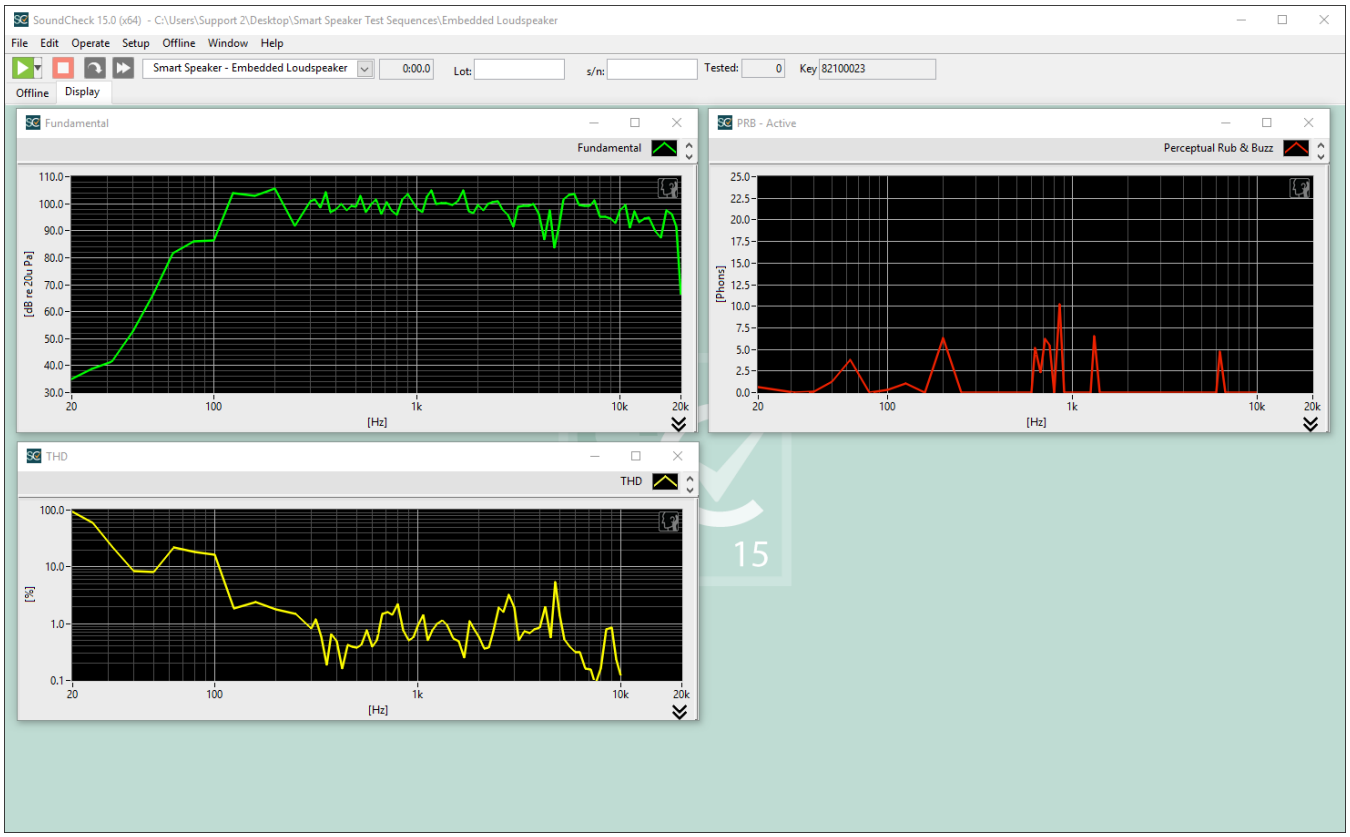
Smart Speaker – Embedded Loudspeaker Test Sequence

Introduction

This sequence demonstrates a method by which SoundCheck can measure the performance of a loudspeaker embedded in a so-called “smart speaker”. This example assumes that the DUT is an Amazon Echo but it can be adapted for use with virtually any other type of smart speaker by substituting the Echo’s voice activation phrase audio file (“Alexa, play Test Signal One”) with one specific to the desired make and model.

The sequence begins by playing the voice activation phrase out of a source speaker, prompting the DUT to playback the mp3 stimulus file from the cloud, followed by a pause step to account for any activation latency. Following the pause, a triggered record step is used to capture the playback from the DUT. The Recorded Time Waveform is then frequency shifted prior to analysis and the results (Frequency Response, THD and Perceptual Rub & Buzz) are shown on the final display step.

We recommend reading the AES paper referenced at the end of this note prior to continuing as it contains additional details on the test methods devised for this sequence.



Final display for *Smart Speaker – Embedded Loudspeaker* Sequence

Software Requirements – SoundCheck Basic or Above

- SoundCheck 15.0
- 2004 - Post Processing

Hardware Requirements

- Listen AudioConnect audio interface part #4050 or similar
- Listen SCM-3 reference microphone part #4002 or similar
- Calibrated mouth simulator or source speaker
- Listen SCAmp audio test amplifier part #4060 or similar (not needed if mouth/speaker is self-powered)

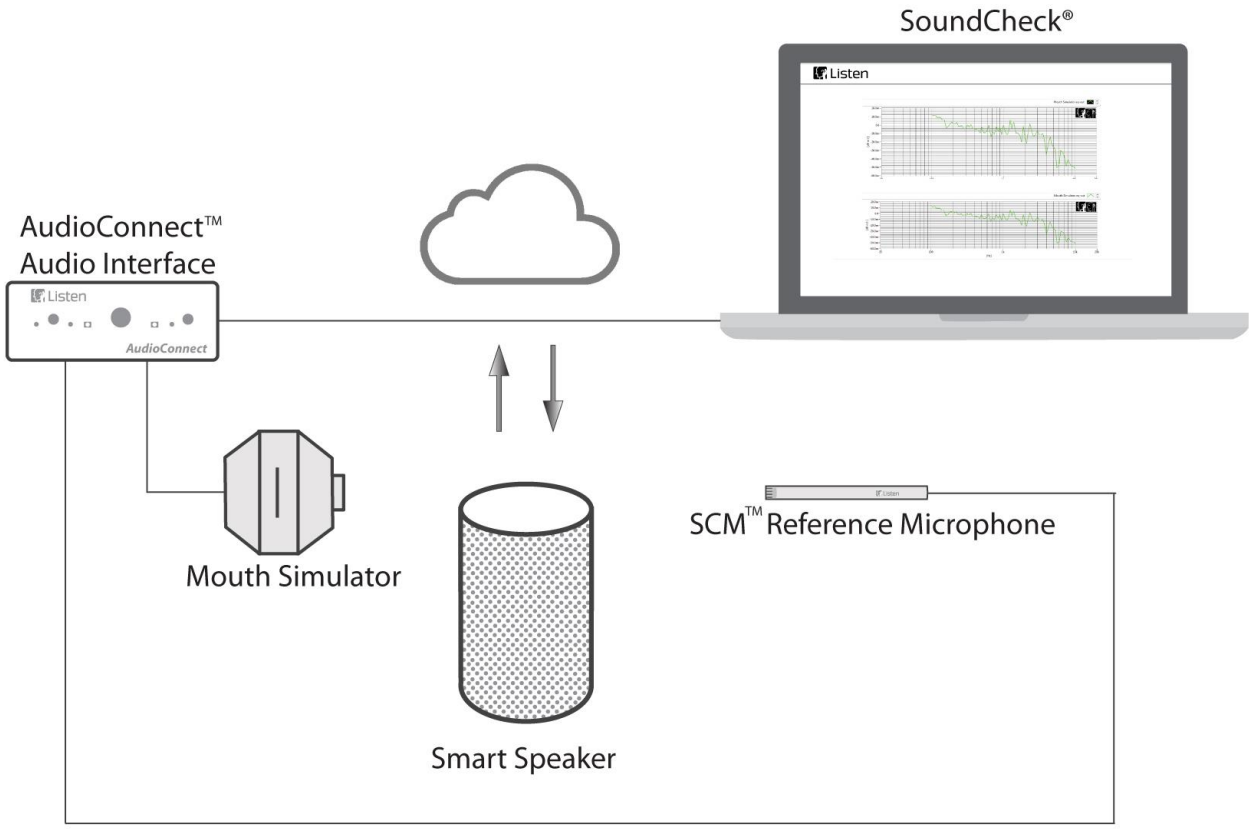
Hardware Setup & Calibration

- Calibrate the reference microphone per the instructions in the SoundCheck manual
- Calibrate the mouth or source speaker per the instructions in the SoundCheck manual
- Set up the hardware per the system diagram below

Setup – Other

- Upload the *Test Signal 1.mp3* file from this sequence's source folder to the DUT's cloud storage music folder

System Diagram



Sequence Logic

Type	Step Name	#	Out	In	Comment
Sti	WAV	1	Source Speaker		// DUT activation WAV - "Alexa, play test signal one"
Sti	Open Loop Stweep	2	Direct Out 1		// Test stimulus with 1 kHz pilot tone
Acq	Play & Record	3	Source Speaker	Reference Mic	// Plays DUT activation WAV from Source Speaker
Mes	Pause	4			// Pause step for DUT activation latency
Acq	Triggered Record	5		Reference Mic	// Records output of DUT test stimulus playback
Pos	Frequency Shift	6			// Corrects for clock frequency differences between SC hardware and DUT
Ana	HarmonicTrak	7			// Analysis
Dis	Display	8			// Display

Notes:

1. Step 1, WAV – Default activation phrase is for Amazon Echo. If testing another device, replace this WAV file with one containing the proper command phrase for the make/model of your DUT. The WAV sample rate is 44.1 kHz so you will need to resample if your Output Channel sample rate is different.
2. Step 2, Open Loop Sweep – This default stimulus has been converted and saved as the Test Signal 1.mp3 file. If you change any of the default parameters, a new Test Signal 1.mp3 file should be created by first exporting the stimulus in WAV format and then converting it to mp3 using a 3rd party program such as Audacity.
3. Step 4, Pause – Default value is 5 seconds. It may need to be adjusted to compensate for the specific delay characteristic of your DUT between the end of the activation phrase and start of stimulus playback.
4. Step 5, Triggered Record – Default value is 5 Pa. It may need to be adjusted to properly trigger from the playback level of your DUT.

References

1. Glenn Hess et al., "Challenges of IoT Smart Speaker Testing", presented at the AES 145th Convention, October 2017.