is needed.
    - If the SDT of the test ear and the bone conduction PTA of the nontest ear differ by 45 dB or greater, masking is needed. It can be more challenging to use masking with children, as they may become confused when masking is presented. However, masking should be attempted if it is warranted by the test results.
13. Switch to the other ear and repeat steps 9 to 12.

5.2.2 Assessing pure tone threshold using the Hughson/Westlake procedure

1. Depending on the child's comfort level, you might decide to do testing in soundfield. However, if the child will allow it, properly place the earphones. Younger children will usually tolerate insert earphones better than supra-aural earphones. See Proper transducer placement ► 117 for more detail.
   - It is helpful to have an extra set of earphones for the person accompanying the child to wear to show the child that it is okay to wear the earphones.
2. For infants under 6 months, it is difficult to get reliable behavioral pure tone responses.
   - For infants older than 6 months, use the head-orienting reflex for Visual Reinforcement Audiometry (VRA).
   - For toddlers, use social reinforcement for Conditioned Play Audiometry (CPA).

3. Make sure that the control panel of the OTOsuite software or the MADSEN Astera² ACP is set to the correct transducer and desired routing, sound level, and frequency.
   - Make sure that threshold (THR) is selected.
   - If presenting in soundfield, select **Warble** for the stimulus type.
   - If testing with earphones, switching between tone, pulsed tone, warble and FRESH noise will keep the patient's attention longer.
4. Begin the test in the ear that has the lower SDT.
5. Start the testing at 1000 Hz.
6. It is recommended that children be tested using an ascending approach.
   - Start at 10 dB and increase the level of the speech stimulus until the child responds. This will ensure that you are not conditioning the child at a level that he/she cannot hear.
   - Once you identify a level that is clearly audible to the patient, confirm that the response instructions are understood by practicing the response task.
   - Present the tone for 1 to 2 seconds.
7. If the patient responds to the initial stimulus level presented, proceed with the test by decreasing the level in 10 dB steps until no response is obtained.
   - Increase the level in 5 dB steps until a response is obtained again. (Because you want to obtain the most information as quickly as possible, you may prefer to decrease the level in 20 dB steps and increase in 10 dB steps until you get close to threshold.)
   - Continue decreasing in 10 dB steps and increasing in 5 dB steps until you determine the lowest level at which the patient responds correctly to two out of three trials. This is the threshold.
   - Once the threshold is obtained, store the response.
8. Continue testing with this up/down procedure in the following order: 4000, 500, 2000, 250, 8000, and if possible reconfirm the threshold at 1000 Hz.
   - If there is a 20 dB difference or greater between octaves, test the interoctave frequencies if possible.
   - Remember, children need constant reinforcement to keep their attention.
9. Switch to the other ear and repeat steps 5 to 8.
10. If there is 40 dB or greater difference between the test ear threshold and nontest ear threshold, the better ear must be masked to test the poorer ear. The Masking Assistant can assist you in determining which thresholds need to be masked. It can be more challenging to use masking with children, as they may become confused when masking is presented. However, masking should be attempted if it is warranted by the test results.
11. To use masking noise in combination with the pure tone, either check **Stim Lock** to coordinate the presentation of two channels or check **Continuous On** to keep the masking channel presenting continuously.
12. After the air conduction thresholds are determined, bone conduction audiometry can be performed.
13. Properly place the bone oscillator. See Proper transducer placement ► 117 for more detail.
14. Instruct the patient and reinforce their participation (for example, "Good Job!").
15. Make sure that the control panel of the OTOsuite software or the MADSEN Astera² ACP is set to the correct transducer and desired routing, sound level, and frequency.
16. Repeat steps 5 to 8.

- If there is a difference of 10 dB or greater between the bone conduction threshold and the air conduction threshold of the same ear, masking is needed. The Masking Assistant can assist you in determining which thresholds need to be masked.

17. Once all air and bone conduction thresholds are determined, the PTA for each will appear in the **PTA/AI** box.
    - The Articulation Index (AI) and the overlay options can be used for counseling the person accompanying the child.
18. The PTA will be ± 8 dB of the SDT for each ear if the data are reliable.
19. Click in the **Reliability** box to report the reliability of the patient's responses during testing - **Good**, **Fair**, or **Poor**.

5.3 Special Tests

5.3.1 Performing Tone Decay using the Modified Carhart Method

1. Properly place the earphones.
    - Begin the test with the air conduction transducer.
2. Give the patient a responder.
3. Instruct the patient so that he/she knows what to expect: "You will hear a continuous tone. Press the button on the responder as long as the tone stays the same. If the pitch changes or you can no longer hear the tone, release the responder button."
4. Select tone decay in the Test Selector.
    - Make sure that the control panel of the OTOsuite software is set to the correct transducer, and desired routing, sound level and frequency. Any frequency can be used.
5. Make sure that the tone decay box and the timer box have appeared in the display.
6. Start the test at 5 dB above the patient's threshold for that frequency in that ear.
7. As soon as the subject responds, start the timer. You will be presenting a tone for at least one minute.
8. If the patient indicates that the tone was audible at the same pitch for one minute, then the test is complete.
    - Store the test result in the **Tone Decay Box**.
9. If the patient indicates that the tone is no longer audible or changes pitch before one minute passes, increase the level of the tone by 5 dB.
    - Reset the timer when you increase the level and begin timing again.
10. Continue increasing the tone by 5 dB until a level is reached at which the patient indicates that the tone is audible at the same pitch for one minute.
11. If desired, test additional frequencies or the opposite ear.
12. Store the test result in the **Tone Decay** box.

5.3.2 Performing a pure tone Stenger

1. To perform this test, the pure tone thresholds for the chosen stimulus frequency should be at least 20 dB different in each ear.
    - You must suspect that the patient is malingering.
2. Properly place the earphones.
    - Begin the test with the air conduction transducer.
3. Instruct the patient to push the button in response to the tone even if the sound is very soft.
4. Select Puretone Stenger in the Test Selector.

- Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing, frequency, and sound level.
- Choose any frequency.
- Set the level for the better ear at 10 dB above recorded threshold and set the level in the poorer ear at 10 dB below recorded threshold.

5. Make sure that the **Stenger** box has appeared in the display.
6. Make sure that **Stim Lock** is enabled and present the tone to both ears simultaneously.
7. If the patient truly has a hearing loss in the poorer ear, he/she will only hear the presented tone in the better ear and will respond that the tone is present.
   - This is a negative Stenger response.
8. If the patient does not truly have a hearing loss in the poorer ear, he/she will only hear the presented tone in the reportedly poorer ear. As the patient is trying to appear as if he/she has a hearing loss in that ear, the patient will not respond to the tone.
   - This is a positive Stenger response.
9. Store the test result in the **Stenger** box.

5.3.3 Performing speech Stenger

1. To perform this test, the SRT should be at least 20 dB different in each ear.
   - You must suspect that the patient is malingering.
2. Properly place the earphones. Begin the test with the air conduction transducer.
3. Instruct the patient to repeat the word back to the examiner even if the word is very soft.
4. Select Speech Stenger in the Test Selector.
   - Make sure that the control panel of the OTOsuite software is set to the correct transducer, and desired routing and sound level.
   - Set the level for the better ear at 10 dB above recorded SRT and set the level in the poorer ear at 10 dB below recorded SRT.
5. Make sure that the **Stenger** box has appeared in the display.
6. Make sure that **Stim Lock** is enabled and present the word to both ears simultaneously.
7. If the patient truly has a hearing loss in the poorer ear, he/she will only hear the presented word in the better ear and will respond by repeating the word.
   - This is a negative Stenger response.
8. If the patient does not truly have a hearing loss in the poorer ear, he/she will only hear the presented word in the reportedly poorer ear. As the patient is trying to appear as if he/she has a hearing loss in that ear, the patient will not repeat the word.
   - This is a positive Stenger response.
9. Store the test result in the **Stenger** box.

5.3.4 Performing Weber

1. Properly place the bone oscillator on the forehead.
2. Instruct the patient so that he/she knows what to expect: "You will hear a tone. Tell me whether you hear the tone in the left, right or both ears."

3. Select **Weber** in the Test Selector.
   – Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing, sound level and frequency.
4. Make sure that the **Weber** box has appeared in the display.
5. Present a pure tone at a frequency below 1000 Hz and a sound level above the patient's bone conduction threshold.
6. If the patient reports hearing the tone equally in both ears, this is indicative of normal hearing.
7. If the patient reports hearing the tone in the poorer ear, this is indicative of a conductive hearing loss.
8. If the patient reports hearing the tone in the better ear, this is indicative of a sensorineural hearing loss.
9. Store the test result in the **Weber** box.

5.3.5 Performing Rinne

1. This test is performed using a 256 or 512 Hz tuning fork and compares that patient's hearing to air and bone conduction.
   – This test is used to confirm a conductive hearing loss.
2. Instruct the patient that two tones will be presented to him/her. Ask the patient to tell you when the tone can no longer be heard.
3. Make sure that the **Rinne** box is present.
4. Strike the tuning fork against the knee or the elbow, not the table, otherwise the vibrations will be excessive and cause the patient discomfort.
5. Hold the fork for 2-3 seconds and then place it on the patient's mastoid.

> ***Note*** • *The time interval from initial stimulus perception to inability to hear the tone.*

6. Strike the fork again.
7. Hold the fork for 2-3 seconds and then place it in front of the patient's ear.

> ***Note*** • *The time interval from initial stimulus perception to inability to hear the tone.*

8. If air conduction perception is better than bone conduction, this is a positive Rinne and agrees with normal hearing
9. If bone conduction perception is better than air conduction, this is a negative Rinne and indicative of a conductive hearing loss.
10. If air conduction and bone conduction are equal, this is a positive Rinne and indicative of a sensorineural hearing loss.
11. Store the test result in the **Rinne** Box.

5.3.6 Performing Alternate Binaural Loudness Balancing (ABLB) test

If you have measured thresholds prior to performing ABLB, then these will appear already plotted in the ABLB graph.

1. Properly place the earphones.
2. Give the patient the responder(s).

3. Instruct the patient so that he/she knows what to expect: "You will hear a continuous tone. The level of this tone will be changed periodically. Press the button on the responder immediately each time you hear a change. I will ask you if the test tone is softer than, louder than or equal to the reference tone in the opposite ear."
4. Choose the ABLB tab or select ABLB in the Test Selector.
   - Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing.
   - If left ear is selected as the test ear in the Control Panel Routing section, then the right ear will be the reference ear.
5. Set the reference level (**Ch 1**).
6. Set the test level (**Ch 2**) to 10 dB above the patient's threshold for that ear.
7. Adjust the level of the test signal (**Ch 2**) until the patient reports that the two signals sound equally loud.
8. Store the data points.
9. Repeat steps 5 to 8 for additional frequencies.
10. If desired, switch routing to test the opposite ear and repeat steps 5 to 8.

5.3.7 Performing Short Increment Sensitivity Index (SISI) test

1. Properly place the earphones.
2. Give the patient the responder(s).
3. Instruct the patient so that he/she knows what to expect: "You will hear a continuous tone. The level of this tone will be changed periodically. Press the button on the responder immediately each time you hear a change."
4. Choose the **SISI** tab or select **SISI** in the Test Selector.
   - Make sure that the control panel of the OTOsuite software is set to the correct transducer and desired routing.
   - Make sure that the frequency is correct.
5. Begin the test in the ear with the lower PTA or SRT.
6. Start with 5 dB SISI dB step and set the level 20 dB above the patient's threshold for that frequency in that ear.
7. The test begins with 1000 Hz.
8. Make sure that the patient understands the response task.
9. Change the SISI dB step to 1 dB. Set the level 20 dB above the patient's threshold for that frequency in that ear and press the **Play** button.
10. Store the data points.
11. Repeat steps 6 to 10 for additional frequencies.

5.4 Testing with sound files

5.4.1 Playing sound files without word lists

Prepare playback

1. Use either **Int. CD** or **Int. File** as **Sound Source**.
2. If **Int. CD** is chosen, select **CD Drive Selection** and/or **CD Track Selection** in the **Options** dialog or directly in the **Player Panel**. This will list CD tracks in the **Player Panel** combo box.

3. If **Int. File** is chosen, select **Sound File Selection** in the **Options** dialog or browse for a folder containing sound files in the **Player Panel**. This will list all sound files contained in the same folder as the **Sound File Selection** file in the **Player Panel** combo box.

How to play back / stop playback

1. Use either the **Play** or **Pause** button.
2. A click on the **Pause** button (actually a stop icon) will pause playing (this is different when using word lists).
3. A click on **Reset** stops the playback and resets the score.

How to score

- Use the score buttons or shortcut keys (+, -).

When to reset score

Notice the field **Reset Score Counter** in the **Options** dialog.

- **Reset Score Counter** = **True**

  The **Scoring panel** is reset if you change **Channel Settings** (except **Continuous On**), the **Intensity** or if the **Reset** button is clicked.

- **Reset Score Counter** = **False**

  Does not change the score even if **Reset** is clicked.

5.4.2 Playing sound files with word lists

Prepare playing

1. Use either **Int. CD** or **Int. File** as **Sound Source**.
2. If **Int. CD** is chosen, select a CD drive in **CD Drive Selection** in the **Options** dialog or in the **Player Panel**. It is important that an XML file (extension *.wordlistdefinition) describing the word lists exist on your PC (in the installation folder). If not the tracks on the CD will be listed and not the actual words.
3. If **Int. File** is chosen, select a .wav file in the **Sound File Selection** which is located in the same folder as a wordlistdefinition file. You can also browse for a folder in the **Player Panel** that contains a wordlistdefinition.

How to play/stop files

1. Use either the **Play** or **Pause** button.
2. A double click on a word in the **Word list control** plays the selected word.
3. A **Play** button click will start to play back the word list from the current index to the end.
4. If you like to change index during playback, just change index in the **Word list control** and it will keep on playing from that position.

How to score

- Use the score buttons or shortcut keys (**+**, **-**), or make a right click on a given word already played in the **Word list control**.

When to reset score

Notice the field **Reset Score Counter** in the **Options** dialog.

- **Reset Score Counter** = **True**

The **Scoring panel** as well as the **Word list control** images (**+**, **-**) is reset if changes are made to the **Channel Settings** (except **Continuous On**), the **Intensity** or when the **Reset** button is clicked.

- **Reset Score Counter** = **False**

We actually reset the score in some cases even if **Reset Score Counter** = **False**. This is in situations where we go from using a word list to e.g. **Stimulus CH1** = **Stimulus CH2** = **Mic**.

6 Unpacking and installing

This section applies both to MADSEN Astera² and the Audiometer Control Panel (ACP). If the ACP is not part of your configuration, disregard the instructions relating to the ACP.

To install and get started with MADSEN Astera² and the OTOsuite Audiometry Module, follow the sequence below:

- Install OTOsuite on the PC before you connect to MADSEN Astera² from the PC.
- Unpack MADSEN Astera² (see Unpacking ► 131).
- Assemble MADSEN Astera² (see Installing MADSEN Astera² and the ACP ► 134Assembling the ACP ► 137
- Run the OTOsuite Configuration Wizard to connect to and set up communication with MADSEN Astera². (See Configuring the Audiometry Module ► 147).

6.1 Unpacking

Unpack the device carefully.
When you unpack the device and accessories, it is a good idea to keep the packing material in which they were delivered. If you need to send the device in for service, the original packing material will protect against damage during transport, etc.Visually inspect the equipment for possible damage.
If damage has occurred, do not put the device into operation. Contact your local distributor for assistance.Check with the packing list to make sure that you have received all necessary parts and accessories. If your package is incomplete, contact your local distributor.

1. Check the Test Report (Calibration Certificate), make sure that the transducers (headphones, and bone oscillators) are the correct ones, and that they comply with the ordered calibration standards.

6.2 Storing

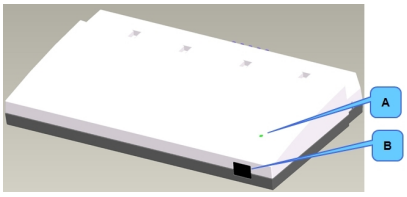
If you need to store MADSEN Astera² before you put it into operation, follow the guidelines below:

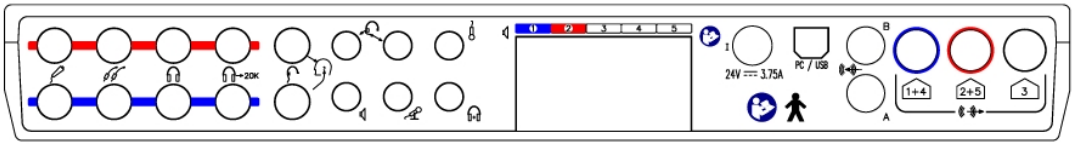
- Store MADSEN Astera² and accessories in the boxes provided to protect the equipment from damage.
- Store MADSEN Astera² and accessories in a dry environment.

  See also Transport and storage ► 164.

6.3 Views of MADSEN Astera²

6.3.1 MADSEN Astera²

Front view - with cable cover	Front view - without cable cover
	
A. On/Off indicator **B.** On/Off switch	**A.** On/Off indicator **B.** On/Off switch

Rear view - Connection panel


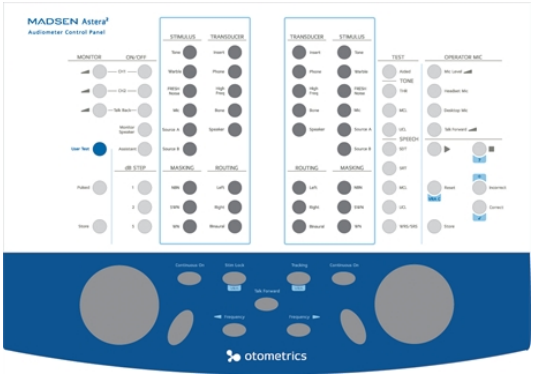
6.3.2 ACP

Front view

MADSEN Astera² is operated from either the software or the ACP front panel.

The ACP front panel controls are described in detail in ACP front panel controls ▶ 106.

Front view



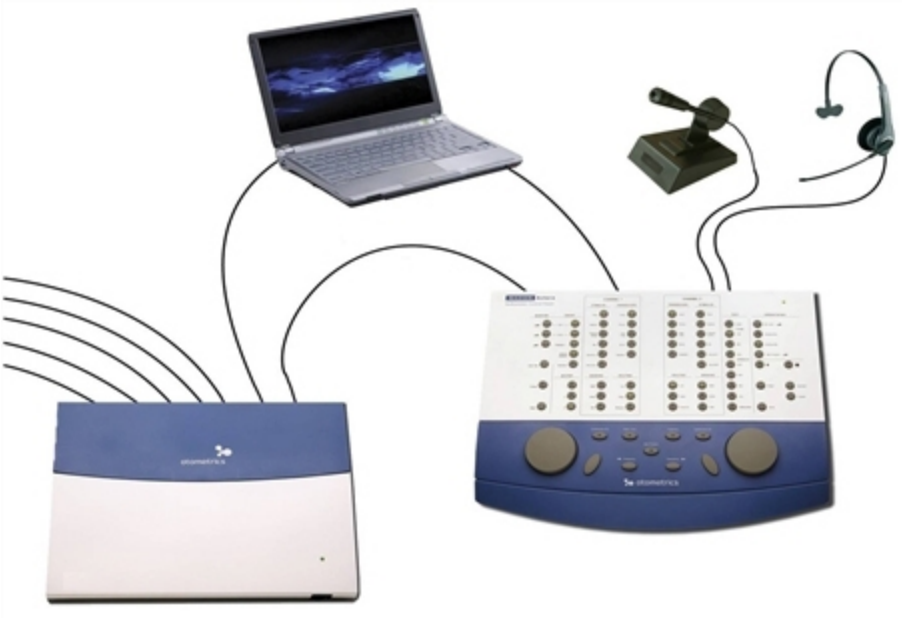
Rear view

The rear panel contains the sockets for connecting various accessories, the sockets for connecting the ACP to MADSEN Astera², and the USB socket for connecting to the PC. See also Assembling the ACP ► 137.

Rear view - Connection panel

6.3.3 Total system view

MADSEN Astera² - ACP - PC connection setup



6.4 Installing MADSEN Astera² and the ACP

This section provides you with instructions on how to assemble and install MADSEN Astera² and the ACP.

> ***Caution*** • *Install the OTOsuite Audiometry Module on the PC before you connect MADSEN Astera² and the ACP to the PC.*

- Before you start using MADSEN Astera², it is recommended that you leave it at room temperature for 30 minutes - particularly if it has been stored at very cold or warm temperatures, e.g. if it has been in a car.
- Choose between placing MADSEN Astera² on the desktop or mounting it on the wall using the wall mounting plate.

Safety aspects

To ensure safe performance, MADSEN Astera² and the ACP must be correctly installed and the requirements listed in Standards and safety ► 157 and Technical specifications ► 161 must be complied with.

Cooling requirements

There are no specific cooling requirements. However, wall-mounting the MADSEN Astera² with the cable connections pointing upwards is the best position for ensuring optimal cooling of the audiometer.

> ***Caution*** • *Do not place anything on top of MADSEN Astera².*

Caution • *Make sure that MADSEN Astera² is placed in a well ventilated location.*

- Place MADSEN Astera² and the ACP in locations away from sources of heat and direct sunlight.
- MADSEN Astera² and the ACP must not come into contact with liquids.

Installation sequence

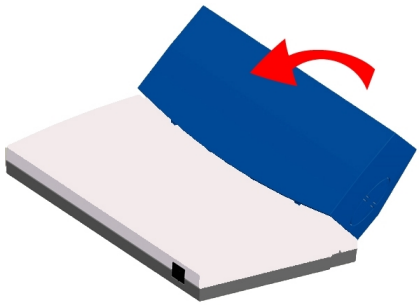
1. Install the OTOsuite Audiometry Module on your PC.
2. Assemble and set up MADSEN Astera².
   - Assembling MADSEN Astera² ▶ 135
   - Wall-mounting MADSEN Astera² ▶ 136, if needed.
   - MADSEN Astera² connection panel ▶ 142
3. Assemble and set up the ACP.
   - Assembling the ACP ▶ 137
   - Connecting the ACP to MADSEN Astera² ▶ 138
   - Connecting accessories to the ACP ▶ 141
4. Switch on MADSEN Astera².
5. Run the Configuration Wizard in OTOsuite to connect to and set up communication with MADSEN Astera². See see Configuring the Audiometry Module ▶ 147.

6.4.1 Assembling MADSEN Astera²

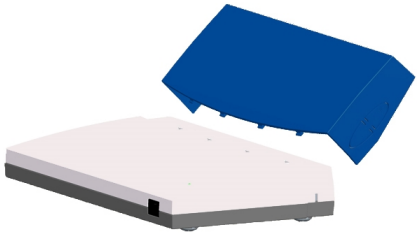
Removing the cable cover

1. To remove the cable cover from MADSEN Astera² press the releases on both sides of the cable cover, swing the cover up into vertical position and lift it off MADSEN Astera².

2. Lift off the cable cover.

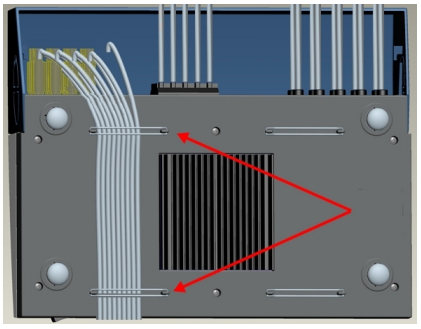


MADSEN Astera² without cable cover.



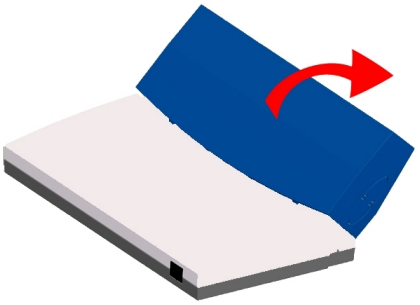
Securing cables to MADSEN Astera²

1. Secure the cables to the back of MADSEN Astera² with the rubber bands provided.



Mounting the cable cover

1. Remount the cable cover by inserting the blue tags of the cable cover into the grooves of MADSEN Astera² and swinging the cover into place until you hear a click.



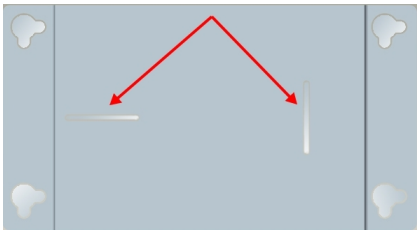
6.4.2 Wall-mounting MADSEN Astera²

You can hang MADSEN Astera² on the wall, orienting it in one of three positions:

While tools are needed to attach the wall-mount plate to the wall, no tools are needed for mounting or dismounting MADSEN Astera² on the wall-mount plate.

> ***Note*** • *Make sure that you use screws specifically suited for the type of wall on which you will be hanging the MADSEN Astera².*

1. Mount the wall-mount plate securely on the wall.
2. Fit the screws through the slots marked by the red arrows.
3. Hang MADSEN Astera² on the wall-mount plate.

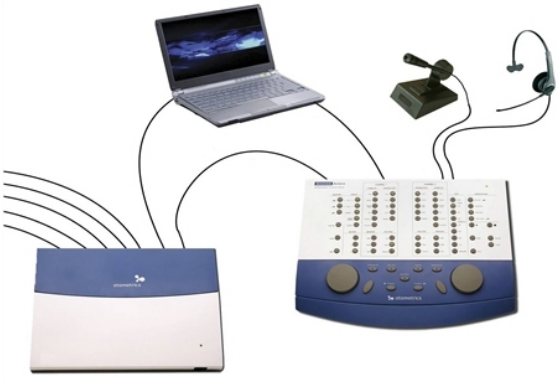


6.4.3 Assembling the ACP

MADSEN Astera² - ACP - PC connection setup

If you are using the ACP:

1. Unfold the feet of the ACP.
2. Place the ACP in front of the PC monitor.
3. Connect the ACP to MADSEN Astera². See Connecting the ACP to MADSEN Astera² ► 138.
4. Connect the ACP to the PC. See Connecting the ACP to the PC ► 139.
5. Connect accessories to the ACP. See Connecting accessories to the ACP ► 141.



6.4.4 Connecting the ACP to MADSEN Astera²

Cabling

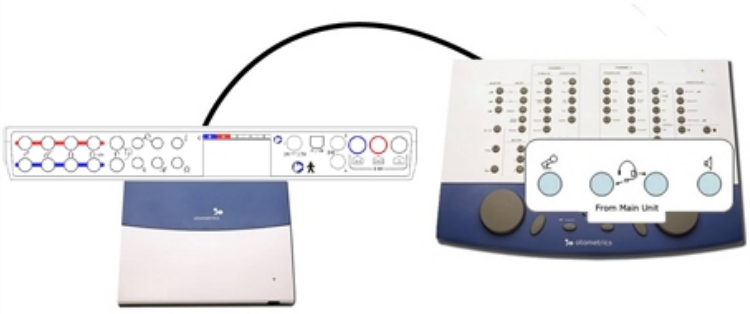
> ***Caution*** • *Make sure that each jack, as depicted on each end of the cable, connects with the specific sockets on the ACP and MADSEN Astera².*

All four cables for connecting accessories are joined in a bundle and color-coded for easy connection:

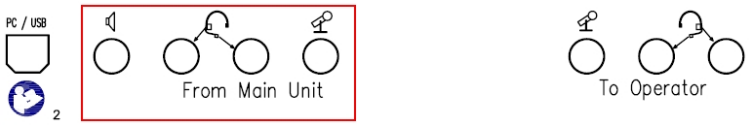
- Yellow: Operator desktop microphone
- Green: Operator monitor headset, headphones
- Pink: Operator monitor headset, boom microphone
- Gray: Operator monitor speaker

Connecting

1. Remove the cable cover from MADSEN Astera².
2. Connect the ACP to MADSEN Astera².



The connections are located at the back of the ACP.

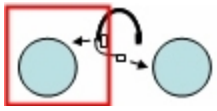


Operator desktop microphone

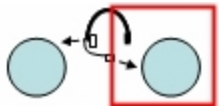
- If you are using a desktop microphone, connect the yellow cable in the cable bundle from the **Operator desktop microphone** socket in the MADSEN Astera² rear panel to the **Operator desktop microphone** socket in the ACP.

Operator monitor headset with boom microphone

- Connect the green cable in the cable bundle from the **Operator monitor headset - headphones** socket in the MADSEN Astera² rear panel to the **Operator monitor headset - headphones** socket in the ACP.

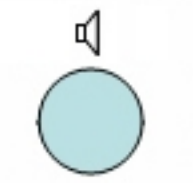


- Connect the pink cable in the cable bundle from the **Operator monitor headset - boom microphone** socket in the MADSEN Astera² rear panel to the **Operator monitor headset - boom microphone** socket in the ACP.



Speaker, built into the ACP

- Connect the gray cable in the cable bundle from the **Operator monitor speaker** socket in the MADSEN Astera² rear panel to the **Operator monitor speaker** socket in the ACP.



3. When you have connected the accessories, slide the cable cover onto MADSEN Astera² and click it into place.

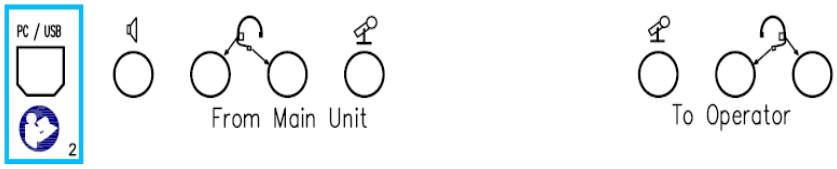
6.4.5 Connecting the ACP to the PC

The ACP is powered from the PC through a USB connection.

Caution • *Install the OTOsuite Audiometry Module on the PC before you connect the ACP to the PC.*

Caution • *To connect the ACP to the PC, use the supplied USB cable. The cable length must not exceed 3 m (approx. 10 feet).*

Caution • *Do not connect the ACP to the PC by using a bus powered hub (USB hub without external power supply). It cannot provide sufficient power to the ACP. The* ***Power on*** *LED on the ACP will flash to indicate an error. Use instead a USB hub with external power supply.*



The following applies only when used with the specified power supply, External power supply, Delta Electronics Inc., type MDS-090AAS24:

2 The installation must be carried out in accordance with Medical Electrical Systems clause 16 in IEC 60601-1 (3rd), AAMI ES60601-1 and CSA C22.2 NO. 60601-1-08-CAN/CSA. The supplementary provisions on the reliability of electro-medical systems.

It is a general rule for all electrical equipment used in the proximity of the client that:

- The connected equipment must comply with IEC 60601-1 (3rd).

The following applies only when used with the specified power supply, XP Power, type PCM80PS24:

2 The installation must be carried out in accordance with IEC 60601-1-1, UL 60601-1 and CAN/CSA-C22.2 NO 601.1-90. The supplementary provisions on the reliability of electro-medical systems.

It is a general rule for all electrical equipment used in the proximity of the client that:

- The connected equipment must comply with IEC 60601-1 (2nd) and/or IEC 60601-1-1.

Any PC connected to the ACP must comply with the requirements of UL/IEC 60950, "Safety of information technology equipment, including electrical business equipment".

Only the supplied cable must be used for the connection.

Direct connection to PC using single USB cable

Caution *• Make sure that the total length of the USB cable used for connecting the ACP to the PC does not exceed 3 meters (10 feet).*

2

1. Unfold the feet of the ACP.
2. Place the ACP in front of the PC monitor.
3. Plug one end of the USB cable into the USB socket located in the ACP rear panel and the other end of the cable into a USB socket on the PC.

Connection to PC using externally powered USB hub

Caution *• If the PC, the externally powered USB hub and the ACP are connected, make sure that you switch on power to the hub before or right when you switch on the PC. This is to ensure that the USB connection between the PC and the hub is established correctly. This connection is established when the PC is switched on.*

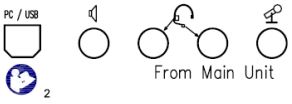
Caution • *If you are using an externally powered hub, no individual USB cable must exceed 3 meters (10 feet).*

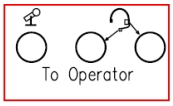
Power up sequence with externally powered USB hub

1. Connect the externally powered USB hub to the mains socket and switch it on.
2. Plug the single USB cable from the externally powered USB hub directly into a USB socket on the PC.
3. Connect the USB cable from the externally powered USB hub to the USB socket located in the ACP rear panel.

6.4.6 Connecting accessories to the ACP

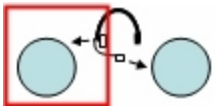
- Connect the operator monitor headset, the boom microphone, and the desktop microphone (if needed), to the ACP.





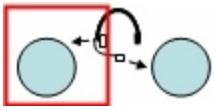
Operator monitor headset with boom microphone

- Connect the operator monitor headset to the **Operator monitor headset** socket.



The jack is marked with this symbol.

- Connect the boom microphone on the monitor headset to the **Operator boom microphone** socket.



The jack is marked with this symbol.

Operator desktop microphone

- If you are using a desktop microphone, connect it to the **Operator desktop microphone** socket.

The jack is marked with this symbol.

6.5 MADSEN Astera² connection panel

Caution • *Install OTOsuite on the PC before you connect to MADSEN Astera² from the PC.*

The following applies only when used with the specified power supply, XP Power, type PCM80PS24:

The installation must be carried out in accordance with IEC 60601-1-1, UL 60601-1 and CAN/CSA-C22.2 NO 601.1-90. The supplementary provisions on the reliability of electro-medical systems.

It is a general rule for all electrical equipment used in the proximity of the client that:

- The connected equipment must comply with IEC 60601-1 (2nd) and/or IEC 60601-1-1.

  except for the PC, and equipment connected to the line in and the line out sockets of MADSEN Astera².

The following applies only when used with the specified power supply, External power supply, Delta Electronics Inc., type MDS-090AAS24:

The installation must be carried out in accordance with Medical Electrical Systems clause 16 in IEC 60601-1 (3rd), AAMI ES60601-1 and CSA C22.2 NO. 60601-1-08-CAN/CSA. The supplementary provisions on the reliability of electro-medical systems.

It is a general rule for all electrical equipment used in the proximity of the client that:

- The connected equipment must comply with IEC 60601-1 (3rd).

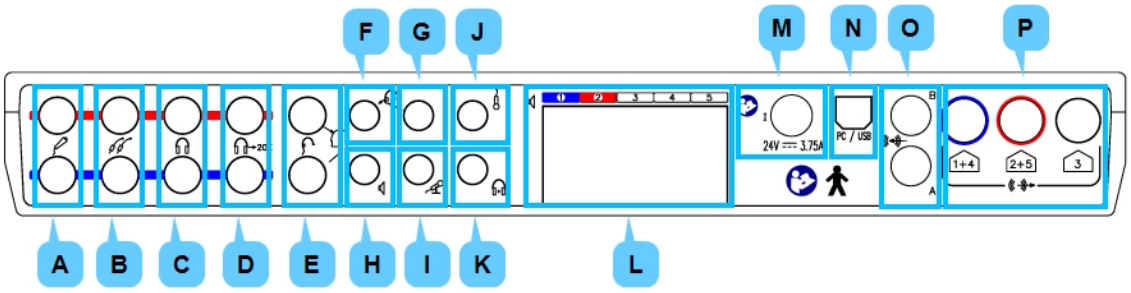
  except for the PC, and equipment connected to the line in and the line out sockets of MADSEN Astera².

See Technical Specifications, Power supply.

See also Connector warning notes ► 157 and General warning notes ► 158.

- When you have connected the accessories, configure your system setup. To do so, see Configuring the Audiometry Module ► 147.

  The connections are located at the back of MADSEN Astera².



A. Patient Responders ▶ 143
B. Insert earphones ▶ 143
C. Headphones - air conduction ▶ 143
D. High-frequency headphones - air conduction ▶ 143
E. Bone oscillator ▶ 143
F. Operator monitor headset - headphones ▶ 144
G. Operator monitor headset - boom microphone ▶ 144
H. Operator monitor speaker ▶ 144
I. Operator desktop microphone ▶ 145
J. Talkback microphone ▶ 145
K. Assistant monitor headset ▶ 145
L. Sound field speakers (power output) ▶ 145
M. External power supply ▶ 145
N. PC/USB connection ▶ 146
O. Line-in ▶ 146
P. Sound field speakers (line output) ▶ 146

Note • *Blue corresponds to Left and Red corresponds to Right.*

Patient Responders

- If you are using only one Patient Responder, plug it into either of these sockets.
- If you are using two Patient Responders, you can set up the specific **Left** and **Right** separation of the Patient Responders in see Configuring the Audiometry Module ▶ 147.

Insert earphones

- Plug the insert earphones into the Right and Left **Insert** sockets.If you are using a mono insert earphone, plug it into the **Left Insert** socket (the lower socket).

Headphones - air conduction

- Plug standard headphone cables (red and blue jacks) into the Right and Left **Headphone** sockets.

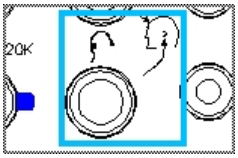
High-frequency headphones - air conduction

- Plug the high-frequency HDA 200 headphone cables (red and blue jacks) into the Right and Left **High-frequency headphone** sockets.

Bone oscillator

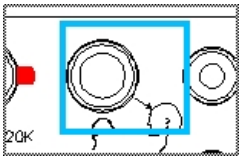
Mastoid

- If you are using a standard bone oscillator for Mastoid placement, plug it into the **Mastoid** socket (the socket pointing to the Mastoid location on the client).



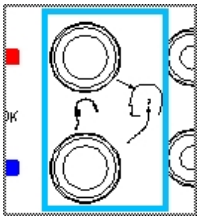
Forehead

- If you are using a bone oscillator for Forehead placement, plug it into the **Forehead** socket (the socket pointing to the Forehead location on the client).



Two bone oscillators

- If you are using two bone oscillators, plug the mastoid bone oscillator into the Mastoid **Bone** socket, and the forehead bone oscillator into the Forehead **Bone** socket.



***Note** • If you switch between mastoid and forehead bone vibrator placement, for calibration to be correct you must select the Configuration Wizard and switch the bone oscillator default placement.*

Operator monitor headset - headphones

***Note** • This applies if you are **not** using the ACP.*

- If you are using headphones with the operator monitor headset, plug the headphones into this socket.

The jack is marked with this symbol.

Operator monitor headset - boom microphone

***Note** • This applies if you are **not** using the ACP.*

- If you are using a boom microphone with the operator monitor headset, plug the boom microphone on the monitor headset into this socket.

The jack is marked with this symbol.

Operator monitor speaker

***Note** • This applies if you are **not** using the ACP.*

Connection for the operator monitor speaker, built into the ACP or as a desktop version.

- Plug the operator monitor speaker into the **Operator monitor speaker** socket.

Operator desktop microphone

> ***Note*** • *This applies if you are **not** using the ACP.*

Connection for the operator desktop microphone.

- Plug the desktop microphone into the **Operator desktop microphone** socket.

The jack is marked with this symbol.

Talkback microphone

Connection for the talkback microphone.

- If you are using a talkback microphone, plug it into the **Talkback microphone** socket.
- Position the talkback microphone in the sound booth facing the client.

Assistant monitor headset

Connection for the assistant monitor headset.

- If you are using an assistant monitor headset, plug it into the **Assistant monitor headset** socket.

Sound field speakers (power output)

Connections for sound field speakers using the built-in amplifiers (4 speakers are currently supported in the software).

- Connect the left speaker to the socket labeled 1, and the right speaker to the socket labeled 2.
- If you are using more than the 2 standard speakers, set up the configuration in the OTOsuite Configuration Wizard. See the OTOsuite Installation and User Manual.

External power supply

> ***Warning*** • *Use only the power supply provided by Otometrics.*

> ***Warning*** • *MADSEN Astera² is not provided with a mains switch.*
> *To connect MADSEN Astera² to the mains supply, plug the mains plug into the wall mains outlet.*
> *To disconnect MADSEN Astera² from the mains supply, pull the mains plug out of the wall mains outlet. Do not position the unit so that it is difficult to pull the mains plug out of the wall mains.*

See Power supply for details.

1. Plug the external power supply into the Power socket in the connection panel.
2. Plug the mains plug of the external power supply into an AC mains outlet with a three-wire protective ground.

PC/USB connection

Caution • *Install OTOsuite on the PC before you connect to MADSEN Astera² from the PC.*

To connect MADSEN Astera² to a PC, use the supplied USB cable.

1. Plug one end of the USB cable into the PC/USB socket in the connection panel and the other into a USB socket on the PC.
2. Switch on MADSEN Astera². The driver installation will be initiated.
3. If the **Found New Hardware Wizard** appears on the screen, click the radio button **No, not this time** and click **Next**.
4. Follow the on-screen instructions.

Line-in

Connection for any line-in device (e.g. CD player or tape recorder).

Caution • *When you connect other electrical equipment to MADSEN Astera², remember that equipment that does not comply with the same safety standards as MADSEN Astera² can lead to a general reduction in the system's safety level.*

Sound field speakers (line output)

Connections for sound field speakers using external amplifiers (5 speakers are currently supported in the software).

- Blue: connection for speakers 1 and 4.
- Red: connection for speakers 2 and 5.
- Black connection for speaker 3.

7 Configuring the Audiometry Module

You must run the **Configuration Wizard** before you can use the Audiometry Module and the audiometer for the first time. You can also use the wizard later to change specific settings or, for example, to repair the connection between the Audiometry Module and the audiometer.

1. Select **Tools > Configuration Wizard...**
2. Click on **Configure...** next to **Audiometry**.
3. Enter your selections and click on **Next** to continue the configuration or **Finish** to return to the **Applications** page of the configuration wizard.

Audiometers	
Connect to the device you wish to use for testing.	• Click on the device you wish to use. – If the device is not listed, check the check box **My device is turned on and ready to be found**, and click on **Search**. – If you are having problems connecting to a device that is included in the list, click on **Repair**.

License Keys	
Enter your License Keys to unlock OTOsuite functions	• If you have purchased additional OTOsuite functions, you will be prompted to enter the relevant license keys.

Audiometer Configuration	
Responders	*Single:* • For use with one patient responder. The response will be shown in single color on the screen. Connect the single responder to either of the patient responder sockets on the MADSEN Astera² rear panel. *Dual-ear specific:* • For use with two patient responders, one for each ear. The response will be shown in dual color on the screen. Connect the corresponding responder to the relevant patient responder socket on the MADSEN Astera² rear panel.

Audiometer Configuration	
Insert phone selection	*Mono insert:* • If you only wish to use a single insert for masking, select the mono insert. ***Note** • If you use only one insert, make sure that it is connected to the **Left** insert socket on the MADSEN Astera² rear panel.* *Dual insert:* • If you wish to use insert phones as a standard transducer, select the dual insert. Connect the corresponding transducer to the relevant insert sockets on the MADSEN Astera² rear panel.
Bone oscillator placement	*Mastoid* • If you wish to use mastoid placement of the bone oscillator, select Mastoid. This selection will enable the calibration data entered for mastoid placement. Connect the mastoid bone oscillator into the Mastoid socket on the MADSEN Astera² rear panel. *Forehead* • If you wish to use forehead placement of the bone oscillator, select Forehead. This selection will enable the calibration data entered for forehead placement. Connect the mastoid bone oscillator into the Forehead socket on the MADSEN Astera² rear panel.

Test Type	
Show xxxx test type	• Click to enable viewing any of these test types as a test tab selection on the Audiometry test screens. If a User Test is set up to include either of these tests, and they have been disabled in this screen, you will be prompted to enable them here.

Bone Oscillator Level Limitation	
Mastoid/Forehead Placement Max. Level	Define the output level limitations for Bone Conduction testing in order to avoid vibrotactile stimulation.

Masking Assistant	
Masking Criteria	Define the masking criteria for Insert phone(s), earphones, and high frequency earphones.
Air-Bone Gap Criterion	Set the dB level for the Air-Bone gap criterion.

Frequency Specific Warble	
Depth/Rate	Define the depth and rate for using frequency specific warble.
Enable Frequency Specific Warble	Click to enable or disable.

Preferences	
Enable BSA (United Kingdom only)	• Click to enable storing Tone audiometry according to the recommendations of the British Society of Audiology.
Use Masking Threshold	• If the BSA masking threshold is needed, click to enable.
SRT Designation	• You can define how SRT data is stored in NOAH by selecting the appropriate type of speech material designation. This enables proper viewing in NOAH AUD.
Enable Portable Sound-Field Audiometry	• Select to allow manual calibration of speaker signal for free-field speech audiometry.

Pediatric	
VRA Device	Select the type of Visual Reinforcement you wish to use. The applicable VRA buttons will be enabled in the Pediatric test panel, on the keyboard, and on the ACP.
Enable Center Device	If you have selected OTOsuite Pediatric with VRA, you can add a center VRA device to your test. A center VRA button will populate the Pediatric test panel.
Enable 6 kHz	Enable to enlarge the audiogram to show up to 6 kHz.
Enable SDT	Enable to allow for storing Speech responses in the Pediatric audiogram.
Store Unmasked SF as Unspecified Ear	Stores the unmasked sound field measurements as binaural data. Switching on contralateral masking enables storing the data to the selected stimulus ear.
Store Unmasked BC as Unspecified Ear	Stores the unmasked bone conduction measurements as binaural data. Switching on contralateral masking enables storing the data to the selected stimulus ear.

8 Communicating with the device

Connecting to the device

OTOsuite is designed to communicate with and display test data generated by Otometrics test devices.

- When you start up OTOsuite, click on the **Control Panel** icon. OTOsuite will automatically connect to the test device.
- See also the section "Activating the Control Panel" in the OTOsuite User Guide.

Firmware update

If a Firmware Update message appears, see:

- Updating device firmware ► 151

Information about the test device

To see information relating to the test device, select **Help > About Device**.

8.1 Reconnecting to the device

If the control panel for a test type is shown, and communication with the selected test device is interrupted, a message appears stating that there is no longer connection to the device.

- Click the **Connect** button on the **Control Panel** to reconnect to the selected test device.

8.2 Updating device firmware

If the OTOsuite software version contains a more recent firmware for the device, a message will appear when next you switch on the device.

It is recommended that you update the device firmware to make sure that the device and OTOsuite perform correctly.

- Follow the on-screen instructions.

9 Maintenance and calibration

MADSEN Astera² requires no preventive maintenance except for regular calibration of the transducers.

See Calibration ► 154.

9.1 Service and repair

It is recommended that you keep the packing material in which MADSEN Astera² was delivered. If you need to send it in for service, the original packing material will ensure protection against damage during transport, etc.

> ***Warning*** • *For the sake of safety and in order not to void the warranty, service and repair of electro-medical equipment should be carried out only by the equipment manufacturer or by service personnel at authorized workshops. In case of any defects, make a detailed description of the defect(s) and contact your supplier. Do not use a defective device.*

> ***Note*** • *There are no user-serviceable parts inside the MADSEN Astera² cabinet.*

9.1.1 Fuses

MADSEN Astera² has no user-accessible fuses.

9.2 Cleaning

There are no specific requirements to sterilization or disinfection of the test device.

Cleaning the device

Make sure that the instrument is kept clean and free of dust:

- Remove dust using a soft brush.
- To clean the cabinet, use a soft, slightly damp cloth with a small amount of mild detergent on it.

> ***Caution*** • *Do not allow any moisture inside the instrument!*

Cleaning accessories

Headphones

The headphones are in constant contact with the patient, and should therefore be kept clean.

Clean the headphones between patients, e.g. with a non-alcohol based antibacterial wipe, such as Audiowipes.

Eartips for Insert Earphones

> ***Warning*** • *To prevent cross-infection, use new eartips when you test the next client.*

The eartips are disposable and therefore should not be cleaned or re-used. There are no special requirements for the disposal of the eartips.

Bone oscillator

Clean the bone oscillator between patients, e.g. with a non-alcohol based antibacterial wipe, such as Audiowipes.

9.3 Calibration

Annual calibration

The audiometer, headphones, bone oscillators, and sound field speakers must be calibrated once a year by your authorized service department.

The audiometer is dispatched from the factory together with a Test Report (Calibration Certificate). The Test Report specifies the transducers that have been calibrated (i.e., those which have been supplied together with the instrument), according to which standards, and the equipment used for calibration. Results are listed for each transducer at all standard frequencies.

In general, the instrument is calibrated in dB HL and dB masking level using the stated reference equivalent thresholds; dB HL is related to sound pressure levels, dB SPL = dB re 20 µPa, and force levels (dB re 1 µN).

Caution • *Note that calibration has been performed only on the transducers supplied! If you wish to use any other transducer for testing with the device, please contact your local distributor first.*

10 Troubleshooting

10.1 Powering

Problem	Cause	Solution
The On/Off light indicator is not lit	• There is no power supply to the device.	• Check that the cables of the power supply are firmly connected to the device and the mains outlet socket. • Check that the mains supply is switched on.

10.2 Software/device communication

Problem	Cause	Solution
During installation, the installation process may be interrupted. Various error messages may occur.	• The PC's virus scan is active and prevents the installation process from progressing.	• Deactivate the PC virus scan until the installation process is completed.
When OTOsuite is launched, one or more error messages may appear regarding XML errors.	• An earlier version of OTOsuite was installed. An extended version of data sets has been installed with the new version of OTOsuite.	• Accept the error message. This message only appears the first time the new version of OTOsuite is launched.
There is no connection to the device.	• The USB cable connecting the device to the PC was connected prior to installing OTOsuite. This results in a Windows default driver being allocated.	1. Select the Windows Device Manager followed by Universal Serial Bus controllers. The faulty connection will be marked by a yellow question mark in the list. 2. Uninstall the driver. 3. Make sure OTOsuite is installed and relaunch OTOsuite.

11 Standards and safety

This manual contains information and warnings, which must be followed to ensure the safe performance of the devices and software covered by this manual. Local government rules and regulations, if applicable, should also be followed at all times.

See Symbols used ► 157 and Connector warning notes ► 157.

11.1 Symbols used

MADSEN Astera² complies with the standards listed below.

	Electronic equipment covered by the Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). All electrical and electronic products, batteries, and accumulators must be taken to separate collection at the end of their working life. This requirement applies in the European Union. Do not dispose of these products as unsorted municipal waste. You can return your device and accessories to Otometrics, or to any Otometrics supplier. You can also contact your local authorities for advice on disposal.
	Consult user manual for warnings and cautions.
	Consult user manual for warnings and cautions.
	Consult instructions for use.
	Complies with Type B requirements of IEC60601-1.
	Complies with Medical Devices Directive 93/42/EEC and RoHS Directive (2011/65/EC).
	MEDICAL - General Medical Equipment as to electrical shock, fire and mechanical hazards only in accordance with UL 60601-1, first edition, 2003 CAN/CSA-22.2 No. 601.1-M90.
	MEDICAL - General Medical Equipment as to electrical shock, fire and mechanical hazards only in accordance with medical- general medical equipment ANSI/AAMI ES60601-1 (2005), CAN/CSA-C22.2 No. 60601-1 (2008) 90 EA.

11.2 Connector warning notes

Warning • *Never mix connections between the two types of connectors shown below:*

Direct connectors

- All connectors within the red frame are connected directly to patient transducers.

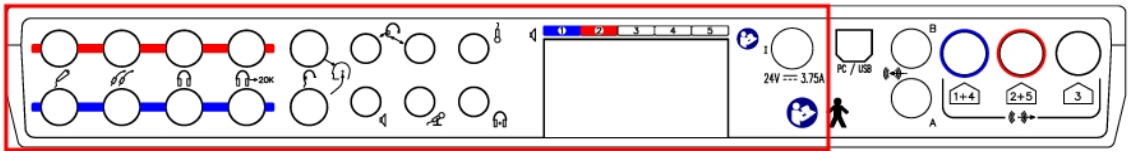


Fig. 1 Sockets with direct connections to patient transducers - MADSEN Astera² connection panel

Isolated connectors

- All connectors within the red frame are isolated from patient transducers.

> ***Note*** • *The safety standards listed in Standards and safety ► 157 do not apply to the isolated connectors used in the MADSEN Astera² audiometer.*

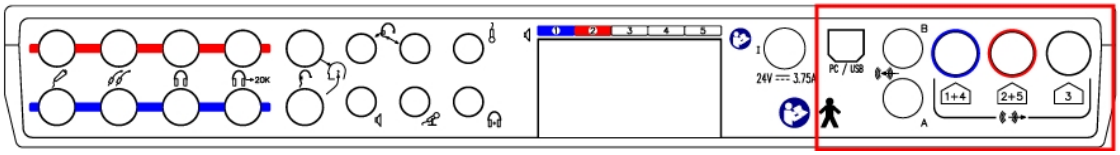


Fig. 2 Connectors isolated from patient transducers - MADSEN Astera² connection panel

11.3 General warning notes

1. This class of equipment is allowed in domestic establishments when used under the jurisdiction of a health care professional.
2. MADSEN Astera² is intended for diagnostic and clinical use by audiologists and other trained health care professionals in testing the hearing of their patients.
3. To prevent cross-infection, use new eartips when you test the next client.
4. Accidental damage and incorrect handling can have a negative effect on the functionality of the device. Contact your supplier for advice.
5. For the sake of safety and in order not to void the warranty, service and repair of electro-medical equipment should be carried out only by the equipment manufacturer or by service personnel at authorized workshops. In case of any defects, make a detailed description of the defect(s) and contact your supplier. Do not use a defective device.
6. It is recommended to install the unit in an environment that minimizes the amount of static electricity. For example, anti-static carpeting is recommended.
7. Do not store or operate the device at temperatures and humidity exceeding those stated in the Technical Specifications, Transport and storage.
8. Keep the unit away from liquids. Do not allow moisture inside the unit. Moisture inside the unit can damage the instrument and it may result in a risk of electrical shock to the user or patient.
9. Do not use the instrument in the presence of flammable agents (gases) or in an oxygen-rich environment.
10. No parts may be eaten, burnt, or in any way used for purposes other than the applications defined in the Intended Use section of this manual.

11. The device and any device to be connected which has its own power supply should be turned off before any connections are established. *To disconnect the device from the mains supply, pull the mains plug out of the wall mains outlet. Do not position the unit so that it is difficult to pull the mains plug out of the wall mains.*
12. For safety reasons, accessories connected to the equipment's outlet fittings must be identical to the type supplied with the system.
13. It is recommended that an annual calibration be performed on accessories containing transducers. Furthermore, it is recommended that calibration be performed if the equipment has suffered any potential damage (e.g. headphones dropped on the floor).

    Note that calibration has been performed only on the transducers supplied! If you wish to use any other transducer for testing with the device, please contact your local distributor first.
14. Disposable accessories, such as eartips, should not be reused and must be replaced between patients to prevent cross-infection.
15. Unwanted noise may occur if the device is exposed to a strong radio field. Such noise may interfere with the performance of the device. Many types of electrical devices, e.g. mobile telephones, may generate radio fields. We recommend that the use of such devices in the vicinity of MADSEN Astera² be restricted.

    Likewise, we recommend that the instrument is not used in the vicinity of devices sensitive to electromagnetic fields.
16. Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.
17. The device can be disposed of as normal electronic waste, according to local regulations.

18. Use only the specified power supply.

    See Technical Specifications, Power supply.

    When assembling an electro-medical system, the person carrying out the assembly must take into account that other connected equipment which does not comply with the same safety requirements as this product (e.g. PC and/or printer) may lead to a reduction in the overall safety level of the system. The equipment must comply with UL/IEC 60950.

    The following applies only when used with the specified power supply, XP Power, type PCM80PS24:

    When selecting accessories connected to the device, the following points must be considered:

    - Use of connected equipment in a patient environment.
    - Proof that connected equipment has been tested in accordance with IEC 60601-1 (2nd) and/or IEC 60601-1-1 and UL 60601-1 and CAN/CSA-C22.2 NO 601.1-90.

    The following applies only when used with the specified power supply, External power supply, Delta Electronics Inc., type MDS-090AAS24:

    When selecting accessories connected to the device, the following points must be considered:

    - Use of connected equipment in a patient environment.
    - Proof that connected equipment has been tested in accordance with IEC 60601-1 (3rd), AAMI ES60601-1 and CAN/CSA-C22.2 NO. 60601-1-08-CAN/CSA.

      Do not touch the output DC plug of the power supply or connectors of the device or connected devices and the patient at the same time.
19. To comply with Medical Electrical Systems in IEC 60601-1-1 or IEC 60601-1 (3rd) computer and printer must be placed out of reach of the client, i.e. not closer than approx. 1.5 meters/5 ft.
20. Do not touch non-medical parts, such as the laptop/computer or printer and the patient at the same time.

11.4 The OTOsuite Audiometry Module

CE XXXX	Complies with Medical Devices Directive 93/42/EEC and RoHS Directive (2011/65/EC).
	Used in error message dialogs if software program fails. See the detailed information in the dialog box.

11.5 Manufacturer

GN Otometrics A/S
Hoerskaetten 9, 2630 Taastrup
Denmark
☎ +45 45 75 55 55
🖷 +45 45 75 55 59
www.otometrics.com

11.5.1 Responsibility of the manufacturer

The manufacturer is to be considered responsible for effects on safety, reliability, and performance of the equipment only if:

- All assembly operations, extensions, re-adjustments, modifications or repairs are carried out by the equipment manufacturer or personnel authorized by the manufacturer.
- The electrical installation to which the equipment is connected complies with EN/IEC requirements.
- The equipment is used in accordance with the instructions for use.

The manufacturer reserves the right to disclaim all responsibility for the operating safety, reliability and performance of equipment serviced or repaired by other parties.

12 Technical specifications

12.1 MADSEN Astera²

MADSEN Astera² is type 1066 from GN Otometrics A/S.

Channels

Two separate and identical channels

Frequency range

TDH39 earphones:	Standard frequencies: 125 - 12500 Hz
HDA 200/HDA 300 earphones:	Standard frequencies: 125 - 20000 Hz
Insert earphones:	Standard frequencies: 125 - 8000 Hz
BC:	Standard frequencies: 250 - 8000 Hz
SF:	Standard frequencies: 125 - 20000 Hz
Tone accuracy:	> 0.03%
FRESH noise stimulus:	Available in entire frequency range within the transducer specified range. (for SF 125 - 12500 Hz). Accuracy 0.3%
Narrow Band Noise masking:	Available in entire frequency range
Frequency resolution:	1/48, 1/24, 1/12, and 1/6 oct, 1 Hz step

Stimulus types

- Tone
- Warble
- Pulsed tone
- Pulsed warble
- FRESH noise — Frequency-specific hearing assessment noise. Consists of noise bands, with frequency-specific filter width. The FRESH noise is filtered to obtain very steep slopes outside the passband.
- Pulsed FRESH noise

Masking types

- Narrow Band Noise
  - AC and BC — Correlated
  - SF — Non-correlated[A]
- Speech Weighted Noise
  - AC and BC — Correlated
  - SF — Non-correlated[A]

- White Noise (Wide band noise)
  - AC and BC
  - SF

Correlated
Non-correlated[A]

A. A maximum of 3 non-correlated simultaneous masking signals.

Stimulus modulation

FM (Warble):	Adjustable modulation rate and depth • Modulation rate: 1-20 Hz (default: 5 Hz). • Modulation depth: 1-25% of center frequency (default: 5%).
SISI:	5, 2, 1 dB increments

Accuracy of sound level

Entire level range (AC):	125 to 5000 Hz: ±3 dB 5000 to 20000 Hz: ±5 dB
Entire level range (BC):	250 to 5000 Hz: ±4 dB 5000 to 8000 Hz: ±5 dB

Level resolution

1, 2, or 5 dB step resolution over the entire range

HL Range

Maximum output will be limited by the transducer.

AC:	-10 to 120 dB HL (500 to 4000 Hz; supra-aural earphones)
BC:	-10 to 80 dB HL (1500 to 3000 Hz; mastoid placement)
SF:	103 dB HL (Note: with external amplifier)

Total harmonic distortion

Air < 2.5 %
Bone < 5 %

Selectable transducers

AC:	TDH39, HDA 200/HDA 300, and Insert Earphones
BC:	Bone vibrator (Mastoid / Forehead)
SF:	• Passive sound field speaker, using the built-in amplifier inMADSEN Astera², or • Sound field speaker with built-in amplifier or external amplifier, with both types using the line output from MADSEN Astera².

Transducer options depend on how MADSEN Astera² is ordered and calibrated.

Outputs

AC:	3 x 2 mono jacks, 1/4 "
BC:	2 x mono jacks, 1/4 "
SF power output:	5 x terminals, 5 x 40 W peak, 8Ω load
SF line output:	3 x mini XLR 6 pin 5 x +6 dBu, balanced

External inputs

CD/Analog line in:	0.2 to 2.0 Vrms, 10 kΩ 2 x RCA phone
Talk Back microphone:	• Electret microphone • Input voltage: 0.002 to 0.02 Vrms • Input resistance: 2.21 kΩ. • 3.5 mm jack

Stimulus presentation

Normal:	The signal is presented when the **Stimulate** button is pressed.
Continuous ON:	The signal is interrupted when the **Stimulate** button is pressed.
Pulse:	The signal is pulsed.
Pulse duration:	225 ms on and 225 ms off (default).

Operator accessories

Operator monitor speaker	• 1.5W 8Ω, connected between tip and ring, sleeve floating • 3.5 mm jack
Operator monitor headset - headphones	• 40 mW 16Ω • 3.5 mm jack
Operator monitor headset - boom microphone	• Electret microphone • Input voltage: 0.002 to 0.02 Vrms, • Input resistance: 2.21 kΩ. • 3.5 mm jack
Operator desktop microphone	• Electret microphone • Input voltage: 0.002 to 0.02 Vrms, • Input resistance: 2.21 kΩ. • 3.5 mm jack
Assistant monitor headset	• 40 mW 16Ω • 3.5 mm jack

Static force of transducer headbands

TDH 39:	4.5 N ±0.5 N

Bone vibrator:	5.4 N ±0.5 N
HDA 200:	10 N
HDA 300:	10 N

USB port connector

Type:	USB device port
Interface:	USB 2.0
Speed:	Full-speed (12 Mb/s)

Transport and storage

Temperature:	-30°C to +60°C (-22°F to 140°F)
Air humidity:	10% to 90%, non-condensing
Air pressure:	500 hPa to 1060 hPa

Operating environment

Mode of operation:	Continuous
Temperature:	+15°C to +35°C (59°F to 95°F)
Air humidity:	30% to 90%, non-condensing
Air pressure:	980 hPa to 1040 hPa.

(Operation in temperatures exceeding -20°C (-4°F) or +60°C (140°F) may cause permanent damage.)

Warm-up time

< 5 min.

> ***Note*** • *Should be extended if MADSEN Astera² has been stored in a cold environment.*

Disposal

MADSEN Astera² can be disposed of as normal electronic waste, according to WEEE and local regulations.

Dimensions

Approx. 325 x 255 x 60 mm (12.8 x 10 x 2.4 inches)

Weight

Approx. 1.3 kg (2.85 lb)

Power supply

External power supply, types:

Delta Electronics, Inc.	Output: 24 V DC, 3.75 A
MDS-090AAS24	Input: 100-240 V AC, 50-60 Hz, 1.5 A - 0.75 A

	Patient Safety when used with the specified power supply, Delta Electronics, Inc., type MDS-090AAS24: • Complies with IEC 60601-1 (3rd), Class 1, Type B; AAMI ES60601-1; CSA C22.2 NO. 60601-1-08-CAN/CSA. • EMC: IEC 60601-1-2
XP Power PCM80PS24	Output: 24 V DC, 3.33 A max Input: 100-240 V AC, 47-63 Hz, 1.1 A - 0.45 A Patient Safety when used with the specified power supply, XP Power, type PCM80PS24: • Complies with IEC 60601-1 (2nd), Class 1, Type B; UL 60601-1; CAN/CSA-C22.2 NO 601.1-90.

Power consumption

< 90 VA

Mains cables

8-71-240 POWER CABLE, W/ SCHUKO PLUG
8-71-290 MAINS CORD, H05VV, DK PLUG
8-71-80200 MAINS CORD, H05VV, UK PLUG
8-71-82700 POWER CABLE AUSTRALIA
8-71-86400 POWER CABLE CHINA
7-08-027 MAINS CORD, H05VV, CH PLUG
7-08-017 POWER CABLE, SJ, US HOSP. PLUG

Standards

Audiometer:	IEC60645-1, Type 1, IEC60645-2 and ANSI S3.6
Patient Safety:	Patient Safety when used with the specified power supply, Delta Electronics, Inc., type MDS-090AAS24: • Complies with IEC 60601-1 (3rd), Class 1, Type B; AAMI ES60601-1; CSA C22.2 NO. 60601-1-08-CAN/CSA. • EMC: IEC 60601-1-2 Patient Safety when used with the specified power supply, XP Power, type PCM80PS24: • Complies with IEC 60601-1 (2nd), Class 1, Type B; UL 60601-1; CAN/CSA-C22.2 NO 601.1-90.
EMC:	IEC 60601-1-2

12.2 ACP

Outputs

Monitor headphone	3.5 mm jack (32 Ω.)
Boom microphone	3.5 mm jack
Desktop microphone	3.5 mm jack

Inputs

Monitor headphone	3.5 mm jack (32 Ω.)
Boom microphone	3.5 mm jack
Desktop microphone	3.5 mm jack
Built-in monitor speaker	3.5 mm jack (8 Ω)

Operator interface

- 76 buttons (61 with built-in LEDs)

2 rotary knobs (32 steps in each rotation)

USB port connector

Type:	USB device port
Compliant:	USB 2.0
Speed:	Full-speed (12 Mb/s)

Transport and storage

Temperature:	-30°C to +60°C (-22°F to 140°F)
Air humidity:	10% to 90%, non-condensing

Operating environment

Mode of operation:	Continuous
Temperature:	+5°C to +40°C (41°F to 104°F)
Air humidity:	30% to 90%, non-condensing

(Operation in temperatures exceeding -20°C (-4°F) or +60°C (140°F) may cause permanent damage.)

Warm-up time

< 1 minute

Disposal

MADSEN Astera² ACP can be disposed of as normal electronic waste, according to WEEE and local regulations.

Dimensions

Approx. 410 x 290 x 36 mm (16.1 x 11.4 x 1.4 inches)

Weight

Approx. 2.1 kg (4.6 lb)

Power supply

No external power supply. Supplied by the USB (5 V).

> ***Note*** • *If you are using a USB hub, use a* ***powered*** *USB hub.*

Power consumption

Normal operation: < 360 mA 5 V

Suspend mode: < 500 µA 5 V

Standards

Patient Safety:	Complies with IEC 60601-1, Class 1, Type B; UL 60601-1; CAN/CSA-C22.2 NO 601.1-90.
EMC:	IEC 60601-1-2

12.3 Accessories

Standard accessories and optional accessories may vary from country to country - please consult your local distributor.

MADSEN Astera²

- Audiometer Control Panel (ACP)
- TDH 39 headphones
- HDA 200 headphones for high-frequency audiometry/HDA 300 headphones for high-frequency audiometry
- Otometrics insert phones
- Bone oscillators: NB-71, B-71
- Sound field loudspeakers
- Monitor headphones with boom microphone
- Assistant headphones
- Desktop microphone
- Talkback microphone
- Monitor speaker
- Patient Responder (one or two)
- Power supply and mains cable
- Wall mounting plate
- Connection cables
- AURICAL FreeFit
- MADSEN Astera² Reference Manual
- MADSEN Astera² User Guide

ACP

- USB cables
- Wrist support

12.4 Notes on EMC (Electromagnetic Compatibility)

- MADSEN Astera² is part of a medical electrical system and is thus subject to special safety precautions. For this reason, the installation and operating instructions provided in this document should be followed closely.

- Portable and mobile high-frequency communication devices, such as mobile phones, may interfere with the functioning of MADSEN Astera².

Guidance and manufacturer's declaration - electromagnetic emissions for all equipment and systems		
MADSEN Astera² is intended for use in the electromagnetic environment specified below. The user of MADSEN Astera² should ensure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	MADSEN Astera² uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	MADSEN Astera² is suitable for use in all environments, including domestic environments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

Guidance and manufacturer's declaration - electromagnetic immunity for all equipment and systems			
MADSEN Astera² is intended for use in the electromagnetic environment specified below. The user of MADSEN Astera² should ensure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	+/- 6 kV contact +/- 8 kV air	+/- 6 kV contact +/- 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	+/- 2 kV for power supply lines +/- 1 kV for input/output lines	+/- 2 kV for power supply lines +/- 1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	+/- 1 kV line (s) to line(s) +/- 2 kV line (s) to earth	+/- 1 kV line (s) to line(s) +/- 2 kV line (s) to earth	Mains power quality should be that of a typical commercial or hospital environment.

Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0.5 cycle 40 % UT (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	<5 % U_T (>95 % dip in U_T) for 0.5 cycle 40 % UT (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	Mains power quality should be that of a typical commercial or hospital environment. If the user of the MADSEN Astera² requires continued operation during power mains interruptions, it is recommended that the MADSEN Astera² be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
U_T is the AC mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration - electromagnetic immunity - for equipment and systems that are NOT life-supporting			
MADSEN Astera² is intended for use in the electromagnetic environment specified below. The user of MADSEN Astera² should ensure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Radiated RF IEC 61000-4-3	3 V/m 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of MADSEN Astera², including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance: $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ for 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ for 80 MHz to 2.5 GHz, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be less than the compliance level in each frequency range. [b] Interference may occur in the vicinity of equipment marked with this symbol: ((•))

Note 1: At 80 MHz and 800 MHz the separation distance for the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

a. The ISM (industrial, scientific and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40,70 MHz.

b. The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which MADSEN Astera² is used exceeds the applicable RF compliance level above, the MADSEN Astera² should be observed to verify normal operation. If abnormal performance is observed, additional measures might be necessary, such as reorienting or relocating MADSEN Astera².

Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distances between portable and mobile RF communications equipment and MADSEN Astera²

The MADSEN Astera² is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the MADSEN Astera² can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the MADSEN Astera² as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: At 80 MHz and 800 MHz the separation distance for the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

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