INTELLIGENT HEARING SYSTEMS

Smart Notes

HF Transducer Calibration in Animal Ears using the 10B+

Introduction

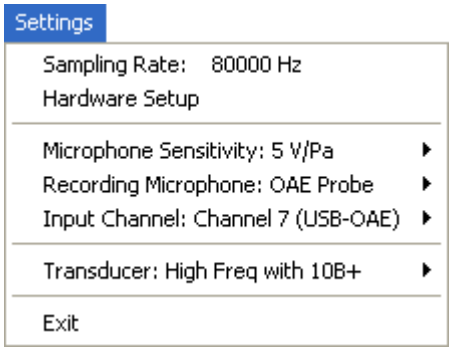
Since the High Frequency transducers are calibrated using a Z-coupler; the calibration values do not accurately reflect the values necessary to correct for an animal cavity. The actual correction values needed will vary from one type of animal subject to the next, due to the different size cavities. The application note on OAE testing at high frequency outlines the reasons for these correction values; while the application note on 10B+ Losses for High Frequencies shows the methodology of how those values are obtained. IHS performs the High Frequency T Calibration procedure for each system with a 10B+ probe microphone and High Frequency Transducers before it is shipped and provides you with a table for microphone corrections similar to the one that follows. Remember that these values vary across microphones and you should use the values IHS provided for your system's 10B+ microphone and not the sample values provided here.

Frequency	Value to be added to DPOAE Amplitudes in dB
14k	13
16k	15
18k	15
20k	6
22k	18
24k	18
26k	7
28k	2
30k	0
32k	6

Customizing the Calibration Table:

The actual values needed for correction will vary depending on the size of the cavity where the test is performed; size which varies greatly between research subjects such as mice, rats or birds. In order to create your calibration table you will need to assemble a sample of recordings from a few sets of ears, we recommend using at least a dozen ears.

1. From the launch pad main menu, start the Calibration Module by clicking on System > Calibrate
2. Enter your name when requested for the log, then enter the system password ('IHS' is the default system password)
3. Go to the Settings menu and select the following (see figure):
   a. Mic. Sensitivity: 5V/Pa SmartOAE
   b. Recording Microphone: OAE Probe
   c. Input Channel: Channel 7 (USB-OAE)
   d. Transducer: High Freq with 10B+ Probe



4. Go to the Acquire Menu and First Select the Max Freq. to 16000. Make sure your Sound Output Booster Box is set to DIRECT.
5. At the bottom of the screen, enter 70 as the intensity value for Channel 1 and make sure SPL mode is selected.
6. Mark the check box next to the Channel 1 speaker button to turn on the sound.

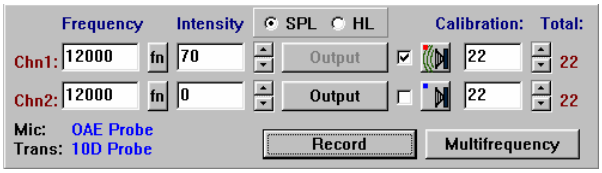


Figure 1 - Calibration Module Control Panel

7. Place the probe inside the animal's ear correctly sealed.

8. Then click the Multi-frequency button at the bottom right of the screen to record the responses.
9. Once done, go to the Results Menu and Select Print Table.
10. Now go to the Acquire Menu and change the Max Frequency to 32000.
11. Switch the Sound Output Booster box to High Pass Filter.
12. Make sure the probe is still in place (Do not move it if it is).
13. Repeat steps 5 thru 9. (Please note that the responses at 16 kHz and below are not valid because we have turned on the High Pass filter Box).
14. Repeat the entire procedure for Channel 2, printing all tables.
15. Label all these tables as Ear 1, for reference.
16. Repeat the process above for every ear you record to obtain the correct averages and label the tables accordingly.

Once you have a set of data for all ears with both transducers independently, you can start calculating the correction values. It may be easier to perform this operation in a spreadsheet program.

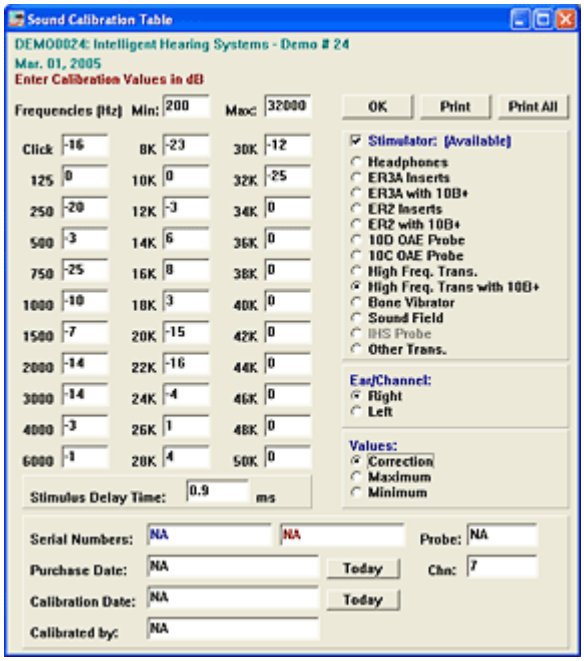
1. Create a spreadsheet and enter the frequency values in the first column as they appear on your printed reports, from 500 Hz to 32000 Hz.
2. Copy your data from the printed tables to your spreadsheet, using one column per ear-channel set. Keep in mind that for the values under 16kHz, you must enter the first set of data that was recorded up to that point; for values above 16 kHz, you must use the values acquired using the High Pass filter.
3. From all the acquired data, eliminate the highest value and the lowest value for each frequency. This is done to prevent abnormal data from affecting the calibration values.
4. Add the remaining values and obtain the average, dividing by the number of ears tested and rounding the result to the closest whole number. Keep in mind that we have taken a couple of values out, so you must adjust the averaging equation accordingly.

Frequency	EAR1CH1	EAR2CH2	SUM	AVG
6000Hz	-7	-9	-16	-8

5. The values from your table, up to 12 kHz, may not need to be adjusted since the frequency response of the 10B+ microphone is flat up to that point. However, for values 14kHz and above, you need to factor in the microphone losses by adding the loss to the recorded value

Frequency	AVG	10B losses	True HF Value
22000Hz	-10	18	8

6. Now, you need to apply the true correction value to your correction table. In your spread sheet, create a column with the factory provided correction values and another for the maximum output values for each ear, leaving an empty column in between each of those. The values can be obtained from the calibration module, open the calibration table by choosing Edit SPL Table from the calibration menu. Make sure to select High Frequency Transducers with 10B+ from the list of stimulators.



7. For frequencies from 500Hz to 12 kHz, if the average value is larger than 5dB in either direction, add the values to the right ear original correction (REOC) and apply it the right ear original maximum (REOM) as shown in the following table. Repeat the procedure for the left ear values. If the average value is less than 5dB, keep the correction values as they were.

Frequency	AVG	REOC	REMC	REOM	REMM
6000Hz	-8	-41	-49	127	135

Notice that the Maximum values are affected inversely as the correction values. In the example, the more negative correction allows the maximum to be incremented by the same amount; this occurs because the hardware can output a certain voltage level and adjusting the correction down leaves room for the maximum to be increased safely.

WARNING: Increasing the Maximum beyond safe levels may damage your system. Make sure you adjust the maximum and the correction accordingly.

8. For frequencies from 14 kHz and up, add the values obtained for the True HF value to the right ear original correction (REOC) and apply it to the right ear original maximum (REOM) as shown in the following table. Repeat the procedure for the left ear values.

Frequency	THF	REOC	REMC	REOM	REMM
22000Hz	8	-2	6	93	87

9. Once you have all your new modified values, you may enter them into your calibration table and save them as IHSSPL.CAL. These calibration values will apply for all the tests performed using IHS equipment, while using the 10B+ coupled with the High Frequency Transducers.
10. Make sure to print copies of the calibration table for your records.

Using the Calibration Table

If you only have one calibration table, the calibration values will be automatically used in all of the IHS programs you have installed. You may view the current values being used from the auditory stimulus generation window in SmartEP, or from the system information menu on SmartDPOAE.

If you test more than one type of research animal with different size cavities, you may need to create multiple calibration files for your system, one for each type of cavity. These calibration files will need to be loaded into the system as necessary, using the system calibration utility. To do this:

1. Save your calibration files with descriptive names for future reference, such as “Mouse-HF-Calibration.Cal” or “Bird-Calibration.CAL”.
2. When you are in need to change the calibration values, open the Calibration module as before.
3. Load the Calibration table you need to use by choosing “Calibration > Load SPL Table” from the main menu.
4. Save the loaded table as IHSSPL.CAL using the “Calibration > Save SPL Table” option from the main menu.

It is recommended to keep hard copies of all calibration files that you generate for safe keeping. Try to limit the number of users that have access to the calibration tables. You should backup your calibration files to a safe place in your hard drive.