

Oldenburg Measurement Applications

Software package for
audiometric and diagnostic
measuring methods

Operation manual
Calibration



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2 General remarks

The following documentation describes the operation of the calibration of the software environment 'Oldenburg Measurement Applications'. This documentation is subject to alteration.

3 Information on the demo calibration

When you are running the 'Oldenburg Measurement Applications' in demo mode, a special demo calibration is always used which is available even without having done a real output level calibration. WHEN USING THE DEMO CALIBRATION, THE ACTUAL OUTPUT LEVELS ARE NOT NECESSARILY CORRECT. Furthermore, signals presented in demo mode are usually not adapted to particular transducers (headphones). Any result obtained in demo mode will therefore differ from regular measurement results and MUST NOT be used or considered in any way as a valid measurement result.

4 Calibration functions in the main menu

The item 'Measurements' of the main menu of the start dialog of the 'Oldenburg Measurement Applications' contains the submenu 'Calibration' with the following items:

Item	Function
Apply default demo calibration	Creates a backup of the existing demo calibration and activates a default demo calibration for the actual audiometer. Select this item if your demo calibration is damaged or invalid.
Apply empty calibration	Creates a backup of the existing demo calibration and activates a default demo calibration for the actual audiometer. Select this item if your demo calibration is damaged or invalid. Normally this happens only after a manual manipulation of the calibration file.
Install broadband calibration reference	Installs a new user defined broadband signal (.WAV file) for the calibration. After installing a new signal it can be calibrated and it can be used in measurements that support user defined signals. Please refer to the paragraph 'Installation of a broadband calibration reference'.

5 Running the calibration

Run the calibration by clicking the button 'Calibration' on the start dialog of the Oldenburg Measurement Applications. In the next dialog you can select a combination of audiometer and transducer to be calibrated (Figure 1, the appearance of the dialog can vary depending on your system configuration, only entries for the actual selected audiometer are displayed):

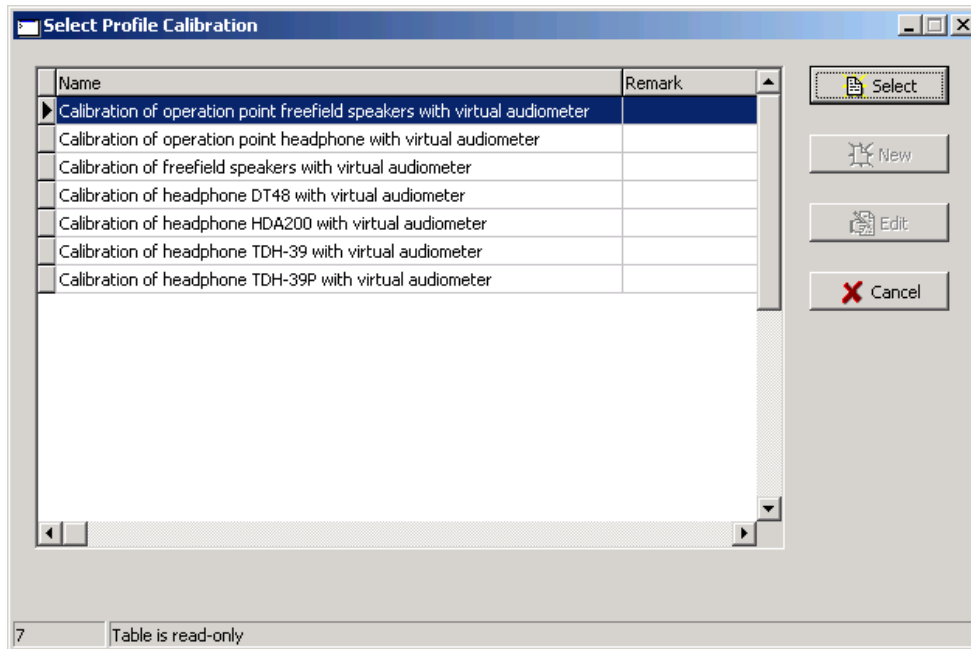


Figure 1

Select the desired entry in the list and click 'Select'. Since the calibration must be performed by an expert the calibration is password protected. On the first start of the calibration you are prompted for a new password (Figure 2, left panel). Remember this password carefully; you will be prompted for it on any later calibration (Figure 2, right panel). You can change the password by clicking 'Edit'.

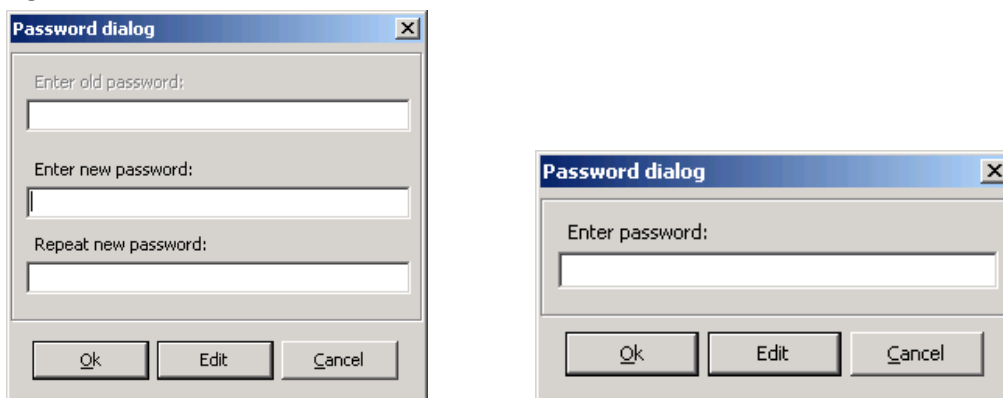


Figure 2

After entering the password click 'Ok'. Read the following hint carefully and follow the instructions (Figure 3).

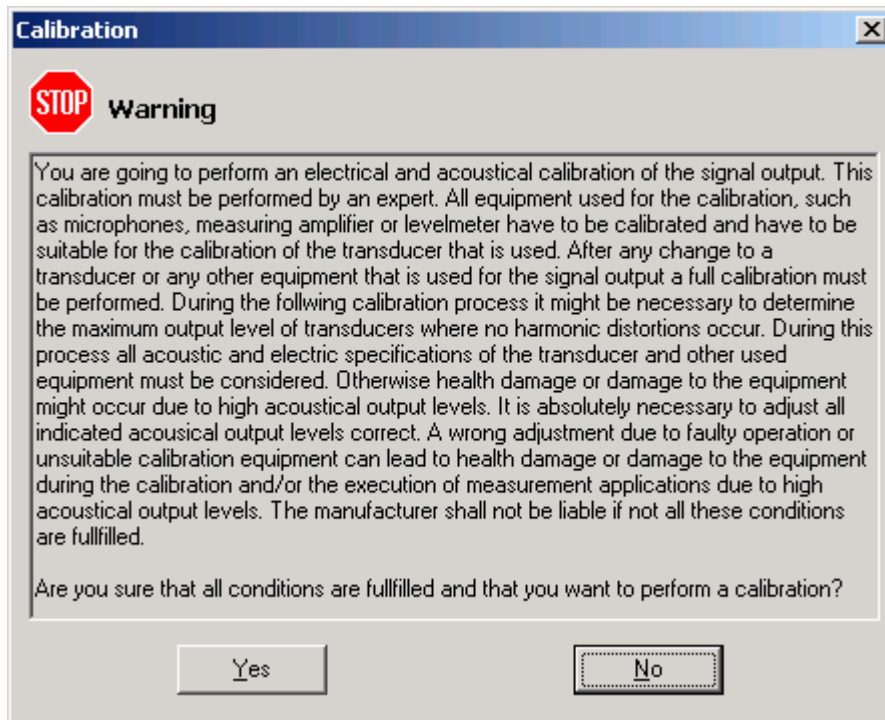


Figure 3

If you have selected a headphone to be calibrated a signal type selection dialog appears (Figure 4). This selection dialog is not shown if the measurement 'Categorical Loudness Scaling' is not installed or when the software runs in demo mode. Select 'Calibrate Loudness Scaling signals' only if you want to calibrate special signals for the measurement 'Categorical Loudness Scaling', otherwise select 'Calibrate other signals'.

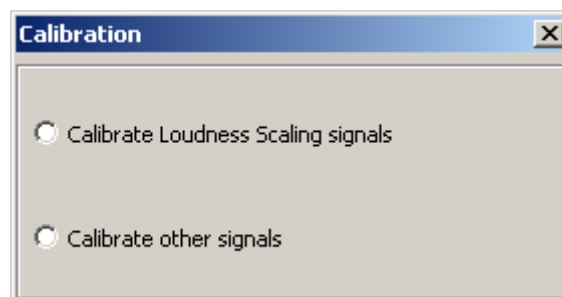


Figure 4

The measurement applications

- Freiburg speech test
- Göttingen sentence test
- Categorical Loudness Scaling
- Oldenburg children rhyme test
- Oldenburg sentence test
- Rhyme test (WaKo)
- 2-syllables rhyme test

do use offline deconvolution.

If the documentation does indicate the use of online deconvolution explicitly please select 'Calibrate signals for online deconvolution' to calibrate the signal for this measurement.

If you have selected the entry 'Calibration of post attenuator of Bluebox audiometer' please proceed with chapter 7 'Calibration of the post-attenuator of the Bluebox'

If you have selected on of the entries 'Calibration of input sensitivity of Aurical' or 'Calibration of input sensitivity of Unity' please proceed with chapter 8 'Calibration of the input sensitivity of the audiometers Unity and Aurical'.

If you have selected the entry 'Calibration of operation point headphone with virtual audiometer' please proceed with chapter 9 'Calibration of the operation point of the virtual audiometer'

Otherwise proceed with chapter 6 'Signal calibration'.

6 Signal calibration

After starting the signal calibration the main calibration dialog will appear (Figure 5). Please select one of the following calibration methods:

- Determination of maximum level and calibration: the technical maximum level for the corresponding transducer is determined and the calibration is performed.
- Maximum level: only the maximum level is determined. To select this calibration method the calibration for the corresponding signals must have been performed earlier.
- Calibration: only the signal calibration is performed. To select this calibration method the maximum level for the corresponding signals must have been determined earlier.
- Control calibration: use this calibration method to check, if the calibration values have changed since the last signal calibration. If this method is used, all signals are presented with the calibration level (see below) based on the actual calibration values. Any deviation can be seen immediately. **Note: this calibration method must not be used after any change to the hardware of the signal path (soundcard, audiometer, freefield amplifier, transducer ...). In that case the output levels might be too high and the transducers might be damaged.**

When calibrating freefield speakers you can select if one or both channels should be calibrated.

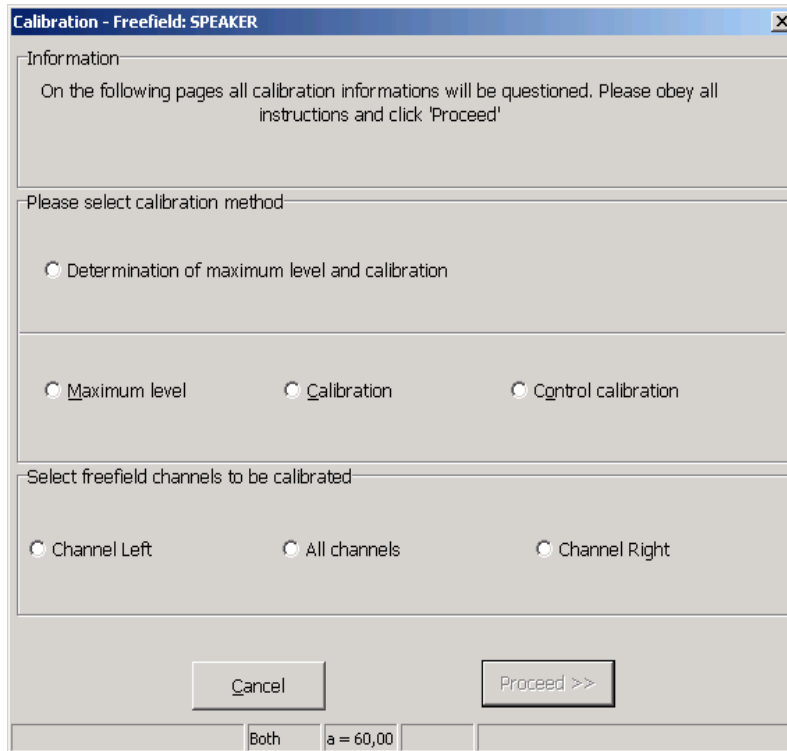


Figure 5

Click 'Proceed' after completing your selection. On the next page you can select the signals to be calibrated from the list of available signals for this transducer (Figure 6). If you have selected a 'Control calibration' all already calibrated signals are pre-selected, otherwise all signals, which are not calibrated, are pre-selected. If the system is calibrated the first time all signals must be calibrated!

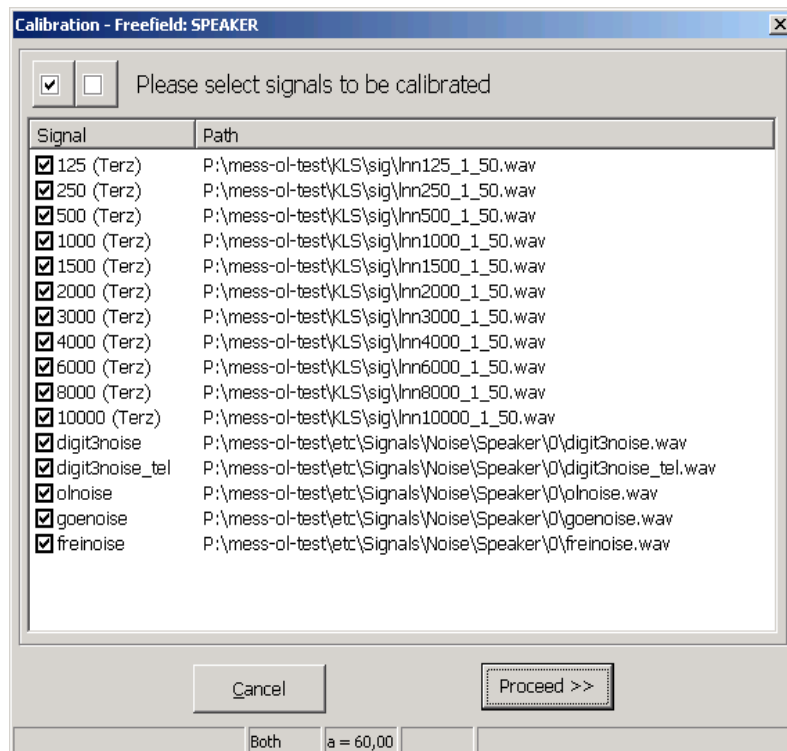



Figure 6

After selecting all desired signals please click 'Proceed'. If you have selected any other calibration method than 'Determination of maximum level and calibration' you might get an error

message, if you try to calibrate the maximum level of a signal that was never calibrated before or vice versa. Otherwise the calibration main screen is shown containing the following controls (Figure 7):

Table 1

dB-buttons (-10, -5, ..., +5, +10)	Use these buttons to increase or decrease the actual output level of the signal.
Ok/Start/Proceed button	This button has different captions and corresponding functions depending on the calibration progress: Start: Starts the calibration. Ok: The actual adjusted level should be accepted and the calibration should proceed with the next calibration step Proceed: The last calibration step should be repeated after a user break (see below).
 Mute button	Mutes the signal output immediately and stops the calibration. After such a break the calibration can be resumed applying the maximum attenuation again by clicking 'Proceed'.
Cancel button	Mutes the signal output immediately and stops the calibration. After a confirmation question the calibration can be cancelled completely or can be resumed using the 'Proceed' button.
Back button	You can repeat the calibration of the last signal using the back button after stopping the calibration with the mute button or the cancel button.

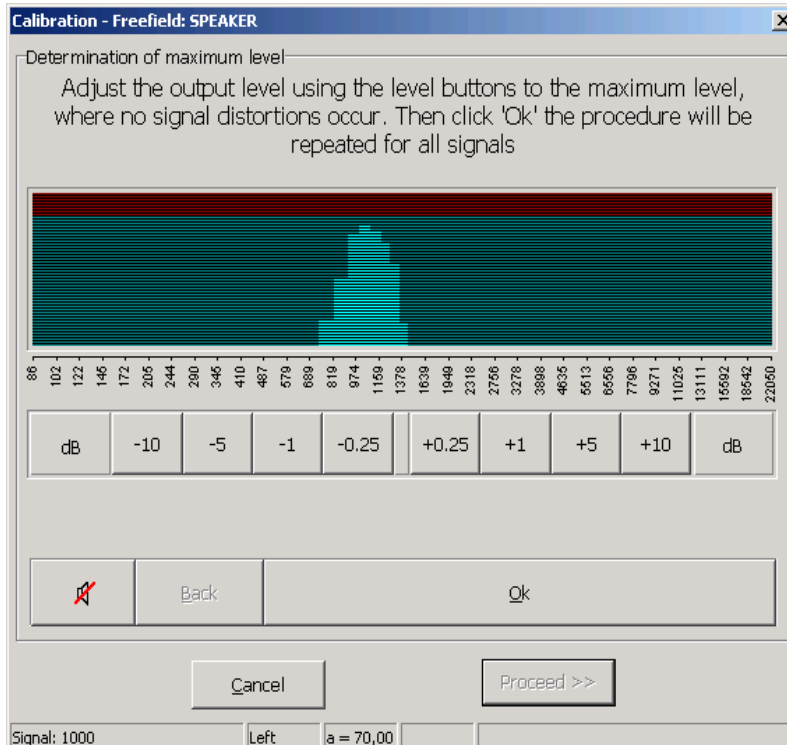


Figure 7

Depending on the selected calibration method, the determination of the maximum level or the calibration itself is started.

Important note: the spectrum of the actual signal is shown during signal output. This spectrum is the pure spectrum of the audio signal itself and independent from the audiometer level!

Determination of the maximum level:

First the selected signals are successively played back on the left channel (or freefield channel 1 respectively). At the start of every signal output the maximum attenuation is applied. Use the dB-buttons (-10, -5 ... +5, +10) to increase the output level to the maximum value, where no distortions can be detected and click 'Ok'. Distortions may be measured with an FFT analyzer or simply by listening to the signal output for overdrive. For standard hardware components only some of the narrowband signals (especially high and very low frequencies) may clip below the audiometer's maximum value, the broadband noise signals are not likely to clip. The procedure is repeated for all selected signals on the left channel (freefield channel 1). Afterwards this procedure is repeated for the right channel (or freefield channel 2 respectively). The minimum value of both channels is used as technical maximum level for the corresponding signal and is written to the calibration file.

Signal calibration:

Attach your level meter (measuring amplifier, artificial ear, freefield microphone or any other suitable level meter) to the left channel of the air conductor or to the freefield transducer that is attached to freefield channel 1.

The selected signals are successively played back on the left channel (or freefield channel 1 respectively). At the start of every signal output the maximum attenuation is applied.

Use the dB-buttons (-10, -5 ... +5, +10) to adjust the output level to the indicated calibration level value (Figure 8) and click 'Ok'. The procedure is repeated for all signals on the left channel (freefield channel 1). The right channel (freefield channel 2) is calibrated accordingly.

If the requested calibration level exceeds the technical maximum level you are prompted for the actual level. Please read the level from your level meter and type it into the edit field (Figure 9).

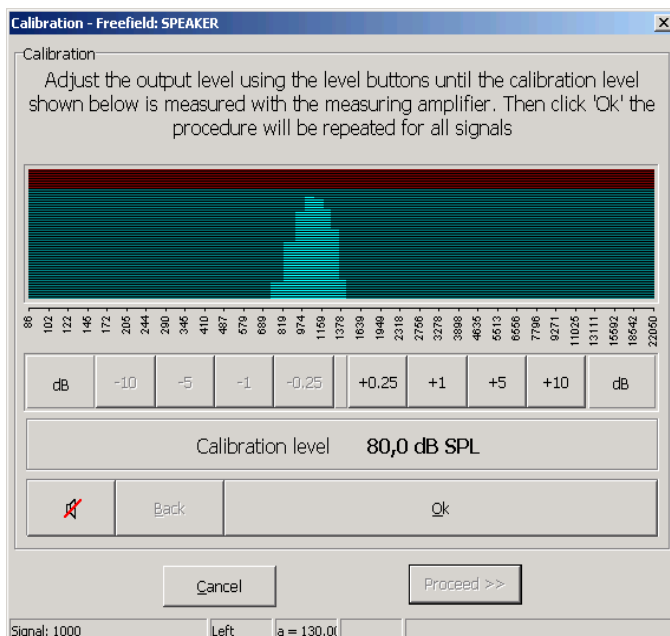


Figure 8

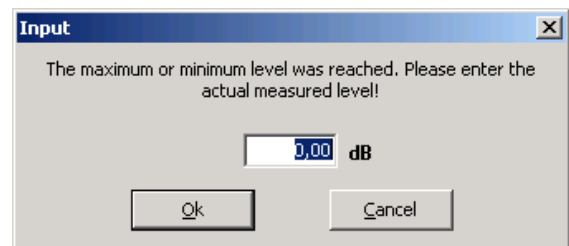


Figure 9

Calibration of the Bluebox research audiometer:

The Bluebox research audiometer consists of three different pre-resistors at the headphone output, which are selected automatically on runtime for different output level ranges. These pre-

resistors must be calibrated independently. Therefore the signal calibration for each signal on each channel is repeated for each pre-resistor and thus the calibration level has to be adjusted three times.

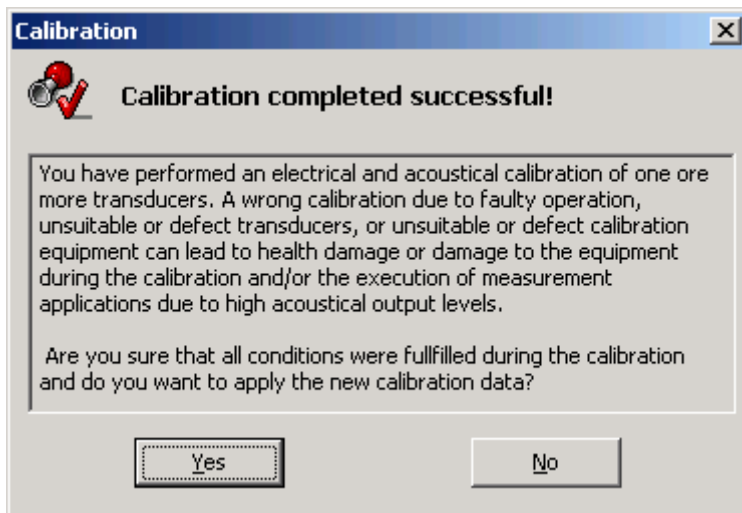


Figure 10

If all calibration steps are performed successfully, a final dialog will appear (Figure 10). Please read the information hint carefully. Clicking 'Yes' applies the new calibration values and exits the calibration dialog.

7 Calibration of the post-attenuator of the Bluebox

Connect an electrical level meter or a measurement amplifier to freefield channel 1 of the Bluebox and disconnect any transducer connected to freefield channel 2. An additional warning is shown at the start of the calibration (Figure 11). Read the hint carefully and follow the instructions.

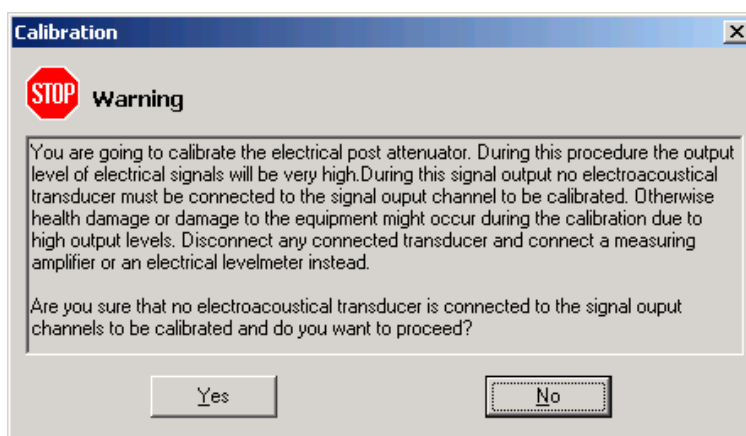


Figure 11

After the confirmation the post attenuator calibration dialog is shown (Figure 12).

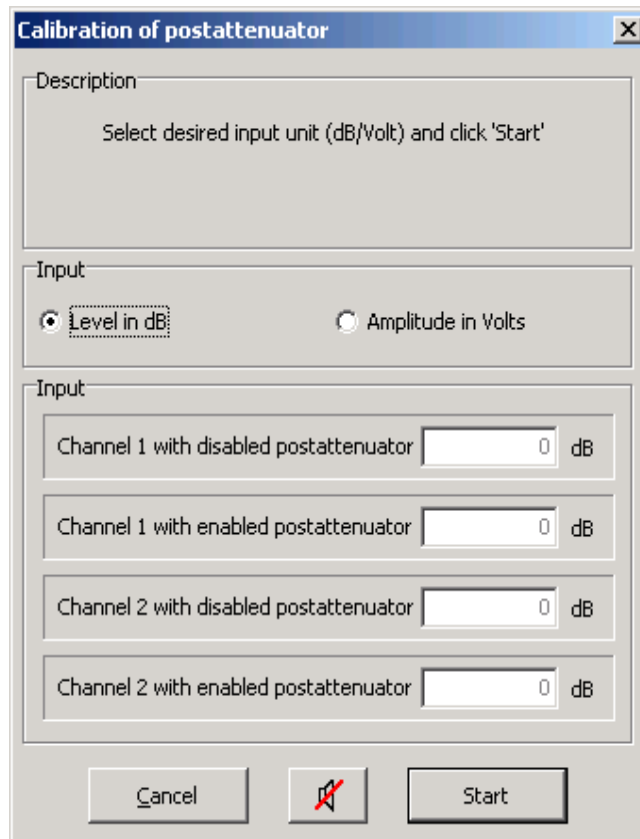


Figure 12

Select the desired input mode ('Level in dB' or 'Amplitude in Volts') and click 'Start'. An additional warning is shown (Figure 13). Read the hint carefully and follow the instructions.

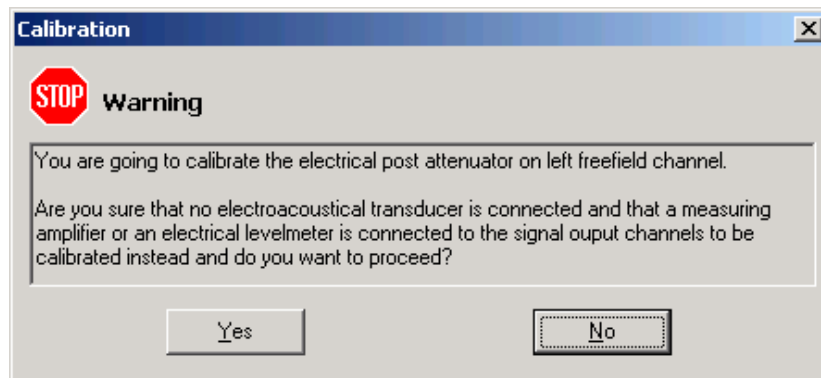


Figure 13

For the function of the mute button and the Cancel button please refer to Table 1 on page 8 in chapter 'Signal calibration'.

In the first step a sine signal is played back on freefield channel 1 without enabling the post attenuator. Pick up the measured level/amplitude and enter it into the automatically enabled green edit field and click 'Proceed' (Figure 14).

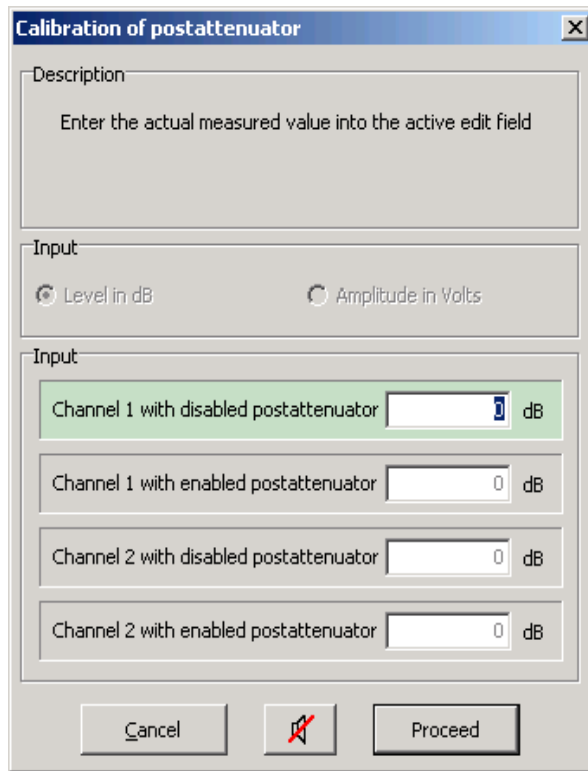


Figure 14

This procedure is repeated with enabled post attenuator. Afterwards an additional warning for freefield channel 2 is shown. The calibration procedure is repeated for the second freefield channel.

If all calibration steps are performed successfully, a final dialog will appear (Figure 10). Please read the information hint carefully. Clicking ‘Yes’ applies the new calibration values and exits the calibration dialog.

8 Calibration of the input sensitivity of the audiometers Unity and Aurical

Before you can start the signal calibration with an audiometer of type ‘Siemens Unity’ or ‘Danavox/Madsen Aurical’ the input sensitivity of the external input EXT 1 (Unity) or CD/Tape (Aurical) has to be calibrated. This calibration is performed in an automated mode.

First the input sensitivity calibration dialog is shown (Figure 15, left panel). After clicking ‘Start’ a sine signal is played back and the input sensitivity is automatically adjusted to its optimum. During this process you can cancel the calibration with the ‘Cancel’ button or stop the output with the mute button (Figure 15, right panel).

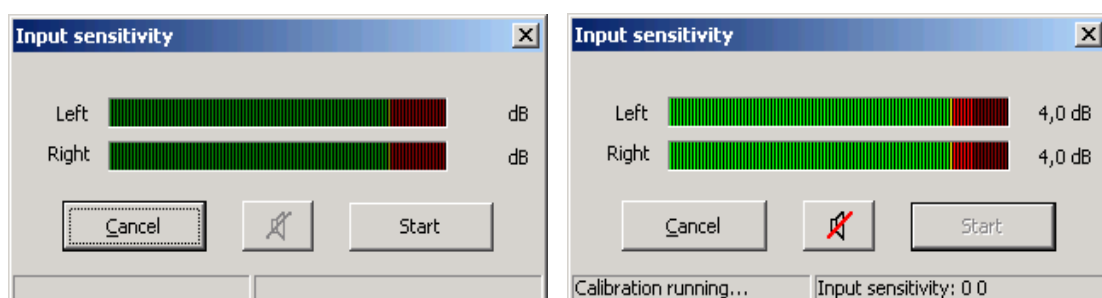


Figure 15

If the value has changed since the last calibration of the input sensitivity, a complete signal calibration of all signals must be performed after this calibration; you will get a corresponding hint (Figure 16).

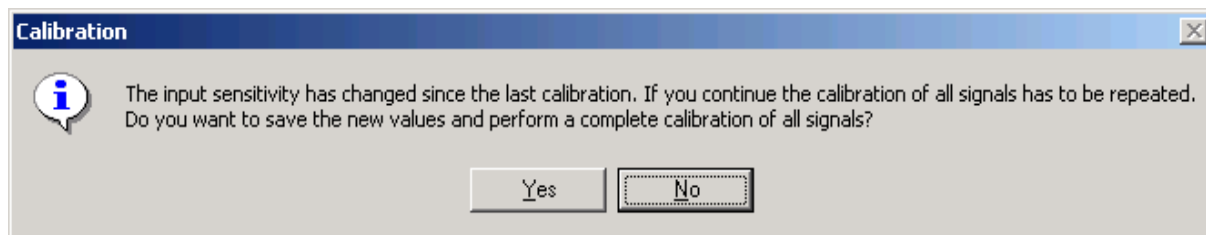


Figure 16

If all calibration steps are performed successfully, a final dialog will appear (Figure 10). Please read the information hint carefully. Clicking 'Yes' applies the new calibration values and exits the calibration dialog.

9 Calibration of the operation point of the virtual audiometer

The virtual audiometer can only be used with high quality soundcards that support the output of 32bit Windows PCM wave files.

The operation point of the virtual audiometer has to be calibrated before the signal calibration can be performed. During this process the external freefield or headphone amplifier is adjusted in a manner that all output levels that are necessary for the measurements can be achieved by digital signal attenuation within the virtual audiometer. **Note:** There must not be any changes applied to the external amplifiers and their settings after a successful calibration of the operation point and the following signal calibration. Otherwise the calibration of the operation point and the signal calibration of all signals must be repeated! For testing purposes you can check your existing calibration of the operation point (see below).

To start the calibration of the operation point select one of the profiles 'Calibration of operation point freefield speakers with virtual audiometer' or 'Calibration of operation point headphone with virtual audiometer'. After the password dialog the 'operation point calibration dialog is shown (Figure 17):

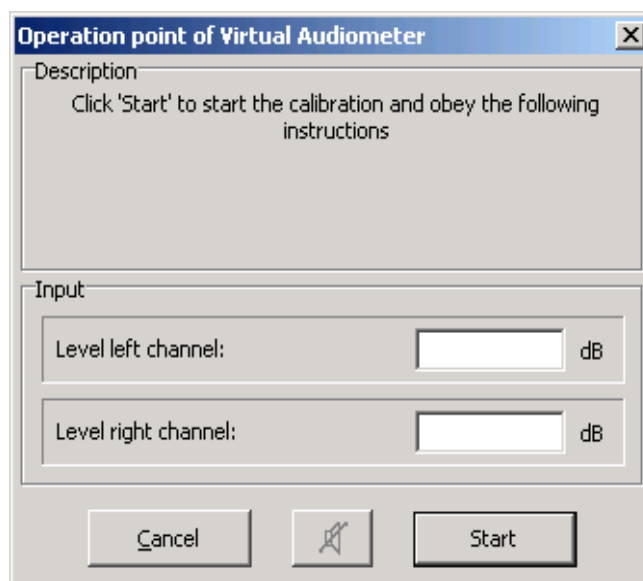


Figure 17

After clicking 'Start' an additional warning is shown (Figure 18). Read the hint carefully and follow the instructions. **Note:** the levels that are shown exemplarily in the following figures can vary depending on your system configuration.

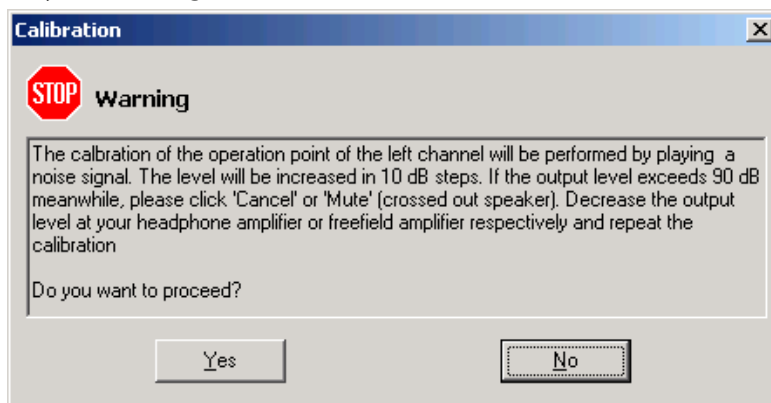


Figure 18

After confirming the warning with 'Yes' a broadband noise is played back on the left channel. The level will be increased in 10 dB steps until the calibration level is reached. During this process the corresponding input field is colored red (no input possible, Figure 19, left panel).

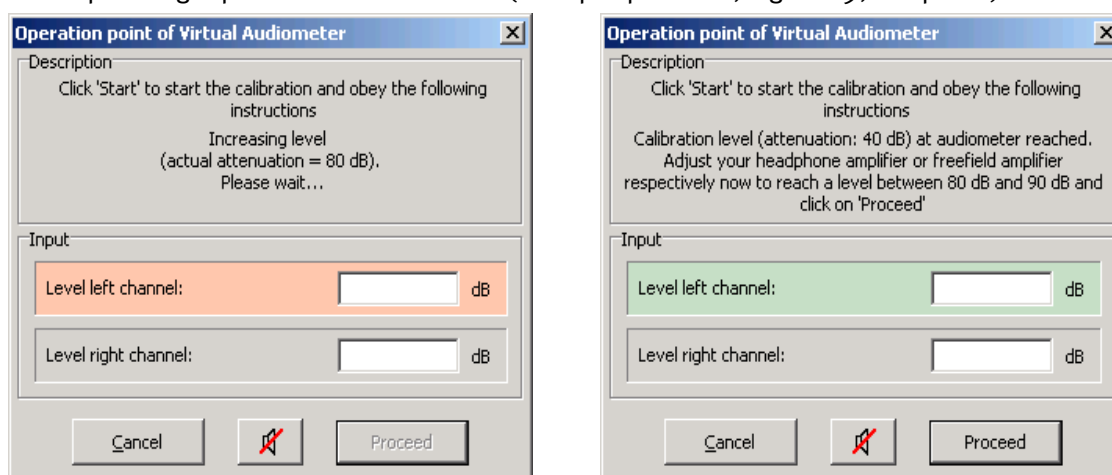


Figure 19

If the output level exceeds the indicated maximum level during this phase (90 dB in this example) then click the 'Cancel' button or the mute symbol to stop the output immediately. Decrease the gain of your external amplifier and start the calibration again.

Note: If you enter a calibration level of 80 dB at an attenuation of 40 dB (Figure 19, right panel), then this indicates that you can present this signal (or any signal with a similar RMS value) with a maximum value of 120 dB. If you present your signal with the virtual audiometer using these calibration values at 20 dB it has to be attenuated by 100 dB. If on the other hand the dynamic range of your audio hardware (e.g. soundcard) is limited to e.g. 105 dB then your signal will be distorted and/or noisy (e.g. by quantum noise) on levels of 20 dB and below. In this case you have to decide if you want to shift the available dynamic range to higher levels by choosing higher calibration levels, or if you want to shift the available dynamic range to lower levels by choosing lower calibration levels. The virtual audiometer might not be suitable for some measurements due to a reduced dynamic range of your hardware.

After reaching the actual calibration attenuation a new hint appears and the corresponding edit field is colored green (Figure 19, right panel). Now adjust your external amplifier until the noise signal is presented within the indicated level range. Adjust your amplifier to the lower border of the level range if it is possible (80 dB in this example). Enter the actual measured level into the corresponding edit field. If you enter a level outside of this level range a warning with additional information will be shown (Figure 20).

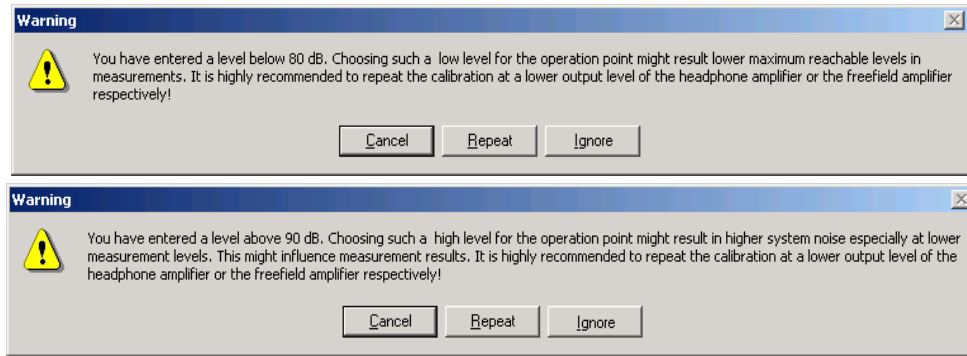


Figure 20

Please read the warnings carefully and follow the instructions.

After clicking 'Proceed' the calibration procedure is repeated for the right channel. If the values have changed since the last calibration of the operation point, a complete signal calibration of all signals must be performed after this calibration; you will get a corresponding hint (Figure 21).

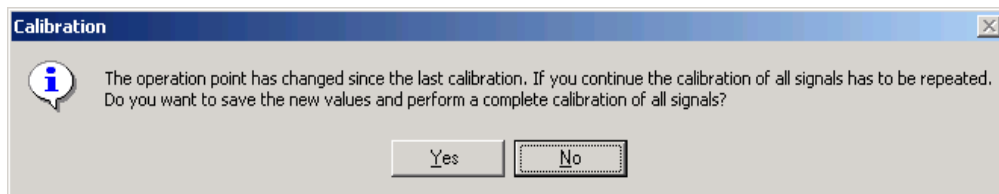


Figure 21

If all calibration steps are performed successfully, a final dialog will appear (Figure 10). Please read the information hint carefully. Clicking 'Yes' applies the new calibration values and exits the calibration dialog.

Control calibration:

If you have already calibrated the operation point of the virtual audiometer once, the calibration levels of the last calibration are show in the corresponding edit fields (Figure 22). In this way you can repeat the calibration and adjust your external amplifiers again to the same levels that were measured during the last calibration.

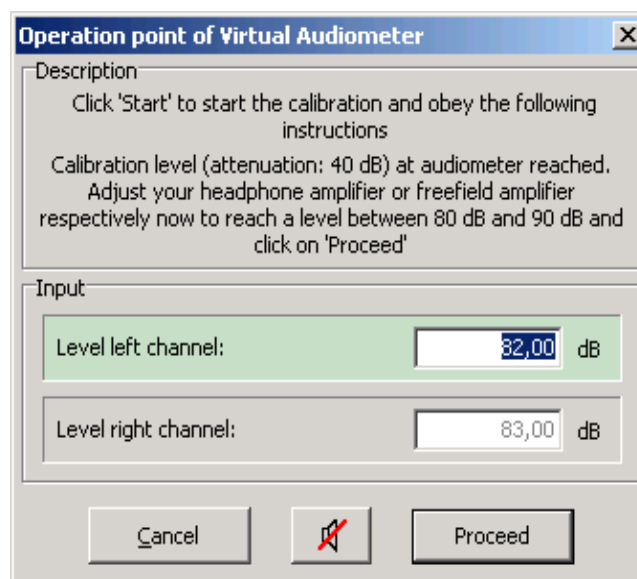


Figure 22

10 Installation of a broadband calibration reference

To install a new broadband calibration reference select the menu entry 'Install broadband calibration reference' in the menu 'Measurements', submenu 'Calibration' of the start dialog of the Oldenburg Measurement Applications. After the password dialog (see Figure 2) a dialog is shown that guides you through installation process (Figure 23).

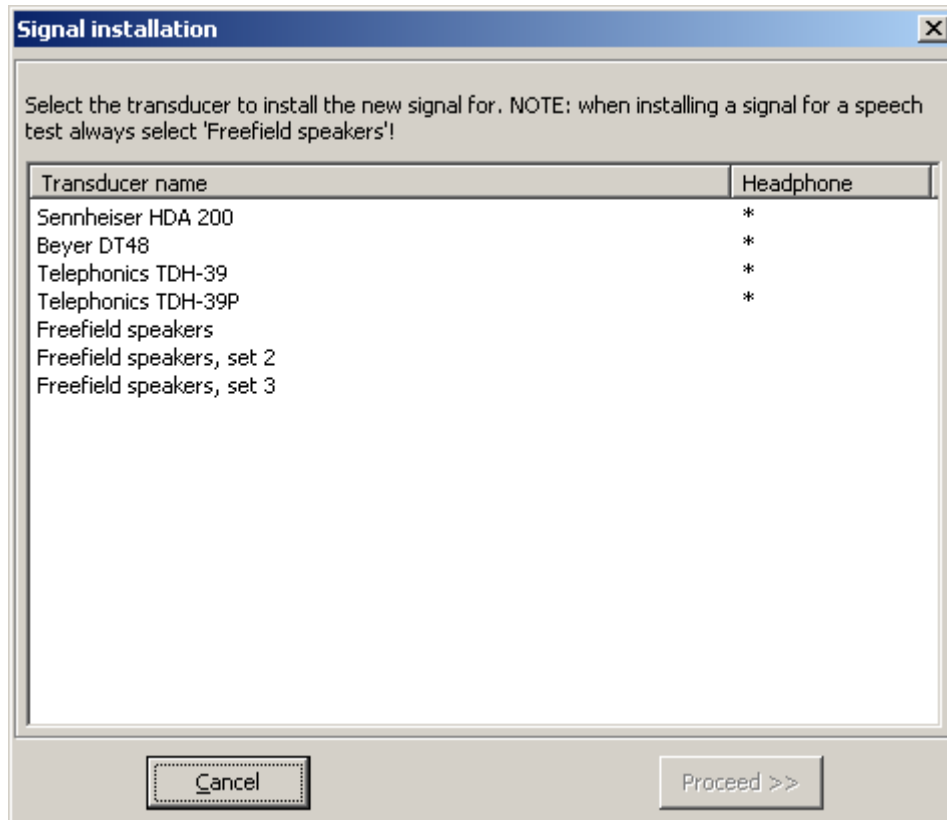


Figure 23

On the first page select the transducer that the signal should be installed for and click 'Proceed'. If more than one set of freefield speakers is listed here (e.g. 'Freefield speakers set 2') please always select 'Freefield speakers'. The additional speakers are reserved for future use. **Note:** if you want to install a calibration reference for a speech test, always select 'Freefield speakers'. The signal will be installed automatically for all headphones as well.

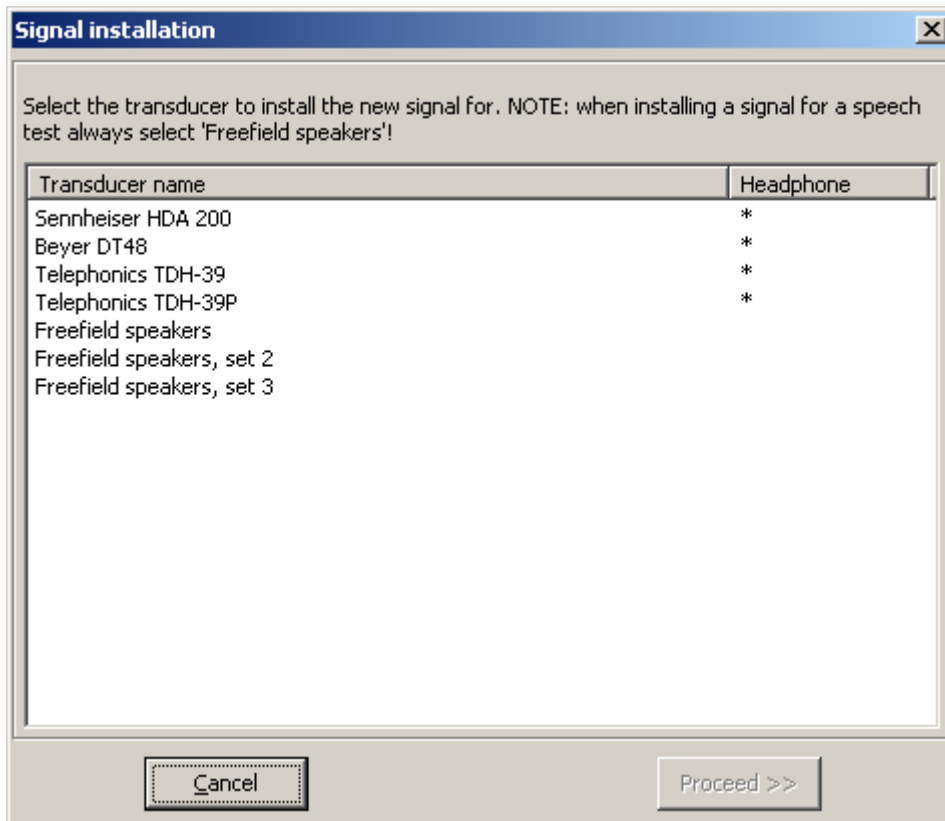


Figure 24

On the next page some signal specific data have to be entered (Figure 25):

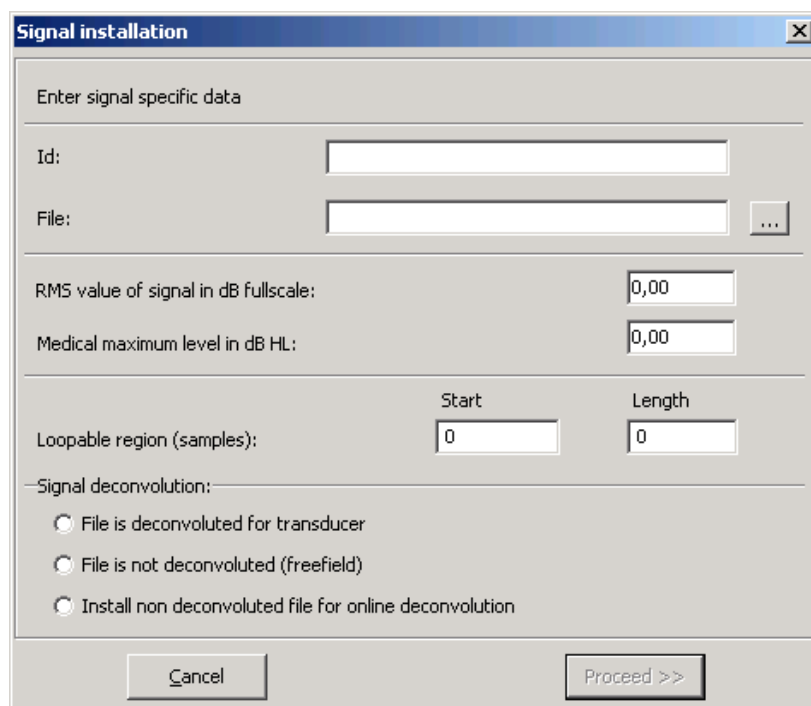


Figure 25

Id:	Unique signal Id. The signal will be added to the signal database with this Id. This Id will be used to identify the signal (e.g. by the calibration itself). An error message will be shown, if the proposed Id is already used by another signal or if it contains white spaces. If so please change the proposed Id.
-----	---

File:	Complete path and filename of the wave file (*.WAV). Clicking on the button with the three dots opens a file selection dialog. Only stereo files with a sampling frequency of 44100 Hz and a resolution of 16 bit are supported.
RMS value of signal in dB full scale	Enter the RMS value of your signal in dB full scale here (for example a sine signal with amplitude of 1 has an RMS value of -3.01 dB full scale). NOTE: a wrong RMS value will result in incorrect calibration values. This can lead to high acoustical levels during measurements that might cause healthy injuries or damage to your hardware.
Medical maximum level in dB HL	Enter the maximum value in dB HL that can be used with this signal or any signal that is referenced to this signal during measurements. NOTE: too high values for the medical maximum level can lead to high acoustical levels during measurements. This can lead to healthy injuries or damage to your hardware.
Loopable region (samples)	If the signal is ramped or modulated you may enter here a region to be used for playback during the calibration (e.g. a plateau region) by specifying a start position within the file and the length of the region in samples. If you specify zero both for 'Start' and 'Length' the complete signal will be used.
File is deconvoluted for transducer	Select this option if the signal is already convoluted to invert the transducers transfer function.
File is not deconvoluted	Select this option, if the file is not convoluted with any transfer function.
Install non deconvoluted file for online deconvolution	Select this option, if the file is not convoluted with any transfer function and you want to install the signal to be used in measurements that use online deconvolution. ATTENTION: use this advanced option only if you now that all prerequisites apply!

Click 'Proceed' after completing all data to get to the page with transducer specific data (Figure 26). On this page you have to enter the RETSPL (reference equivalent threshold sound pressure level) and the freefield correction (if any). After clicking 'Ok' you will get a final hint (Figure 27) and now the signal can be calibrated as described in chapter 6 'Signal calibration'.

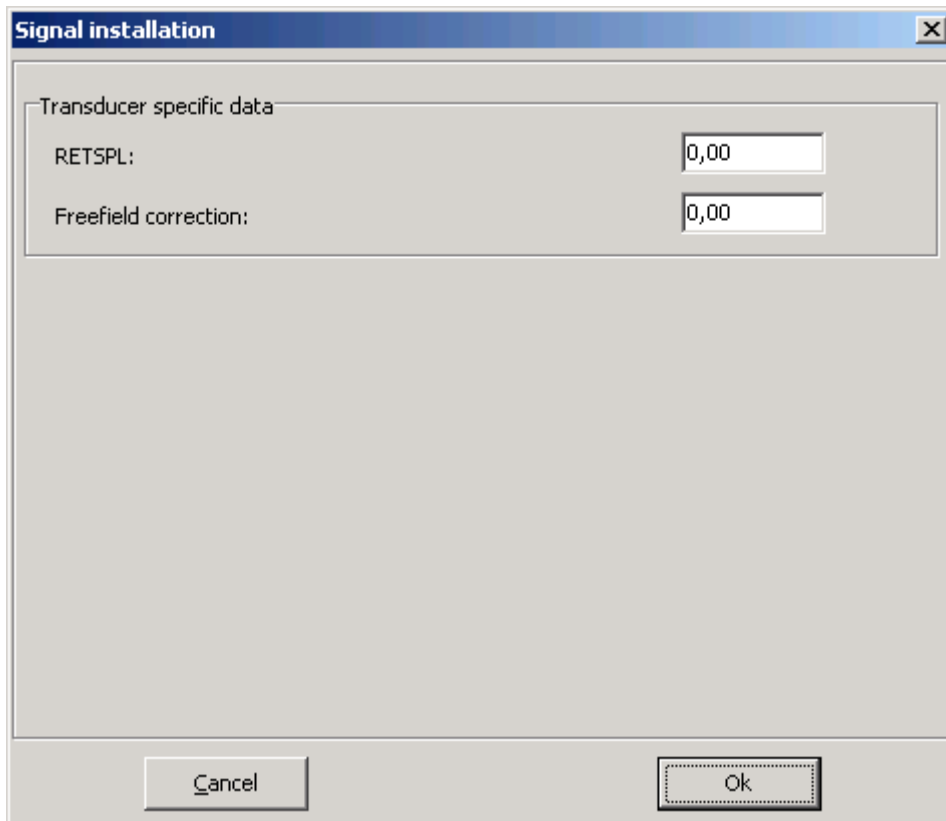


Figure 26

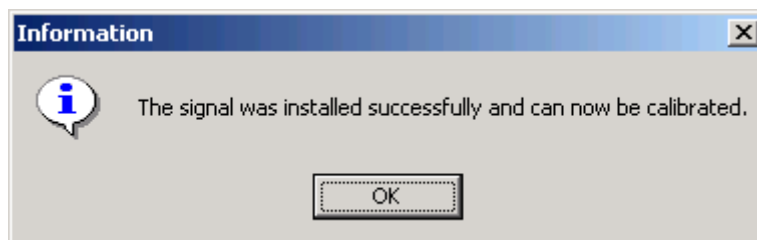


Figure 27