



# MAESTRO

FITTING AND HEARING AID TEST  
FUNCTIONALITIES

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INVENTIS S.r.l.  
Corso Stati Uniti, 1/3  
35127 Padova, Italy  
Tel.: +39 049 8962844  
Fax: +39 049 8966343  
[www.inventis.it](http://www.inventis.it)  
[info@inventis.it](mailto:info@inventis.it)

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# CHAPTER 1

## Preliminary checks

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When using the Trumpet for a Real Ear Measurement (REM) test, observe the following guidelines:



*Be certain to select the correct sound level for the test signals before presenting them to the patient, so that they will be tolerated and not harmful.*

### **1.1 MAESTRO INSTALLATION**

Before commencing any operation described in this Product Insight, make certain that the Maestro software application is installed on the PC and updated to the latest version available. For more information, consult - *General Functionalities of the Maestro Product Insight*.



## CHAPTER 2

### Video-otoscopy

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To conduct otoscopic exams in Maestro, the Harmonica video otoscope is required. Simply connect the device to your computer using the USB cable, the software will recognize the device and show the video-otoscope module. For more detailed instructions on setup and operation, please consult the Harmonica Video Otoscope User Manual.

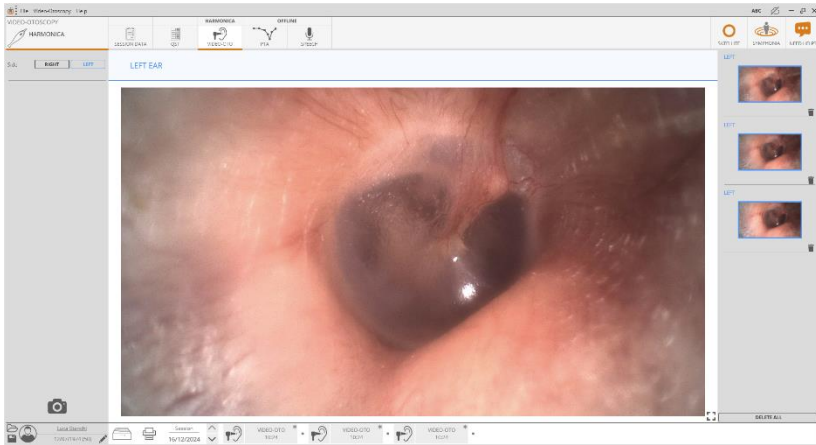
#### 2.1 ACQUIRING NEW IMAGES

The following picture shows the button, located in the bar at the top of the Maestro software main screen, which is used to activate the otoscopy exam (refer to *Maestro – General Functions – Product Insight* for more information about the general settings of the Maestro software and how to access the various exams):





The button above appears only after having connected Harmonica Video-Otoscope to the PC with USB cable.

After having opened the Video-Otoscope module, the following acquisition window is shown:



The image coming from the otoscope is displayed in the center, while the thumbnail of the images acquired by the user is shown in the right panel.

To view the image in full screen mode, simply click once on the image itself or on the icon  at the bottom right of the main screen. To exit full screen mode, click the image itself or the  button at the bottom right of the screen again.

To acquire a new image, press the button on the handpiece. The picture will be added automatically to the thumbnails list and a new icon, which represents the new acquired image (identified with the label VIDEO-OTO and the acquisition time) will appear in the bottom panel.

In the left column there is a shutter button that can be used as an alternative to the one on the device to save the current image:



To delete an image from the right list, click on the small bin on the bottom right corner of each image.

Clicking on it, a pop-up appears, which alerts the user to continue or not with the removal operation.



In order to remove all the acquired images at once, click on “DELETE ALL.”

Each image has to be associated to an ear. The ear currently under examination can be specified before starting the acquisition process, by selecting the corresponding button on the top left corner of the acquisition screen.

It is also possible to change the ear to which the image has been associated, after the acquisition procedure. This change can be done from the display screen (refer to the next paragraph *Displaying the acquired images* for more details) but it can't be performed any more after the image has been stored.

Please note that all the images listed on the right side of the acquisition window are just acquired, not still stored.

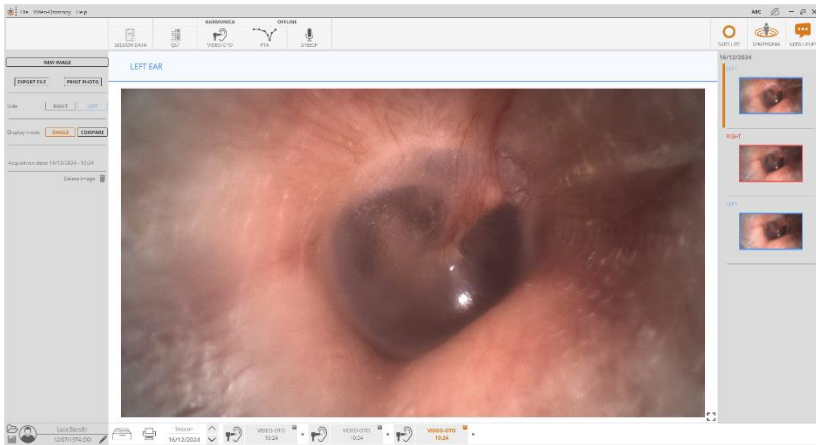
When the exam is saved, all the images will disappear immediately from the right list and the icons at the bottom of the window, representing the acquired images, will now show a little floppy disk instead of the asterisk ‘\*’.

After a few minutes of inactivity, the device automatically enters power-saving mode. In this state, the light is turned off, and the display shows the message "Harmonica video-otoscope in stand-by. Please, press the button on the device to resume."

## **2.2 DISPLAYING THE ACQUIRED IMAGES**

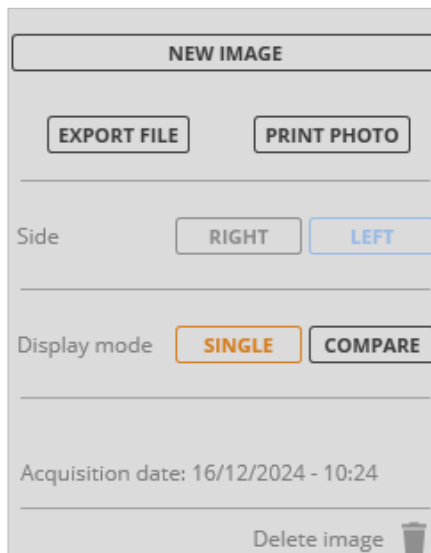
In order to display an acquired image, it is necessary to click once on it or on its corresponding icon in the lower bar of the acquisition window.

An example of the display of the acquired image is shown below:



Both the newly acquired images and the stored ones are shown in the right column. It is possible to distinguish between stored images and newly acquired ones by the little bin icon that is only shown near the latter ones. Once an image has been stored, it is no longer possible to delete it.

The figure below shows some operations that can be performed on the image currently displayed in full screen.



**New Image:** allows the user to go back to the acquisition window;

**Export File:** allows saving the image for viewing in .png format;

**Print Photo:** allows printing the exam info and the image displayed with a maximum size optimized for use with photo printers in 10x15 cm format;

**Side:** allows the user to change the ear to which the image has been associated during the acquisition procedure. This can be done only if the image has not been stored yet;

**Mode:** when accessing the display window, the “SINGLE” option is set as default. The “COMPARE” option allows comparing the current image with another one. The user has to drag the second image from the right list to the gray area to the right of the selected image;

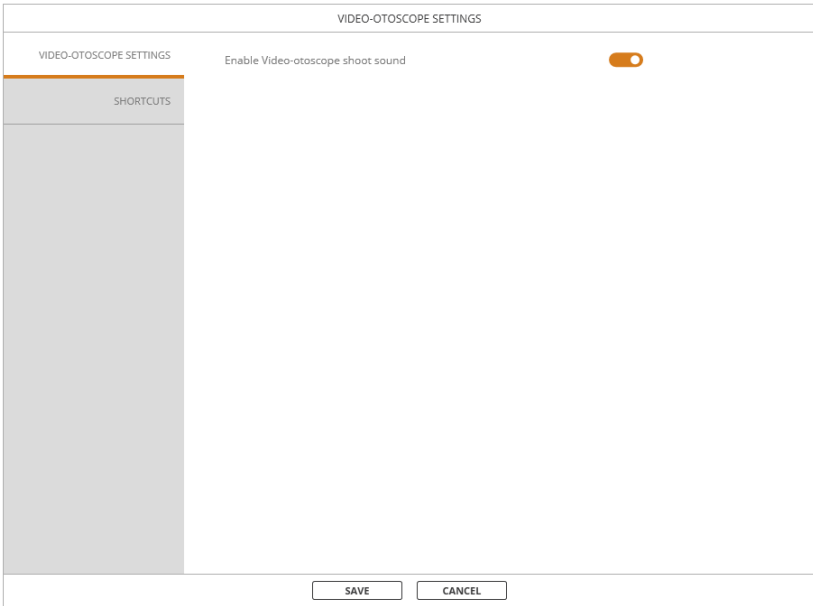
**Delete image:** allows the user to delete an image, only if it hasn't been stored yet. When Maestro is used in standalone or database mode, it is possible to delete an image already stored from the Archive screen; it is instead necessary to proceed from Noah if Maestro is used as a Noah module (refer to *Maestro – General Functions – Product Insight* for more information about how to delete an image already stored).

In order to go back to the acquisition window, click on the VIDEO-OTO exam icon in the upper bar, or click on “NEW IMAGE” button on the left.

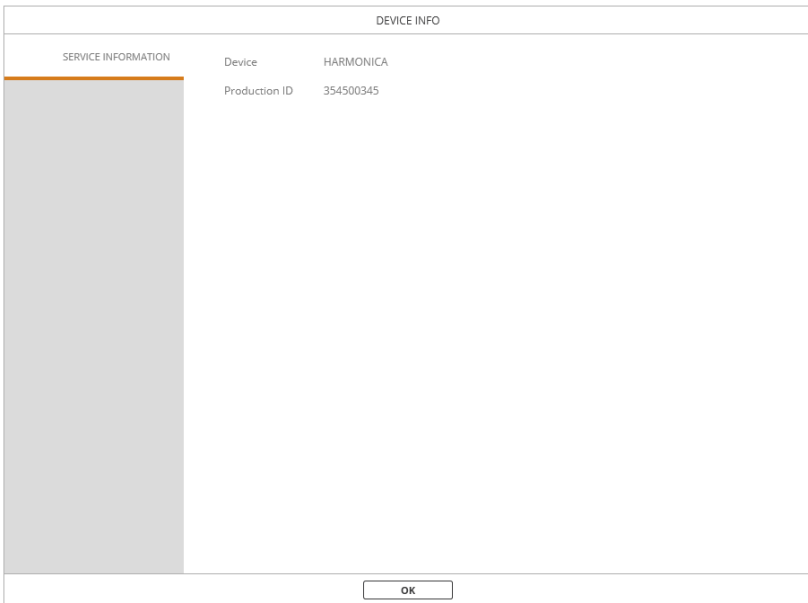
## **2.3 SERVICE INFORMATION AND SETTINGS**

In the main menu on the gray bar at the top is the item “Video-Otoscopy”, this menu allows to open Video-Otoscope settings and device info menu.

By clicking in the Video-Otoscopy settings menu, the following window will appear. From this menu is possible to enable the Video-Otoscope shoot sound and modify shortcuts related to Video-Otoscopy module.



By opening the device Info menu is possible to see internal data of the device, as shown in the following picture.



## CHAPTER 3

### The REM test

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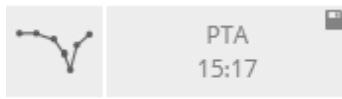
The Maestro application can be used to run or display a Real Ear Measurement type test. If the Trumpet is not connected, off-line mode will be displayed purely for demonstration purposes. If the test is to be conducted, on the other hand, then connect the device to the USB port of the PC and plug the adapter into a power socket, as described in detail in the *Trumpet User Manual*. For guidance on preparing the patient for the test, refer likewise to this same manual.



*To conduct a REM test, the REM license must be activated on the device in question. Should the software indicate that the license has not been activated, contact the supplier of the product, or Inventis customer service.*

### 3.1 ASSOCIATED AUDIOMETRY

Refer to the *Maestro Product Insight - Impedance-audiometry functionalities* for further information on acquisition or addition of a liminal tone audiometry test. The audiometry acquisition appears in the bottom part of the window (examination management bar) with the following icon:



The audiometry can be viewed by clicking on the icon.

After selecting the REM exam at the top of the program (exam selection bar), the most recent audiometry of the same patient will automatically be linked to the REM exam (unless another audiometry is already linked). To link a different audiometry, drag the visible audiometry icon in the visit management bar to the main area of the graphical interface and release it.

Alternatively, from the *Rem* → *associated PTA* menu, select which PTA (pure tone audiometry) to associate with the REM test.

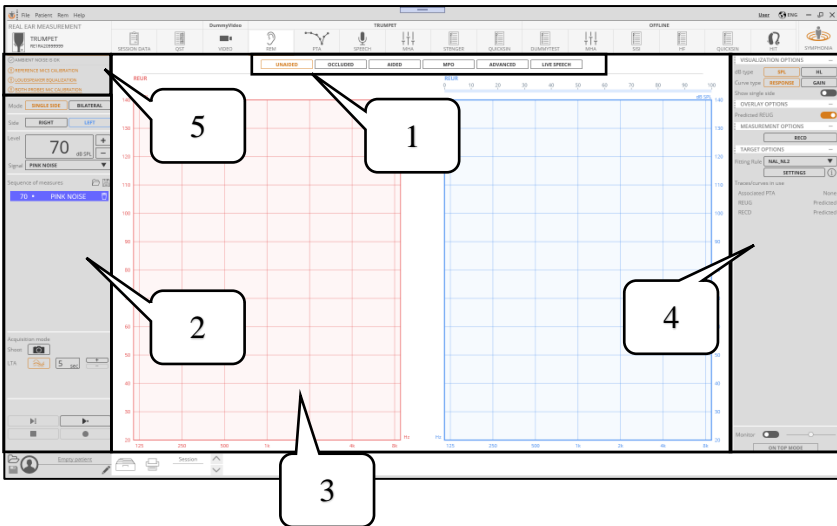
The PTA is now associated with the REM test. It can be displayed in the RESPONSE graph when AIDED mode is selected, and will be utilized to calculate the target curve relative to the selected prescription mode.

### 3.2 ACCESSING THE REM TEST

To access the REM exam, click on the relative icon of the exam selection bar (refer to the *Maestro – General Functions – Product Insight* for more information on general settings of the Maestro software and on how to access the various exams):



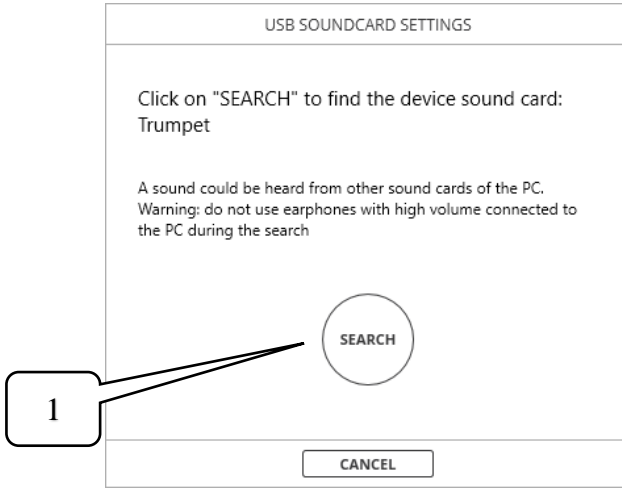
The following window will appear:



1. Test modes
2. Signal commands and controls
3. Graphs
4. Measurement and visualization options
5. Calibration warnings and alerts

### 3.3 AUDIO CARD SETTINGS

If the Trumpet is being connected to the PC for the first time and the REM test is accessed using Maestro, the following window will appear to allow selection of the audio card:



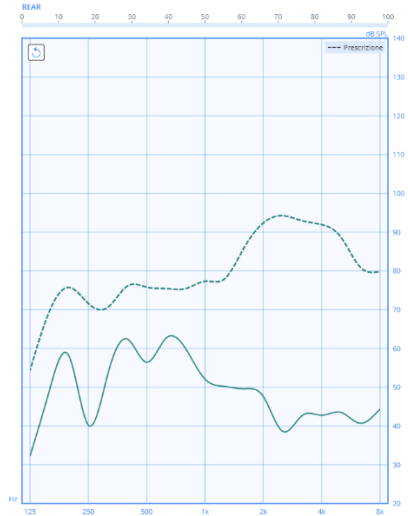
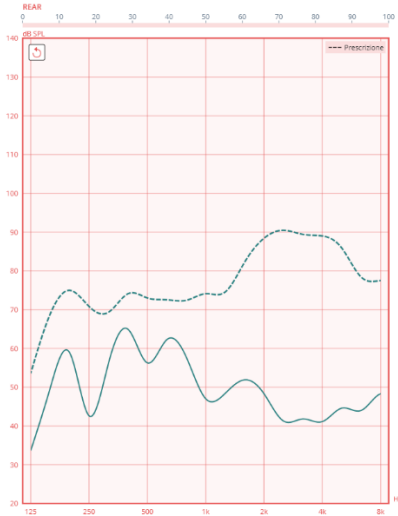
Press button **1** and wait for the confirmation message that the operation has been completed.

The test screen of the audio card can be accessed at any given moment by navigating the menu, clicking *Rem* → *Device* → *USB audio card*.



*Do not use headphones or speakers connected to the PC during this operation, as a loud sound may be emitted.*

## 3.4 GRAPHS

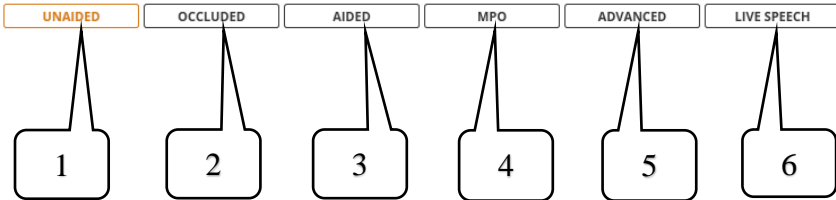


The main area of the interface, in the centre of the screen, contains two graphs. If the "Show single side" visualization option is disabled, the graphs relate to the two sides; if enabled, both graphs relate to the same side. The graph for the active side has a horizontal bar above it, representing the RMS measured in real time by the microphone of reference on the corresponding side. This bar is red for the right side and blue for the left side. It is possible to change the scale of the vertical axis (dB or dB SPL) of both graphs by clicking with the mouse in the graph area and dragging the cursor up or down or by positioning the mouse in the graph area and using the scroll wheel.



### 3.5 TEST MODES

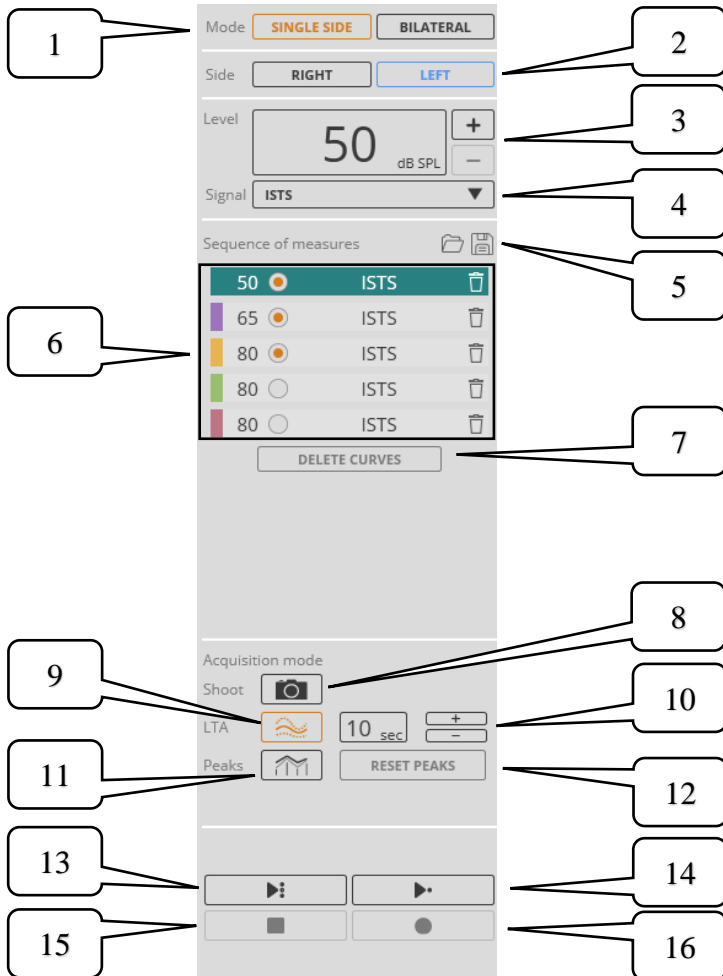
The bar positioned above the graphs allows selection of the measurement mode:





<b>1</b>	Selects acquisition of the Unaided Response curve ( <b>REUR</b> ) and the Unaided Gain curve ( <b>REUG</b> )
<b>2</b>	Selects acquisition of the Occluded Response curve ( <b>REOR</b> ) and the Occluded Gain curve ( <b>REOG</b> ), with the hearing aid inserted but switched off
<b>3</b>	Selects acquisition of the Aided Response curve ( <b>REAR</b> ) and Aided Gain curve ( <b>REAG</b> ), with hearing aid inserted and switched on, and displays the insertion gain ( <b>REIG</b> )
<b>4</b>	Selects acquisition of the hearing aid response curve when emitting a stimulus at 85 – 90dB SPL, which maximizes the sound output from the hearing aid ( <b>MPO</b> – Maximum Power Output)
<b>5</b>	Selects acquisition of the response and gain curve, giving full control over the measurement and visualization options. In this mode the device will display only the curve measured by the probe microphone (output) or the superimposed curves measured by the reference microphone (input) and the probe microphone
<b>6</b>	Allows the acquisition of signals live (with no output from the speaker) or the emission of signals simulating speech, and enables comparison between the response curve measured with the hearing aid inserted and operational, and the estimated response without hearing aid. It also allows fittings with the speech mapping technique.

### 3.6 SIGNAL COMMANDS AND CONTROLS

The column on the left of the screen contains the following command and control functions:

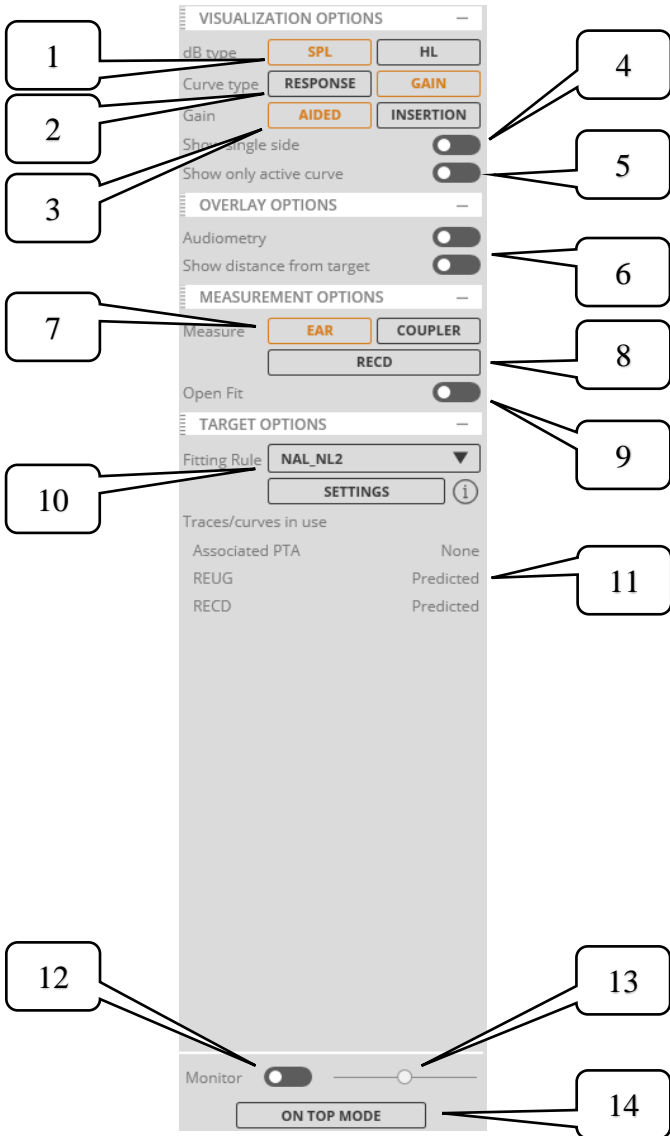


1	Allows selection of the measurement method used to conduct the test
2	Selects the ear on which the test is to be conducted
3	Selects the volume at which the sound will be emitted (also adjustable during emission)
4	Allows selection of the type of signal to be used
5	Allows the operator to store (right button) or upload (left button) the intended sequence of measurements
6	Navigable list of measurements taken (depending on the mode, one or more measurements might not be available). Clicking the trash icon, the measurement will be deleted. By pressing the circle-shaped button on the left it is possible to include  or exclude  the signal from the sequence of measures (the latter function is only available in AIDED mode).
7	Deletes all measurements
8	Selects "snapshot" acquisition mode. Clicking on button <b>16</b> in this mode, a snapshot of the curve will be stored
9	Selects "LTA" acquisition mode. Clicking on button <b>16</b> in this mode, the program will save a time-based average of the curves recorded over the interval indicated in the box alongside
10	Allows selection of the time period over which curves are generated and averaged in "LTA" acquisition mode.

11	<p>Selects "peak" acquisition mode. During this type of acquisition three different curves are shown at the same time: the <b>maximum curve</b>, which represents the maximum value measured for each frequency index, represented by a continuous broken line, the <b>instantaneous curve</b>, which represents the current value of the acquisition, represented by pins, and the <b>temporary maximum curve</b>, which represents the temporary maximum value reached by the instantaneous curve and tends to go down towards the current values of the instantaneous curve itself, represented by a dashed broken line. Pressing the <b>16</b> button will only save the maximum curve.</p>
12	<p>Allows resetting all the "peak" mode curves during their acquisition</p>
13	<p>Allows starting the emission of the selected sequence of stimuli. Clicking this button, the measurement will be displayed but not recorded. When the recording ends, the next measurement included in the sequence is automatically launched</p>
14	<p>Starts the emission of the currently selected stimulus. Clicking this button, the measurement will be displayed but not recorded</p>
15	<p>Stops the emission of the stimulus. Clicking this button, the measurement currently displayed will be cleared</p>
16	<p>Starts acquisition of the measurement, depending on the mode selected</p>

### 3.7 MEASUREMENT AND VISUALIZATION OPTIONS

The column on the right of the screen allows selection of the following options:



1	Selects the display of the loudness scale: dB HL or dB SPL
2	Allows choosing between displaying the curve in response or gain mode
3	Allows choosing the type of curve gain between hearing aid (Aided) or insertion
4	Enables or disables the single side view. If enabled, both graphs are related to the ear currently selected, one showing the response curve and the other showing the gain curve
5	Allows selection of whether to display only the active curve, or all those in the list of measurements taken (not available if only one measurement is possible)
6	<p>Superimpose options allow the selection of which elements to display in the graph. Depending on the mode, the audiogram can show:</p> <ul style="list-style-type: none"> <li>- Audiometry (PTA track associated previously)</li> <li>- Distance from target curve (shaded area highlighting the distance between acquisition and target curves)</li> <li>- Predicted REUG</li> <li>- Measured REUG</li> <li>- Percentile (the area of the graph comprising from 30% to 99% of the measurements)</li> <li>- Speech banana</li> <li>- Modified speech banana</li> <li>- Usable area (delimited by the UCL curve and the audiometric thresholds)</li> </ul>
7	Allows selection of whether to make a real ear measurement or utilize the coupler
8	Opens the window allowing acquisition, insertion or display of the RECD curve
9	Enables or disables "open fitting" mode.

10	Selects the type of prescription that generates the target curve and allows adjustment of the settings
11	Shows the date of the PTA associated with the REM exam and the list of the predicted or measured curves that are used by the fitting rule
12	Enables or disables the monitor earphones signal
13	Adjusts the volume of the monitor earphones signal
14	Allows viewing the program in "On Top" mode during an "AIDED", "MPO" or "LIVE SPEECH" measurement. Shows the window of the program reduced in size and always on top, so that the operator can use a hearing aid setting application, if so desired, while keeping the Maestro interface on the screen

In “ADVANCED” mode, the various “DISPLAY OPTIONS” include the facility of selecting the resolution of the curve, between 1/3 and 1/24 octave.

### 3.8 REM MENU

In the top toolbar of the screen, the *Rem* menu offers further options:

**New exam:** creates a new REM exam associated with the current patient

**Preferences:** opens the general preferences window (see section 3.9 *REM preferences*).

**Sequences → Load...:** to load a previously saved measurement sequence (see section 3.14 *Load or save sequences of measures*)

**Sequences → Save...:** to save the current measurement sequence (see section 3.14 *Load or save sequences of measures*)

**Prescription → Settings...:** accesses the settings of the prescription currently selected in “TARGET OPTIONS” in the Options area on the right of the screen

**Calibrations → Probes calibration:** opens the probe tube calibration screen (see section 3.12 *Probes calibration*)

**Calibrations → Speaker equalization:** opens the speaker equalization screen (see section 3.11 *Speaker equalization*)

**Calibrations → Calibrate RECD loudspeaker:** opens the RECD loudspeaker calibration (see section 3.13.9 *RECD loudspeaker calibration*)

**Calibrations → Calibrate Drum loudspeaker:** starts the Drum speaker equalization procedure (see section 4.6.3 *Drum speaker equalization*)

**Calibrations → Calibrate with code:** opens the calibration screen with code (see section 5.2 *Calibration of Trumpet probe microphones with code*)

**Calibrations → Load linearization file:** opens the loading screen for the linearization file (see section 5.4 *Loading the linearization file of a new pair of Trumpet probes*)

**Device → USB soundcard:** opens the screen allowing selection and testing of the soundcard (see section 3.3 *USB soundcard settings*)

**Device → Information:** accesses information relating to the connected device

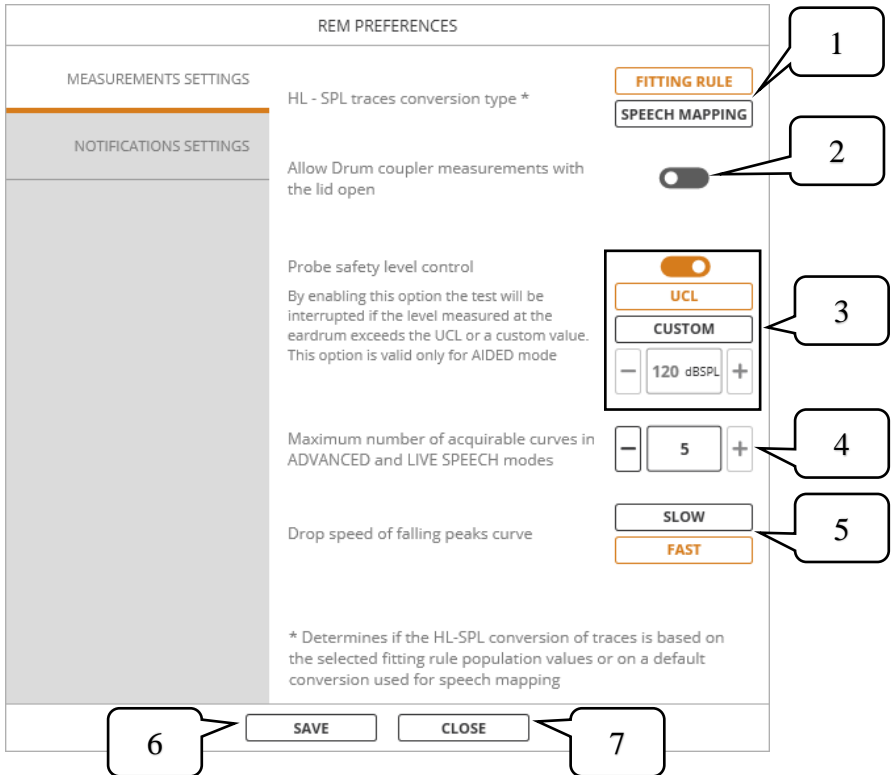
**Device → Probe connection:** to set the type of connection to REM probes (wired or wireless, only for Trumpet devices that support it. See section 3.10 *Wireless probes*)

**Associated PTA:** select an element from the list that opens, to associate this PTA with the current REM test, or select “None” to disassociate the PTA associated previously with the test.



### 3.9 REM PREFERENCES

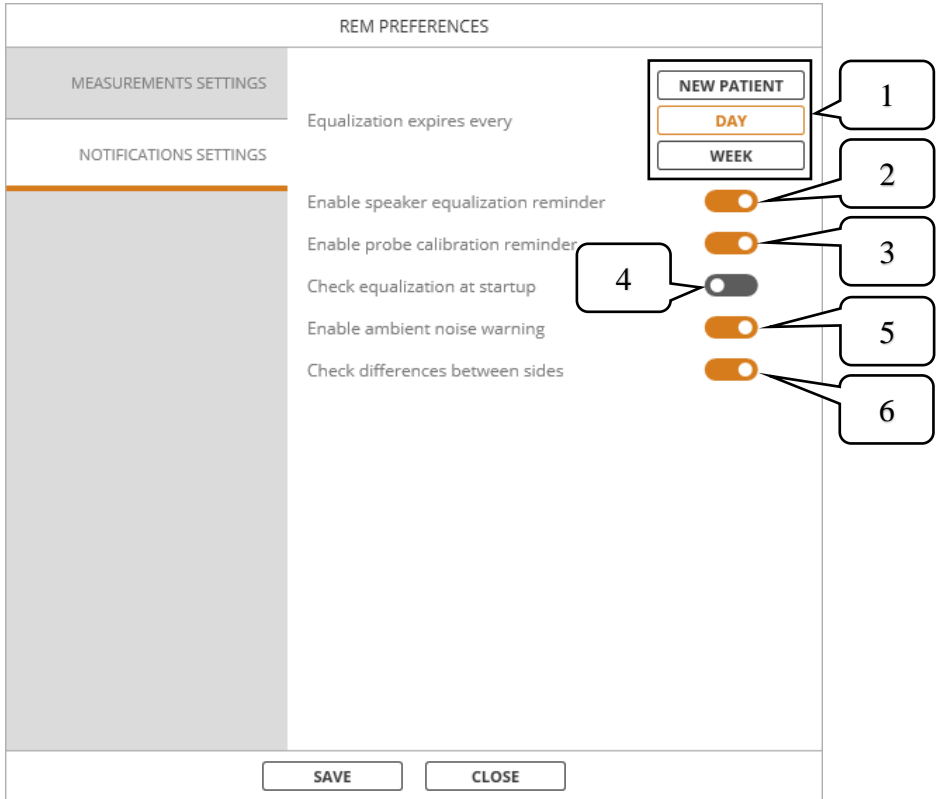
Selecting *Rem* → *Preferences* from the menu, the window illustrated below will be accessed, in the "Measurements settings" tab:



- |   |   |
|---|---|
| 1 | Chooses the type of conversion of the traces from HL to SPL: the "Prescription" option uses the population data provided by the selected target curve, while the "Speech mapping" option uses a conversion independent from it, used by default for fitting with speech mapping |
| 2 | Enables or disables the control on the Drum cover closure when it is used to make RECD measurements.  |

3	Enables or disables the application of a safety threshold controlling sound intensity measured at the eardrum, only in "AIDED" mode. If the option is enabled, the operator can select UCL, or a value customizable in a range between 110 and 130 dB SPL. When the UCL thresholds of the patient or the customized value are exceeded, the speaker will be muted.
4	Selects the maximum number of curves that can be acquired in "ADVANCED" and "LIVE SPEECH" modes.
5	Selects the speed of descent of the temporary maximum curve in peak acquisition mode ("LIVE SPEECH" mode only). Selecting "SLOW" the curve will be more permanent in the graph, otherwise it will tend to go down faster.
6	Stores the displayed preferences
7	Closes the change preferences window

Click on the "Notification settings" tab to access the following screen instead:



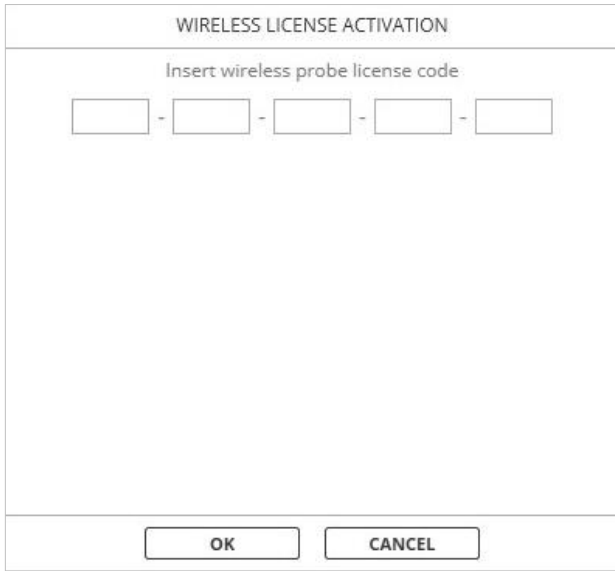
- |   |  |
|---|--|
| 1 | Allows selection of the frequency with which the program will request a new equalization: selecting the option NEW PATIENT, equalization will be requested every time Maestro is started up or when the <i>File</i> → <i>New Patient</i> menu is selected, otherwise daily or weekly, the first time the software is launched when the validity of the equalization is found to have expired |
| 2 | Enables or disable the reminder to perform equalization when it expires (see point 1).   |
| 3 | Enables or disables the reminder to calibrate the probes for each new patient.   |

4	Enables or disables an automatic check for correct equalization. Enabling the option, the check will be run every time Maestro is started up (though not when the <i>File</i> → <i>New Patient</i> menu is selected) and the equalization has not yet expired (see point <b>1</b> ). Should the check reveal any element of uncertainty, it is advisable to run a new equalization
5	Enables or disables the check on background noise
6	Enables or disables the display of alerts regarding the detection of differences in measurements existing between the two sides

### 3.10 WIRELESS PROBES

In Maestro you can choose whether to perform the REM exam using wired or wireless probes. The device defaults to using the type of probes it was purchased with, and you can change this setting in the menu at *Rem* → *Device* → *Probe Connection* (it is saved when you exit Maestro). If this option is not available it means that the Trumpet connected can only use wired probes, or that Maestro needs to be updated.

If wireless probes have been purchased for a Trumpet with wired probes, you must first activate the license and pair the probes to the device in order to use them. Then select *Wireless* in the menu *Rem* → *Device* → *Probe Connection*. If the wireless license has never been activated on the device before, a pop-up will prompt you to enter it:



After entering the code and clicking “OK,” a pop-up of instructions on how to perform the pairing between the device and the wireless probes will appear (see *Trumpet – User Manual* for more information). Once paired, the Trumpet will begin to download the calibration from the probes. Do not disconnect the device or turn off the probes during this operation. Once the procedure is completed, the probes will be available for use in the same way as the wired versions.

When the wireless probes are connected, the battery charge status will appear in the upper left area:



When the battery icon turns red it is necessary to charge the probes to prevent them from suddenly turning off (a pop-up will warn you of this eventuality).

**Attention:** to charge the probes, the wireless license must first have been activated on the Trumpet, otherwise it will not act as a charger. Furthermore, the Trumpet must be connected to the power supply and a powered USB socket (PC or other).

It is possible to connect the wireless probes to the device only when in the Maestro REM module. If the probes are switched on and have already been paired with the device, after a few seconds they will be connected automatically. If this does not happen and the LED continues to flash blue, first check if the probe connection is set to *Wireless* by going to the menu *Rem* → *Device* → *Probe Connection*: if it is correct, try to pair the probes to the device again (refer to manual *Trumpet – User Manual* for details on the pairing procedure).

When you change the module (for example to acquire the audiometry) or close Maestro, the probes will automatically disconnect but remain on, and then turn off by themselves after one minute if they are not recharged. When the button is pressed to perform the in coupler measurements, the probes are switched off.

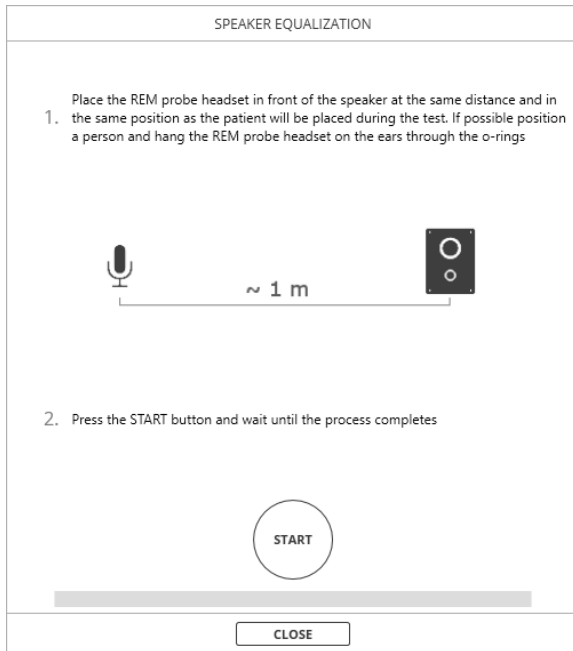
While in the REM module with the wireless probes connected but not charging, if no measurement is started for 20 consecutive minutes they will be switched off to save battery power.

### **3.11 SPEAKER EQUALIZATION**

If the option “Check equalization on start-up” (*Rem* → *Preferences* menu on the GENERAL SETTINGS CARD) is enabled, when Maestro is launched, the system verifies that the last equalization of the speaker is still valid: if not, the user will be prompted to open the speaker equalization window.

In the event that the validity of the equalization has lapsed (see point **1** of the section *REM Preferences*) or it was never executed, the system will prompt the user to start up the speaker equalization window.

The image below illustrates the speaker equalization window:



To equalize the speaker:

1. Place the headset in front of the speaker and put it on a person sitting in the position where the tests will be carried out.
2. Check that there are no reflective elements in the vicinity of the set of probes, and that the configuration of the room is substantially the same as during the actual test
3. Click the START button and wait until the process is completed
4. Click the CLOSE button to close the window.

The speaker equalization window can be accessed from the menu *Rem* → *Calibrations* → *Equalize speaker*.



*Before commencing each test, or at least before commencing any test on a new patient, it is very important to equalize the speaker correctly, or at any rate to check that the existing equalization setting is correct. If the equalization is omitted or wrong, this can jeopardize the measurements heavily and produce incorrect readings.*

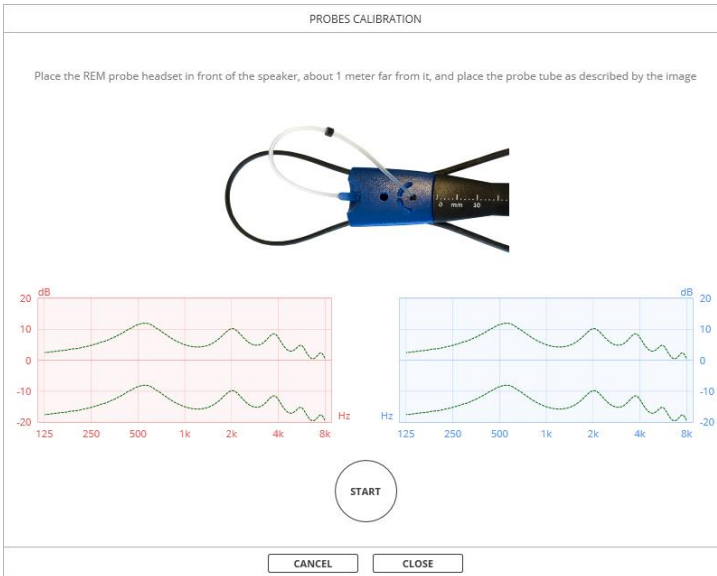


If the equalization procedure is unsuccessful, make certain that there are no reflective elements near the microphone, or that the noise level in the room is not a source of disturbance. Repeat the procedure: if equalization is persistently unsuccessful, contact Inventis customer service.

## 3.12 PROBES CALIBRATION

The probe tubes must be calibrated every time they are changed; accordingly, every time the test is conducted on a new patient, the system will prompt the user to run the calibration of the tubes before the first measurement is made (if the warning is active).

The following image illustrates the tube calibration window.



To calibrate the probe tubes, position the set of probes as indicated in the *Trumpet User Manual*. Having positioned the probes as required, proceed as follows:

1. Click **START** and wait until the calibration has been completed for both sides
2. Click **CLOSE** to save the current calibration and close the window.

If you have wireless probes, you can briefly press the button to start the calibration.



Clicking the CANCEL button, the calibration will not be saved and the window closes.

The CLOSE button is enabled only when at least one of the two sides has been correctly calibrated.

If the calibration is unsuccessful on one or both sides, a message will appear warning that the probe tubes should be checked.



*It is very important to calibrate the probe tubes correctly every time they are changed. If the calibration is omitted or wrong, this can jeopardize the measurements heavily and produce incorrect readings.*



*If the calibration procedure is unsuccessful, check the integrity of the probe tube and try inserting a new one, if necessary. Repeat the procedure: if calibration is persistently unsuccessful, contact Inventis customer service.*



*Use only biocompatible silicone tubes supplied by Inventis S.r.l..*

The calibration window can be accessed from the menu *Rem* → *Calibrations* → *Probes calibration*.

## **3.13 TAKING A MEASUREMENT**

This section examines all the measurements that can be conducted with the Trumpet device. Make certain that the device has been properly connected (see the beginning of this chapter), that the Maestro program has been launched, and that the REM test is selected (see section *Accessing the REM test*).

### **3.13.1 Before starting**

Before commencing a new session of Real Ear Measurements, position the patient correctly and make the necessary connections, as described in the *Trumpet User Manual*. In addition, make certain that the settings of the prescription for the target curve have been entered correctly.

Proceed as follows:

1. Select the correct prescription in the “Options” column (right hand side of the screen) under the item “TARGET OPTIONS”






2. Click the SETTINGS button or go to the menu *Rem* → *Prescription* → *Settings...*
3. When the dialogue window opens, check all of the fields and edit as necessary.


### 3.13.2 Unaided measurements


In “UNAIDED” mode, unaided response (REUR) or unaided gain (REUG) measurements can be taken — without any hearing aid — to assess the natural amplification of the patient's auditory canal.

In this mode, a single measurement is available.

To perform this type of measurement, proceed as follows:

1. Make certain that the system is equalized and that the probe tube is calibrated and inserted correctly in the patient's ear
2. Select the side (right or left) to be tested
3. Select an intensity level
4. Select the type of signal to be generated
5. Select an acquisition mode ( or )
6. In the case of  mode, select the duration of the acquisition
7. Click the start button 
8. The intensity or the type of signal can be adjusted while the stimulus is being reproduced.
9. Click the  button to start acquisition of the measurement. The reproduction of the stimulus will stop automatically when the set acquisition interval comes to an end.

The stimulus can be cut short manually by clicking the stop button . The current measurement will be deleted.

The measurement can be deleted by clicking the trash button .

The acquisition mode and interval cannot be changed while the signal is being generated or while acquisition of the measurement is in progress.






### 3.13.3 Occluded measurements


In “OCCLUDED” mode, occluded response (REOR) or occluded gain (REOG) measurements can be taken with the hearing aid inserted and switched off, to establish the level of occlusion introduced by the physical presence of the hearing aid.


In this mode, a single measurement is available.

The REUG curve acquired previously can be displayed and used as a reference in establishing to what extent the mere positioning of the hearing aid may influence the resonance of the auditory canal.

To perform this type of measurement, proceed as follows:

1. Make certain that the system is equalized and that the probe tube is calibrated and inserted correctly in the patient's ear
2. Check that the hearing aid is correctly inserted and that it is switched off
3. Select the side (right or left) to be tested
4. Select an intensity level
5. Select the type of signal to be generated
6. Select an acquisition mode ( or )
7. In the case of  mode, select the duration of the acquisition
8. Click the start button 
9. The intensity or the type of signal can be adjusted while the stimulus is being reproduced.
10. Click the  button to start acquisition of the measurement. The reproduction of the stimulus will stop automatically when the set acquisition interval comes to an end.

The stimulus can be cut short manually by clicking the button . The current measurement will be deleted.

The measurement can be deleted by clicking the trash button .

The acquisition mode and interval cannot be changed while the signal is being generated or while acquisition of the measurement is in progress.







### 3.13.4 Measurements with Hearing Aid


In “AIDED” mode, aided response (REAR) or aided gain (REAG) measurements can be taken with a hearing aid inserted and switched on. It is also possible to compare the gain provided by the hearing aid with the ideal target calculated from the selected prescription.


These measurements can be taken in the ear or via a coupler, provided that an RECD value is available (measured or entered manually).

In this mode, the device offers a modifiable sequence of 5 measurements.

To perform this type of measurement, proceed as follows:

1. Make certain that the system is equalized and that the probe tube is calibrated and inserted correctly in the patient's ear
2. Check that the hearing aid is properly inserted, and that it is switched on and correctly set
3. Select the side (right or left) to be tested
4. For each measurement of the sequence:
  - a. Select an intensity level
  - b. Select the type of signal to be generated
5. Select an acquisition mode ( or )
6. In the case of  mode, select the duration of the acquisition
7. Press the  button to start a single measurement or the  button to start a sequence of measurements.
8. The intensity or the type of signal can be adjusted while the stimulus is being reproduced.
9. Click the  button to start acquisition of the measurement. If a single measurement is in progress the emission will be interrupted at the end of the acquisition period, otherwise, if a sequence of measurements is in progress the next measurement included in the sequence will be started automatically when the recording ends.

The stimulus and acquisition sequence can be cut short manually by clicking the stop button . The current measurement (not yet completed) will be deleted.

The measurement can be deleted by clicking the trash button .

All measurements can be deleted by clicking the DELETE CURVES button.

The acquisition mode and interval cannot be changed while the signal is being generated or while acquisition of the measurement is in progress. These two parameters are common to all 5 measurements in "AIDED" mode. If the intention is to change the parameters, all curves acquired previously in the same mode must first be deleted.

During measurements in “AIDED” mode, the central part of the screen shows the table relating to the calculation of the Speech Intelligibility Index (SII):

SII (%)	
20	-
44	-
55	-
-	-
-	-

This index represents an indication of speech comprehension when the patient is presented with a certain stimulus, as a percentage (a SII around 80% is an excellent score). Note that the SII is only an indicative value and does not represent a similar measurement to what could be obtained with speech audiometry.

The background color of the number in the table represents the curve it relates to. The results in the left column of the table are related to the chart shown on the left (right ear) and those in the right column to the chart shown on the right (left ear). If the user has selected the option to show only one side, the table will contain only one column for the currently selected side.


Since the SII uses the audiometric threshold and the response measurement in the ear to derive the result, if one of these pieces of information is absent a dash “-” is shown instead of the calculated number.

### 3.13.5 MPO measurements


In “MPO” (Maximum Power Output) mode, the device can provide response measurements to check that the output from the hearing aid does not exceed the uncomfortable loudness level (UCL) identified for the patient, even when a signal of high intensity is generated. The phantom line curve displayed is a reference calculated by the selected prescription on the basis of the relative parameters (SETTINGS button in the Options bar on the right, or in the menu *Prescription* → *Settings...*); the curve acquired in MPO mode should never register a value higher than the reference curve.


In this mode, all measurement parameters are preset and cannot be changed. The level is set automatically at 85 dB SPL for measurements in the ear, or at 90 dB SPL for coupler measurements. The stimulus is generated for 4 seconds approximately.

To perform this type of measurement, proceed as follows:

1. Make certain that the system is equalized and that the probe tube is calibrated and inserted correctly in the patient's ear
2. Check that the hearing aid is properly inserted, and that it is switched on and correctly set
3. Select the side (right or left) to be tested
4. Click the  button to start acquisition of the measurement.

Reproduction of the stimulus stops automatically.

The stimulus can be cut short while it is being emitted by clicking the button . The current measurement (not yet completed) will be deleted.

The measurement can be deleted by clicking the trash button .






### 3.13.6 Advanced measurements


In “ADVANCED” mode, the user can take response or gain measurements while retaining full control over the display of the curves and over the measurement options.


These measurements can be taken in the ear or via a coupler, provided that an RECD value is available (measured or entered manually).


In this mode, after selecting the parameters of the first measurement, up to 5 further measurements can be acquired.

To perform this type of measurement, proceed as follows:

1. Make certain that the system is equalized and that the probe tube is calibrated and inserted correctly in the patient's ear
2. Check the settings and the positioning of the hearing aid (in cases where verification is required for the measurement being conducted)
3. Select the side (right or left) to be tested
4. Select an intensity level
5. Select the type of signal to be generated
6. Select an acquisition mode ( or )
7. In the case of  mode, select the duration of the acquisition
8. Press the  button to start a single measurement or the  button to start a sequence of measurements.

9. The intensity or the type of signal can be adjusted while the stimulus is being reproduced.
10. Click the  button to start acquisition of the measurement. If a single measurement is in progress the emission will be interrupted at the end of the acquisition, otherwise if a sequence of measurements is in progress the next measurement will be started automatically with the same settings as the previous one. If the maximum number of curves set is reached, the emission stops.

The stimulus and acquisition sequence can be cut short manually by clicking the stop button . The current measurement (not yet completed) will be deleted.

The measurement can be deleted by clicking the trash button .

All measurements can be deleted by clicking the DELETE CURVES button.




The acquisition mode and interval can be changed while acquisition of the measurement is in progress. These two parameters can be different for different measurements.





### 3.13.7 Live speech measurements


In LIVE SPEECH mode, the operator can make a comparison for consultancy purposes between the measured response — with the hearing aid inserted and operational — and the estimated response without a hearing aid in real time, without the need for two measurements (with and without the hearing aid). In this mode, besides the speech-like signals used in other modes, the voice of the operator and/or of relatives can be used ("live" signal: operating in this mode, the built-in speaker will be muted). This mode can also be used for fitting with live speech mode.


In this mode, after selecting the parameters of the first measurement, up to 5 further measurements can be acquired.

To perform this type of measurement, proceed as follows:


1. Make certain that the system is equalized and that the probe tube is calibrated and inserted correctly in the patient's ear
2. Check that the hearing aid is properly inserted, and that it is switched on and correctly set
3. Select the side (right or left) to be tested
4. Select an intensity level
5. Select the type of signal to be generated
6. Select an acquisition mode (,  or )

7. In the case of  mode, select the duration of the acquisition
8. Press the  button to start a single measurement or the  button to start a sequence of measurements.
9. The intensity or the type of signal can be adjusted while the stimulus is being reproduced.
10. Click the  button to start acquisition of the measurement. If a single measurement is in progress the emission will be interrupted at the end of the acquisition, otherwise if a sequence of measurements is in progress the next measurement will be started automatically with the same settings as the previous one. If the maximum number of curves set is reached, the emission stops.

The stimulus and acquisition sequence can be cut short manually by clicking the stop button . The current measurement (not yet completed) will be deleted.

The measurement can be deleted by clicking the trash button .

All measurements can be deleted by clicking the DELETE CURVES button.

In case of  mode all the curves can be reset during their acquisition by pressing the RESET PEAKS button.

### 3.13.8 Coupler measurements

As an alternative to real-ear methods, measurements can also be taken using a coupler, for Aided, Advanced and MPO modes. This is particularly useful when fitting children with a hearing aid, or indeed uncooperative patients in general.

To measure an RECD curve and make coupler measurements an RECD unit (optional) needs to be connected to the Trumpet, or such measurements can be made using a Drum device connected to the same PC as the Trumpet.

Select the coupler measurement option in the Maestro software.

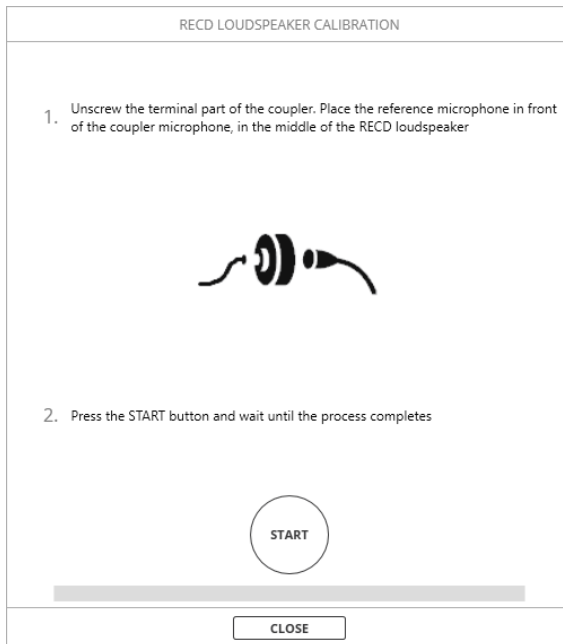
The ear or coupler option is common to all measurements made in Aided, Advanced and MPO modes. Changing the option, all of the measurements in question will be reset.



### 3.13.9 RECD loudspeaker calibration

If the coupler measurement option is selected in the Maestro application, the system verifies that the most recent equalization of the speaker and the most recent calibration of the microphones are still valid: if not, the equalization window will appear as illustrated in the figure below. This same window can be selected directly from the menu: *Rem* → *Calibrations* → *Calibrate RECD loudspeaker*.

The calibration lapses after one month and the system will prompt the user automatically to perform a new one.



To perform a new calibration, place the coupler microphone and the reference microphone in front of each other and place them in the center of the RECD speaker. The two microphones must be positioned close together. In this configuration, simply click the START button and wait until the process is completed. Click the CLOSE button to close the window.

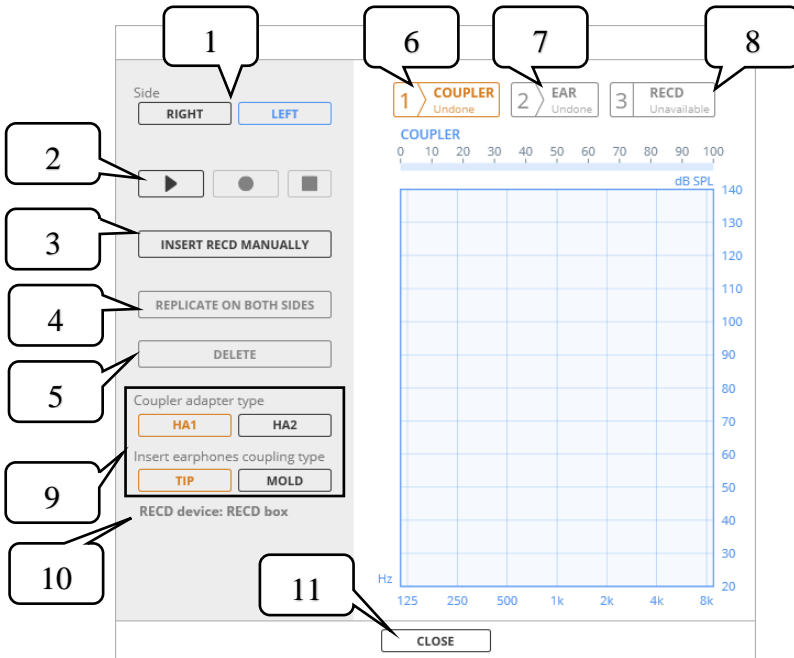
An example of how the microphones are positioned during calibration is shown in the *Trumpet User Manual* under the section *Measure a coupler response*.

### 3.13.10 RECD

The RECD (*Real Ear to Coupler Difference*) curve represents the acoustic difference between the coupler and the patient's ear. This curve can be acquired before making REM measurements in coupler to improve the accuracy of the fitting, otherwise the population RECD curve for the selected fitting rule will be automatically selected.

The RECD can be measured with an RECD unit (optional) connected to the Trumpet or with a Drum device connected to the PC. The device connected to the RECD screen access will be considered the device of reference for coupler measurements until Maestro is restarted.

To measure an RECD curve or enter one manually, click the RECD button. The screen shown below will open:



1	Selects the ear on which the test is to be conducted
2	Signal Start, Record and Stop buttons
3	Field allowing manual input of RECD curve values between 125 and 8000 Hz
4	If an RECD curve was entered for one side, this field can be used to copy the values to the other side
5	Deletes the curve entered for the side currently selected
6	Allows the operator to move around the coupler measurement acquisition screen
7	Allows the operator to move around the real ear measurement acquisition screen
8	Allows the operator to move around the resulting RECD curve display screen
9	Allows selecting the coupler type and pairing used for the insert headphones used during the RECD measurement.
10	Specifies which device is in use to measure the RECD curve.
11	Closes the window.

When the window opens, the operator can acquire the measurement made with the coupler (button **6** will be selected). Prepare the coupler according to the chosen preset (see the *Trumpet - User Manual* in the section *Measurements in the 2cc coupler*) and press the Start button in region **2**. The insert earphone will produce a signal that is measured by the coupler microphone and displayed in the graph. To record the signal, click the Record button in the controls field **2**.

It is now possible to proceed with the *in situ* measurement. To do this, disconnect the insert earphones from the coupler, put the headset on the patient and insert the probe tube into the patient's ear. Prepare the insert earphones and, taking care not to disturb the tube, insert them in the patient's ear. Bring up the screen relating to acquisitions in the ear, clicking button **7**. Clicking the Start button in the controls field **2**, the screen will display the profile of the signal measured by the probe microphone and emitted by the insert earphones. To record the signal, click the Record button in the controls field **2**.

The screen relative to the RECD curve will be automatically selected (button **8** in the illustration), where it will be possible to view the profile of the resulting Real Ear to Coupler Difference: the difference between the two measurements just acquired.

Alternatively, if there are already values for the RECD curve acquired previously, these can be entered manually using button **3** in the illustration (*INSERT RECD MANUALLY*): the user can enter the values required, in a frequency range between 125 and 8000 Hz.

The user can also acquire / enter the RECD curve for one side only, then simply copy the values to the other side: clicking button **4** in the illustration (*REPLICATE ON BOTH SIDES*), the curve entered for one ear will be copied for the other ear.

Finally, button **5** in the illustration can be used to delete the curves entered previously.

Note that the curve in coupler is related to the particular HA1/HA2 configuration and the selected insert headphones, and so it only needs to be acquired once as it is memorized (except for the configuration of the insert headphones with mold, because this is customized for the specific patient). It is also linked to the acquisition device (RECD unit or Drum).

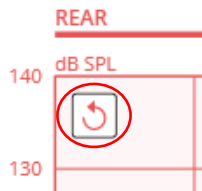
Once the RECD measurement has been acquired it will be possible to select the measurement in coupler in the right column, for "AIDED", "MPO" and "ADVANCED" measurements.

For detailed instructions on how to connect and ensure the correct positioning of different hearing aids when using the 2cc coupler, refer to the *Trumpet User Manual* in the *Measurements in the 2cc coupler* section.

### 3.13.11 Bilateral mode

Clicking the “Bilateral” button in the left hand column of the screen (see section *Signal commands and controls*), acquisition becomes possible from both sides at once, for each method of measurement in the ear. Clicking “Single side”, the system will revert to acquisition from one side at a time. In bilateral mode, the measurement conditions (selected signal and level) are univocal, whereas in single side mode, different conditions can be selected for left and right. When changing from single to bilateral mode, the measurement conditions applied for all methods will be those of the side currently selected.

If a bilateral curve is recorded and the intention is to repeat the measurement on one of the two sides only, simply click the reset button located in the top left corner of the graph relative to the side of interest:



A prompt will appear asking for confirmation, and the measurement will then restart on the side selected. If the measurement is completed, the previous curve will be overwritten; if interrupted by clicking STOP, the previous curve will be reinstated.

## 3.14 LOADING OR STORING MEASUREMENT SEQUENCES

The user can upload and/or store settings for the sequence of measurements used in the current mode.

To save the current sequence of measurements, click the floppy disk icon alongside "Measurement sequence" on the left hand part of the screen (commands and controls bar, left hand column. See also *Signal commands and controls* section) or go to the menu *Rem* → *Sequences* → *Save....* The following window will appear:

SEQUENCE MANAGER

Please insert a name for the sequence

Enter a name for the sequence and click the STORE CURRENT button. The sequence will now be available to upload.

To upload a sequence of measurements stored previously, click the folder icon alongside "Measurement sequence" on the left hand part of the screen (commands and controls bar, left hand column. See also *Signal commands and controls* section) or go to the menu *Rem* → *Sequences* → *Load....* The following window will appear:

SEQUENCE MANAGER

Select a sequence

Name	Type	

The sequence will be loaded to both sides

Select one of the sequences listed (these can also be deleted if so desired, by clicking the trash icon to the right of the name) and click LOAD. The selected sequence will now be applied to the mode with which it is compatible, for both sides.

**NOTE:** sequences can be uploaded or stored only in certain modes: UNAIDED, OCCLUDED or AIDED.

### 3.15 VIEW EXAM

Clicking the icon of a saved REM test (refer to *Maestro Product Insight – General Functionalities*), viewing mode will be activated. In this mode, curves already acquired are displayed for read-only viewing, and cannot be edited. Also, it is not possible to change either the prescription by which the displayed target was generated, or the relative settings, but only to view them.

The "Options" column on the right no longer shows the "MEASUREMENT OPTIONS", whilst the "Commands and Controls" column on the left contains only the list of measurements conducted in the mode and on the side currently selected. Clicking on the measurement, the following screen will appear in the space below the list, containing various items of information relative to the measurement selected: type of signal utilized, level, duration of measurement (or time average, only if LTA acquisition mode), acquisition mode, whether the measurement was in the ear or in the coupler, and whether the hearing aid utilized was open fitting or otherwise.

Device serial number :	RE1RA16123456
Signal :	PINK NOISE
Level :	55 dB
Duration :	15 s
Acquisition mode :	LTA
Measure :	Ear

## 3.16 PRESCRIPTIONS

The software contains a number of prescriptions for generating the target curve. These rules and their settings can be selected from the right hand column of the screen (see section *Measurement and visualization options*).

Further information on prescriptions can be found by visiting these websites and consulting the articles indicated:

- NAL-NL1 (version 1.4), [www.nal.gov.au](http://www.nal.gov.au).  
Byrne, D., Dillon, H., Ching, T., Katsch, R., & Keidser, G. (2001). *NAL-NL1 procedure for fitting nonlinear hearing aids: Characteristics and comparisons with other procedures*. *Journal of the American Academy of Audiology*, 12, 37-51.
- NAL-NL2 (version 1,933), [www.nal.gov.au](http://www.nal.gov.au).  
Keidser, G., Dillon, H., Flax, M., Ching, T., & Brewer, S. (2011). *The NAL-NL2 prescription procedure*. *Audiology Research*, 1, 88-90.  
Johnson, E., & Dillon, H. (2011). *A comparison of gain for adults from generic hearing aid prescriptive methods: Impacts on predicted loudness, frequency bandwidth, and speech intelligibility*. *Journal of the American Academy of Audiology*, 22, 441-459.
- DSL m[i/o] V5 (version 5), [www.dslio.com](http://www.dslio.com).  
Bagatto, M., Moodie, S., Scollie, S., Seewald, R., Moodie, S., Pumford, J., & Liu, K.P.R. (2005). *Clinical protocols for hearing instrument fitting in the Desired Sensation Level method*. *Trends in Amplification*, 9(4), 199-226.



## CHAPTER 4

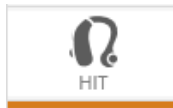
### The HIT test

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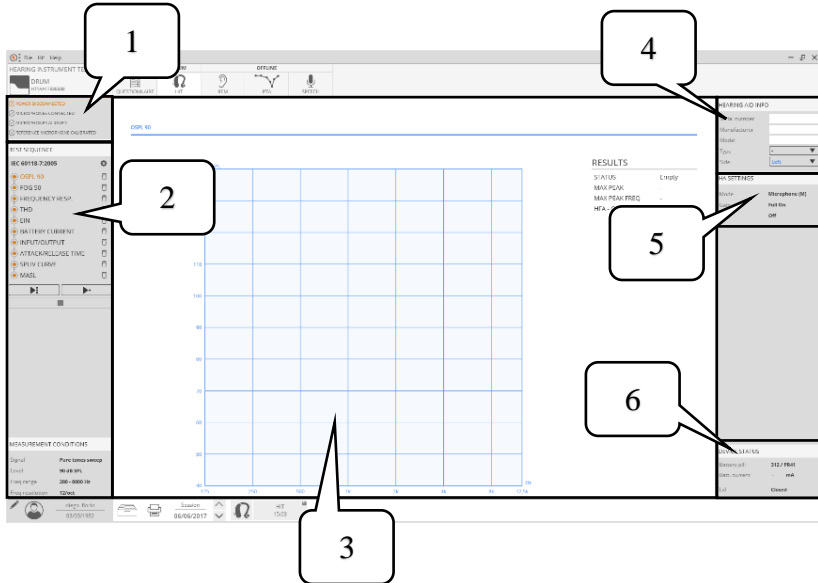
The Maestro application can be used to run or display a HIT (Hearing Instrument Test) type test. If the Drum is not connected, off-line mode will be displayed purely for demonstration purposes. If the test is to be conducted, on the other hand, then connect the device to the USB port of the PC and plug the adapter it into a power socket, as described in detail in the *Drum User Manual*. Refer likewise to this same manual for directions on how to prepare the hearing aid for a test.

#### 4.1 ACCESSING THE HIT EXAM

To access the HIT test, click on the relative icon of the test selection bar (refer to the *Maestro Product Insight – General Functionalities* for more information on general settings of the Maestro software and on how to access the various tests):



The following window will appear:

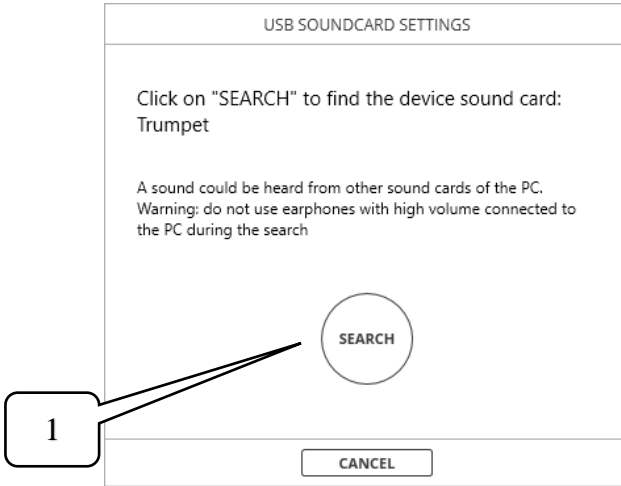


1. Calibration warnings and alerts
2. Test sequence and commands
3. Graphs and numerical results
4. Information regarding H.A.

5. AIDED settings or display settings
6. Device status

## 4.2 AUDIO CARD SETTINGS

If the Drum is being connected to the PC for the first time and the HIT test is accessed using Maestro, the following window will appear to allow selection of the audio card:



Press button **1** and wait for the confirmation message that the operation has been completed.

The test screen of the audio card can be accessed at any given moment by navigating the menu, clicking *Hit* → *Device* → *USB audio card*.



*Do not use headphones or speakers connected to the PC during this operation, as a loud sound may be emitted.*

## Alerts

The following items can be viewed in the alerts display panel:

**Connection to power supply:** Indicates whether or not the device is properly connected to the electrical power supply by way of its adapter (shown only if connected).

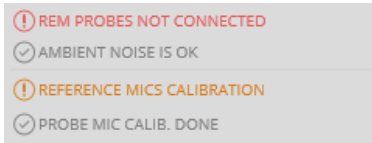
**Connection of microphones:** Indicates whether or not all microphones of the device have been properly connected (shown only if at least one is disconnected).

**Microphones alignment:** Indicates whether or not the coupler microphone has been calibrated, aligning it with the reference microphone (Frequency: once a month).



**Reference mic calibration:** Indicates whether or not the calibration of the reference microphone is still valid (Frequency: once a year, shown only if it is no longer valid).

Should any one of these conditions not be recognized by the software, the item in question will be highlighted and an alert generated. Notifications that prevent measures from being taken are coloured red, while those that allow them are coloured yellow.

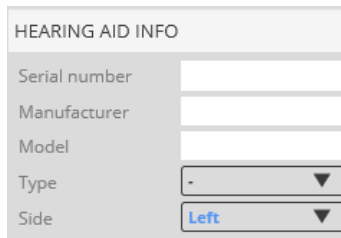


## 4.3 INFORMATION ON THE HEARING AID AND ITS SETTINGS

### 4.3.1 Hearing aid data

In the “Hearing aid info” section, the operator can enter the details of the hearing aid that is being analyzed during the HIT test.

These details are: the serial number of the device, the manufacturer and model of the product, the type of hearing aid in question and the ear with which it is associated.



The image shows a screenshot of a web form titled "HEARING AID INFO". The form contains five input fields: "Serial number", "Manufacturer", "Model", "Type", and "Side". The "Type" field is a dropdown menu with a "-" symbol and a downward arrow. The "Side" field is a dropdown menu with "Left" selected and a downward arrow.

HEARING AID INFO	
Serial number	<input type="text"/>
Manufacturer	<input type="text"/>
Model	<input type="text"/>
Type	- ▼
Side	Left ▼

These items of data are associated with the tests conducted and will be indicated in the printout of the tests.

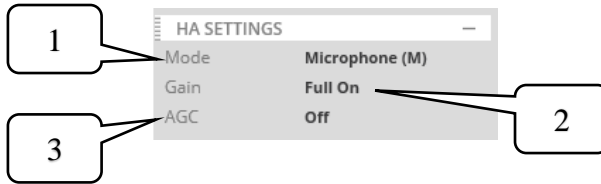
If, at the moment of saving, no fields have been edited and an alert is displayed in the preferences menu, the system will generate a prompt, asking if the user wishes to enter details of the hearing aid before proceeding to save the test.

### 4.3.2 Hearing aid settings

The “H.A. Settings” section indicates the settings of the hearing aid to be enabled, so that the test can be conducted in accordance with the requirements indicated in reference standards for measuring the operational characteristics of hearing aids (refer to the section *Commands and controls for measurements* when selecting the reference standard).

It is fundamentally important to set the hearing aid as explained here, in order to ensure that the results obtained will be comparable with those indicated in the technical specifications sheet of the appliance (refer to *References standards and measurements* for a detailed description of the different settings required for each measurement).

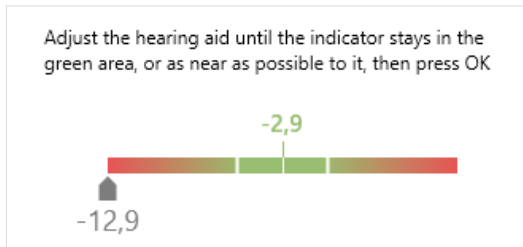
In particular, the section "H.A. Settings" shows the following parameters, relative to the measurement currently selected.



1	Shows the operating mode of the hearing aid to be set for the selected measurement: the mode indicated will be either <i>Microphone (M)</i> or <i>Telecoil (T)</i> .
2	Indicates the level of gain to be set for the selected measurement
3	Indicates whether or not Automatic Gain Control is to be activated or deactivated for the selected measurement.

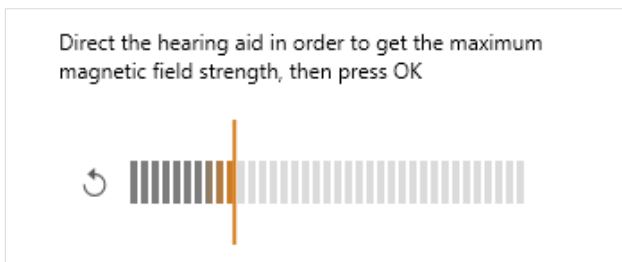
To ensure the operator is able to make the settings for the hearing aid, at the start of each new measurement procedure, and in the event that the required settings are different from those of the last measurement performed, the system will launch a guided procedure for setting the appliance as prescribed by the reference standard.

**Gain:** the gain of the hearing aid can be set for operation in *Full On* mode, or in *RTS* mode. With operation in *Full On* mode, maximum gain must be set on all channels. When operating in *RTS* mode, the hearing aid gain must be set in such a way that with an input signal of 60 dB SPL, the average *HFA* (*High Frequency Average*) gain measured will be equivalent to the average response measured with an input signal of 90 dB SPL reduced by 77 dB (*HFA-OSPL90* – 77dB), allowing a tolerance of 1.5 dB (consult reference standards ANSI S3.22 and IEC 60118-7 for the complete definition). The guided procedure for entering the settings of the hearing aid, when necessary, shows a window for setting the *RTS* mode:



To set *RTS* mode, the operator must deactivate *Full On* mode and regulate the gain of the hearing aid so that the average *HFA* gain (indicated by the gray arrow in the illustration) falls within the prescribed range (band colored green in the illustration).

**Mode:** the hearing aid can be set up for operation in *Microphone* (*M*) mode or in *Telecoil* (*T*) mode, which disables the microphone and activates magnetic field amplification. For measurements requiring the activation of *Telecoil* mode, the hearing aid must be positioned in such a way as to maximize the amplification of the magnetic field. The guided procedure for entering the settings of the hearing aid, when necessary, includes a window for maximizing the amplification of the magnetic field:



As the position of the hearing aid changes, the gray/orange bar represents the value of the magnetic field amplification currently measured, whilst the vertical orange marker indicates the maximum magnetic field amplification value measured during the entire course of the procedure and stored in the system memory. To maximize the amplification of the magnetic field, simply position the hearing aid in such a way that the gray/orange bar indicates the highest value obtainable: the maximum value marker helps the operator to keep track of the high point registering at a given moment. Clicking the arrow alongside the bar, the operator can reset the maximum value measured and restart the procedure.

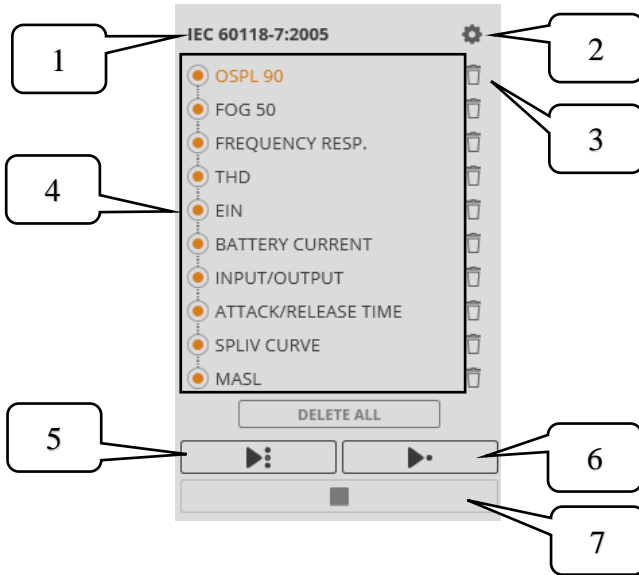
**AGC:** for the majority of measurements prescribed by reference standards, all adaptive functions of the hearing aid must be disabled, including the “automatic gain control” function (*AGC Off*). By contrast, certain particular measurements (such as the Input-Output measurement in the *Reference standards and measurements* section, for example) require activation of the automatic gain control (*AGC On*).

To change the settings of the hearing aid and configure it as required for each of the measurements to be performed, the operator must use the proprietary software provided by the manufacturer of the product. Accordingly, reference should be made to the user manual or the software instructions for indications relative to the various settings required.



## 4.4 COMMANDS AND CONTROLS FOR MEASUREMENTS

The column on the left of the screen contains the following command and control functions:



1	Allows the system to display the reference standard used for conducting the test
2	Gives direct access to the Acquisition Settings section of the Preferences menu
3	Trash icon: clicked to delete the corresponding measurement
4	Allows inclusion or exclusion of a measurement from the current sequence (by checking or unchecking the bullet alongside the corresponding item)
5	Button used to start the sequence of tests selected previously

<b>6</b>	Button used to start only the single measurement currently selected (name highlighted in orange)
<b>7</b>	Stop button: interrupts the measurement in progress

Displayed below this window is a section with the measurement conditions relative to the selected test:

MEASUREMENT CONDITIONS	
Signal	Pure tones sweep
Level	90 dB SPL
Freq range	200 - 8000 Hz
Freq resolution	12/oct

These describe the modes for acquisition of the test. These include:

**Signal:** the type of signal emitted by the device

**Level/s:** the level (or range of levels) at which the signal is emitted

**Frequency range:** the range of frequencies used for acquisition purposes

**Frequency resolution:** the resolution in frequencies used for acquisition purposes

**Freq-Level:** indication of the frequencies at which pure tones are emitted, and of the relative level of emission (THD measurement)

**Frequency(ies):** the frequency or frequencies utilized for acquisition purposes

**Level step:** the step between one level and the next utilized during acquisition

**Pre-delay:** the time for which the signal is held at low level (A - Attack pre-stimulus) or high level (R - Release pre-stimulus) before changing the level (Attack-Release measurement)

## 4.5 DEVICE STATUS

The “Device status” section will display the following parameters:

DEVICE STATUS	
Battery pill	675 / PR44
Batt. current	3.04 mA
Lid	Open

1	Shows the type of battery connected to the device
2	The level of current delivered by the battery for operation of the hearing aid, displayed in real time
3	Indicates the status of the lid of the device (open or closed)

## 4.6 HIT MENU

In the top toolbar of the screen, the *Hit* menu offers further options:

**New exam:** creates a new HIT exam associated with the current patient.

**Calibrations → Microphones Alignment:** opens the window for microphones alignment (see section 4.7.2 *Microphones Alignment*).

**Calibrations → Speaker equalization:** starts the Drum speaker equalization procedure (see section 4.7.3 *Drum speaker equalization*)

**Calibrations → Calibrate with code:** opens the microphone alignment screen (see section 5.3 *Calibrating the Drum microphone of reference by code*).

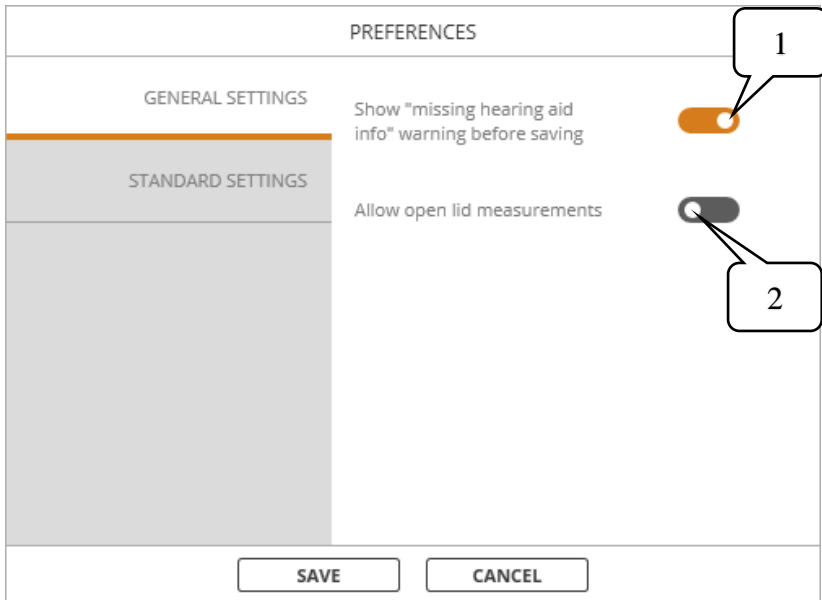
**Preferences:** opens the general preferences window (see section 4.7.1 *HIT Preferences*).

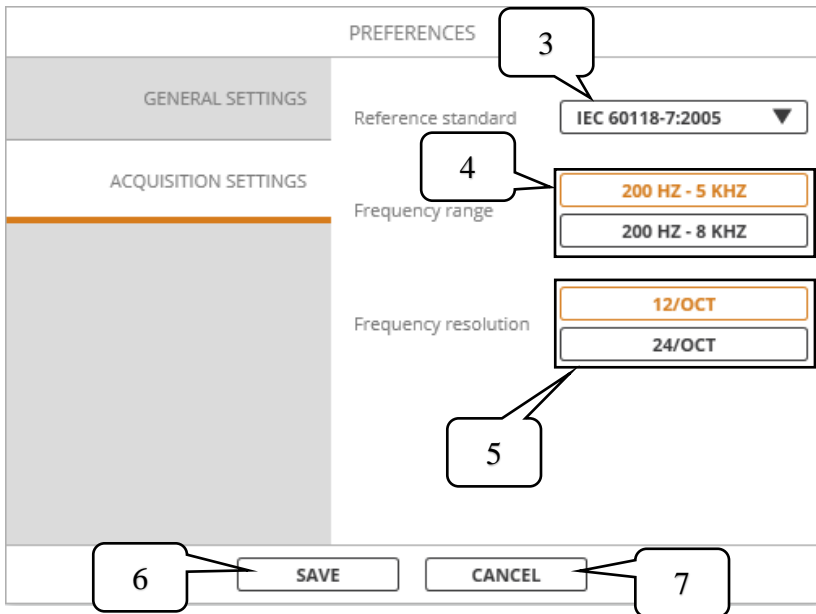
**Device → USB audio card:** opens the screen allowing selection and testing of the audio card (see section 4.2 *Audio card settings*)

**Device → Device info:** accesses information relating to the connected device

### 4.6.1 HIT preferences

Selecting *Hit* → *Preferences* from the menu, the window illustrated below will be accessed:



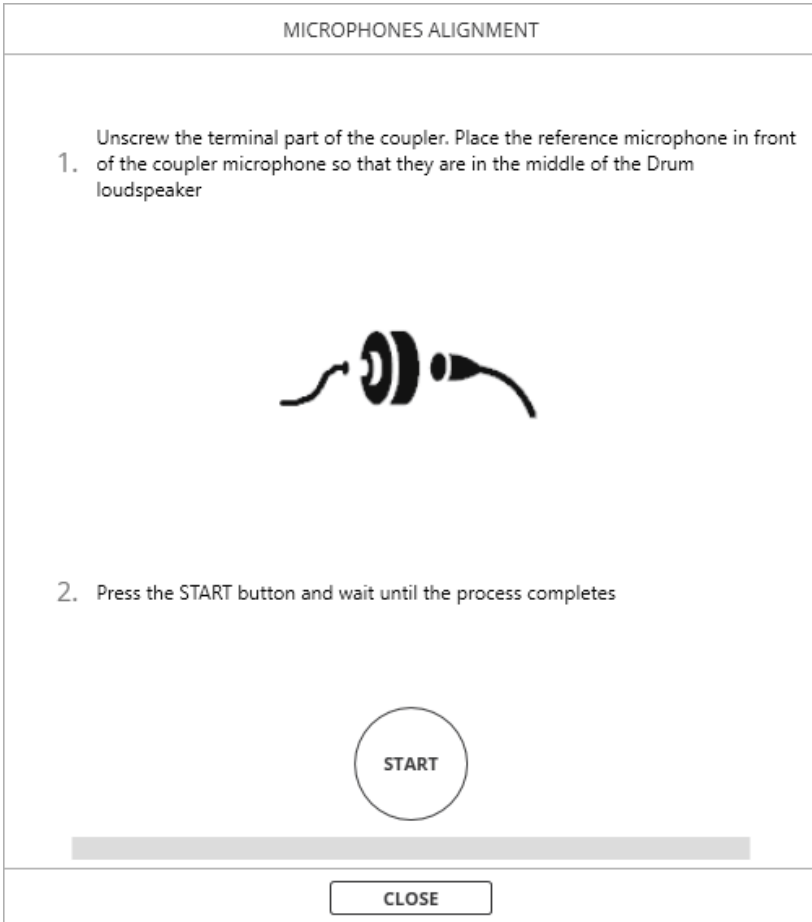


1	The user can activate an alert that will appear at the moment of saving or creating a new test, only in the event that there has been no input of information relative to the hearing aid.
2	Allows choosing whether to enable or disable the control for closing the Drum cover during acquisitions and measurements
3	Selects the standard of reference to be used for the test sequence
4	Selects the frequency range to be used in standard tests
5	Select the frequency resolution to be used in standard tests
6	Stores the displayed preferences
7	Closes the window in which preferences are edited, without saving changes

## 4.6.2 Microphones alignment

The coupler microphone must be calibrated by alignment with the reference microphone, once a month or the first time it is changed; accordingly, the system will prompt the user every month to run the calibration procedure before starting the first measurement. This option cannot be disabled.

The microphones alignment window is shown in the following illustration:



To calibrate the coupler microphone, place the microphones as indicated in the *Drum User Manual*.

With the microphones correctly in position, click START and wait until the calculation procedure has been completed. If the calibration is unsuccessful, a message will appear warning that the microphones should be checked.



*It is particularly important to calibrate the coupler microphone correctly. If the calibration is omitted or wrong, this can jeopardize the measurements heavily and produce incorrect readings.*

### 4.6.3 Drum speaker equalization

To equalize the Drum speaker it is necessary to place the microphone of reference in the center of the test chamber, pointing it cross-wise to the speaker. The hearing aid can be left in the room. Once everything is in place, close the Drum cover and start the equalization by clicking the *Speaker equalization* button in *Calibrations*. Then wait for the procedure to be completed correctly. If the equalization is unsuccessful, a message will appear warning that the microphones should be checked.

Equalization is also launched automatically when making the first custom broadband measurement of the session or starting a custom sequence that contains a broadband measurement, or after changing the lid status before launching the same type of measurement.



*It is particularly important to equalize the microphone of reference correctly. If the equalization is omitted or wrong, this can jeopardize the measurements heavily and produce incorrect readings.*

## 4.7 TAKING A MEASUREMENT

This section describes the controls used for configuring and conducting single measurements or sequences of measurements using the Drum device. Make certain that the device has been properly connected (see the beginning of this chapter), that the Maestro program has been launched, and that the HIT exam is selected (see section *Accessing the HIT exam*).

The HIT exam can execute and save standard measurements with preset parameters to be in line with the selected standard of reference as well as custom measurements with user customizable parameters. To select the type of measurements to be made, simply click on the corresponding button on the left side of the main screen under "Mode":




The corresponding measurement sequence will be shown.

### 4.7.1 Before starting

Before commencing a new session of HIT Measurements, position the hearing aid correctly and make the necessary connections, as described in the *Drum User Manual*. Also, make certain that all items of information on the hearing aid have been entered correctly. Finally, verify that the reference standard with which the test is to comply has been correctly identified, and if not, change it accordingly.


### 4.7.2 Taking a single standard measurement

To select a specific test, simply position the mouse pointer on the name of the test and click: the name will be highlighted in orange, and the graph and the table of corresponding results will appear.

Pressing the start button  for the single measurement, the system will run the test currently selected. Should it be necessary to change the settings for the hearing aid, or if preliminary measurements are missing, a guided procedure will help the user to continue the procedure.

Pressing the stop button  the test currently in progress will be cancelled and no results presented.

Once the test has been completed, the software will perform no further measurements but simply present the graph and the results for the measurement just terminated.

The trash icon  will fill up, indicating that a measurement has been acquired for the type of test in question. The measurement can be deleted, if necessary, by clicking on the trash icon.


In the event that the single measurement start button is clicked after a measurement has already been acquired for this same test, an alert window will appear warning the user that if the action is confirmed, the measurement acquired previously will be deleted.





### 4.7.3 Configuring and launching a sequence of standard measurements


With Drum, the operator can carry out a sequence of standard tests, preselected and launched with a single click.


The icons on the left of the tests are clickable, so that single tests can be included in or excluded from a sequence.

The  icon indicates that the corresponding test is included in the sequence.

A gray icon  indicates that the corresponding test is excluded from the sequence.

Pressing the start button  for a sequence of measurements, the system will run the sequence currently selected. The sequence always starts from the first included test available. On completion of the first test, the next text of the sequence commences automatically, and so on until the last of the selected tests has been performed. At the end of the sequence, the graph and the results for each measurement can be viewed by exploring the tests. Should it be necessary between one test and the next to change the settings for the hearing aid, or if preliminary measurements are missing, a guided procedure will help the user continue the procedure.

Clicking the stop button  the sequence will be interrupted, the current measurement is cancelled and the result will not appear. Should certain measurements have been completed before the interruption occurs, the results of these can be viewed by exploring the relative tests. Once a sequence has been stopped, it cannot be restarted from where the interruption occurred. In the event that the sequence needs to be completed after being interrupted, these remaining measurements must be started one by one using the single start button.

At the end of the sequence, the trash icon changes from empty  for all the tests, indicating that a measurement has been taken for each type of test. The single measurements can be deleted, if necessary, by clicking on the trash icon.

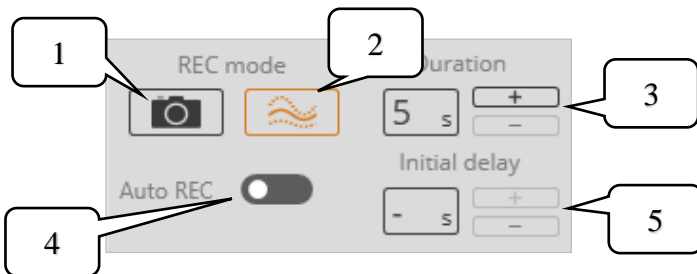
In the event that the sequence start button is clicked after a measurement has already been acquired for at least one test of the sequence, an alert window will appear warning the user that if the action is confirmed, all of the measurements acquired previously will be deleted.

#### 4.7.4 Custom measurements

The custom measurement sequence contains measurements whose parameters can be customized by the user. Moreover, it is possible to select the type of measurements included in the list, up to a maximum of 5 of the same type. The available measurements include:


- **Sweep frequency measure:** A pure tones sweep with selectable intensity level, resolution and frequency range, whose response or gain can be recorded;
- **Broadband frequency measure:** emission of a broad spectrum signal like noise, speech simulation (ISTS, ICRA), etc. with selectable intensity level and recording of the response or gain spectrum;
- **Total harmonic distortion:** emission of a pure tone of selectable frequency and intensity level and measurement of three harmonic distortion;
- **Battery current drain:** output of a pure tone of selectable frequency and intensity level and measurement of the current absorbed by the hearing aid;
- **Input/Output:** emission of a pure tone with variable intensity level for which it is possible to select frequency, intensity range and pitch (in dB) of the increase in sound intensity to build the output curve according to the input between the initial and final level;
- **Attack/Release:** emission of a pure tone for which it is possible to select the frequency, intensity range and duration of the pre-stimulus and record the attack and release times and their curves.


For broadband frequency measurements there is also the possibility to choose the type of curve recording below the measurement parameters:




It is possible to select whether to record the measurement by simply locking the curve shown in real time in an instant (button **1.**) or to make an LTA (Long Time Average, button **2.**) which will average the curve for the number


of seconds selectable with the controls **3**. . Furthermore, with selector **4**. it is possible to decide whether the recording of the measurement should start automatically (or not) after pressing the play button, waiting for the number of seconds selectable with the controls **5**. . This setting can be useful to allow the hearing aid time to adapt to the incoming signal before recording, automatically and repeatable.

Pressing the start button  for the single measurement, the system will run the test currently selected.



Pressing the stop button  the test currently in progress will be cancelled and no results presented.

In case of broadband frequency measurement where automatic recording has not been selected, pressing the  button will start recording according to the selected mode.


Once the test has been completed, the software will perform no further measurements but simply present the graph and the results for the measurement just terminated.

The trash icon  will fill up, indicating that a measurement has been acquired for the type of test in question. The measurement can be deleted, if necessary, by clicking on the trash icon.


In the event that the single measurement start button is clicked after a measurement has already been acquired for this same test, an alert window will appear warning the user that if the action is confirmed, the measurement acquired previously will be deleted.

Pressing the start button  for a sequence of measurements, the system will run the sequence. The sequence always starts from the first test in the list. On completion of the first test, the next test commences automatically, and so on until the last of the selected tests has been performed. When switching to a broadband frequency measurement where automatic recording has been selected, it will start after the number of seconds set and at its end the test sequence will continue. Otherwise the sequence will not continue until the user manually presses the  button.

At the end of the sequence, the graph and the results for each measurement can be viewed by exploring the tests.

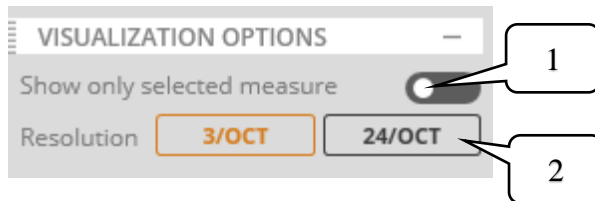
Clicking the stop button  the sequence will be interrupted, the current measurement is cancelled and the result will not appear. Should certain measurements have been completed before the interruption occurs,

the results of these can be viewed by exploring the relative tests. Once a sequence has been stopped, it cannot be restarted from where the interruption occurred. In the event that the sequence needs to be completed after being interrupted, these remaining measurements must be started one by one using the single start button.

At the end of the sequence, the trash icon changes from empty to full  for all the tests, indicating that a measurement has been taken for each type of test. The single measurements can be deleted, if necessary, by clicking on the trash icon.

In the event that the sequence start button is clicked after a measurement has already been acquired for at least one test of the sequence, an alert window will appear warning the user that if the action is confirmed, all of the measurements acquired previously will be deleted.

On the right side of the main window there are some display options:



With **1.** it is possible to choose to display only the current measurement instead of grouping all measurements of the same type in the same graph. The color of the curve in the graph corresponds to the color of the dot to the left of the test name in the list of measurements (left side of the screen). When a measurement is selected, only the dots corresponding to measurements of the same type as the selected measurement are colored, otherwise they are not filled. Sweep and broadband measurements are grouped not only by type, but also by the choice of displaying the response or gain. If this option is changed, the curve is redrawn in the correct graph. Attention: after saving this option can no longer be changed!

With **2.** it is possible to select the frequency display resolution of the curves corresponding to broadband measurements, between 3 and 24 bands per octave. The option applies to all broadband curves.

#### 4.7.5 View exam

Clicking the icon of a saved HIT exam (refer to *Maestro – General Functions – Product Insight*), the display mode will be activated. In this mode, curves already acquired are displayed for read-only viewing, and cannot be edited.

In addition, it is not possible to edit hearing aid information stored in the system, which will be displayed only if entered previously.

The panel on the right hand side no longer shows "Device status" information, but only "Battery", which serves to indicate whether or not the selected test has been conducted using the battery simulator as the power source for the hearing aid and any "Visualization options" for custom measurements. The left hand panel shows all of the measurements available for the type of standard selected or custom measurements, and those for which data are stored currently, accompanied by the full trash icon. It is not possible, in any event, to delete the data of a single measurement.

Clicking on the measurement, the graph will appear with the results and, in the area below the list of measurements, the "Measurement Conditions" window, showing the parameters on which the measurement was based (parameters vary from test to test). In viewing mode, the alerts panel will show only warnings relative to the alignment status of the microphones and the calibration of the reference microphone (only if expired, otherwise it is hidden) that were valid at the moment of conducting the test.

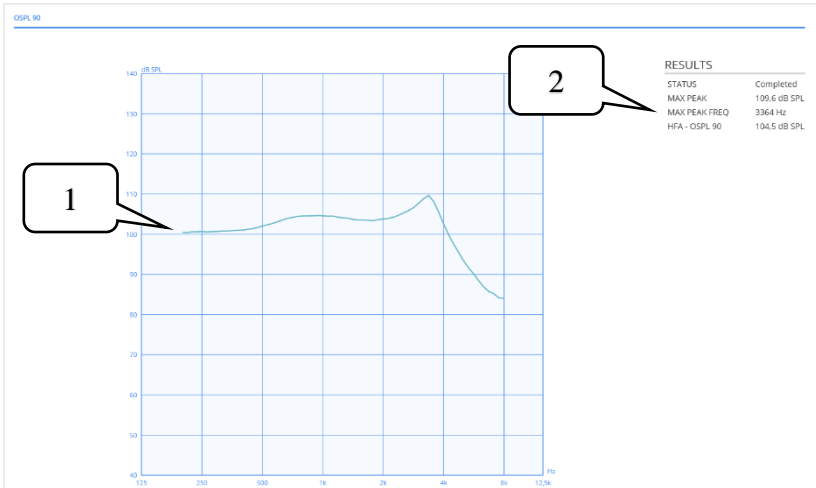
## **4.8 REFERENCE STANDARDS AND MEASUREMENTS**

This section of the manual gives a brief description of all the measurements that can be conducted with the Drum device. In particular, the measurements available to the user are compliant with those defined by reference standards for measurement of the performance characteristics of hearing aids: "ANSI/ASA S3.22-2014 – Specification of Hearing Aid Characteristics" and "IEC 60118-7 2005 - Measurement of the performance characteristics of hearing aids for production, supply and delivery quality assurance purposes". Correct positioning internally of the Drum and correct setting of the operating mode selected for the hearing aid will ensure that the results obtained from tests compare reliably with those indicated in the technical specification sheets of hearing aids, which are based typically on the measurements defined in the mentioned standards.

For more detailed information on the single measurements, refer to standards ANSI/ASA S3.22-2014 and IEC 60118-7 2005.

### 4.8.1 OSPL 90

This is the output response curve (of the coupler microphone) measured in the selected frequency range (200 Hz – 5kHz or 200 Hz – 8 kHz), at the selected frequency resolution (12 bin/octave or 24 bin/octave), with the input consisting in a sweep of pure tones at 90 dB SPL and the hearing aid set up for operation in *Microphone (M)* mode, with *Full On* gain and *AGC* mode deactivated.

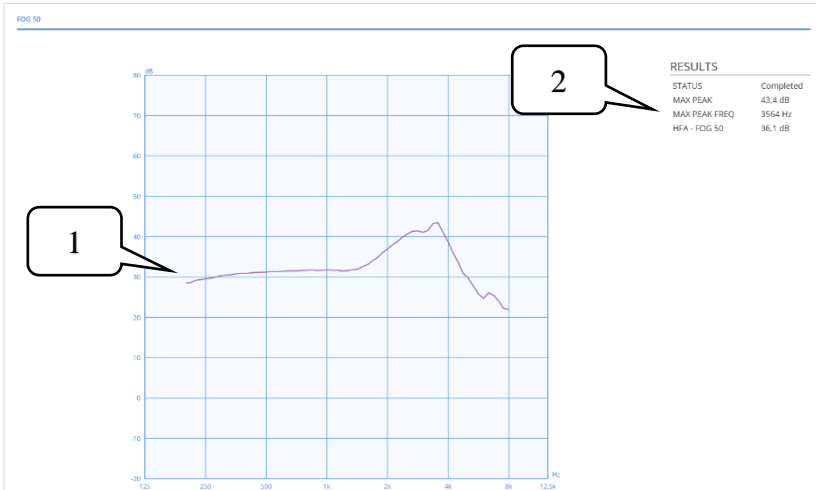


In addition to the response curve shown in the graph (ref 1 in the illustration) the following numerical results are also calculated (ref 2 in the illustration):

- *Max peak*: peak value of the response curve
- *Freq. Max Peak*: the frequency corresponding to the measured peak value
- *HFA-OSPL 90*: average of the response values measured at *HFA (High Frequency Average)* frequencies as defined in the reference standards (1000 Hz, 1600 Hz and 2500 Hz).

## 4.8.2 FOG 50

This is the gain curve calculated as the difference between the output response curve (of the coupler microphone) and the input signal, measured in the selected frequency range (200 Hz – 5kHz or 200 Hz – 8 kHz), at the selected frequency resolution (12 bin/octave or 24 bin/octave), with the input consisting in a sweep of pure tones at 50 dB SPL and the hearing aid set up for operation in *Microphone (M)* mode, with *Full On* gain and *AGC* mode deactivated.

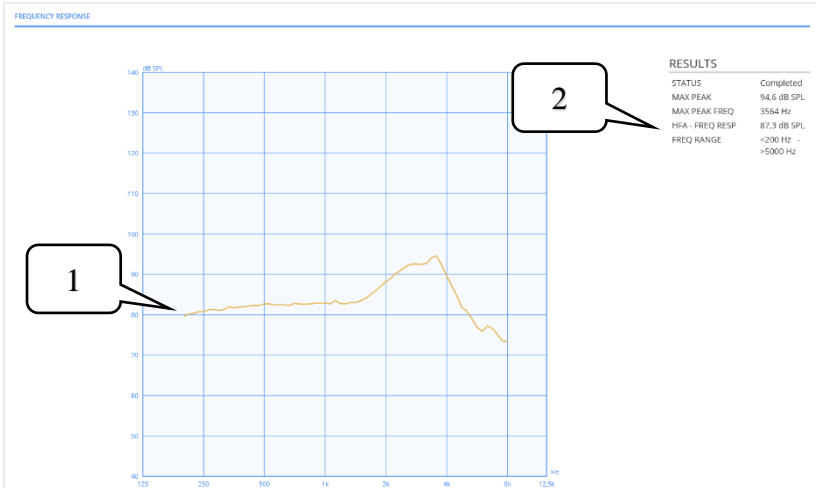


In addition to the gain curve shown in the graph (ref 1 in the illustration) the following numerical results are also calculated (ref 2 in the illustration):

- *Max peak*: peak value of the gain curve
- *Freq. Max Peak*: the frequency corresponding to the measured peak value
- *HFA-FOG 50*: average of the gain values measured at *HFA (High Frequency Average)* frequencies as defined in the reference standards (1000 Hz, 1600 Hz and 2500 Hz).

### 4.8.3 Frequency response

This is the output response curve (of the coupler microphone) measured in the selected frequency range (200 Hz – 5kHz or 200 Hz – 8 kHz), at the selected frequency resolution (12 bin/octave or 24 bin/octave), with the input consisting in a sweep of pure tones at 60 dB SPL and the hearing aid set up for operation in *Microphone* (M) mode, with gain in *RTS* mode and *AGC* mode deactivated.



In addition to the response curve shown in the graph (ref 1 in the illustration) the following numerical results are also calculated (ref 2 in the illustration):

- *Max peak*: peak value of the response curve
- *Freq. Max Peak*: the frequency corresponding to the measured peak value
- *HFA-frequency response*: average of the response values measured at *HFA* (*High Frequency Average*) frequencies as defined in the reference standards (1000 Hz, 1600 Hz and 2500 Hz).
- *Frequency range*: frequency range [ $f_1 - f_2$ ] of the response curve, where  $f_1$  and  $f_2$  are respectively the minimum and the maximum frequency at which the response curve assumes a value equal to the average of the values recorded at *HFA* frequencies, minus 20 dB.

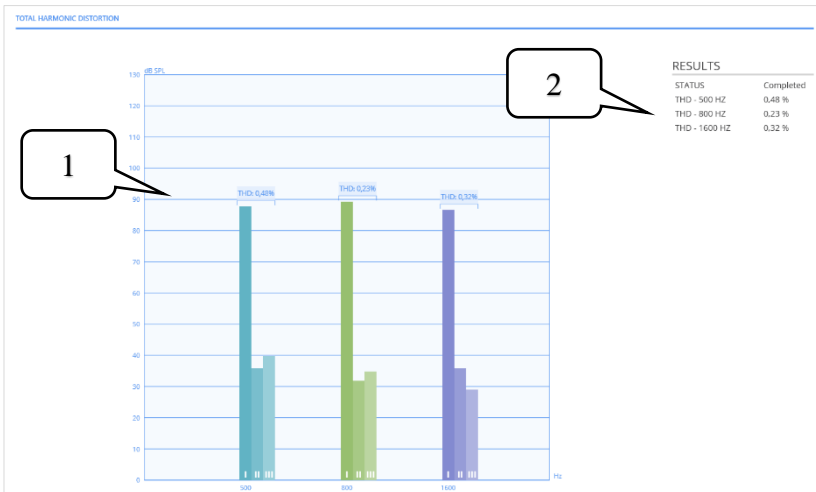


#### 4.8.4 THD

Total Harmonic Distortion is calculated taking account of harmonics up to the third order, for the following test frequencies:

- 500 Hz, with input signal at 70 dB SPL
- 800 Hz, with input signal at 70 dB SPL
- 1600 Hz, with input signal at 65 dB SPL

The measurement of harmonic distortion is conducted setting the hearing aid in *Microphone (M)* mode, with gain in *RTS* mode and *AGC* mode deactivated.



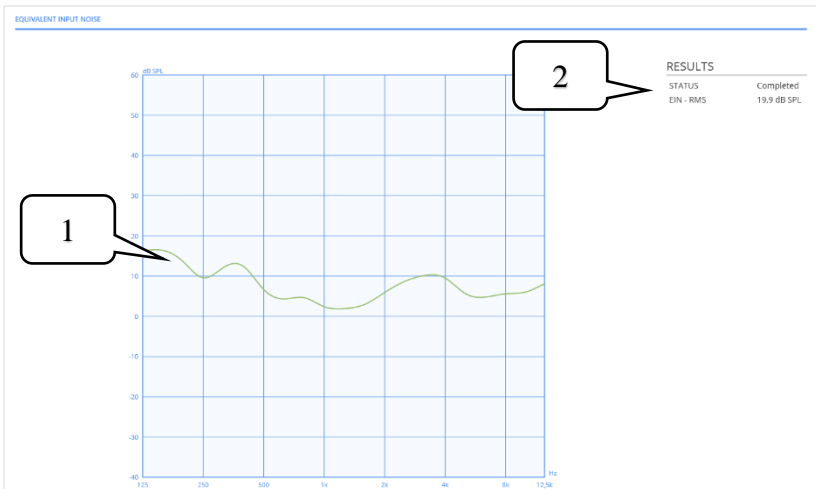
The bar graph reproduced above shows the sound pressure values, for each test frequency, measured at the fundamental and at the second and third harmonic (ref 1 in the illustration), whilst the values of harmonic distortion calculated are indicated in the numerical results section (ref 2 in the illustration).

## 4.8.5 EIN

This measurement is an estimate of the electrical noise at the input of the hearing aid (*Equivalent Input Noise*) attributable purely to the amplification chain of the actual device, defined as the difference between the *RMS* of the response curve measured at the coupler microphone in the absence of any input signal ( $L_0$ ) and the average gain calculated at the *HFA* frequencies (1000 Hz, 1600 Hz e 2500 Hz) applying an input signal of 50 dB SPL:

$$EIN = L_0 - HFA - G50 \text{ dB SPL}$$

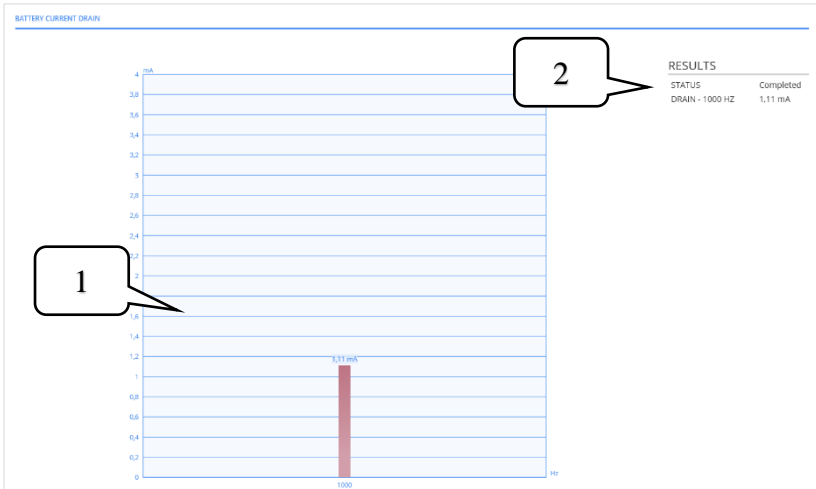
The measurement is conducted with the hearing aid set to *Microphone (M)* mode, with gain in *RTS* mode and with *AGC* mode deactivated.



The graph pictured here shows the response curve measured without any input signal (ref 1 in the illustration) minus the value HFA-G50, whereas calculation of the equivalent input noise is shown in the numerical results section (ref 2 in the illustration).

## 4.8.6 Battery drain

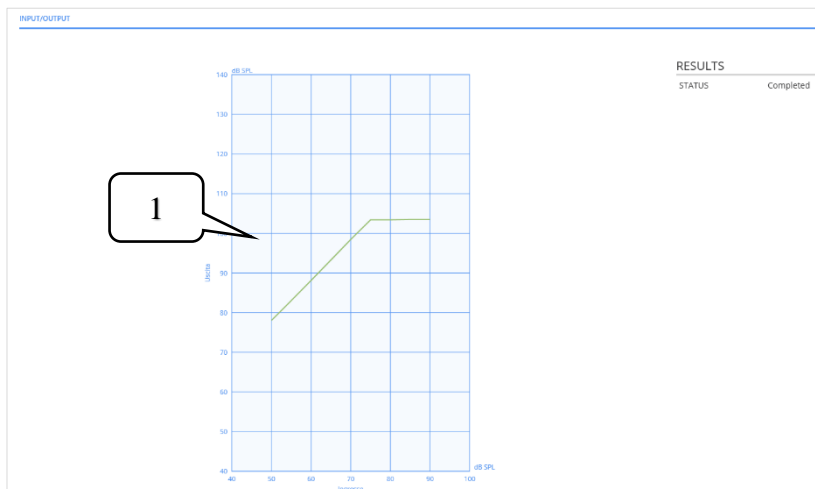
Measurement of the current drawn by the hearing aid with input signal at 1000 Hz and sound level at 65 dB SPL. Current draw is calculated by means of a special battery simulator, with indication of the type and the value of drain currently measured. The measurement is conducted with the hearing aid set to *Microphone (M)* mode, with gain in *RTS* mode and with *AGC* mode deactivated.



The graph (ref 1 in the illustration) and the numerical results (ref 2 in the illustration) indicate the level of current drawn by the hearing aid, expressed in mA.

### 4.8.7 Input/Output

Measurement of the output (coupler microphone) on the basis of an input signal generated at 2 kHz with sound level varying from 50 dB SPL to 90 dB SPL by steps of 5 dB. The measurement is conducted with the hearing aid set to *Microphone (M)* mode, with gain in *RTS* mode and with *AGC* mode activated.



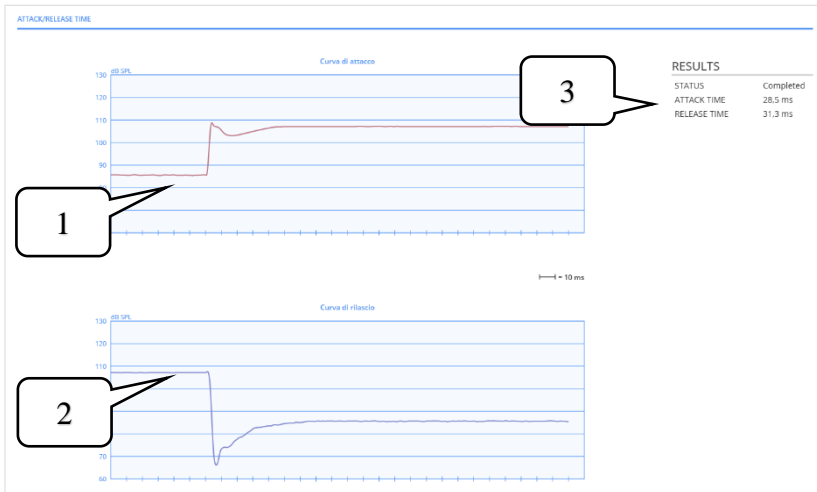
The graph shows the measurement of the input-output curve in response to a changing level of the input signal (ref 1 in the illustration).

### 4.8.8 Attack/Release time

Measurement of the attack and release time against an input signal generated at 2 kHz, effecting a sharp change in the sound level from 55 dB SPL to 90 dB SPL for calculation of the attack time, and from 90 dB SPL to 55 dB SPL for calculation of the release time. The measurement is conducted with the hearing aid set to *Microphone (M)* mode, with gain in *RTS* mode and with *AGC* mode activated.

The calculated attack time is defined as the interval of time registering between the moment when the input signal is increased from 55 dB SPL to 90 dB SPL and the moment when the level of the output measured at the coupler microphone assumes a stable value accurate to 3 dB.

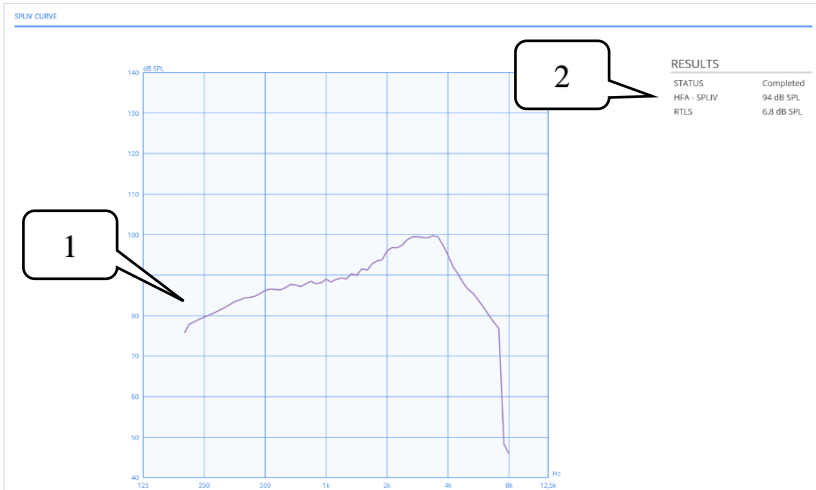
The calculated release time is defined as the interval of time registering between the moment when the input signal is reduced from 90 dB SPL to 55 dB SPL and the moment when the level of the output measured at the coupler microphone assumes a stable value accurate to 3 dB.



The graphs show the temporal attack curve (ref 1 in the illustration) and the temporal release curve (ref 2 in the illustration), whilst the attack and release times calculated are indicated in the numerical results section (ref 3 in the illustration).

### 4.8.9 SPLIV curve

Output response curve (of the coupler microphone) measured in the selected frequency range (200 Hz – 5kHz or 200 Hz – 8 kHz), at the selected frequency resolution (12 bin/octave or 24 bin/octave) and in the presence of a sinusoidal magnetic field having a strength of 31.6 mA/m, oriented in such a way that the vertical reference of the hearing aid coincides with the direction of the magnetic field. The measurement is conducted with the hearing aid set to *Telecoil (T)* mode, with gain in *RTS* mode and with *AGC* mode deactivated.



In addition to the response curve shown in the graph (ref 1 in the illustration) the following numerical results are also calculated (ref 2 in the illustration):

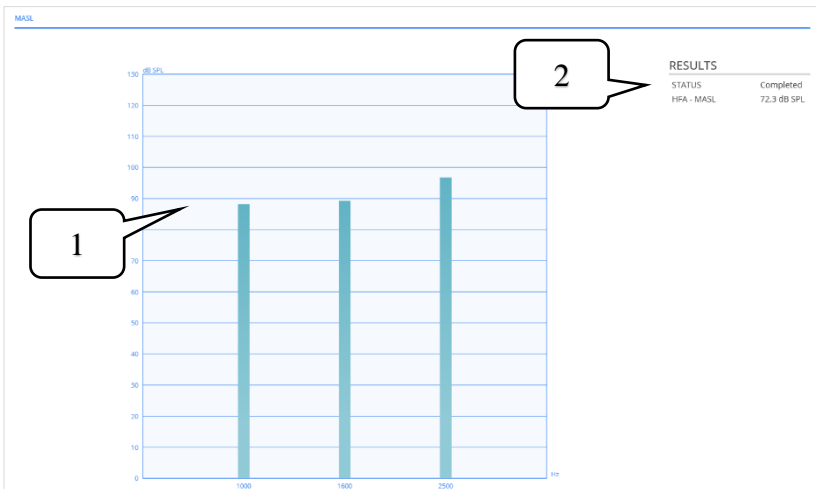
- *HFA-SPLIV*: average of the response values measured at *HFA (High Frequency Average)* frequencies as defined in the reference standards (1000 Hz, 1600 Hz and 2500 Hz).
- *RTLS (Relative Test Loop Sensitivity)*: calculated by establishing the average of the output values measured via the coupler microphone at the *HFA* frequencies (1000 Hz e 2500 Hz), with an input signal at 60 dB SPL, which is then subtracted from the *HFA-SPLIV* value.

#### 4.8.10 MASL

Measures the maximum magneto-acoustic sensitivity of the hearing aid (*MASL*, *Magneto-acoustical sensitivity level*), defined as the *HFA* average of the output measured in the presence of a magnetic field having a strength of 1 mA/m. The *MASL* value is calculated on the basis of the following formula:

$$\text{MASL} = D - 20 \text{ dB}$$

where *D* is the average of the output values measured via the coupler microphone at *HFA* frequencies (1000 Hz, 1600 Hz and 2500 Hz), in the presence of a magnetic field having a strength of 10 mA/m. The measurement is conducted with the hearing aid set to *Telecoil (T)* mode, with gain in *Full On* mode and with *AGC* mode deactivated.



The bar graph shows the output values measured at *HFA* frequencies in the presence of a magnetic field having a strength of 10 mA/m (ref 1 in the illustration), whilst the numerical results section indicates the calculated *MASL* value (ref 2 in the illustration).





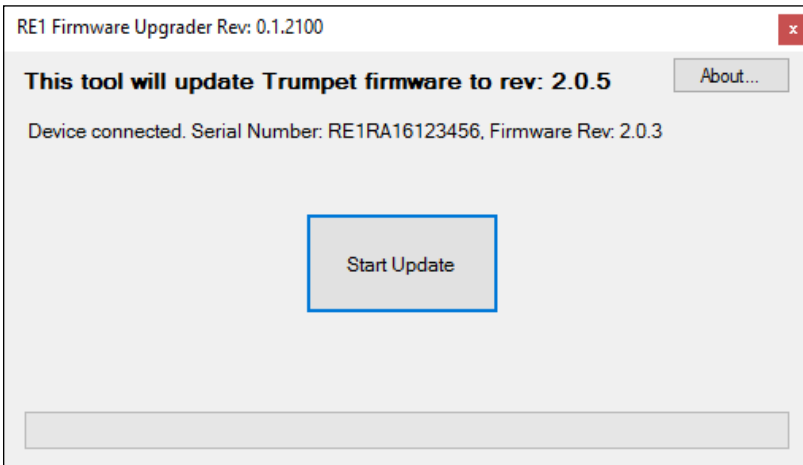
# CHAPTER 5

## Additional operations

Additional tools installed together with the Maestro suite will allow the user to carry out simple routine service operations on the device when necessary, such as updating the firmware, for example.

### 5.1 TRUMPET AND DRUM FIRMWARE UPGRADE

The firmware upgrade tool allows users to check whether or not their device is up to date, and if not, to upgrade the firmware to the latest version available. The tool will start up automatically when Maestro is opened, if the firmware of the connected device is obsolete. The upgrade screen is illustrated below:



Should it be necessary to update the Drum, the screen is much the same and the operations required are the same.

Click the "Start Update" button to start the update. Wait until the procedure has been completed: the message "Firmware update successful" will confirm that the upgrade has been successful. Click "OK" to complete the procedure.



*Do not on any account disconnect the device or its power adapter, or turn off the PC, during the course of the update procedure.*



*If an error should occur during the firmware upgrade procedure, or if the device becomes disconnected or is switched off, follow the instructions that will appear.*

## 5.2 CALIBRATION OF TRUMPET PROBE MICROPHONES BY CODE

The Maestro application provides the facility of calibrating the reference microphones of the REM probes, or the RECD coupler microphone, using a calibration code.

Connect the Trumpet to the PC, access the Maestro REM module and go to the *Rem* → *Calibrations* → *Calibrate with code* menu to open the screen shown below:

CALIBRATE THROUGH CODE

Transducer serial number

Calibration code  -  -  -

Enter the serial number of the transducer to be calibrated, and the calibration code — each in the relative field — then click the OK button.

The system will detect the type of transducer automatically, then apply and save the calibration.



*The calibration code, associated with the serial number of a transducer, can be issued only by Inventis S.r.l. or an authorized technician.*



*A single calibration code cannot be used more than once*

### 5.3 CALIBRATION OF THE DRUM MICROPHONE OF REFERENCE BY CODE

Using the Maestro application it is possible to calibrate the Drum microphone of reference using a calibration code.

Connect the Drum to the PC, open the Maestro HIT module and go to the *Hit* → *Calibrations* → *Calibrate with code* menu to open the screen shown below:

CALIBRATE THROUGH CODE

Transducer serial number

Calibration code  -  -  -

Enter the serial number of the transducer to be calibrated, and the calibration code — each in the relative field — then click the OK button.

The system applies and saves the calibration.



*The calibration code, associated with the serial number of a transducer, can be issued only by Inventis S.r.l. or an authorized technician.*

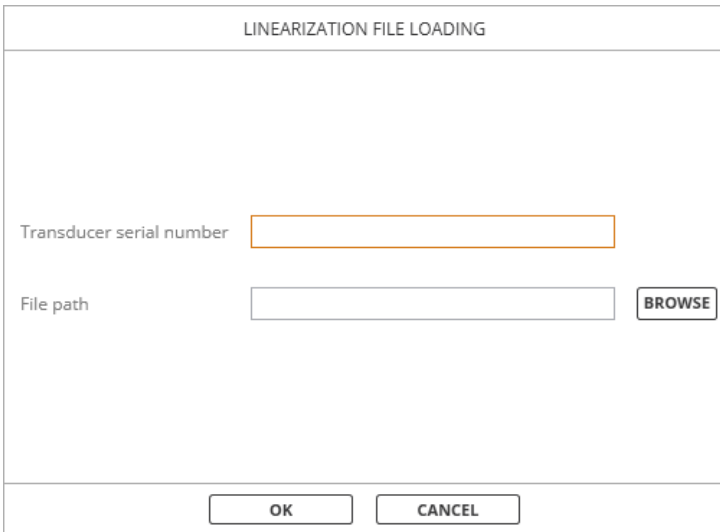


*A single calibration code cannot be used more than once*

## 5.4 LINEARIZATION FILE LOADING OF A NEW PAIR OF WIRED TRUMPET PROBES

For a new pair of wired Trumpet probes it is necessary to load the linearization file sent with the probes. This can be done with Maestro.

Connect the Trumpet to the PC, access the Maestro REM module and go to the *REM* → *Calibrations* → *Load linearization file* menu to open the following screen:



The screenshot shows a dialog box titled "LINEARIZATION FILE LOADING". It has a white background with a thin border. At the top, the title is centered. Below the title, there are two input fields. The first is labeled "Transducer serial number" and is an empty rectangular box with a thin orange border. The second is labeled "File path" and is an empty rectangular box with a thin grey border. To the right of the "File path" box is a button labeled "BROWSE" in all caps. At the bottom of the dialog box, there are two buttons: "OK" and "CANCEL", both in all caps and separated by a small gap.

Enter the serial number of the probes, then click on "BROWSE" and open the file provided by Inventis together with the probes. Then click "OK" and wait for the confirmation message.



*The linearization code associated with the serial number of a transducer can be issued only by Inventis S.r.l.*



*The same linearization file cannot be used more than once*



*The linearization file must only be loaded the first time a new pair of probes is paired with the Trumpet. To recalibrate them, the calibration code produced by a technician or his/her direct intervention is sufficient.*

## APPENDIX A:

### Bibliographical references

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## APPENDIX B:

### Troubleshooting


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For problems regarding the installation of the Maestro suite, or patient management, or general settings, refer to the *Maestro Product Insight - General Functionalities*.

For problems regarding the Trumpet device, refer to the *Trumpet User Manual*.

For problems regarding the Drum device, refer to the *Drum User Manual*.

For problems regarding the Harmonica device, refer to the *Harmonica Video Otoscope – User Manual*.

<b>Problem</b>	<b>Possible cause</b>	<b>Solution</b>
Maestro open but following button does not appear: 	Harmonica is not connected to computer via USB cable.	Connect Harmonica to the computer with the USB cable and restart Maestro. Please avoid the use of any non-powered USB hub





## APPENDIX C:

### Glossary (acronyms)

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#### REM

- **LTA (Long Term Average)**: temporal average of curves measured over a period of time, in seconds
- **MPO (Maximum Power Output)**: measurement of response in the ear with hearing aid inserted and switched on, and input consisting in a sweep of tones at 85 dB SPL (90 dB SPL for coupler measurement)
- **REAG (Real Ear Aided Gain)**: measurement of gain in the ear with hearing aid inserted and switched on
- **REAR (Real Ear Aided Response)**: measurement of response in the ear with hearing aid inserted and switched on
- **RECD (Real Ear to Coupler Difference)**: curve representing the difference between response at the coupler and response in the actual ear. Allows comparison between measurements obtained with the coupler and those that would be obtained in the ear
- **REM (Real Ear Measurement)**: direct measurement technique favoring an optimum outcome when fitting the hearing aid
- **REOG (Real Ear Occluded GAIN)**: measurement of gain in the ear with hearing aid inserted but switched off
- **REOR (Real Ear Occluded Response)**: measurement of response in the ear with hearing aid inserted but switched off
- **REUG (Real Ear Unaided Gain)**: measurement of gain in the ear without hearing aid
- **REUR (Real Ear Unaided Response)**: measurement of response in the ear without hearing aid

# HIT

- **AGC (Automatic Gain Control):** various functionalities of the hearing aid that combine to adapt its gain automatically to sudden variations in level of the input signal
- **BTE (Behind The Ear):** a type of hearing aid worn behind the pinna, also known as post-auricular or retroauricular
- **CIC (Completely In the Canal):** a type of hearing aid occupying only the auditory canal, smaller than the more visible ITE hearing aid
- **EIN (Equivalent Input Noise):** a measurement serving to represent the level of the sound output from the hearing aid that is attributable purely to electrical noise inherent in the amplification chain of the device itself
- **FOG50 (Full On Gain 50):** a coupler gain measurement with the input consisting in a sweep of tones at 50 dB SPL and the hearing aid in Full On gain mode
- **HFA (High Frequency Average):** average values at 1000, 1600 and 2500 Hz of the response curve or the gain curve
- **HIT (Hearing Instrument Test):** set of measurements used to obtain the standard curves of the hearing aid in a test chamber and establish whether or not it is functioning correctly
- **ITC (In The Canal):** type of in-the-ear hearing aid that does not occupy the auricular space outside the auditory canal, but only the space within the canal
- **ITE (In The Ear):** type of in-the-ear hearing aid that occupies the auricular space lying externally of the auditory canal
- **MASL (Magneto-Acoustical Sensitivity Level):** coupler response measurement mediated for HFA frequencies, relating to a magnetic field of 1 mA/m. Measured in a field of 10 mA/m subtracting 20 dB from the result
- **OSPL90 (Output Sound Pressure Level 90):** coupler response measurement with the input consisting in a sweep of tones at 90 dB SPL and the hearing aid in Full On gain mode
- **RIC (Receiver In The Canal):** a behind-the-ear type hearing aid with a receiver located not in the device itself but in the auditory canal

- **RITE (Receiver In The Ear)**: a behind-the-ear type hearing aid with a receiver located not in the device itself but immediately outside the auditory canal
- **RTG (Reference Test Gain)**: average HFA gain of the hearing aid equivalent to HFA-OSPL90 – 77
- **RTLS (Relative Test Loop Sensitivity)**: relative magnetic sensitivity — the difference between average HFA response with a magnetic input and with a microphone input (ANSI S3.22-2014; defined in IEC 60118-7:2005 as **ETLS** - Equivalent TLS)
- **RTS (Reference Test Setting)**: setting of the gain curve that is selected in the hearing aid to obtain an average HFA gain equal to the RTG value
- **SPLIV (Sound Pressure Level In a Vertical magnetic field)**: coupler response measurement with input consisting in an alternating vertical magnetic field parallel with the coil of the hearing aid (ANSI S3.22-2014, defined in IEC 60118-7:2005 as **SPLI**)
- **THD (Total Harmonic Distortion)**: coupler harmonic distortion measurement using pure tone input