

## Calibration of High Frequency Transducers

### Introduction

This document shows the calibration procedure used by Intelligent Hearing systems for High Frequency Transducers. This calibration values can then be applied when performing tests using these transducers for stimulation.

### Required Equipment

#### Coupler Components:

- Knowles Electronics DB-100 Zwislocki Ear Simulator Coupler (Z-Coupler)
- Knowles Electronics DB-050 Canal Extension and Nut
- Bruel & Kjaer DB-0264 1/2" to 1/4" Adapter
- Etymotic Research ER1-08 Adapter
- Teflon Micro Gasket
- Micro Acoustic Coupler Cavity

#### Amplifier Model:

- Bruel & Kjaer Nexus Conditioning Amplifier 2690

#### Microphone:

- Bruel & Kjaer Type 4136 – 1/4" Condenser Microphone

### Bruel & Kjaer Amplifier Settings

Refer the user manual of Bruel & Kjaer (2690) Amplifier for setting up the following parameters. This general procedure requires the following settings:

#### Amplifier Set-Up:

- Filter Settings: 20 Hz – 100 kHz
- Output: 1 Volt/Pa

#### Transducer Set-up:

- Type: 1 (not changeable)
- Sensitivity: 1.330 mV/Pa
- Mode: User

#### Transducer Supply:

- Auto
- Polarization Voltage: 200 V
- Length: 0 m (when using standard cable)

#### Floating / Correction:

- No \* 1.0000

#### Store / Recall Set-Up:

- System should be set to correct default settings. If in doubt, check all menus.

#### Display Set-up:

- Display Backlight: Yes
- Display Contrast: Set as required

#### Transducer Test / Ref. Sig.:

- Not Used

#### Battery Set-Up:

- Not Used – should be connected to AC power supply through B&K ZG400 supply

#### Serial Interface:

- Not Used

#### Self Test:

- As required.

### Setting up the Hardware

To assemble the B&K unit:

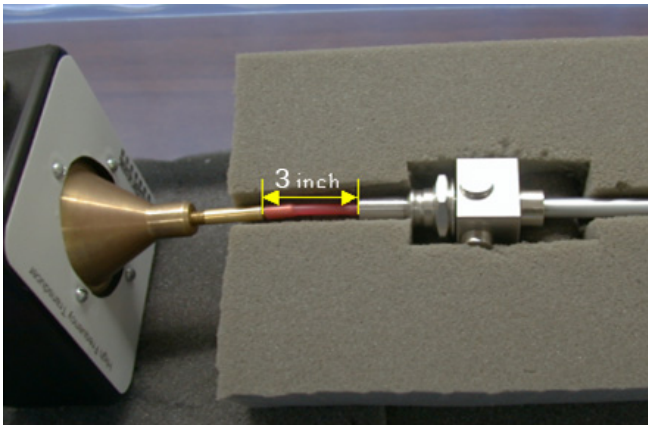
1. Put the DB-050 Canal Extension & Nut together and screw them into the Micro Acoustic Coupler.
2. Insert the Teflon Micro Gasket to the opposite side of the Coupler.
3. Insert the B&K 1/2" to 1/4" adapter on the Teflon Micro Gasket. The 'top' goes toward the Teflon Gasket.
4. Take the Symmetrical Protection Grid out of the microphone.
5. Carefully put the microphone into the Micro Acoustic Coupler Cavity.

# Calibration of High Frequency Transducers

To connect the USB system:

1. Install the USB system. Please refer to the USB Installation Manual for proper installation of the USB System.
2. Connect the Microphone from the Zwislocki coupler to the B&K Amplifier, via the Channel 1 Input.
3. A BNC cable is connected on one end to the Aux 3 input at the back of the USB DSP box and the other end to the Channel 1 Output at the back of the Bruel & Kjaer.
4. Make sure all connections are in place and the power is ON.

Before you start the calibration, you must connect the High Frequency Transducer to the Z-Coupler using a 3 inch silicon tube. Refer to the following figure for connection.

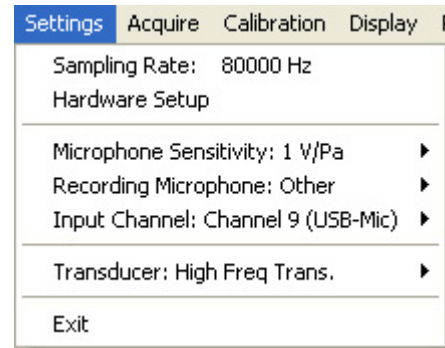


## Performing the Calibration

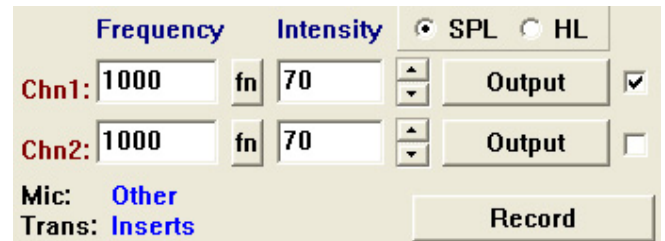
1. Start the IHS Launch pad and run the calibration module, by clicking on "System > Calibrate" from the main menu.
2. Enter your name and when prompted for a password, enter the system password. The default system password is 'ihs'.
3. After starting the calibration program make sure the following settings are selected. These settings are handled using the "Settings" menu tab on the Calibration Module. Use the following figure for reference

- o Microphone Sensitivity: 1V/Pa B&K

- o Recording Microphone: Other
- o Input Channel: Channel 9 (USB-mic)
- o Transducer: High Freq. Transducer



4. Go to the Acquire Menu and First Select the Max Freq. to 16000. Make sure the Sound Output Booster Box is set to DIRECT.
5. In the Control Panel, for each Channel set the following:
  - o Frequency: 1000Hz
  - o Intensity: 70dB SPL



6. Check the box next to the Output button for Channel 1 so that a continuous tone is output for the channel.
7. Click the Record button.
8. If all the connections are ok you should see a 1 KHz sinusoidal wave at the display window.
9. Now click the Multi-frequency button on the lower right corner to automatically record and display all frequencies up to the maximum that you have just selected.
10. Go to Results -> Print the Multi-Frequency table. The printed table will look similar to the following:

Multi-Frequency Calibration:	
Test Intensity	
SPL Calibration	
(Selected-Measure= Calibration)	
Click	: 80 - 84.82 = -4.82 80+ 0 = 80 - 84.82 = -4.82

# Calibration of High Frequency Transducers

125Hz	: 80 - 81.63 = -1.63	80+ 0 = 80 - 81.63 = -1.63
250Hz	: 80 - 82.03 = -2.03	80+ 0 = 80 - 82.03 = -2.03
500Hz	: 80 - 81.68 = -1.68	80+ 0 = 80 - 81.68 = -1.68
750Hz	: 80 - 81.82 = -1.82	80+ 0 = 80 - 81.82 = -1.82
1000Hz	: 80 - 82.13 = -2.13	80+ 0 = 80 - 82.13 = -2.13
1500Hz	: 80 - 88.06 = -8.06	80+ 0 = 80 - 88.06 = -8.06
2000Hz	: 80 - 82.33 = -2.33	80+ 0 = 80 - 82.33 = -2.33
3000Hz	: 80 - 80.54 = -0.54	80+ 0 = 80 - 80.54 = -0.54
4000Hz	: 80 - 85.09 = -5.09	80+ 0 = 80 - 85.09 = -5.09
6000Hz	: 80 - 82.18 = -2.18	80+ 0 = 80 - 82.18 = -2.18
8000Hz	: 80 - 83.55 = -3.55	80+ 0 = 80 - 83.55 = -3.55
10000Hz	: 80 - 89.57 = -9.57	80+ 0 = 80 - 89.57 = -9.57

And so on until 16000Hz.

- Now go to the Acquire Menu and change the Max Frequency to 32000.
- Switch the Sound Output Booster Box to High Pass Filter without moving the High Frequency Transducer
- Repeat Steps 9-10 for the new range.
- Please note that the responses at 16 kHz and below are not valid because we have turned on the High Pass filter Box.
- After printing the two Multi-Frequency Tables for Channel 1 go to "Calibration > Edit SPL Table".
- Select "High Freq. Trans." from the stimulator list and make sure the correct ear is selected, Right corresponds to Channel 1.
- Make sure the correct Serial Numbers and purchase dates are entered. The left stimulator field is in blue, the right in red.
- Enter the calibration date by clicking on the Today button
- Referring to the Multi Frequency table just printed out; make the corrections to the above SPL Table as shown in the following example.

## For Example consider the Click:

The original correction value is -32 dB SPL and the current correction value after calibration is -4.82 dB SPL; round up to -5 dB SPL. Hence the new correction value for the Click would be  $-32 - 5 = -37$  dB SPL. Update all the correction values up to 32 kHz in the SPL table using the technique discussed, remembering to use the values from the first table up to 16 kHz, and the values from the second from 16 kHz to 32 kHz.

The Maximum Outputs also need to be adjusted according to the correction values. Do so by selecting Maximum from the Values options and entering the corrected values. In our click example, if the current maximum is 125, then the new maximum would be 130. (note that this is an inverse to the correction values)

After making the adjustments to the SPL calibration table run the Multi-frequency test described above again in order to make sure that the frequency response is flat. Disconnect the Right Channel 1 HF Transducer and connect the Left Channel 2 HF Transducer. Repeat the procedure as outlined using Channel 2 as your output source.

Please note that IHS calibrates the system using the Zwislocki coupler, which simulates a 1.5cc cavity. We highly recommend that in order to ensure better accuracy for the type of testing that you perform; you should run the above test with a cavity that better simulates the cavity used for testing. You may also use this procedure to calibrate the 10B+ with High Frequency Transducers. If you use this procedure to calibrate the 10B+ with High Frequency Transducers make sure to set the stimulator correctly and to select the correct calibration table when adjusting the correction values.