
Service Manual – EN
Hearing aid analyzer
Callisto™



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1. Introduction

1.1 About this manual

This manual is for our Hearing aid analyzer, Callisto™. The contents of this manual cover instrument related data, such as disassembly and calibration. Technical specifications, schematics and a parts & accessories list can be found as appendices in the back of this manual.

1.2 About warnings and cautions

The below warning, caution and notice symbols are used throughout the manual, indicating the level of attention required for a given action:



WARNING

The **WARNING** label identifies conditions or practices that may present danger to the patient and/or user.



CAUTION

The **CAUTION** label identifies conditions or practices that could result in damage to the equipment.

NOTICE

NOTICE is used to address practices not related to personal injury.

1.3 General information

We continuously strive to improve our products and their performance, hence the specifications in this service manual are subject to change without further notice.

The performance and specifications of our products can only be guaranteed if technical maintenance is conducted routinely every year. Technical maintenance should be carried out by qualified personnel authorized by Interacoustics.

We are happy to receive any inquiries about our products. Our contact details are:

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2. Disassembly

Tools required
Torx T6



WARNING

Before starting this procedure, make sure to disconnect the instrument from the power supply

This chapter contains a disassembly guide for Callisto™. Carried out by a technician authorized by Interacoustics, the most common action(s) would be replacing the battery and/or the mainboard

The other common action that Callisto™ requires, namely calibration, is described thoroughly in [Chapter 3](#).

2.1 Replacing the battery

Use a Torx T6 to remove the screw from the rear panel.



Figure 1

Press the knob cover gently from the bottom side of the cabinet. This releases the knob.



Figure 2

While pushing the bottom cover plate downwards, slide the cover plate to the right. Then, tip the plate upwards and remove it.



Figure 3

Access to the inside of the cabinet is now enabled, and battery replacement possible.

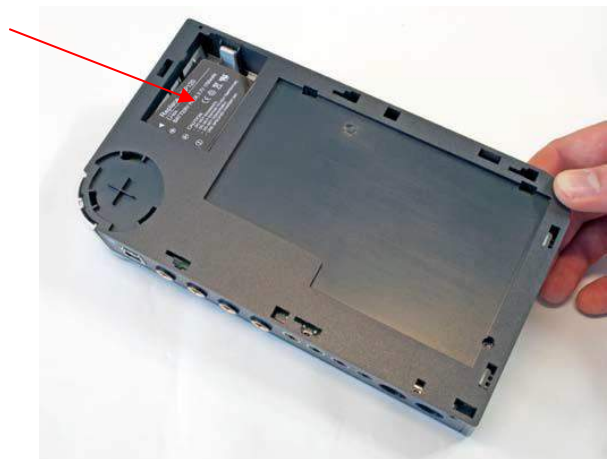


Figure 4

2.2 Replacing the PCA mainboard

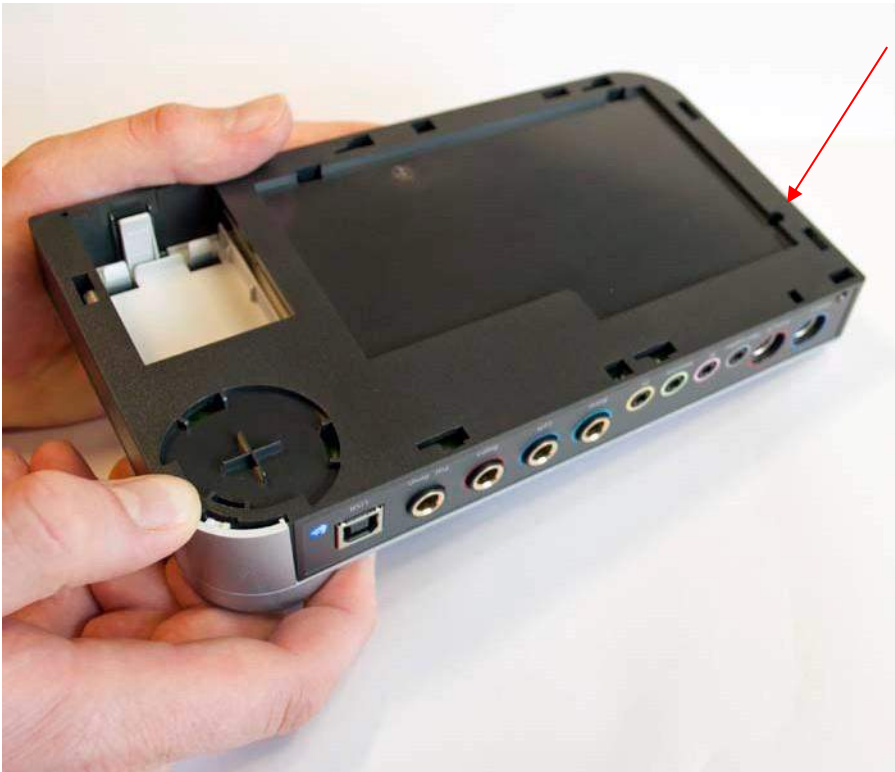


Figure 5

Having enabled access to the inside of the cabinet (as described in the previous paragraph), use a Torx T6 to remove the screw indicated to the left.



Figure 6

Separate the cabinet parts by pulling the knob outwards and lifting the bottom housing.

When the parts are pulled apart, the 4 snap locks are released.

The print board is removed by gently releasing the 2 snap locks. Then, release the mainboard.

Use a small screwdriver to carefully push back the lower cabinet locks

3. Calibration

3.1 Service, adjustment and repair

Annual calibration (ANSI/ASA S3.6 and S3.46)

The calibration procedure validates all relevant performance requirements specified in ANSI/ASA S3.6 and S3.46. After the audiometric equipment has been submitted for calibration, a calibration certificate with the recorded values must be completed, signed and dated by the technician. This demonstrates that the instrument conforms to all relevant requirements specified in this standard.

NOTICE

It is considered good practice to perform annual checks of the audiometric test room's noise level as part of the annual calibration using the applicable table per ANSI/ASA S3.1 *American National Standard Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms* to ensure that audiometer performance will not be affected by any changes in the audiometric test room's noise levels

Annual calibration (IEC 60645-1 and IEC 60645-5)

A basic calibration shall be performed by an authorized laboratory. The procedure shall be such that, after the audiometric equipment has been submitted for a basic calibration, it should meet the relevant requirements specified in IEC 60645-1 and IEC 60645-5.

Upon receipt of the calibrated instrument and before being put back into service, the instrument should be checked in accordance with the procedures outlined in [Checklist for calibration](#).

NOTICE

We recommend attaching a calibration check label, displaying the next date of calibration, to the equipment

3.2 General equipment requirements

Below, the minimum equipment requirements for performing correct calibration and hardware testing are described:

1. Spectrum analyzer (SA)
2. Tone generator (TG)
3. Oscilloscope (OS)
4. Millivoltmeter (MV)
5. Multimeter (MM)
6. Acoustical coupler, 6cc and 2cc fulfilling the demands of IEC 303 and IEC 126
7. 1" pressure field condenser microphone for the above mentioned couplers, fulfilling the demands of IEC 1094-1

Furthermore, we recommend using:

- An acoustic calibrator for the control of the complete measuring chain
- A general purpose frequency counter

3.3 Calibration of test equipment

All test equipment used for the calibration of audiometers is to be calibrated annually. Calibration of all test equipment must be performed by a laboratory traceable to the National Institute of Standards and Technology (NIST) or equivalent. Test equipment calibration documents are to be kept on file.

3.3.1 Calibration mode entering

Connection between the instrument and a computer, should be conducted as described in [Installing the Callisto Suite](#). The calibration program is activated by starting the program and following the on-screen instructions. The program is found via the below path:

32 bit: C:\Program Files\Interacoustics\Callisto Suite\CalibrationCallisto.exe

64 bit: C:\Program Files (x86)\Interacoustics\Callisto Suite\CalibrationCallisto.exe

3.3.2 Checklist for calibration ¹

This list is a useful tool for making sure that no aspect of the calibration process is forgotten. Hence, we highly recommend using the list as the structure when calibrating.

Functional checks	Pass/Fail
Visual inspection, safety: check power cord and accessory cords for signs of wear or damage and the general physical condition of instrument	
Headband: tension	
Cushions: check condition and replace if required	
Patch cords: check plugs and leads for intermittency	
Patient response: check for proper operation	
Pure-tone electroacoustic measurements	
Frequency (Hz): actual measurement recorded (all frequencies)	
Distortion (%): recorded as a percentage of THD on all frequencies	
Output levels (all transducers): recorded as a deviation from standard	
Linearity of all channels (all transducers) (dB): recorded as a deviation from standard	
Rise/fall time (m/sec): actual measurement recorded	
Overshoot (dB): actual measurement recorded	
On/off ratio: measured and recorded in dB down	
Crosstalk: measured and recorded in dB down	
Pulse tones: duration (m/sec). Actual measurement recorded (pass/fail)	
SISI: indicate pass or fail and deviation from standard	
Unwanted noise check: record with (pass/fail)	
Interrupter switch	
Switch sounds	
Mechanical sounds	
Masking measurements	
Narrow band noise output level: measured and recorded as deviation from standard, all transducers	
White noise output level: measured and recorded as deviation from standard, all transducers	
Speech electroacoustic measurements	
Speech output level: signal applied to input, VU meter at zero. Measured and recorded as deviation from standard, all transducers	
Distortion: recorded as percentage of THD	
Speech noise: output measured and recorded as deviation from standard	
Sound field measurements	
Warble/FM output level: actual measurement recorded (all frequencies) as deviation from standard	
Speech inputs in sound field output level: signal applied to input, VU meter set at zero. Measured and recorded as deviation from standard	
Narrow band noise output level: measured and recorded as deviation from standard, all transducers	
Speech/white noise output level: measured and recorded as deviation from standard, all transducers	
Distortion: recorded as percentage of THD	

¹ Post calibration and before operation, the instrument should be checked for normal function.

3.4 Installing the Callisto Suite

The Callisto Suite comes as pre-installed software in USB format.

The suite contains the calibration software required for the annual Callisto™ calibration.

The below section includes a guide describing proper installation of the software. For further information and/or installation of other Windows® versions than Windows® 10, refer to Callisto™ Instructions for Use.

Insert the installation USB and follow the steps.

Accept the *License terms and conditions*, and the low-lighted *Install* will become available.

Click *Install* to initiate installation.

NOTICE

If there is no automatic initiation of the installation procedure, click *Start* and then via the file finder, click the USB drive to view the contents. Click the *setup.exe* file to initiate the installation.



Figure 7

NOTICE Browse for an alternative location. For further information on this, refer to the Callisto™ Instructions for Use.

Click *OK* to determine the program file location.

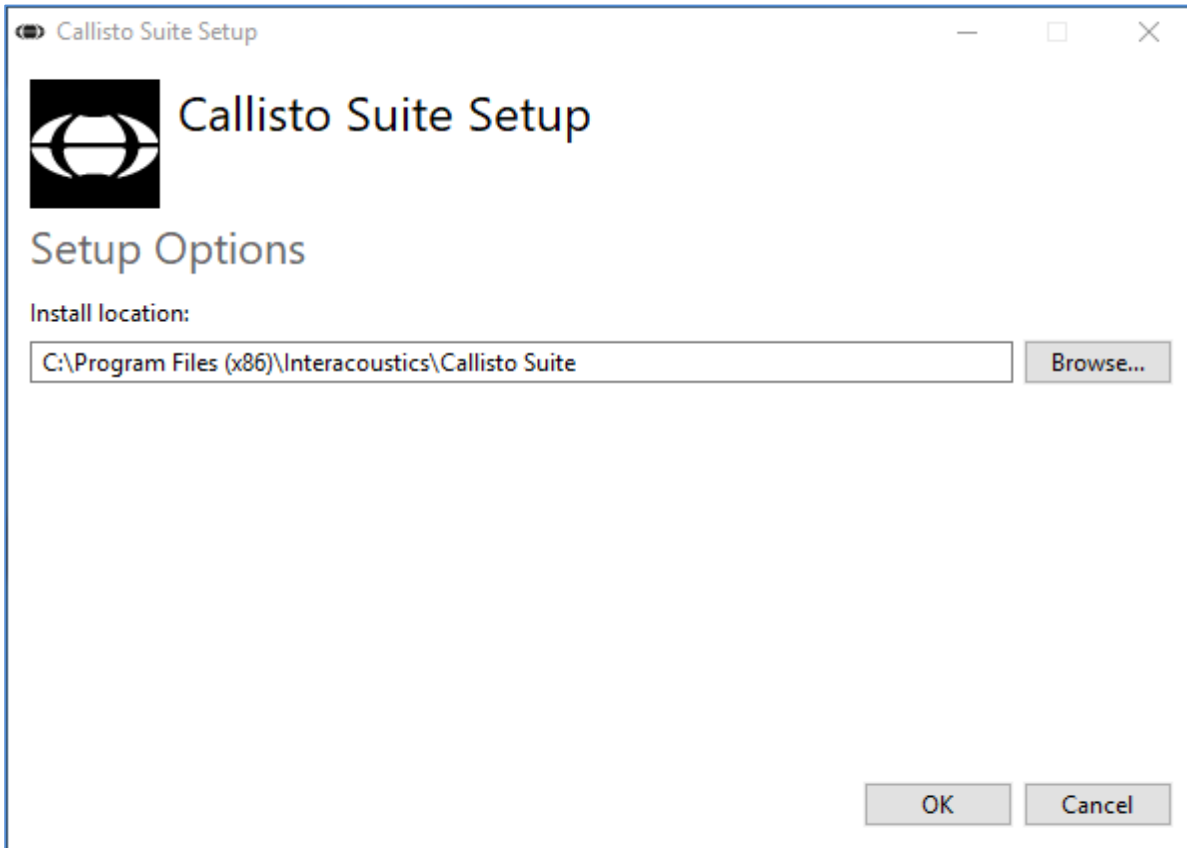
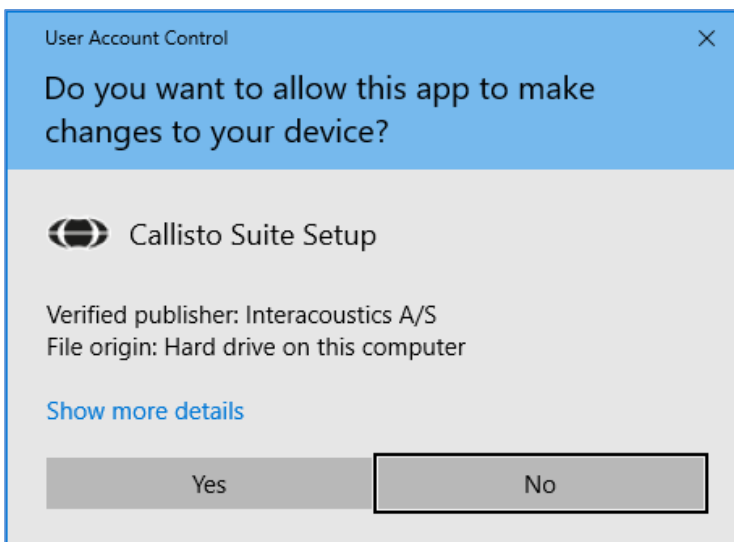


Figure 8



Finally, click *Yes* to allow installation of the Callisto™ Suite.

Figure 9

Allow the installer to process and complete the software installation.
Upon completion, click *Close*. The Suite is now installed.

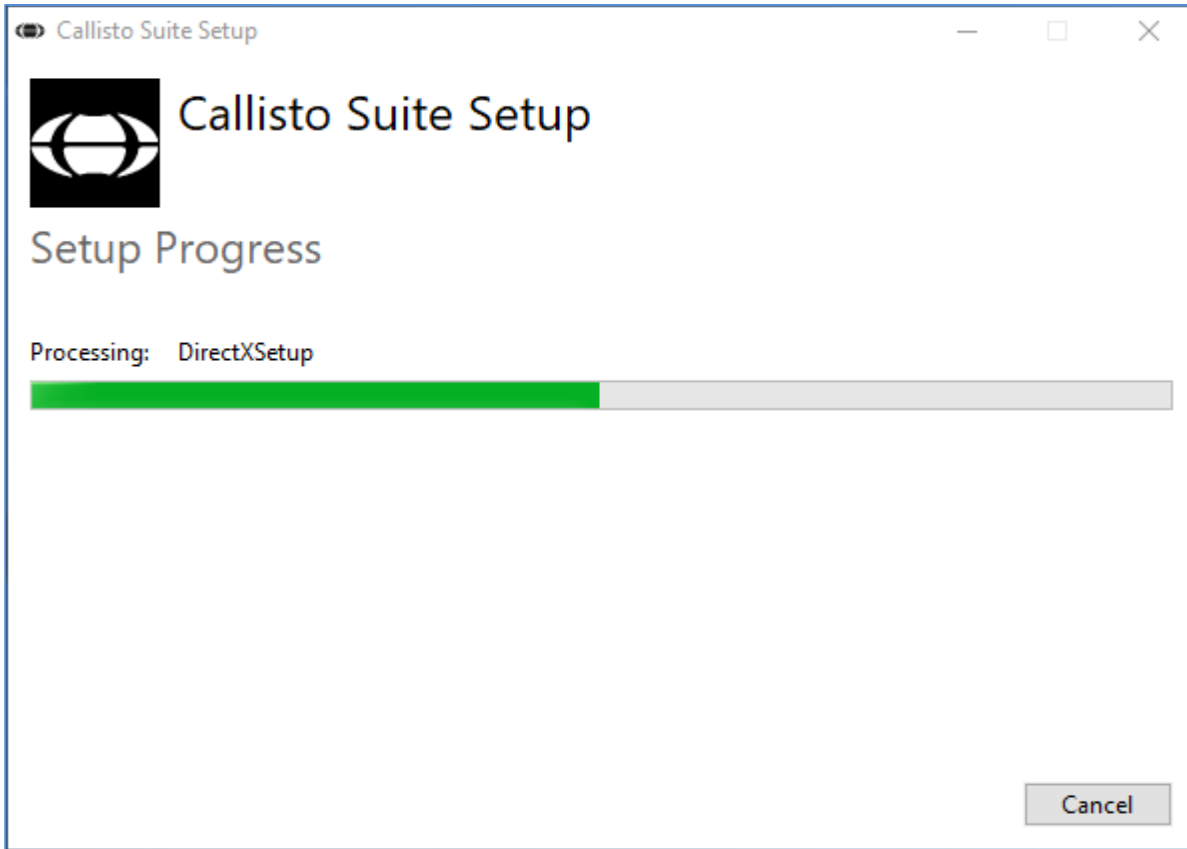


Figure 10

3.5 Main startup

Connect Callisto™ to the computer with a USB cable and switch on the instrument.

NOTICE Please note that the *Hardware* tab is used solely for production purposes. Hence, no further description of the tab in this service manual.

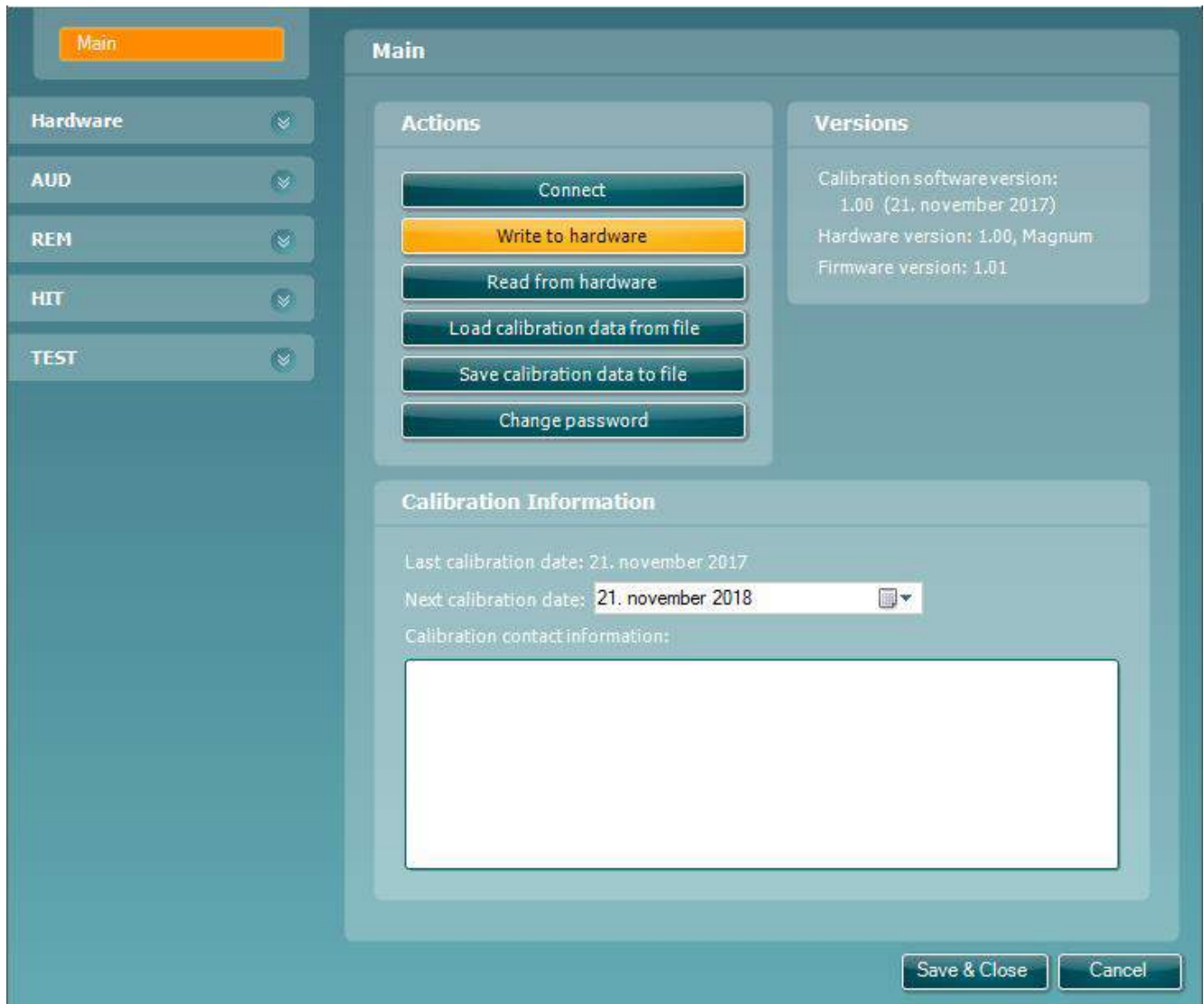


Figure 11

3.6 Saving the calibration data

This paragraph describes how to save the calibration data obtained during the calibration.

Following each calibration step, click *Main* in the menu, and then click *Write to hardware*.

A dialog box with the message *Calibration data successfully written to hardware* pops up upon successful completion of the action.

It is now possible to continue the calibration procedure via the menu tabs.

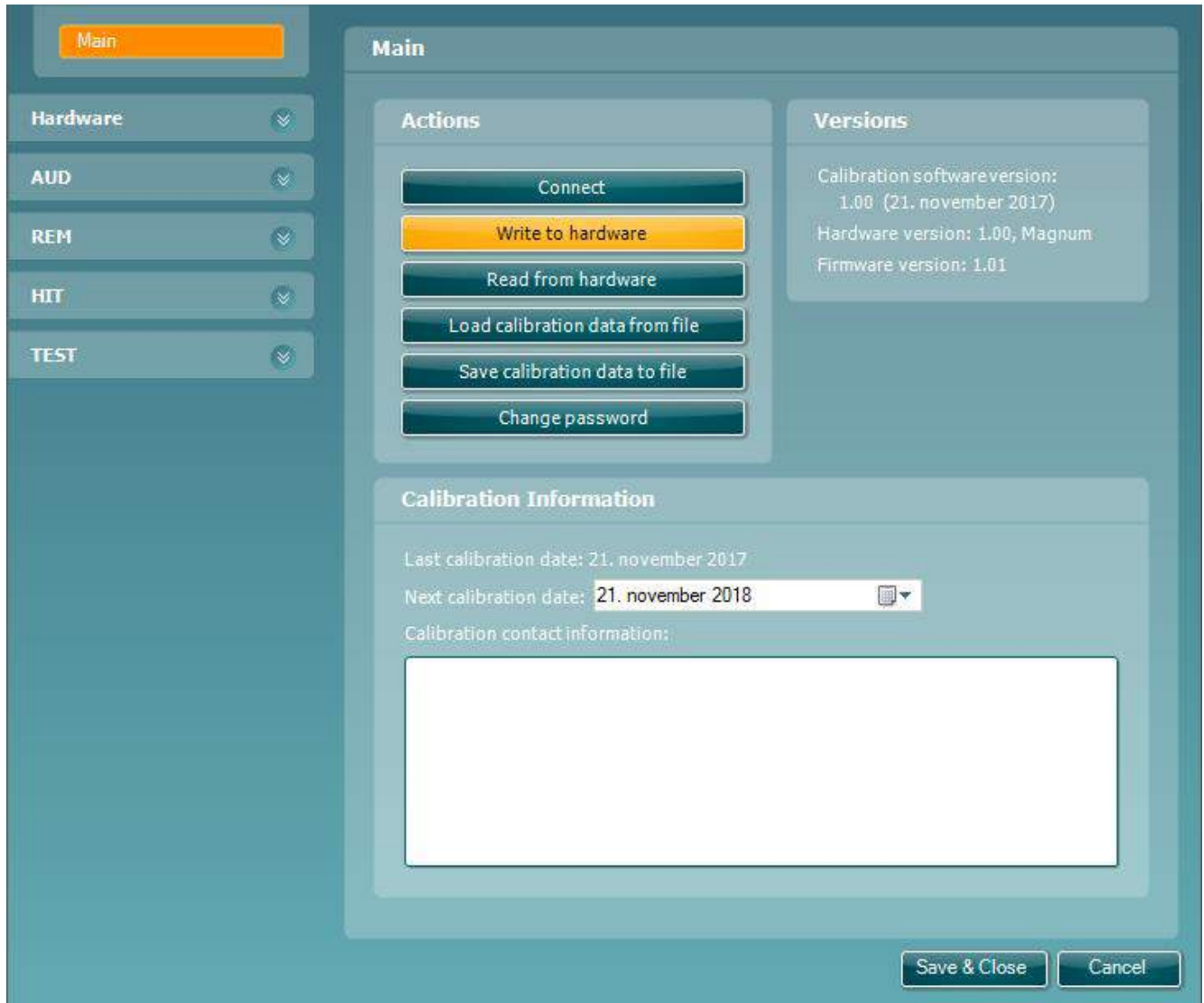


Figure 12

3.7 Calibration of the Callisto™ modules

Callisto™ offers three modules, namely HIT440, REM440 and AC440. In the following section, the calibration procedure for the three modules is described individually.

3.7.1 HIT440

Click *Connect*.

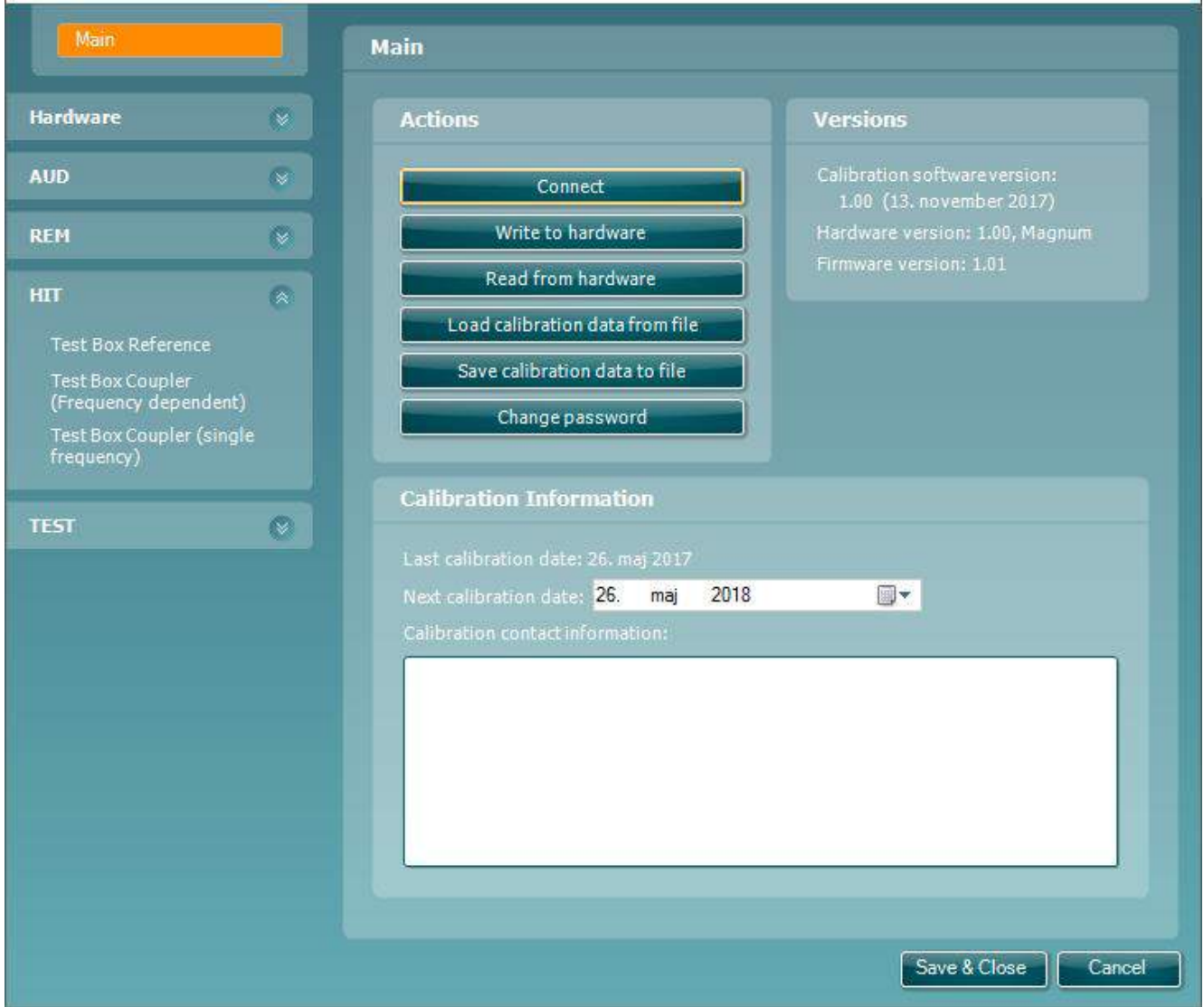


Figure 13

Equipment requirements

- 94dB (max 114dB) calibrator, or equivalent
- Calibration adaptor for HIT

3.7.1.1 Test box reference

First, uncheck the box *Uncalibrated*.

Then, place the reference microphone in the acoustical calibrator fitted with the calibration adaptor for HIT, as illustrated to the right hand side.

Select the *Calibrator frequency*.

Finally, slide the adjustment button until 94dB ±0,5dB is reached on the *Measured* bar.



Figure 14

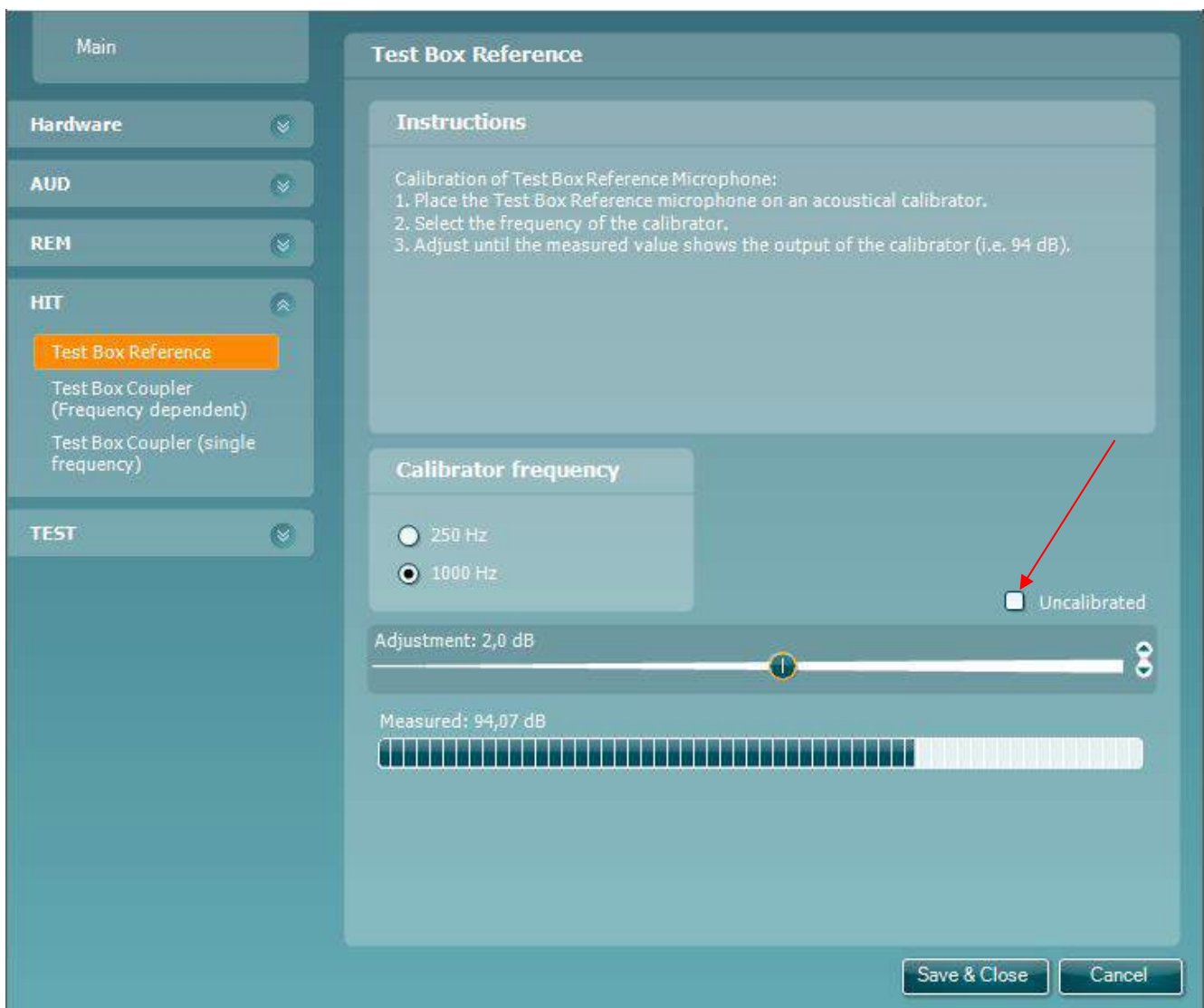


Figure 15

3.7.1.2 Test box coupler - frequency dependent

Via the menu, click *Test Box Coupler (Frequency dependent)*, and follow the on-screen instructions.

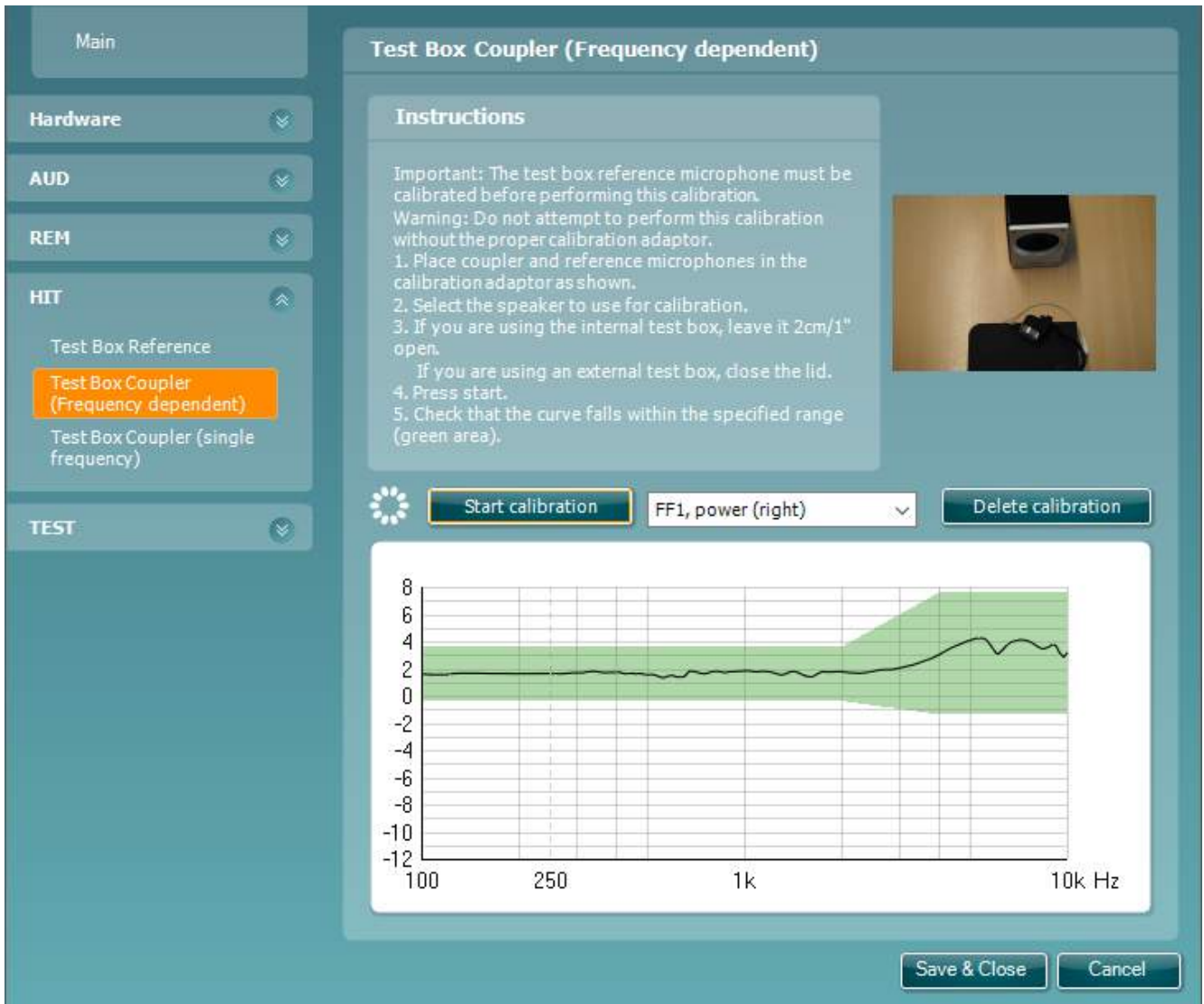


Figure 16

To the right hand side, the coupler and reference microphone set up correctly.



Figure 17

3.7.1.3 Test box coupler - single frequency

First, uncheck the box *Uncalibrated*.

Then, place the measuring microphone in the acoustical calibrator fitted with a calibration adaptor for HIT, as illustrated to the right hand side.

Select the *Calibrator frequency*.

Finally, slide the adjustment button until 94dB \pm 0,5dB is reached on the *Measured* bar.



Figure 18

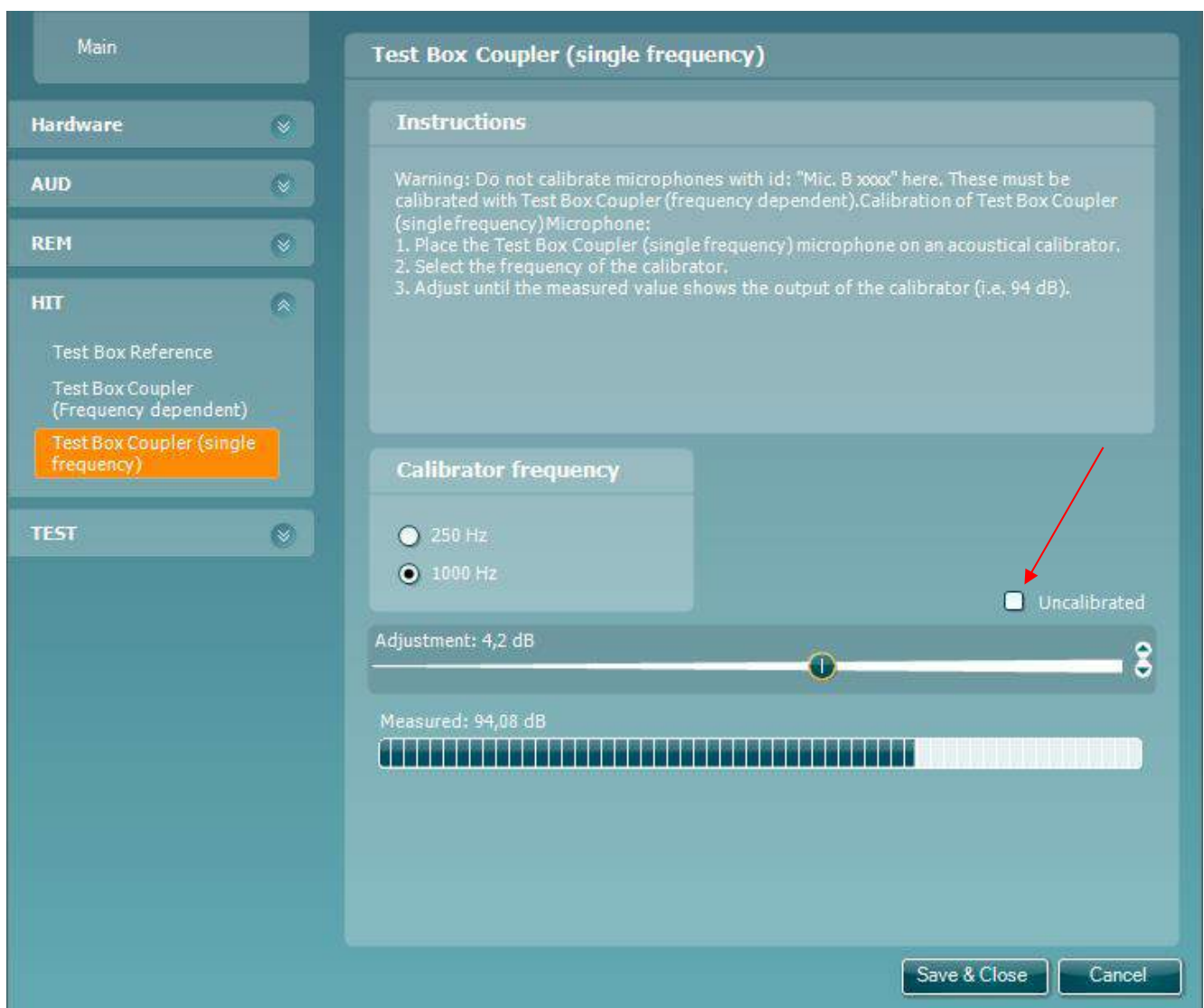


Figure 19

3.7.2 REM440

The REM features are found when folding out the *REM* menu.

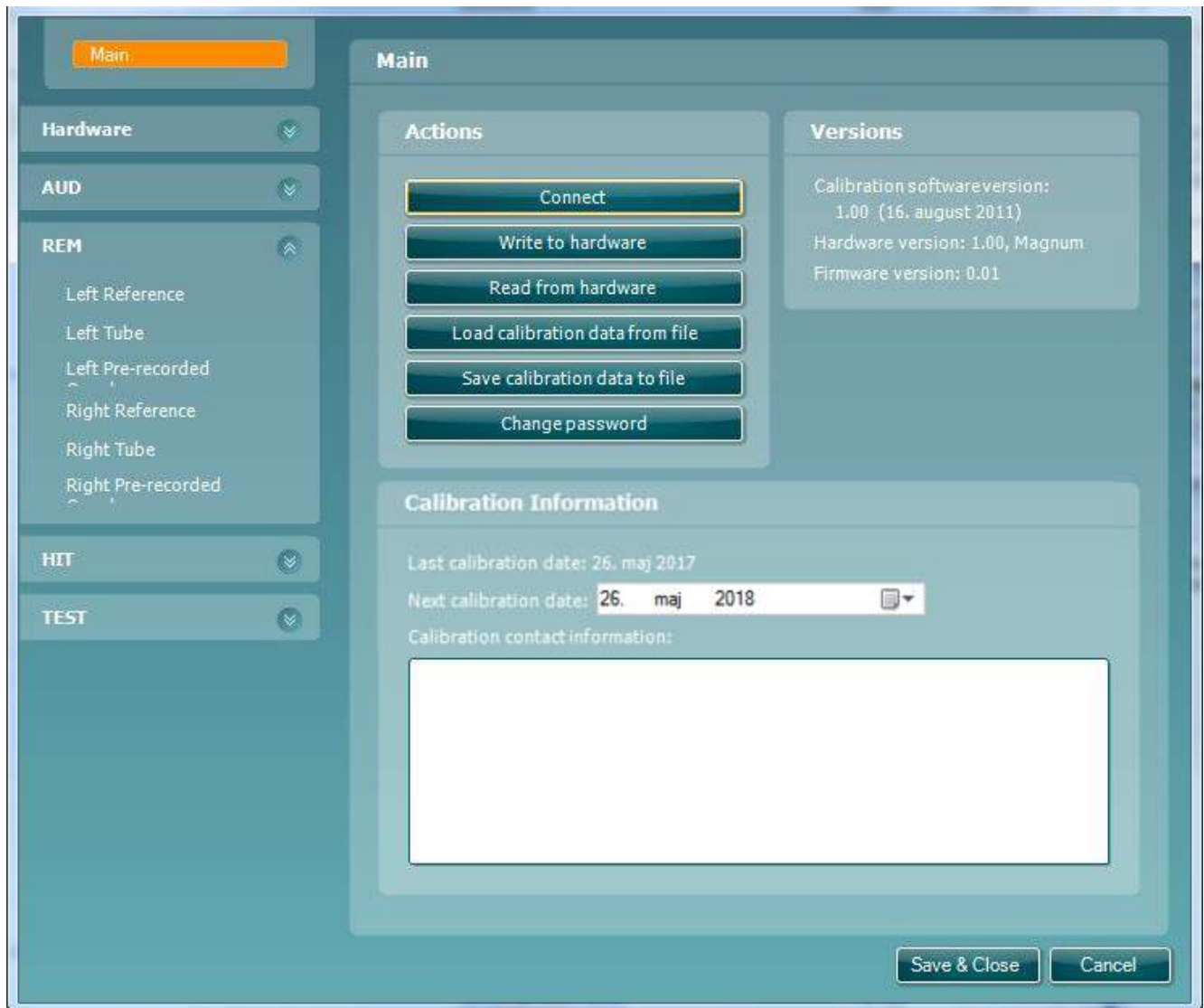


Figure 20

Equipment requirements

- The in-situ reference microphone
- The in-situ measuring microphone
- The SPL probe microphone
- In-situ probe measuring
- SPL probe measuring

3.7.2.1 The in-situ reference microphone

Via the REM menu, select the calibration type.

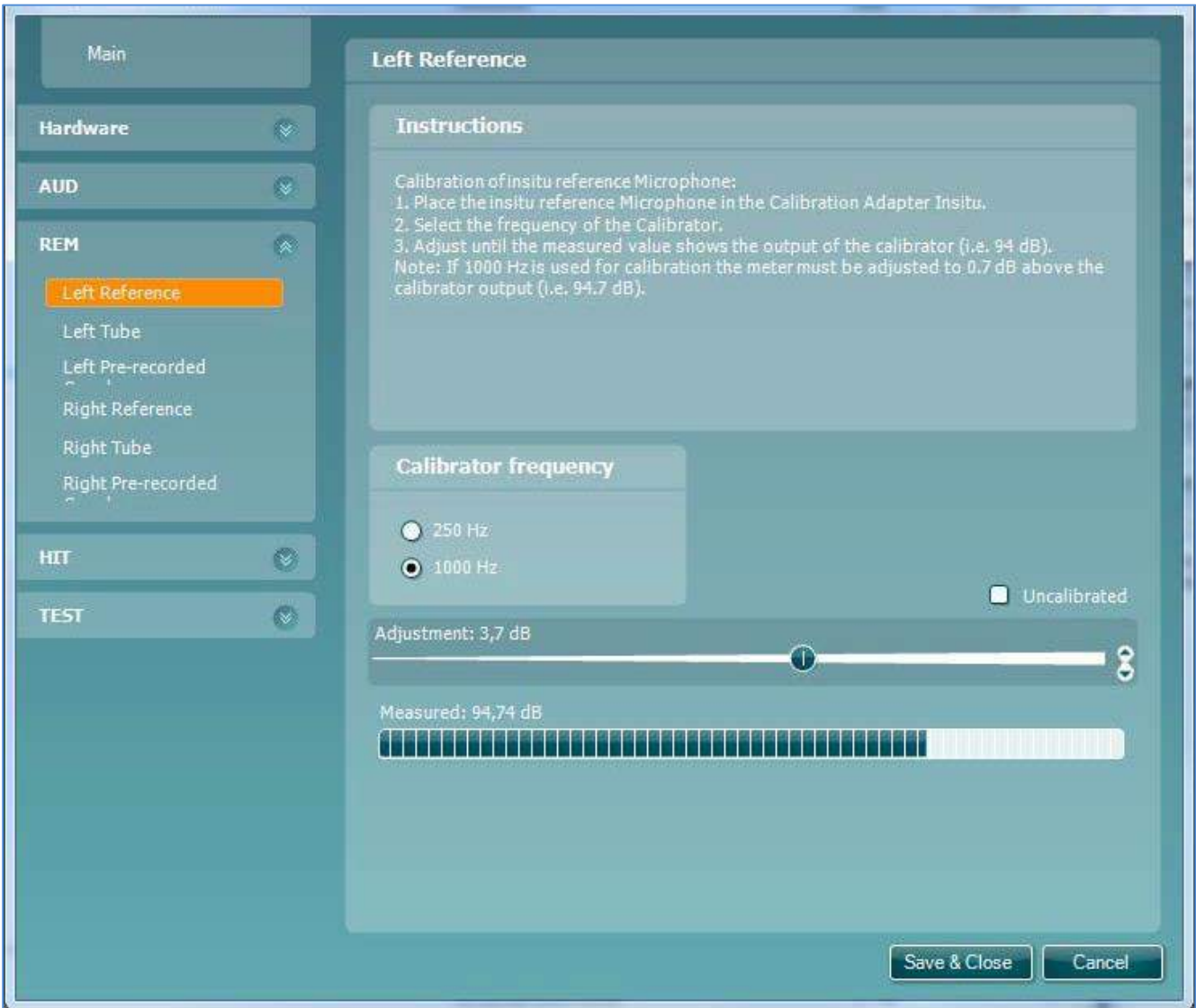


Figure 21



Figure 22

Equipment requirements:

- 94 dB (max.114 dB) calibrator
- Calibration adaptor for HIT
- Calibration adaptor for in-situ reference
- REM calibration adaptor²
- SPL60 probe
- Tube nipple³
- IGT60 probe tubes



Figure 23

² REM calibration adaptor only necessary to calibrate SPL60 probe.

³ Also used on EARTone 3A.

3.7.2.2 The in-situ measuring microphone

Follow the on-screen instructions.

NOTICE *Start Measuring* mentioned under step 3 is in fact the *Start calibration* field.



Figure 24



Figure 25



Figure 26

3.7.2.3 The SPL probe microphone

Follow the on-screen instructions.

NOTICE *Start Measuring* mentioned under step 3 is in fact the *Start calibration* field.

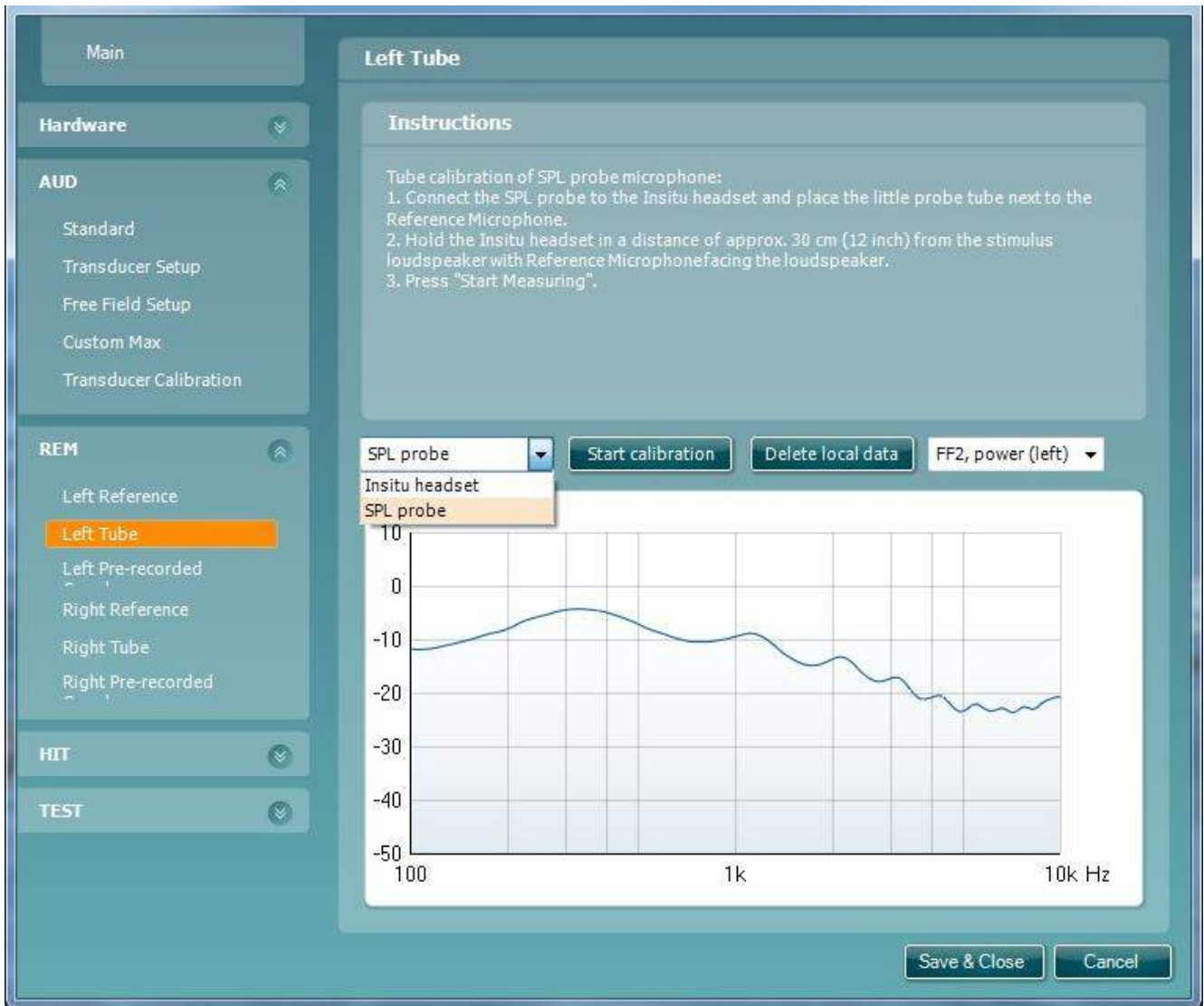


Figure 27



Figure 28



Figure 29



3.7.2.4 In-situ headset pre-measuring of coupler data

Follow the on-screen instructions

NOTICE *Start Measuring* mentioned under step 3 is in fact the *Start calibration* field.

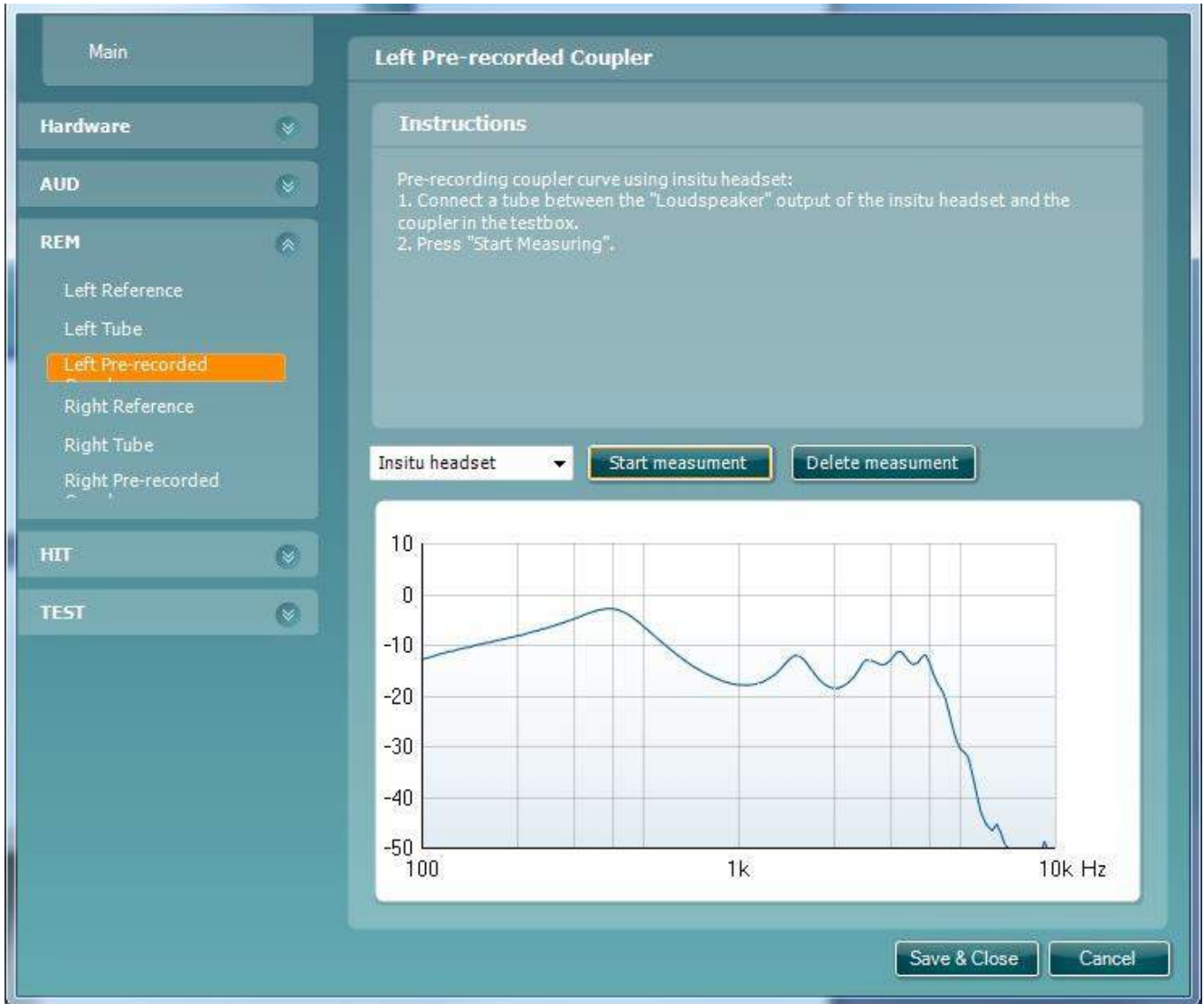


Figure 30



Figure 31

3.7.2.5 SPL probe pre-measuring of coupler data

Follow the on-screen instructions

NOTICE *Start Measuring* mentioned under step 3 is in fact the *Start calibration* field.

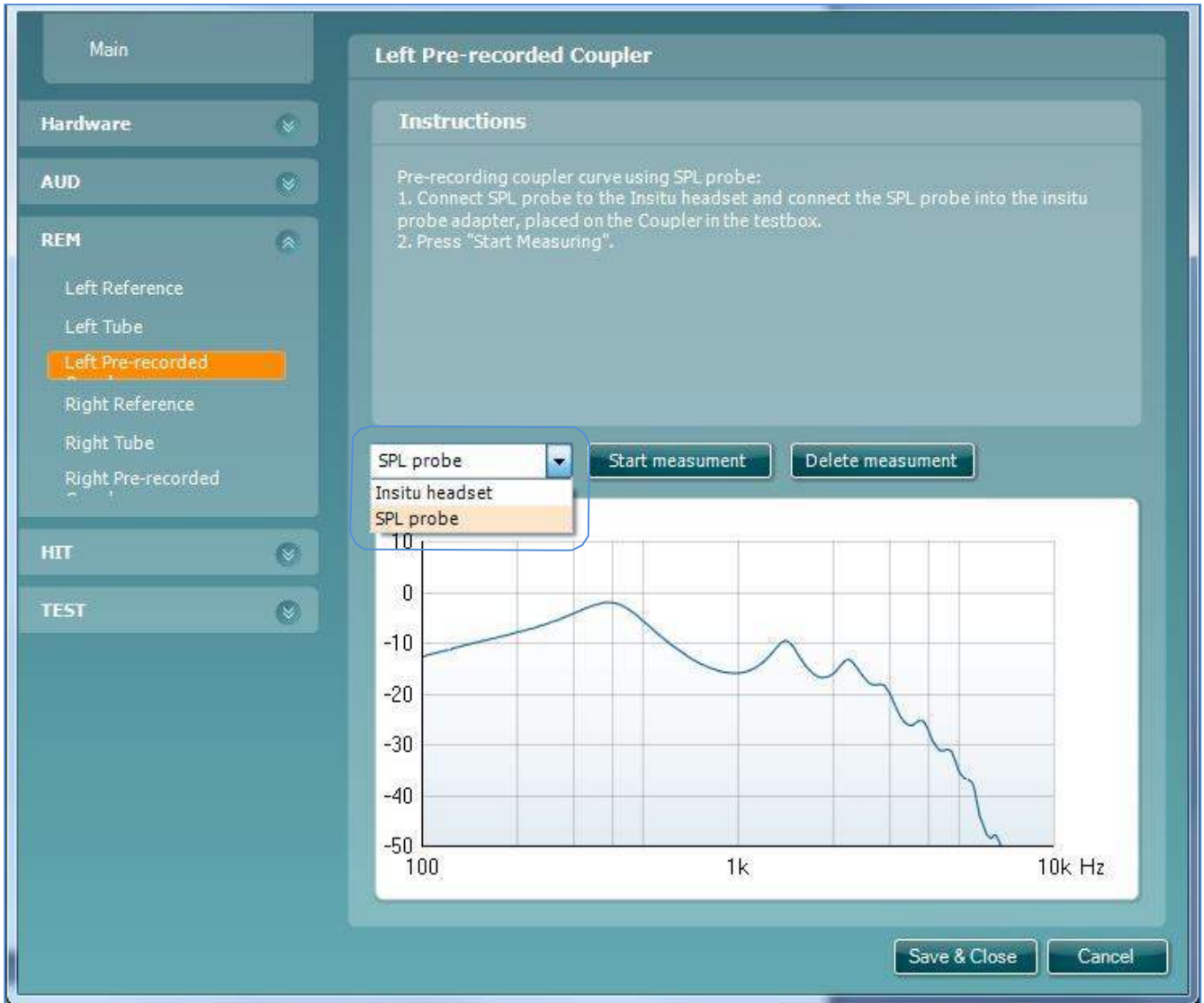


Figure 32

NOTICE *Start Measuring* mentioned under step 3 is in fact the *Start calibration* field.

Follow the on-screen instructions.



Figure 33



Figure 34

NOTICE Repeat the total procedure for all the right in-situ transducers

3.8 Calibration of transducers

This chapter contains calibration standards for Callisto.

3.8.1 Calibration standard for Audiometer

- Tone standard** Selected via AUD and *Standard*. The options are ANSI and IEC, the latter being the most common.
- Calibration method** Selected via AUD and *Calibration method*. The options are SPL mode or HL mode.
- SPL mode** The tab marked *Standard* is set to SPL (sound pressure level) by default, so taking the standard for the chosen transducer into account is not necessary. For correction of a 2cc or 6cc coupler/microphone, it is necessary to add or subtract from the 90dB SPL level which can be read on the sound level meter.
- HL mode** If HL (hearing level) is selected, the calibration can be conducted as on a regular audiometer, where the standard is added to the HL values first, and the corrections for the coupler/microphone subsequently.

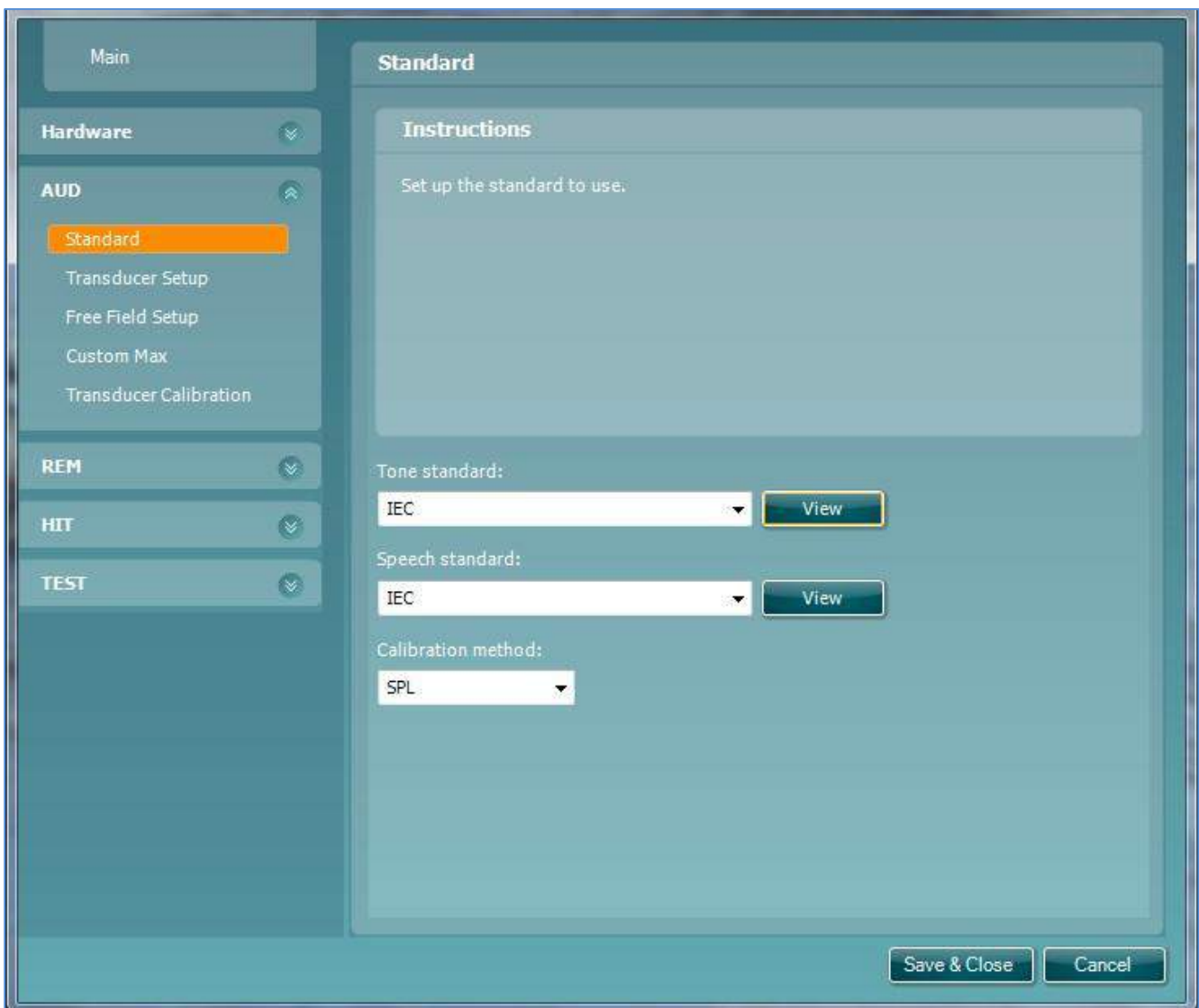


Figure 35

3.8.2 Selecting a transducer / how-to-guide

The following procedure is applicable for all transducer selections. Here, we have exemplified the procedure with the transducer type DD45, which is the standard transducer for this instrument.

Following this section is a list with the specific equipment requirements along with photos of the corresponding equipment setup, for each suitable transducer type. The procedure described below is hence applicable for all the listed transducers.

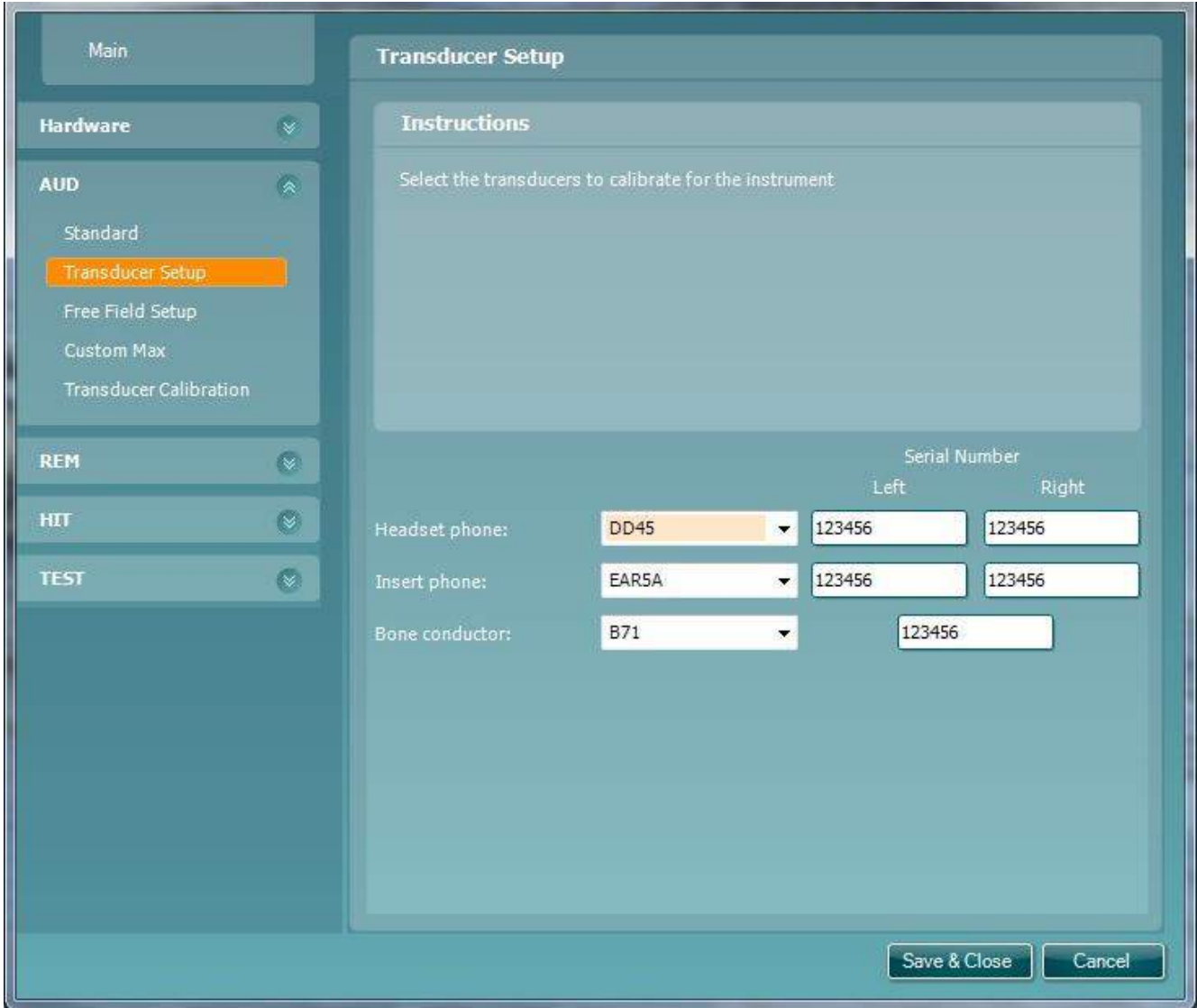


Figure 36

Example:

Select *Transducer Setup*.

Select *Headset phone* as type DD45.

Enter the serial numbers for the left and right phones in the fields *Left* and *Right*, respectively.

3.8.2.1 Calibration exemplified with DD45

From the AUD menu, select *Transducer calibration*.

Follow the on-screen instructions.

Check the frequency accuracy with a frequency counter. The accuracy has to be better than $\pm 1\%$.

Repeat until all stimuli are calibrated, for both left and right transducer.

Save the calibration values via the *Main* menu and writing to hardware as described earlier in this service manual.

Equipment required for DD45 calibration:

- Measuring amplifier
- Acoustical IEC 60318-3 (IEC 303) coupler
- Frequency counter
- Correction values for coupler

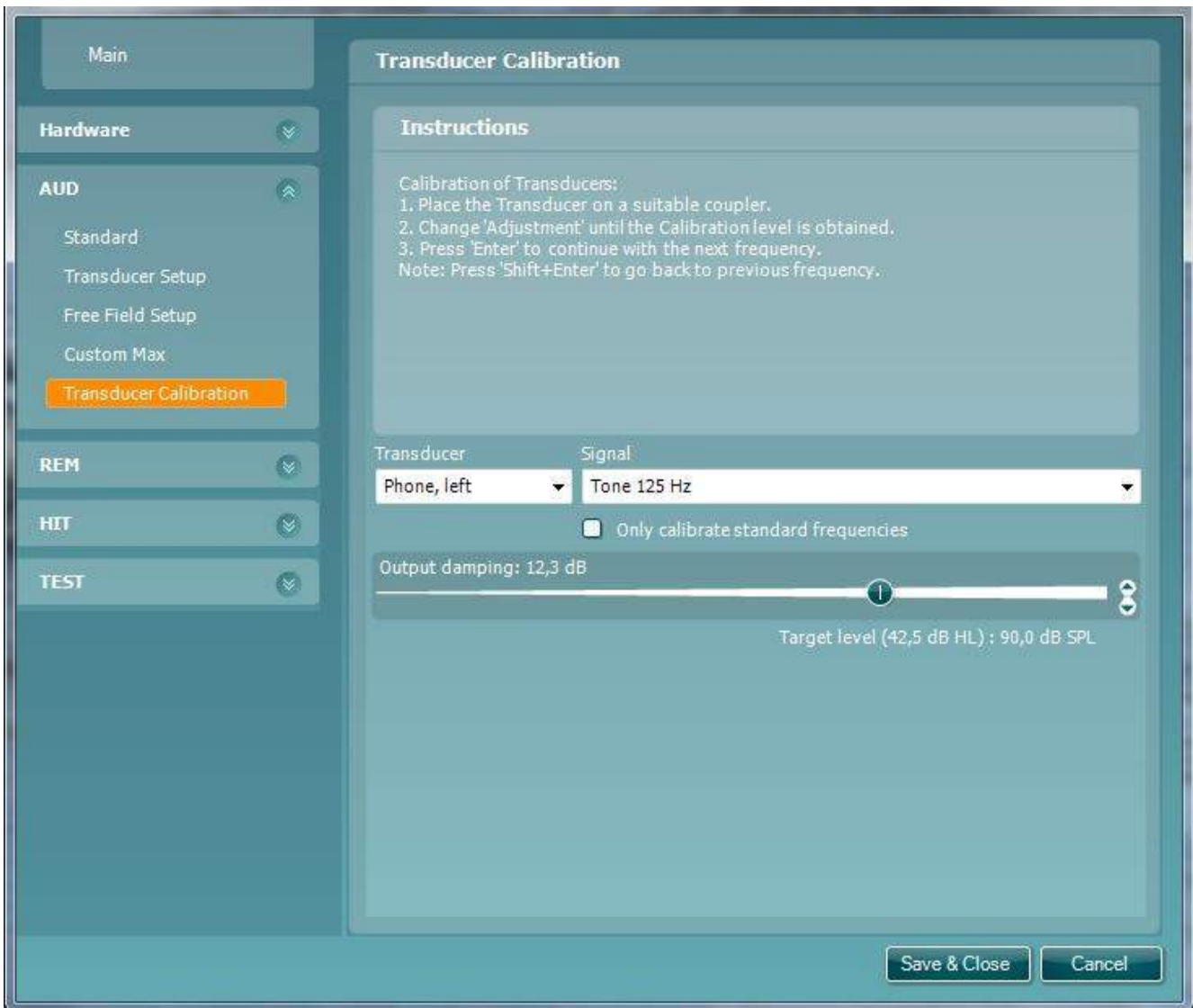


Figure 37

NOTICE Do not forget to add or subtract the correction for your microphone

3.8.3 Transducer types and equipment requirements for calibration

Conduct the same procedure exemplified in [Selecting a transducer / how-to-guide](#) in the previous paragraph. It applies to all the transducers mentioned below.

B71 / B81

- Equipment required for B71 calibration:
- Measuring amplifier
- Artificial mastoid IEC 60318-6
- Frequency counter
- Correction values for mastoid

From the AUD menu, select *Transducer Calibration*.

Place the transducer on the artificial mastoid IEC 60318-6.



Figure 38

TDH39

Equipment required for TDH39 calibration:

- Measuring amplifier
- Acoustical IEC 60318-3 (IEC 303) coupler
- Frequency counter
- Correction values for coupler

From the AUD menu, select *Transducer Calibration*.

Place the transducer on the 6cc IEC 60318-3 (IEC 303) coupler.



Figure 39

IP30

- Equipment required for IP30 calibration:
- Measuring amplifier
- Acoustical IEC 60318-5 (IEC 126) coupler
- Frequency counter
- Correction values for coupler

From the AUD menu, select *Transducer Calibration*.

Place the transducer on the 6cc IEC 60318-3 (IEC 303) coupler.

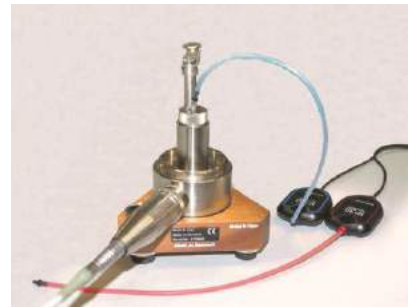


Figure 40

HDA200 / DD450

Equipment required for HDA200 calibration:

- Measuring amplifier
- Acoustical IEC 60318-3 (IEC 303) coupler
- Frequency counter
- Correction values for coupler
- Spacer for HDA200 to coupler IEC 60318-3 (IEC 303)

From the AUD menu, select *Transducer Calibration*.

Place the transducer on the 6cc IEC 60318-3 (IEC 303) coupler.



Figure 41

HDA300

Equipment required for HDA300 calibration:

- Measuring amplifier
- Acoustical IEC 60318-1 coupler
- Frequency counter
- Correction values for coupler
- Calibration adapter for HDA300 to IEC 60318-1 coupler⁴

From the AUD menu, select *Transducer Calibration*.

Place the transducer on the IEC 60318-1 coupler.



Figure 42

E-A-RTone® 3A / E-A-RTone® 5A

Equipment required for E-A-RTONE® 3A / 5A calibration:

- Measuring amplifier
- Acoustical IEC 60318-5 (IEC 126) coupler
- Frequency counter
- Correction values for coupler
- 30° adaptor cable

From the AUD menu, select *Transducer Calibration*.

Place the transducer on the 2cc IEC 60318-5 (IEC 126) coupler.



Figure 43



Figure 44

⁴ Correct placement of the transducer is ensured by using the HDA300 positioning tool mentioned in the spare parts section of this manual.

3.8.4 Free Field

The calibration program is activated by selecting between either the ANSI or IEC standards.

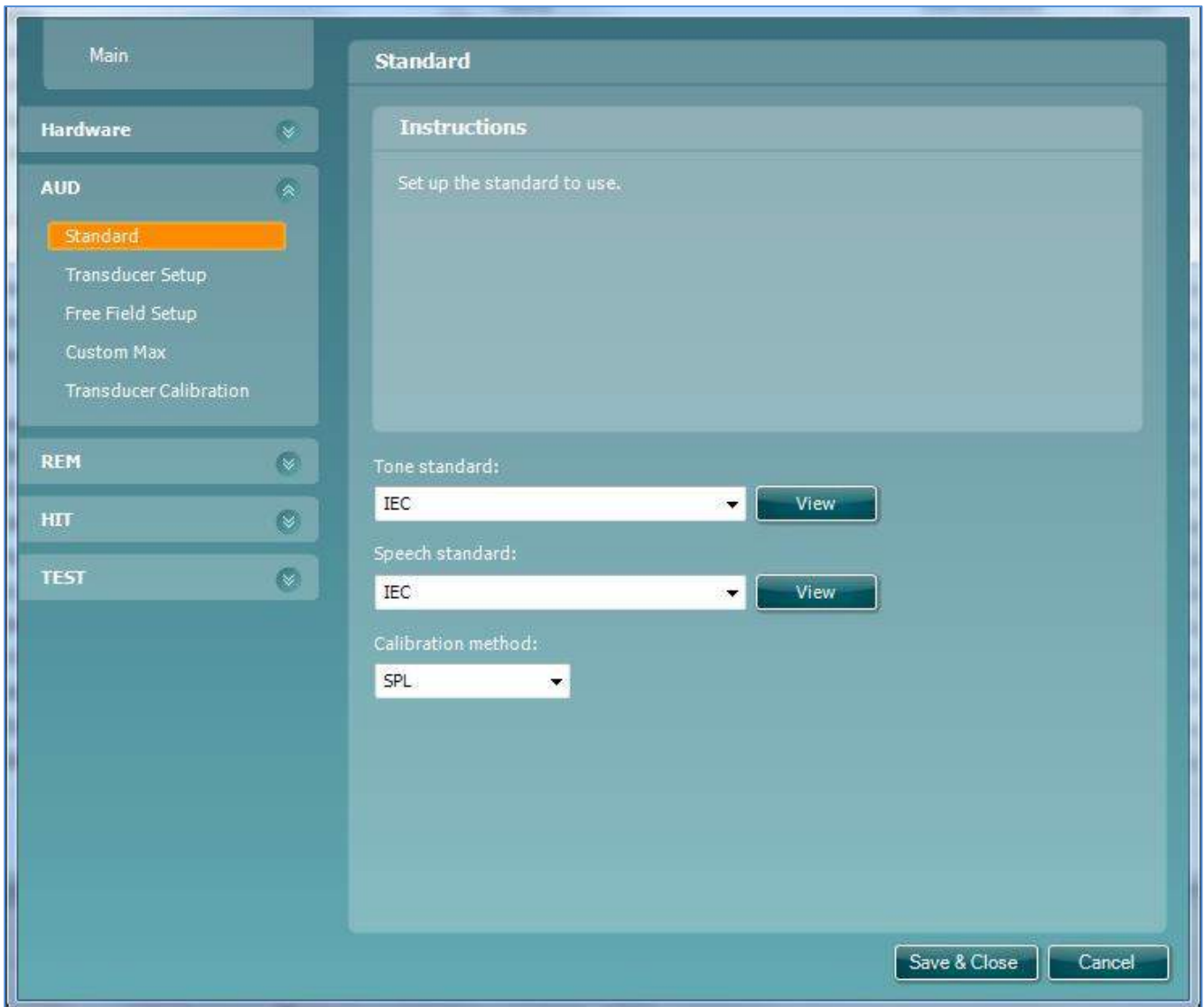


Figure 45

From the AUD menu, select *Free Field Setup*.

Select the appropriate speaker setup.

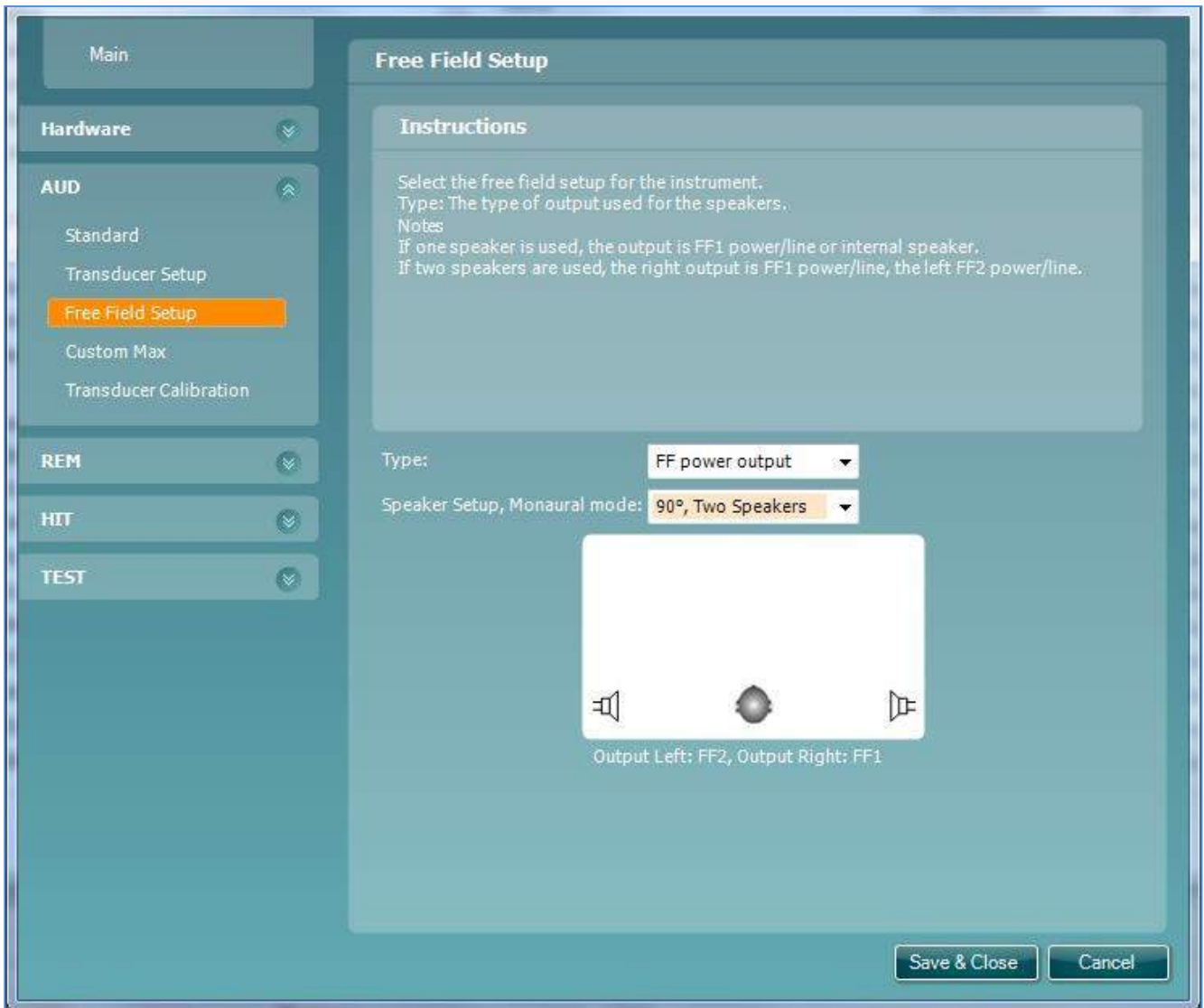


Figure 46

3.8.5 Custom max.

Follow the on-screen instructions.

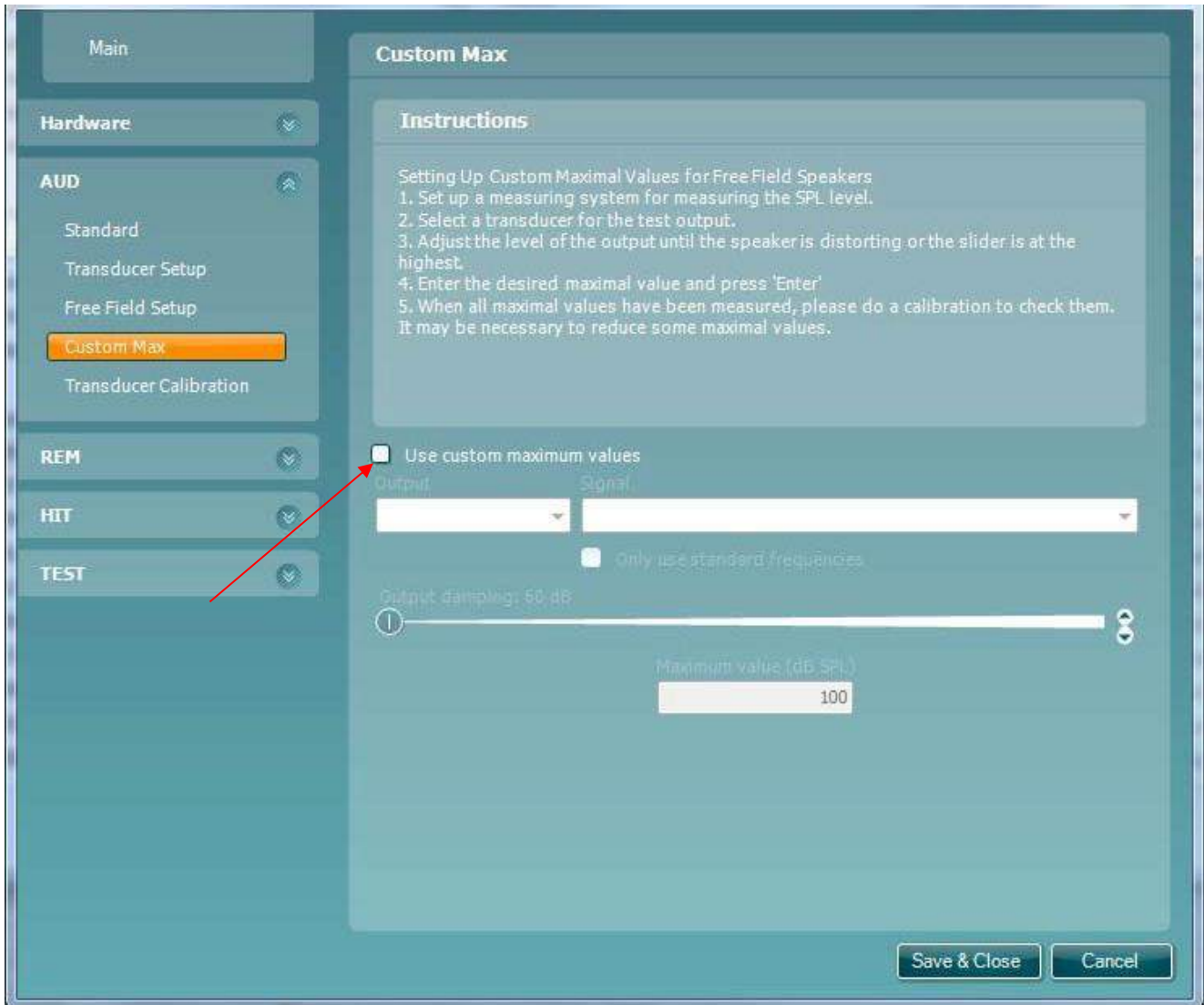


Figure 47

In case the speaker or amplifier setup does not hold sufficient power to stimulate with the predefined maximum output, decreasing the maximum output to fit a given configuration is possible.

When *Custom max.* is not in use, the field *Use custom maximum values* must remain unchecked.

Notices max. output level on the sound level meter. Type in sound level meter values.

Repeat with all frequencies.

B&K 2250 Sound level meter

Select speaker, and then frequency.

Adjust the slider until the speaker is distorting or the slider is at the highest.

Notices max. output level on the sound level meter. Type in sound level meter values.

Repeat with all frequencies.

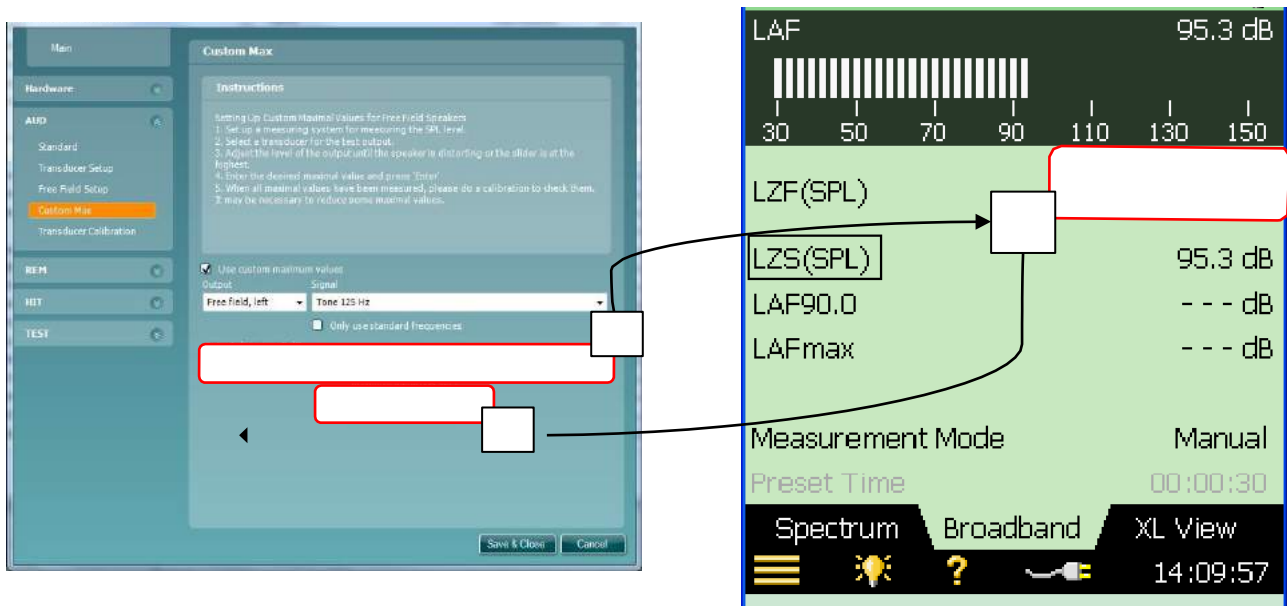


Figure 48

3.8.6 Transducer calibration

Calibrate the left and right speaker.

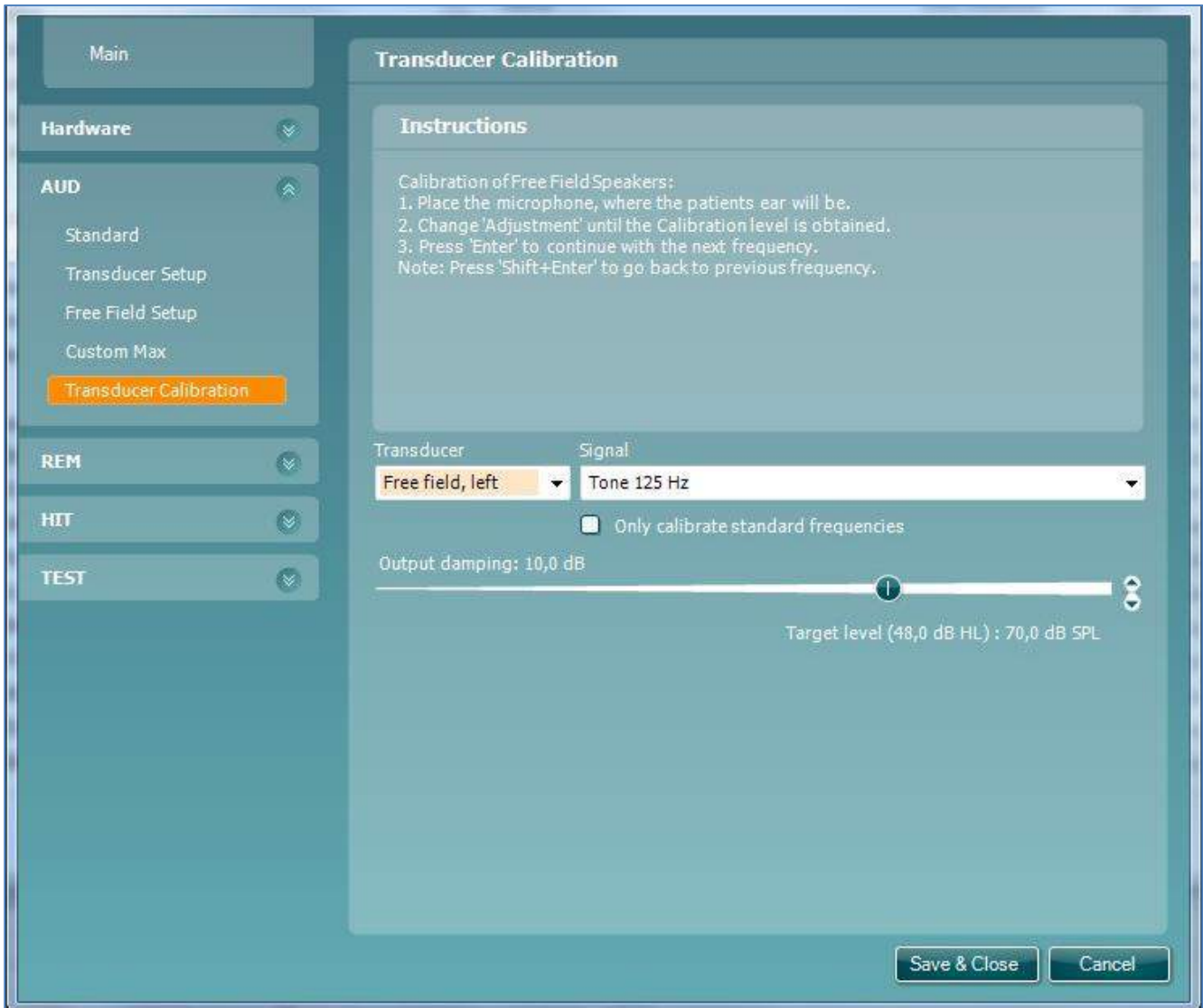


Figure 49

4. Troubleshooting

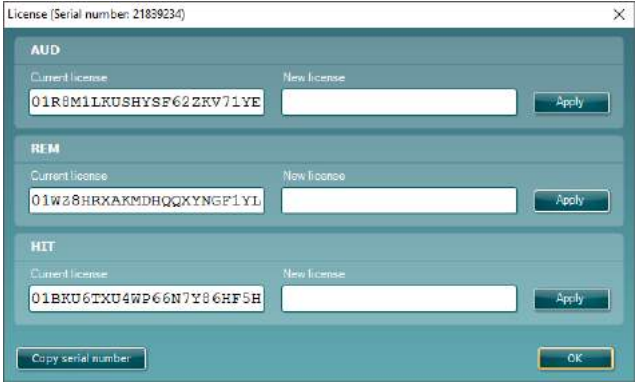
Error Message	What to do
No License	<p>Via <i>Menu / Help</i>, click <i>About</i>.</p> <p><i>License</i>. The dialog shown below pops up. Forward the DSP serial no. to Interacoustics A/S, and a new license key number will be provided.</p>  <p>The screenshot shows a 'License' dialog box with a title bar 'License (Serial number: 21839234)'. It contains three sections: 'AUD', 'REM', and 'HIT'. Each section has a 'Current license' field with a pre-filled key and an empty 'New license' field. Below each section is an 'Apply' button. At the bottom of the dialog are 'Copy serial number' and 'OK' buttons.</p>
Device not connected	<p>Switch off the instrument power.</p> <p>Check for proper USB connection.</p> <p>Switch on instrument power, and verify that the instrument is indeed powered.</p> <p>Use another USB cable.</p>
Hardware error or timeout error	Restart the instrument. If the error continues to appear contact the distributor.
Incompatible operating system or wrong operating system for the application	Windows® 7, 8 and 10
Instrument not calibrated	Contact the distributor for a calibration.
Loudspeaker or reference microphone disconnected	<p>Verify that the reference microphone is connected inside the test box.</p> <p>Check that the stimulus loudspeaker is connected.</p>
File corrupt	A faulty sound file has been selected for stimulus.
The stimulus level is set louder than the dynamic properties of this stimulus allows.	<p>Reduce stimulus level or change stimulus.</p> <p>Follow the instructions.</p>

Figure 50

Appendices

Appendix A - Survey of reference and max hearing level tone audiometer

Pure Tone RETSPL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETFL	RETFL
Tone 125 Hz	47.5	45.0	30.5	27.0	26.0	26.0	26.0		
Tone 160 Hz	40.5	37.5	26.0	24.5	22.0	22.0	22.0		
Tone 200 Hz	33.5	31.5	22.0	22.5	18.0	18.0	18.0		
Tone 250 Hz	27.0	25.5	18.0	20.0	14.0	14.0	14.0	67.0	67.0
Tone 315 Hz	22.5	20.0	15.5	16.0	12.0	12.0	12.0	64.0	64.0
Tone 400 Hz	17.5	15.0	13.5	12.0	9.0	9.0	9.0	61.0	61.0
Tone 500 Hz	13.0	11.5	11.0	8.0	5.5	5.5	5.5	58.0	58.0
Tone 630 Hz	9.0	8.5	8.0	6.0	4.0	4.0	4.0	52.5	52.5
Tone 750 Hz	6.5	8 / 7.5	6.0	4.5	2.0	2.0	2.0	48.5	48.5
Tone 800 Hz	6.5	7.0	6.0	4.0	1.5	1.5	1.5	47.0	47.0
Tone 1000 Hz	6.0	7.0	5.5	2.0	0.0	0.0	0.0	42.5	42.5
Tone 1250 Hz	7.0	6.5	6.0	2.5	2.0	2.0	2.0	39.0	39.0
Tone 1500 Hz	8.0	6.5	5.5	3.0	2.0	2.0	2.0	36.5	36.5
Tone 1600 Hz	8.0	7.0	5.5	2.5	2.0	2.0	2.0	35.5	35.5
Tone 2000 Hz	8.0	9.0	4.5	0.0	3.0	3.0	3.0	31.0	31.0
Tone 2500 Hz	8.0	9.5	3.0	-2.0	5.0	5.0	5.0	29.5	29.5
Tone 3000 Hz	8.0	10.0	2.5	-3.0	3.5	3.5	3.5	30.0	30.0
Tone 3150 Hz	8.0	10.0	4.0	-2.5	4.0	4.0	4.0	31.0	31.0
Tone 4000 Hz	9.0	9.5	9.5	-0.5	5.5	5.5	5.5	35.5	35.5
Tone 5000 Hz	13.0	13.0	14.0	10.5	5.0	5.0	5.0	40.0	40.0
Tone 6000 Hz	20.5	15.5	17.0	21.0	2.0	2.0	2.0	40.0	40.0
Tone 6300 Hz	19.0	15.0	17.5	21.5	2.0	2.0	2.0	40.0	40.0
Tone 8000 Hz	12.0	13.0	17.5	23.0	0.0	0.0	0.0	40.0	40.0
Tone 9000 Hz			19.0	27.5					
Tone 10000 Hz			22.0	18.0					
Tone 11200 Hz			23.0	22.0					
Tone 12500 Hz			27.5	27.0					
Tone 14000 Hz			35.0	33.5					
Tone 16000 Hz			56.0	45.5					

Table 1

DD45 6ccm uses IEC60318-3 or NBS 9A coupler and RETSPL comes from PTB – DTU report 2009-2010. Force 4.5N ±0.5N

DD45 Artificial ear uses IEC60318-1 coupler and RETSPL comes from ANSI S3.6 2010 and ISO 389-1 1998. Force 4.5N ±0.5N

TDH50 6ccm uses IEC60318-3 or NBS 9A coupler and RETSPL comes from ANSI S3.6 2010. Force 4.5N ±0.5N

TDH50 Artificial ear uses IEC60318-1 coupler and RETSPL comes from ANSI S3.6 2010 and ISO 389-1 1998 Force 4.5N ±0.5N

HDA200 Artificial ear uses IEC60318-1 coupler with type 1 adaptor and RETSPL comes from ANSI S3.6 2010 and ISO 389-8 2004. Force 9N ±0.5N

HDA300 Artificial ear uses IEC60318-1 coupler with type 1 adaptor and RETSPL comes from PTB report 2012. Force 8.8N ±0.5N

IP30 / EAR3A 2ccm uses ANSI S3.7-1995 IEC60318-5 coupler (HA-2 with 5mm rigid Tube) and RETSPL comes from ANSI S3.6 2010 and ISO 389-2 1994

IP30 / EAR3A Ear simulator uses ANSI S3.25- IEC60318-4 coupler and RETSPL comes from ANSI S3.6 2010 and ISO 389-2 1994

B71 / B81 uses ANSI S3.13 or IEC60318-6 2007 mechanical coupler and RETFL come from ANSI S3.6 2010 and ISO 389-3 1994. Force 5.4N ±0.5N

Pure Tone max HL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
Signal	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL
Tone 125 Hz	85	85	95	110.0	90.0	90.0	95		
Tone 160 Hz	90	90	100	110	95	95	95		
Tone 200 Hz	95	100	105	115	100	100	100		
Tone 250 Hz	105	105	105	115	105	105	100	45	50
Tone 315 Hz	110	110	110	120	105	105	105	50	60
Tone 400 Hz	115	115	110	120	110	110	105	65	70
Tone 500 Hz	120	120	115	120	110	110	110	65	70
Tone 630 Hz	120	120	115	120	115	115	115	70	75
Tone 750 Hz	120	120	115	120	115	115	120	70	75
Tone 800 Hz	120	120	115	120	115	115	120	70	75
Tone 1000 Hz	120	120	115	120	120	120	120	70	85
Tone 1250 Hz	120	120	110	120	120	120	120	70	90
Tone 1500 Hz	120	120	110	120	120	120	120	70	90
Tone 1600 Hz	120	120	110	120	120	120	120	70	90
Tone 2000 Hz	120	120	110	120	120	120	120	75	90
Tone 2500 Hz	120	120	115	120	120	120	120	80	85
Tone 3000 Hz	120	120	115	120	120	120	120	80	85
Tone 3150 Hz	120	120	110	120	120	120	120	80	85
Tone 4000 Hz	120	120	110	120	115	115	120	80	85
Tone 5000 Hz	120	115	105	115	105	105	110	60	70
Tone 6000 Hz	110	120	100	105	100	100	105	50	60
Tone 6300 Hz	110	115	100	105	100	100	105	50	55
Tone 8000 Hz	105	105	100	105	90	90	100	50	50
Tone 9000 Hz			95	95					
Tone 10000 Hz			90	100					
Tone 11200 Hz			90	100					
Tone 12500 Hz			85	95					
Tone 14000 Hz			75	80					
Tone 16000 Hz			55	65					

Table 2

NB noise effective masking level									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	EM	EM	EM	EM	EM	EM	EM	EM	EM
NB 125 Hz	51.5	49.0	34.5	31.0	30.0	30.0	30.0		
NB 160 Hz	44.5	41.5	30.0	28.5	26.0	26.0	26.0		
NB 200 Hz	37.5	35.5	26.0	26.5	22.0	22.0	22.0		
NB 250 Hz	31.0	29.5	22.0	24.0	18.0	18.0	18.0	71.0	71.0
NB 315 Hz	26.5	24.0	19.5	20.0	16.0	16.0	16.0	68.0	68.0
NB 400 Hz	21.5	19.0	17.5	16.0	13.0	13.0	13.0	65.0	65.0
NB 500 Hz	17.0	15.5	15.0	12.0	9.5	9.5	9.5	62.0	62.0
NB 630 Hz	14.0	13.5	13.0	11.0	9.0	9.0	9.0	57.5	57.5
NB 750 Hz	11.5	12.5	11.0	9.5	7.0	7.0	7.0	53.5	53.5
NB 800 Hz	11.5	12.0	11.0	9.0	6.5	6.5	6.5	52.0	52.0
NB 1000 Hz	12.0	13.0	11.5	8.0	6.0	6.0	6.0	48.5	48.5
NB 1250 Hz	13.0	12.5	12.0	8.5	8.0	8.0	8.0	45.0	45.0
NB 1500 Hz	14.0	12.5	11.5	9.0	8.0	8.0	8.0	42.5	42.5
NB 1600 Hz	14.0	13.0	11.5	8.5	8.0	8.0	8.0	41.5	41.5
NB 2000 Hz	14.0	15.0	10.5	6.0	9.0	9.0	9.0	37.0	37.0
NB 2500 Hz	14.0	15.5	9.0	4.0	11.0	11.0	11.0	35.5	35.5
NB 3000 Hz	14.0	16.0	8.5	3.0	9.5	9.5	9.5	36.0	36.0
NB 3150 Hz	14.0	16.0	10.0	3.5	10.0	10.0	10.0	37.0	37.0
NB 4000 Hz	14.0	14.5	14.5	4.5	10.5	10.5	10.5	40.5	40.5
NB 5000 Hz	18.0	18.0	19.0	15.5	10.0	10.0	10.0	45.0	45.0
NB 6000 Hz	25.5	20.5	22.0	26.0	7.0	7.0	7.0	45.0	45.0
NB 6300 Hz	24.0	20.0	22.5	26.5	7.0	7.0	7.0	45.0	45.0
NB 8000 Hz	17.0	18.0	22.5	28.0	5.0	5.0	5.0	45.0	45.0
NB 9000 Hz			24.0	32.5					
NB 10000 Hz			27.0	23.0					
NB 11200 Hz			28.0	27.0					
NB 12500 Hz			32.5	32.0					
NB 14000 Hz			40.0	38.5					
NB 16000 Hz			61.0	50.5					
White noise	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.5	42.5
TEN noise	25.0	25.0			16.0	16.0			

Table 3
Effective masking value is RETSPL / RETFL add 1/3 octave correction for Narrow-band noise from ANSI S3.6 2010 or ISO389-4 1994.

NB noise max HL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL
NB 125 Hz	65	70	70	75.0	85.0	85.0	80		
NB 160 Hz	70	80	75	75	90	90	85		
NB 200 Hz	80	85	80	80	95	95	90		
NB 250 Hz	85	90	85	80	100	100	95	35	40
NB 315 Hz	90	95	85	85	100	100	95	40	50
NB 400 Hz	95	100	85	90	100	100	100	55	60
NB 500 Hz	100	105	90	90	105	105	105	55	60
NB 630 Hz	105	105	90	95	105	105	105	60	65
NB 750 Hz	105	105	95	95	110	110	110	60	65
NB 800 Hz	105	105	95	95	110	110	110	60	65
NB 1000 Hz	105	105	95	95	110	110	110	60	70
NB 1250 Hz	105	105	95	95	110	110	110	60	75
NB 1500 Hz	105	105	95	95	110	110	110	60	75
NB 1600 Hz	105	105	95	95	110	110	110	60	75
NB 2000 Hz	105	105	95	100	110	110	105	65	70
NB 2500 Hz	105	105	95	105	110	110	105	65	65
NB 3000 Hz	105	105	95	105	110	110	105	65	65
NB 3150 Hz	105	105	95	105	110	110	105	65	65
NB 4000 Hz	105	105	95	105	105	105	105	65	60
NB 5000 Hz	105	100	90	100	100	100	100	50	55
NB 6000 Hz	95	100	85	90	95	95	100	45	50
NB 6300 Hz	95	100	85	90	95	95	100	40	45
NB 8000 Hz	95	95	85	90	90	90	95	40	40
NB 9000 Hz			80	80					
NB 10000 Hz			75	90					
NB 11200 Hz			75	85					
NB 12500 Hz			70	75					
NB 14000 Hz			65	70					
NB 16000 Hz			45	55					
White noise	120	120	110	110	110	110	110	65	
TEN noise	110	100			100	100			

Table 4

ANSI Speech RETSPL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETFL	RETFL
Speech	18.5	19.5	19.0	14.5					
Speech Equ.FF.	18.5	15.5	18.5	16.0					
Speech Non-linear	6.0	7.0	5.5	2.0	12.5	12.5	12.5	55.0	55.0
Speech noise	18.5	19.5	19.0	14.5					
Speech noise Equ.FF.	18.5	15.5	18.5	16.0					
Speech noise Non-linear	6.0	7.0	5.5	2.0	12.5	12.5	12.5	55.0	55.0
White noise in speech	21.0	22.0	21.5	17.0	15.0	15.0	15.0	57.5	57.5

Table 5

DD45 (G_F-G_C) PTB-DTU report 2009-2010.

TDH39 (G_F-G_C) ANSI S3.6 2010.

HDA200 (G_F-G_C) ANSI S3.6 2010 and ISO 389-8 2004.

HDA300 (G_F-G_C) PTB report 2013.

ANSI Speech level 12.5 dB + 1 kHz RETSPL ANSI S3.6 2010 (acoustical linear weighting)

ANSI Speech Equivalent free field level 12.5 dB + 1 kHz RETSPL – (G_F-G_C) from ANSI S3.6 2010(acoustical equivalent sensitivity weighting)

ANSI Speech Not linear level 1 kHz RETSPL ANSI S3.6 2010 (DD45-TDH39-HDA200-HDA300) and EAR 3A - EAR5A – IP30-B71-B81 12.5 dB + 1 kHz RETSPL ANSI S3.6 2010 (no weighting)

ANSI Speech max HL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL
Speech	100	100	85	95					
Speech Equ.FF.	95	95	80	90					
Speech Non-linear	115	110	105	115	105	105	110	60	60
Speech noise	95	95	80	90					
Speech noise Equ.FF.	90	95	75	90					
Speech noise Non-linear	110	105	100	115	100	100	100	50	50
White noise in speech	95	95	85	95	95	95	95	55	60

Table 6

IEC Speech RETSPL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETFL	RETFL
Speech	20.0	20.0	20.0	20.0					
Speech Equ.FF.	3.5	0.5	3.5	1.0					
Speech Non-linear	6.0	7.0	5.5	2.0	20.0	20.0	20.0	55.0	55.0
Speech noise	20.0	20.0	20.0	20.0					
Speech noise Equ.FF.	3.5	0.5	3.5	1.0					
Speech noise Non-linear	6.0	7.0	5.5	2.0	20.0	20.0	20.0	55.0	55.0
White noise in speech	22.5	22.5	22.5	22.5	22.5	22.5	22.5	57.5	57.5

Table 7

DD45 (G_F-G_C) PTB-DTU report 2009-2010.

TDH39 (G_F-G_C) IEC60645-2 1997

HDA200 (G_F-G_C) ANSI S3.6 2010 and ISO 389-8 2004.

HDA300 (G_F-G_C) PTB report 2013.

IEC Speech level IEC60645-2 1997 (acoustical linear weighting)

IEC Speech Equivalent free field level (G_F-G_C) from IEC60645-2 1997 (acoustical equivalent sensitivity weighting)

IEC Speech Not linear level 1 kHz RETSPL (DD45- TDH39-HDA200-HDA300) and EAR 3A – EAR5A – IP30 - B71 - B81 IEC60645-2 1997 (no weighting)

IEC Speech max HL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL
Speech	100	100	85	90					
Speech Equ.FF.	110	110	95	105					
Speech Non-linear	115	110	105	115	95	95	100	60	60
Speech noise	95	95	80	85					
Speech noise Equ.FF.	105	110	90	105					
Speech noise Non-linear	110	105	100	115	90	90	90	50	50
White noise in speech	95	95	85	90	85	85	85	55	60

Table 8

Sweden Speech RETSPL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETFL	RETFL
Speech	22.0	22.0	20.0	20.0					
Speech Equ.FF.	3.5	0.5	3.5	1.0					
Speech Non-linear	22.0	22.0	5.5	2.0	21.0	21.0	21.0	55.0	55.0
Speech noise	27.0	27.0	20.0	20.0					
Speech noise Equ.FF.	3.5	0.5	3.5	1.0					
Speech noise Non-linear	27.0	27.0	5.5	2.0	26.0	26.0	26.0	55.0	55.0
White noise in speech	22.5	22.5	22.5	22.5	22.5	22.5	22.5	57.5	57.5

Table 9

DD45 (G_F-G_C) PTB-DTU report 2009-2010.

TDH39 (G_F-G_C) IEC60645-2 1997.

HDA200 (G_F-G_C) ANSI S3.6 2010 and ISO 389-8 2004.

HDA300 (G_F-G_C) PTB report 2013.

Sweden Speech level STAF 1996 and IEC60645-2 1997 (acoustical linear weighting)

Sweden Speech Equivalent free field level (G_F-G_C) from IEC60645-2 1997 (acoustical equivalent sensitivity weighting)

Sweden Speech Not linear level 1 kHz RETSPL (DD45-TDH39-HDA200-HDA300) and EAR 3A – EAR5A – IP30 – B71- B81 STAF 1996 and IEC60645-2 1997 (no weighting)

Sweden Speech max HL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL
Speech	98	98	85	90					
Speech Equ.FF.	110	110	95	105					
Speech Non-linear	99	95	105	115	94	94	99	60	60
Speech noise	88	88	80	85					
Speech noise Equ.FF.	105	110	90	105					
Speech noise Non-linear	89	85	100	115	84	84	84	50	50
White noise in speech	95	95	85	90	85	85	85	55	60

Table 10

Norway Speech RETSPL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL	RETFL	RETFL
Speech	40.0	40.0	40.0	40.0					
Speech Equ.FF.	3.5	0.5	3.5	1.0					
Speech Non-linear	6.0	7.0	5.5	2.0	40.0	40.0	40.0	75.0	75.0
Speech noise	40.0	40.0	40.0	40.0					
Speech noise Equ.FF.	3.5	0.5	3.5	1.0					
Speech noise Non-linear	6.0	7.0	5.5	2.0	40.0	40.0	40.0	75.0	75.0
White noise in speech	22.5	22.5	22.5	22.5	22.5	22.5	22.5	57.5	57.5

Table 11

DD45 (G_F-G_C) PTB-DTU report 2009-2010.

TDH39 (G_F-G_C) IEC60645-2 1997.

HDA200 (G_F-G_C) ANSI S3.6 2010 and ISO 389-8 2004.

HDA300 (G_F-G_C) PTB report 2013.

Norway Speech level IEC60645-2 1997+20dB (acoustical linear weighting)

Norway Speech Equivalent free field level (G_F-G_C) from IEC60645-2 1997 (acoustical equivalent sensitivity weighting)

Norway Speech Not linear level 1 kHz RETSPL (DD45-TDH39-HDA200-HDA300) and EAR 3A – EAR5A – IP30 – B71- B81 IEC60645-2 1997 +20dB (no weighting)

Norway Speech max HL									
Transducer	DD45	TDH39	HDA200	HDA300	EAR3A	IP30	EAR5A	B71	B81
Impedance	10 Ω	10 Ω	40 Ω	23 Ω	10 Ω	10 Ω	10 Ω	10 Ω	12.5 Ω
Coupler	6ccm	6ccm	Artificial ear	Artificial ear	2ccm	2ccm	2ccm	Mastoid	Mastoid
	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL	Max HL
Speech	80	80	65	70					
Speech Equ.FF.	110	110	95	105					
Speech Non-linear	115	110	105	115	75	75	80	40	40
Speech noise	75	75	60	65					
Speech noise Equ.FF.	105	110	90	105					
Speech noise Non-linear	110	105	100	115	70	70	70	30	30
White noise in speech	95	95	85	90	85	85	85	55	60

Table 12

Free Field						
ANSI S3.6-2010					Free Field max SPL	
ISO 389-7 2005					Free Field max HL is found by subtracting the selected RETSPL value	
Frequency	Binaural			Binaural to Monaural	Free Field Power	
	0°	45°	90°	correction	Tone	NB
Hz	RETSPL dB	RETSPL dB	RETSPL dB	RETSPL dB	Max SPL dB	Max SPL dB
125	22	21.5	21	2	97	82
160	18	17	16.5	2	93	83
200	14.5	13.5	13	2	94	84
250	11.5	10.5	9.5	2	96	86
315	8.5	7	6	2	93	83
400	6	3.5	2.5	2	96	86
500	4.5	1.5	0	2	94	84
630	3	-0.5	-2	2	93	83
750	2.5	-1	-2.5	2	92	82
800	2	-1.5	-3	2	92	87
1000	2.5	-1.5	-3	2	92	82
1250	3.5	-0.5	-2.5	2	93	83
1500	2.5	-1	-2.5	2	92	82
1600	1.5	-2	-3	2	96	86
2000	-1.5	-4.5	-3.5	2	93	83
2500	-4	-7.5	-6	2	91	81
3000	-6	-11	-8.5	2	94	84
3150	-6	-11	-8	2	94	84
4000	-5.5	-9.5	-5	2	94	84
5000	-1.5	-7.5	-5.5	2	93	83
6000	4.5	-3	-5	2	94	84
6300	6	-1.5	-4	2	96	86
8000	12.5	7	4	2	87	72
WhiteNoise	0	-4	-5.5	2		90

Table 13

ANSI Free Field					
ANSI S3.6-2010					Free Field max SPL
					Free Field max HL is found by subtracting the selected RETSPL value
	Binaural			Binaural to Monaural	Free Field Power
	0°	45°	90°	correction	0° - 45° - 90°
	RETSPL	RETSPL	RETSPL	RETSPL	Max SPL
Speech	15	11	9.5	2	90
Speech Noise	15	11	9.5	2	85
Speech WN	17.5	13.5	12	2	87

Table 14

IEC Free Field					
ISO 389-7 2005					Free Field max SPL
					Free Field max HL is found by subtracting the selected RETSPL value
	Binaural			Binaural to Monaural	Free Field Power
	0°	45°	90°	correction	0° - 45° - 90°
	RETSPL	RETSPL	RETSPL	RETSPL	Max SPL
Speech	0	-4	-5.5	2	90
Speech Noise	0	-4	-5.5	2	85
Speech WN	2.5	-1.5	-3	2	87

Table 15

Sweden Free Field					
ISO 389-7 2005					Free Field max SPL
					Free Field max HL is found by subtracting the selected RETSPL value
	Binaural			Binaural to Monaural	Free Field Power
	0°	45°	90°	correction	0° - 45° - 90°
	RETSPL	RETSPL	RETSPL	RETSPL	Max SPL
Speech	0	-4	-5.5	2	90
Speech Noise	0	-4	-5.5	2	85
Speech WN	2.5	-1.5	-3	2	87

Table 16

Norway Free Field					
ISO 389-7 2005					Free Field max SPL
					Free Field max HL is found by subtracting the selected RETSPL value
	Binaural			Binaural to Monaural	Free Field Power
	0°	45°	90°	correction	0° - 45° - 90°
	RETSPL	RETSPL	RETSPL	RETSPL	Max SPL
Speech	0	-4	-5.5	2	90
Speech Noise	0	-4	-5.5	2	85
Speech WN	2.5	-1.5	-3	2	87

Table 17

Equivalent Free Field				
Speech Audiometer				
	TDH39	DD45	HDA200	HDA300
	IEC60645-2 1997 ANSI S3.6- 2010	PTB – DTU 2010	ISO389-8 2004	PTB 2013
Coupler	IEC60318-3	IEC60318-3	IEC60318-1	IEC60318-1
Frequency	G _F -G _c	G _F -G _c	G _F -G _c	G _F -G _c
125	-17,5	-21.5	-5,0	-12,0
160	-14,5	-17.5	-4,5	-11.5
200	-12,0	-14.5	-4,5	-11.5
250	-9,5	-12.0	-4,5	-11.5
315	-6,5	-9.5	-5,0	-11.0
400	-3,5	-7.0	-5,5	-10.0
500	-5,0	-7.0	-2,5	-7.5
630	0,0	-6.5	-2,5	-5.0
750				
800	-0,5	-4.0	-3,0	-3.0
1000	-0,5	-3.5	-3,5	-1.0
1250	-1,0	-3.5	-2,0	0.0
1500				
1600	-4,0	-7.0	-5,5	-0.5
2000	-6,0	-7.0	-5,0	-2.0
2500	-7,0	-9.5	-6,0	-3.0
3000				
3150	-10,5	-12.0	-7,0	-6.0
4000	-10,5	-8.0	-13,0	-4.5
5000	-11,0	-8.5	-14,5	-10.5
6000				
6300	-10,5	-9.0	-11,0	-7.0
8000	+1,5	-1.5	-8,5	-10.0

Table 18

Sound attenuation values for earphones				
Frequency [Hz]	Attenuation			
	TDH39/DD45 with MX41/AR or PN 51 Cushion [dB]*	EAR 3A IP30 EAR 5A [dB]*	HDA200 [dB]*	HDA300 [dB]
125	3	33	15	12.5
160	4	34	15	
200	5	35	16	
250	5	36	16	12.7
315	5	37	18	
400	6	37	20	
500	7	38	23	9.4
630	9	37	25	
750	-			
800	11	37	27	
1000	15	37	29	12.8
1250	18	35	30	
1500	-			
1600	21	34	31	
2000	26	33	32	15.1
2500	28	35	37	
3000	-			
3150	31	37	41	
4000	32	40	46	28.8
5000	29	41	45	
6000	-			
6300	26	42	45	
8000	24	43	44	26.2

Table 19

Appendix B - Technical specifications

Medical CE-marking:	The CE certification indicates that Interacoustics A/S meets the requirements of Annex II of the Medical Device Directive 93/42/EEC. Approval of the quality system is conducted by TÜV - identification no. 0123.	
Standards:	Safety:	IEC/ES 60601-1, 2005 CAN/CSA-C22.2 No. 601.1-M90 IEC 60601-1 1988 .A1:1991, A2:1995 UL 60601-1:2003 Class I, Type B IEC 60601-1-1 2000
	EMC:	IEC 60601-1-2 :2007
	Audiometer Tone:	IEC 60645-1 2001/ANSI S3.6-2010 , Type 1 Tone audiometer IEC 60645-4 1994/ANSI S3.6-2010 , High frequency audiometer
	Audiometer Speech:	IEC 60645-2 1997/ANSI S3.6-2010 Type A or A-E, STAF-1996, Norway. Speech audiometer
	Audiometer Calibration:	AC: DD45 PTB/DTU report 2009 TDH39: ISO 389-1 1998, ANSI S3.6-2010 HDA200: ISO 389-5 2006, ANSI S3.6-2010 HDA300: PTB Report 1.61-4064893/13 2013 E.A.R Tone 3A/5A: ISO 389-2 1994, ANSI S3.6-2010 BC: B71: ISO 389-3 1994, ANSI S3.6-2010 FF: ISO 389-7 2005, ANSI S3.6-2010 HF: ISO 389-8 2004, ANSI S3.6-2010 Effective masking: ISO 389-4 1994, ANSI S3.6-2010
	Hearing Aid Analyzer:	IEC 60118-0 1983, IEC60118-1 1998, IEC 60118-7 2005, ANSI S3.22-2003.
	Real ear measurement:	IEC61669 2001, ISO12124 2001, ANSI S3.46-1997

Specifications for Callisto™ hardware:

PC requirements:	2 GHz Intel Core 2 Duo CPU 2GB Ram 1.5 GB available disk space 1024x768 resolution (1280x1024 or higher recommended) Hardware accelerated DirectX/Direct3D graphics card.
Supported Systems:	Windows® 7 SP1 (x86 and x64) Windows® 8 / 8.1 (x86 and x64) Windows® 10 (x86 and x64)
Available modules:	Callisto™ Suite AUD, REM, HIT.
Database:	OtoAccess and Noah-compatible office systems or later releases
Computer Communication:	USB interface, compatible with USB1.1 or later.
Construction:	Plastic cabinet.
Power:	USB-powered with an internal "power boost" rechargeable battery and load balancer. Average: 300mA (Max: 500mA)
Battery :	NP120 3.7V 1700 mAH battery lithium ion 53x35.2x11.
Battery working voltage :	3.2 to 4.2V
Operation environment:	Rel. Humidity: 15-90% Temperature: 10-35° Ambient Pressure: 98 kPa-104 kPa
Transport temperature:	-20-50 °C
Storage temperature:	0-50 °C
Humidity transportation & storage:	10% to 95% RH. Non-condensing
Dimensions:	212 x 121 x 44 mm / 8.3 x 4.8 x 1.7 inches
Weight:	1.25 lbs (822g / 1.81 lbs with cradle)

Specifications for AC440 software

Medical CE-marking:	The CE certification indicates that Interacoustics A/S meets the requirements of Annex II of the Medical Device Directive 93/42/EEC. Approval of the quality system is conducted by TÜV: identification no. 0123.	
Audiometer standards:	Tone: IEC60645-1/ANSI S3.6 Type 1 Speech: IEC60645-2/ANSI S3.6 Type A or A-E	
Transducers & calibration:	Check the RETSPL levels for transducers located elsewhere in this service manual.	
Air conduction:		
DD45:	PTB/DTU report 2009	Headband static force 4.5N ± 0.5N
TDH39:	ISO 389-1 1998, ANSI S3.6-2010	Headband static force 4.5N ± 0.5N
HDA300:	PTB report 1.61-4064893/13 2013	Headband static force 8,8N ± 0.5N
HDA280:	PTB report 2004	Headband static force 5N ± 0.5N
E.A.R-tone 3A/5A:	ISO 389-2 1994, ANSI S3.6-2010	
IP30:	ISO 389-2 1994, ANSI S3.6-2010 DES-2361	
CIR 33:	ISO 389-2	
Bone conduction:	Placement: Mastoid	
B71, B81:	ISO 389-3 1994, ANSI S3.6-2010	Headband static force 5.4N ± 0.5N
	ISO 389-3 1994, ANSI S3.6-2010	Headband static force 5.4N ± 0.5N
Free field:	ISO 389-7 2005, ANSI S3.6-2010	
High frequency:	ISO 389-5 2004, ANSI S3.6-2010	
Effective masking:	ISO 389-4 1994, ANSI S3.6-2010	
Patient response switch:	Handheld with push button.	
Patient communication:	Talk Forward and Talk Back.	
Monitor:	Output through external earphone or speaker.	
Stimuli:	Pure tone, Warble tone, NB, SN, WN, TEN noise	
Tone:	125-16000 Hz separated in two ranges 125-8000 Hz and 8000-16000 Hz. Resolution 1/2-1/24 octave.	
Warble tone:	1-10 Hz sine ± 5% modulation	
Wave file:	44100 Hz sampling, 16 bits, 2 channels	
Masking:	Automatic selection of narrow band noise (or white noise) for tone presentation and speech noise for speech presentation.	
Narrow band noise:	IEC 60645-1:2001, 5/12 Octave filter with the same centre frequency resolution as pure Tone.	
White noise:	80-16000 Hz measured with constant bandwidth.	
Speech noise:	IEC 60645-2:1993 & ANSI S3.6 2010:125-6000 Hz falling 12 dB/octave above 1 KHz ± 5	
Presentation:	Manual or Reverse. Single or multiple pulses. Pulse time adjustable from 200 mS-5000 mS in 50 mS steps. Simultaneous or alternating.	
Intensity:	Check the Instructions for Use and its accompanying Appendix for maximum output levels	
Steps:	Available Intensity Steps is 1, 2 and 5 dB	
Accuracy:	Sound pressure levels: ± 2 dB. Vibration force levels: ± 5 dB.	
Extended range function:	If not activated, the Air Conduction output will be limited to 20 dB below maximum output.	
Frequency:	Range: 125 Hz to 8 kHz (Optional High Frequency: 8 kHz to 16 kHz) Accuracy: Better than ± 1 %	
Distortion (THD):	Sound pressure levels: below 1.5 % Vibration Force levels: below 3 %	
Signal indicator(VU):	Time weighting:	350 mS
	Dynamic range:	-20 dB to +3 dB
	Rectifier characteristics:	RMS
	Selectable inputs are provided with an attenuator which enable level adjustment for the indicator reference position (0 dB)	
Storing capability:	Tone audiogram: dB HL, MCL, UCL, Tinnitus, R+L Speech Audiogram: WR1, WR2, WR3, MCL, UCL, Aided, Unaided, Binaural, R+L.	
Compatible software:	Noah 4, Noah 3.7, OtoAccess™ and XML compatible	

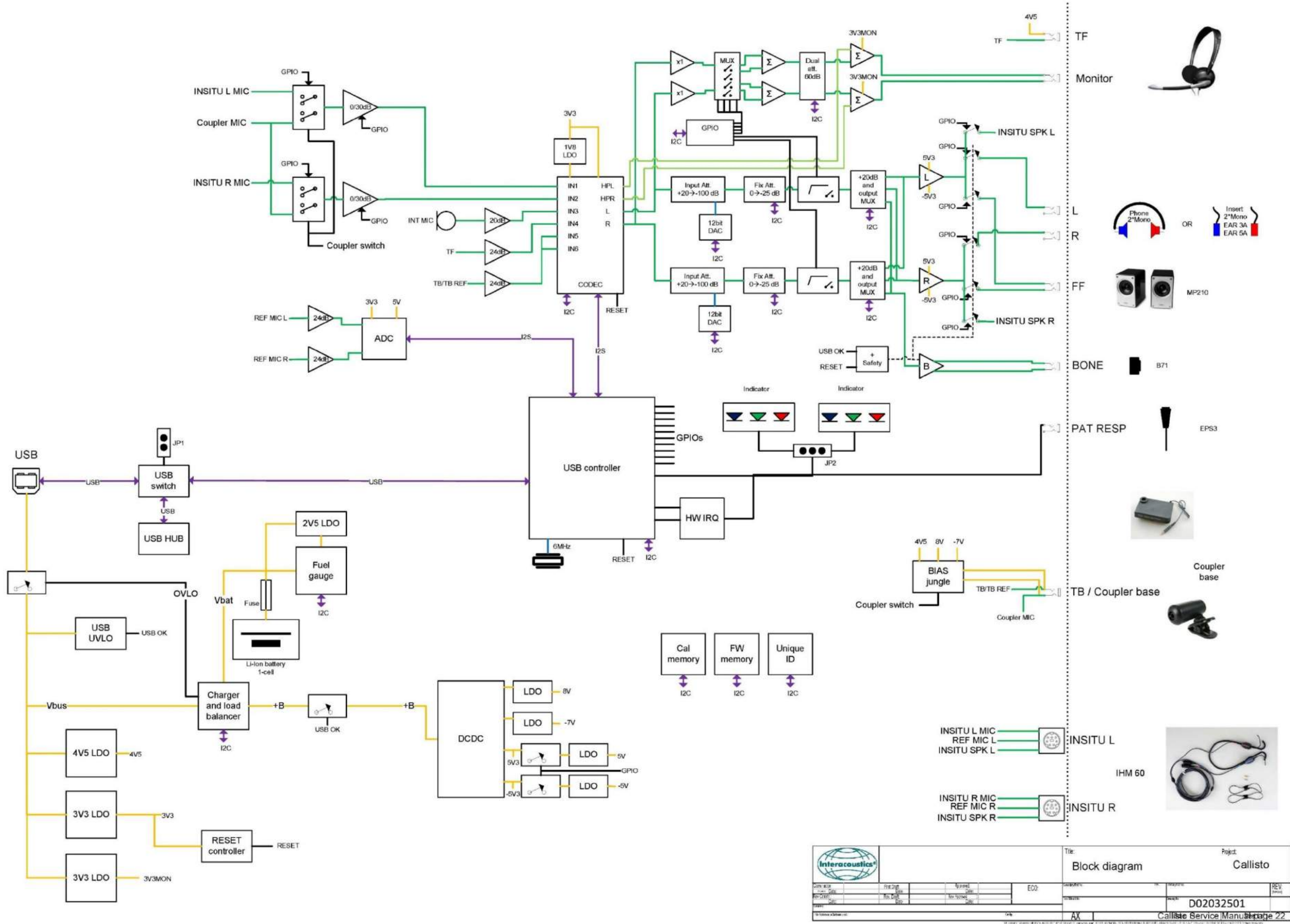
Specifications for REM440 software

Medical CE-marking:	The CE certification indicates that Interacoustics A/S meets the requirements of Annex II of the Medical Device Directive 93/42/EEC. Approval of the quality system is conducted by TÜV: identification no. 0123.	
Real Ear Measurement Standards:	IEC 61669, ISO 12124, ANSI S3.46.	
Stimuli:	Warble Tone, Pure Tone, Random noise, Pseudo random noise, Band limited white noise, Chirp, ICRA, Real Speech, any other sound file (automatic calibration available).	
Frequency range:	100 Hz - 10k Hz	
Frequency accuracy:	Less than $\pm 1\%$	
Distortion:	Less than 2%	
Intensity range:	40 - 90 dB	
Intensity accuracy:	Less than $\pm 1.5\%$	
Measurement Intensity Range:	Probe microphone 40-140 dB SPL ± 2 dB.	
Frequency Resolution:	1/3, 1/6, 1/12, 1/24 octave or 1024 point FFT.	
Probe microphone:	Intensity: 40 - 140 dB	
Reference microphone:	Intensity: 40 - 100 dB	
Intensity Accuracy:	Less than ± 1.5 dB	
Cross talk	Cross talk in the probe and probe tube will alter the obtained results with less than 1 dB at all frequencies.	
Available tests:	REUR REIG RECD REAR REAG	REOR REOG REUG Input – Output
Compatible Software:	Noah 4, Noah 3.7, OtoAccess™ and XML compatible	

Specifications for HIT440 Software

Medical CE marking:	The CE certification indicates that Interacoustics A/S meets the requirements of Annex II of Medical Device Directive 93/42/EEC. Approval of the quality system is conducted by TÜV: identification no. 0123.	
Hearing Aid Analyzer Standards:	IEC 60118-0, IEC 60118-7, ANSI S3.22.	
Frequency Range:	100-10000Hz.	
Frequency Resolution:	1/3, 1/6, 1/12 and 1/24 octave or 1024 point FFT.	
Frequency Accuracy:	Less than ± 1 %	
Stimulus Signal:	Warble Tone, Pure Tone, Random noise, Pseudo random noise, Band limited white noise, Chirp, ICRA, Real Speech, any other sound file (automatic calibration available).	
Sweep Speed:	1,5 - 80 sec.	
FFT	Resolution: 1024 points. Averaging: 10-500.	
Stimulation Intensity Range:	40-100 dB SPL in 1 dB step.	
Intensity Accuracy:	Less than ±1.5 dB	
Measurement Intensity Range:	Probe micro phone 40-145 dB SPL ± 2 dB.	
Stimulus Distortion:	Less than 1 % THD.	
Available tests:	Additional tests can be created and added by the user.	
	OSPL90	Harmonic Distortion
	Full On Gain	Intermodulation Distortion
	Input/Output	Microphone Directionality
	Attack/Recovery Time	
	Reference Test Gain	
	Frequency Response	
	Equivalent Input Noise	
Pre-Programmed Protocols:	The HIT440 software comes with a set of Test Protocols loaded. Additional test protocols can be created and added by the user, or easily be imported into the system	
Compatible Software:	Noah 3.7, Noah 4,, OtoAccess™ and XML compatible	

Appendix C - Block diagram



		Title: Block diagram		Project: Callisto	
DATE: 2023-01-10 BY: [Signature] CHECKED: [Signature] APPROVED: [Signature]	EDD: []	PART: []	REV: []	PART: []	REV: []
Part: D02032501			Callisto Service Manual Page 22		

Appendix D - Parts & accessories

	<p>8010879 8010819</p>	<p>DD45 audiometric headset TDH 39 audiometric headset</p>
	<p>8010876</p>	<p>DD45 telephone 10 ohm</p>
	<p>8010625</p>	<p>TDH39P 10 Ohm earphone Telephonics</p>
	<p>8010817</p>	<p>HBA audiometric head band</p>
	<p>8010894</p>	<p>DD51 cushion</p>
	<p>8010822</p>	<p>Earphone cable IEC-M21 symmetric mono For DD45/TDH39 headsets</p>
	<p>8010796</p>	<p>TDH39AA with Amplivox headset</p>
	<p>8010893</p>	<p>HDA200 headset 30° plugs</p>
	<p>8004172</p>	<p>IEC-M31 earphone cord for HDA 200 headset</p>
	<p>8107154</p>	<p>Calibration adapter</p>

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	8010815	EARTone 3A 10 Ohm insert earphones
	8010797	EARTone 5A insert earphones including 4 large 3C, 10 small 3B and 50 medium 3A ear tips
	8106227	Ear tip 3B EARTone, small, 100 pcs
	8106226	Ear tip 3A EARTone, medium, 100 pcs
	8500100	Ear tip 3C EARTone, large, 24 pcs
	8010800	B71 bone conductor complete 30° plug
	8105742	B71 bone Conductor only
	8011098	P3333 headband for B71
	8011094	IEC-B11 conductor cable
	8010870	Monitor headset with boom PC-131 stereo headset
	8501068	½" microphone

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	8011102	2 cc coupler
	8011104	BTE adaptor with O-ring
	8011105	Body adaptor with O-ring
	8011106	ITE Adaptor with O-ring
	8011291	Reference Microphone
	8004556	Adaptor hose BTE
	8010930	IHM60 in-situ headset kit
	8010868	Headband small complete
	8010867	Headband large complete
	8006481	Goose neck kit in-situ headset For in-situ headset 8010930

	<p>8011472</p>	<p>Nipple tube kit For in-situ headset 8010930</p>
	<p>8002535</p>	<p>Clip headband in-situ For in-situ headset 8010930</p>
	<p>8012831</p>	<p>IGT60 probe tubes, 36 Pcs.</p>
	<p>8103838</p>	<p>APS3 patient response switch</p>
	<p>8012841</p>	<p>Assortment box BET60 SPL audiometric ear tips</p>
	<p>8011379</p>	<p>Probe tip set SPL60 8012841 included 8011206 calibration adaptor included</p>
	<p>8011313</p>	<p>Microphone clip-On</p>
	<p>8000361</p>	<p>Callisto 1.0 1106</p>
	<p>8009978</p>	<p>NP120 3.7V 1700mAh Battery lithium ion 53x35.2x11</p>
	<p>8006286</p>	<p>PCA mainboard 1106</p>

	Manual	8002617	Cradle 1106
		8011361	Coupler base 1106 complete
		8010679	Loudspeaker 8 Ohm edifier MP210
		8505541	Cable free field 1106, right
		8004418	Cable free field 1106, left for loudspeaker 2
		8011241	Cable USB 2m
		80405101	Wax

Appendix E - Update news

The following modifications have been made to this instrument and/or service manual:

Date	Action	Remarks
2017/12	Service manual update to new format. Addition of new information relating to HDA300, DD450, B81 and IP30. Including new technical specifications. Update software paths and addition of test box information. Update part numbers.	Changed the service manual part number for document file from old format D06013501 to new format 8012216.