Listen

Transforming Sound into Knowledge

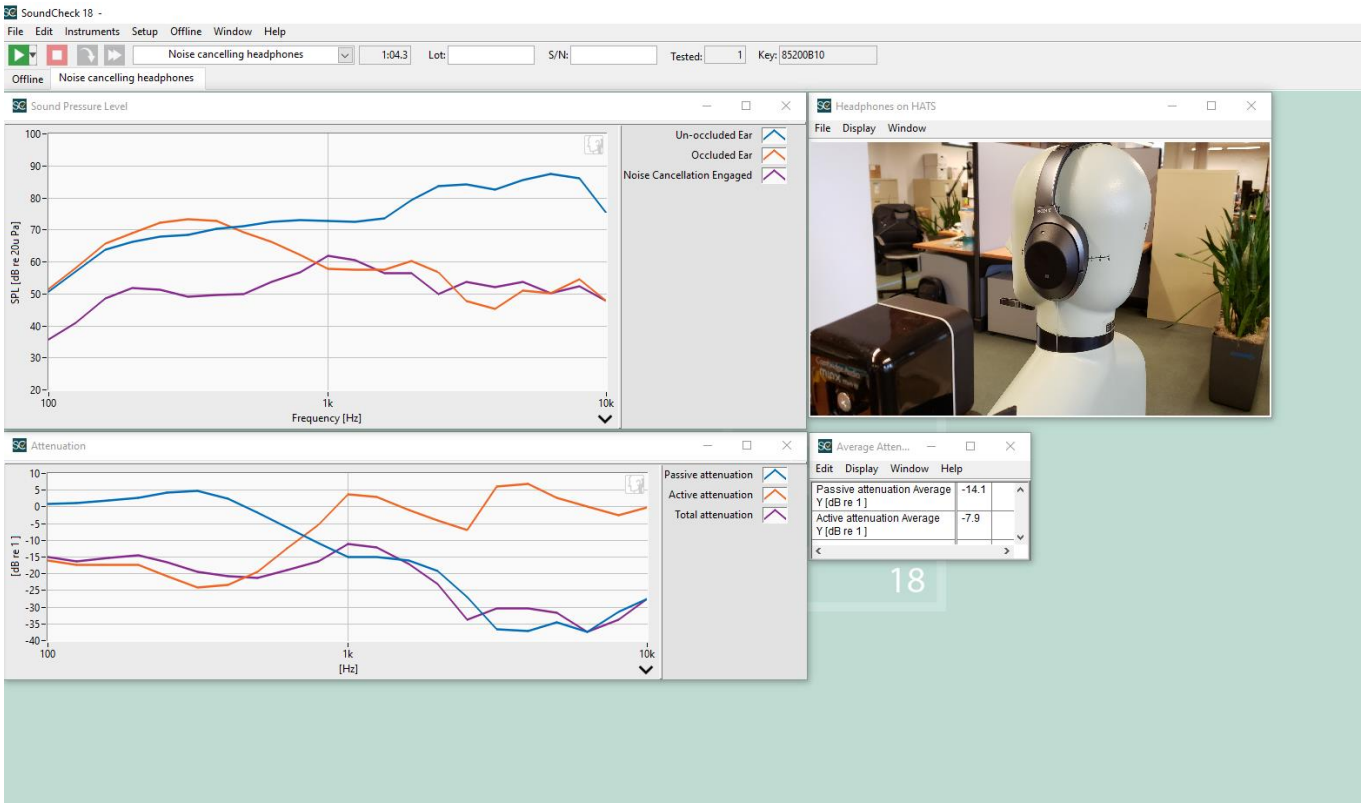
Sequence Note

Noise Cancelling Headphones

Introduction

When measuring noise cancelling headphones there are three important pieces of data to collect. Passive Attenuation is the amount of noise that is reduced at the ear simply by the headphones being worn. Active Attenuation is the amount of noise that is further reduced by turning on the device's active cancellation circuits. Lastly, Total Attenuation is the combined reduction in noise from passive and active sources and is what the end user of the product will experience.

To calculate these metrics this sequence performs three separate measurements using a Head and Torso Simulator and a small speaker which serves as a noise source. The alternative to using the small speaker would be to use a diffuse background noise environment with multiple speakers playing uncorrelated noise. This is a far more complicated arrangement and would require additional steps in the sequence.



Final display results of the measurements

The sequence begins with an option to load example data from disk. If the user selects 'No' a message will appear instructing the user to leave the HATS ears open with no headphones in place. A 10 second pink noise signal is played through the loudspeaker, and the signal at the HATS ear is analyzed with an RTA analysis step. This 1/3rd octave spectrum is called the un-occluded ear measurement. Next the user is prompted to place the headphones on the HATS but leaves the noise cancellation turned off. The pink noise signal is once again played, and the RTA spectrum is called the Occluded Ear measurement. Finally, the user is instructed to turn on the headphones noise cancellation, and a third round of the pink noise is played. This final RTA spectrum is called Noise Cancellation Engaged.

These three measurements comprise the raw data in dBSPL versus frequency. Since the speaker has not been calibrated, these spectra will include the response of the speaker. This is not a problem, as the attenuation parameters are all relative calculation based on the three measurements. Passive Attenuation is the difference between the occluded and un-occluded measurements; Active Attenuation is the difference between the Occluded ear and noise cancellation engaged measurements. Total Attenuation is the difference between the Un-occluded ear measurement and the noise cancellation engaged measurement.

Two graphs are displayed at the end of the sequence showing both the three original measurements and the three calculations derived from the measurements. A table also displays the average of the Passive and the Active Attenuation curves.

Software Requirements

- SoundCheck 18
- p/n 2017 - Stimulus editor
- p/n 2005 – RTA
- p/n 2004 – Post Processing

Hardware Requirements

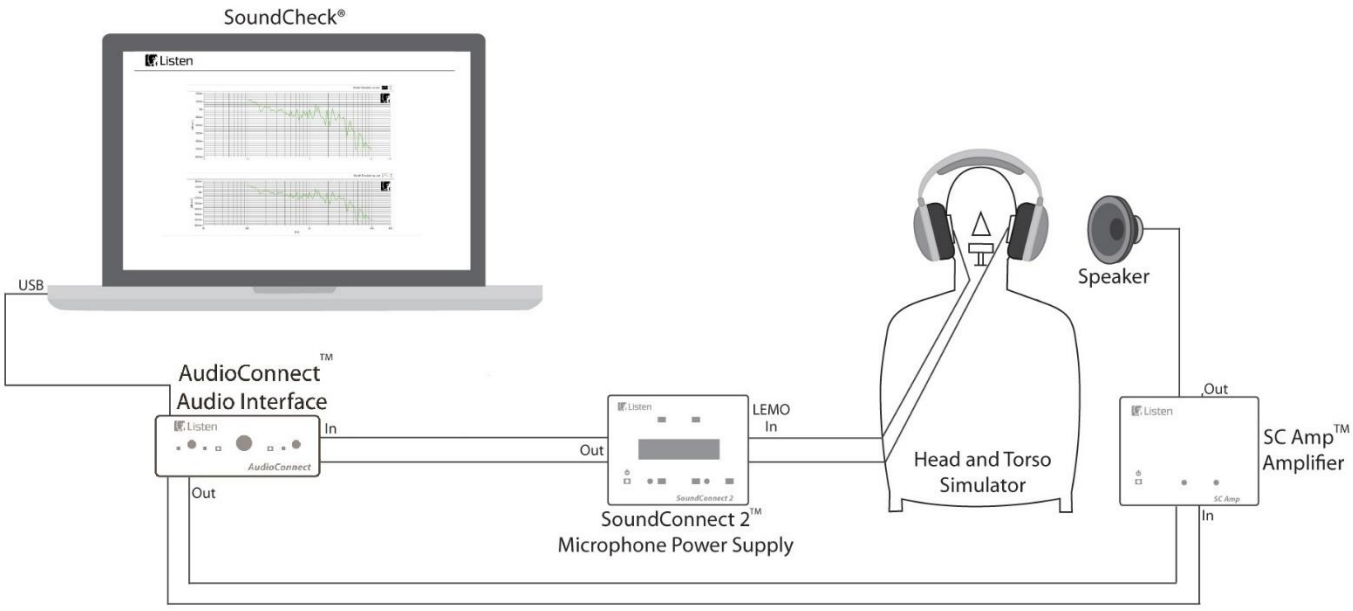
- HATS (B&K 4128 or equivalent)
- AmpConnect p/n 4042 or AudioConnect(4050)
- SCAmp(4060) or equivalent power amplifier
- Small full range loudspeaker

Hardware Setup & Calibration

1. Calibrate the amplifier as instructed in the SoundCheck manual.
2. Calibrate the HATS ear as instructed in the SoundCheck manual.
3. Connect output 1 of your audio interface to the input of the amplifier.
4. Connect the output of the amplifier to your loudspeaker.
5. Position your HATS ear about 1 foot away from the loudspeaker, and connect it to the microphone power supply input
6. Connect the output of the mic supply to the input 1 of your audio interface

You are ready to start the sequence.

System diagram



Sequence Logic

Type	Step Name	#	Out	In	
Mes	Recall data	1			
Rec	Recall curves	2			
Mes	Unoccluded ear	3			
Sti	Pink Noise	4	Amp Ch 1		
Acq	Play & Record	5	Amp Ch 1	HATS Ear L	// Measures un-occluded ear
Ana	RTA	6			
Lim	Test for Signal	7			
Mes	No Acoustical Signal	8			
Mes	Occluded ear	9			
Acq	Play & Record	10	Amp Ch 1	HATS Ear L	// Measures occluded ear
Ana	RTA	11			
Mes	Noise cancelling circuit on	12			
Acq	Play & Record	13	Amp Ch 1	HATS Ear L	// Measures with Active Noise Cancellation engaged
Ana	RTA	14			
Com	comment	15			// The post processing steps below calculate attenuation parameters from either the recalled data or the measured data.
Pos	Curve division	16			// Calculate Passive Attenuation
Pos	Curve Average	17			
Pos	Curve division	18			// Calculate Total Attenuation
Pos	Curve division	19			// Calculate Active Attenuation
Pos	Curve Average	20			
Dis	Noise cancelling headphones	21			

Further sequence development

Ways in which you could modify or further develop the sequence include:

- If the loudspeaker serving as the noise source has a relatively flat output, you could calibrate the speaker itself and equalize the noise so that the RTA spectrum at the ear is flat for the un-occluded measurement.
- The entire setup could be modified to work with a diffuse, multi-speaker configuration
- In a diffuse environment or with two speakers, both ears could be measured at the same time(the above suggestion would require a multi-channel amplifier or powered speakers.
- Increase the resolution of the RTA steps (6, 11, 14) to see more detail in the response of the measurements