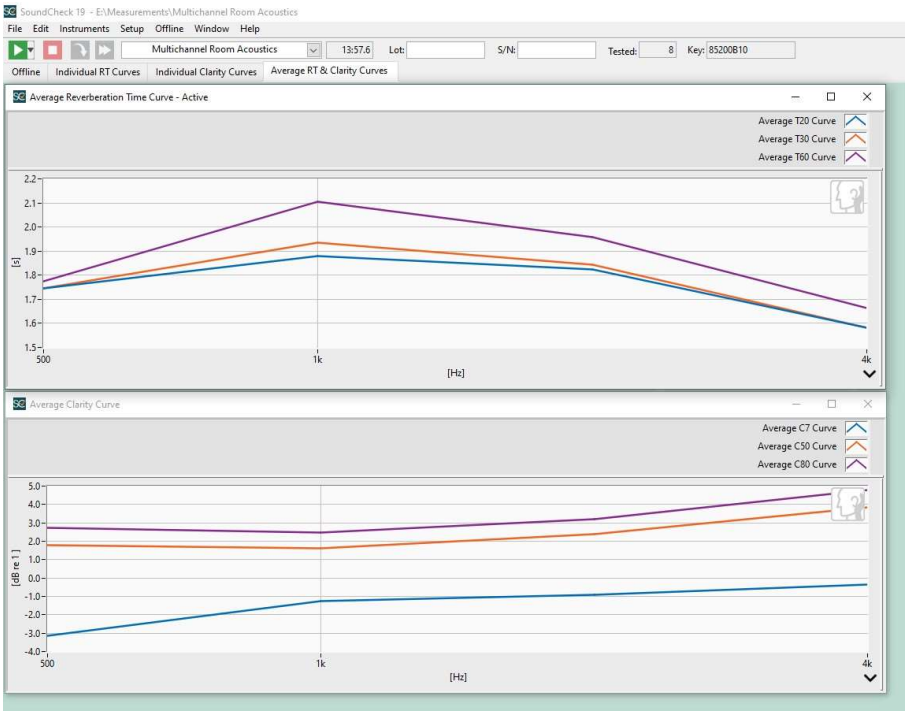
Room Acoustics: Multichannel Reverberation Time and Clarity

Introduction

This sequence measures reverberation time and clarity of a room using multiple microphones to accurately characterize measurement environments. This is important for smart device testing as measurements of both speech recognition and audio output often need to be made in fully characterized rooms with known reverberation times and clarity. The method used in this sequence is fast, accurate, and made using fully calibrated signal paths.

Reverberation time is the time taken for a sound to decrease from first onset to inaudibility. Clarity represents the decibel ratio of the sound energy in a short period at the beginning of an acoustical event to the overall energy in the event. Clarity can simply be understood as the absence of too much smearing of sounds together. The SoundCheck room acoustics module makes it easy to generate reverberation time and clarity measurements including T20, T30, T60 and C7, C50, C80.

A Log Sweep from 250Hz – 15kHz is played through an omni-directional source in the room under test and four microphones measure the impulse responses generated. These waveforms are analyzed using the Time Selective Response and room acoustics algorithm. The room acoustics analysis is configured for 1/1 octave resolution. Rules regarding the setup of the stimulus and the output of the room acoustics module can be found in the manual. Results are shown on separate display tabs for the individual microphone locations as well as the average for the room. Room acoustics values are calculated using the integrated impulse response method according to ISO 3382-1:2009; further details about the measurement technique are included in the SoundCheck manual.



Final output display of room acoustics sequence

Hardware Requirements

- Listen AmpConnect 621(PN 4046) or other multichannel interface with 4+ inputs
- Amplifier(if not included in speaker or integrated into audio interface) * Not required if using AmpConnect 621
- 4x SCM 3 Reference microphones or similar measurement microphone (PN:4002)
- B&K 4292-L Omnidirectional source speaker or equivalent
- B&K 4231 calibrator or equivalent

Software Requirements

- SoundCheck 19 or later
- Module P/N 2006 - Time Selective Response
- Module P/N 2050 – Room Acoustics RT60

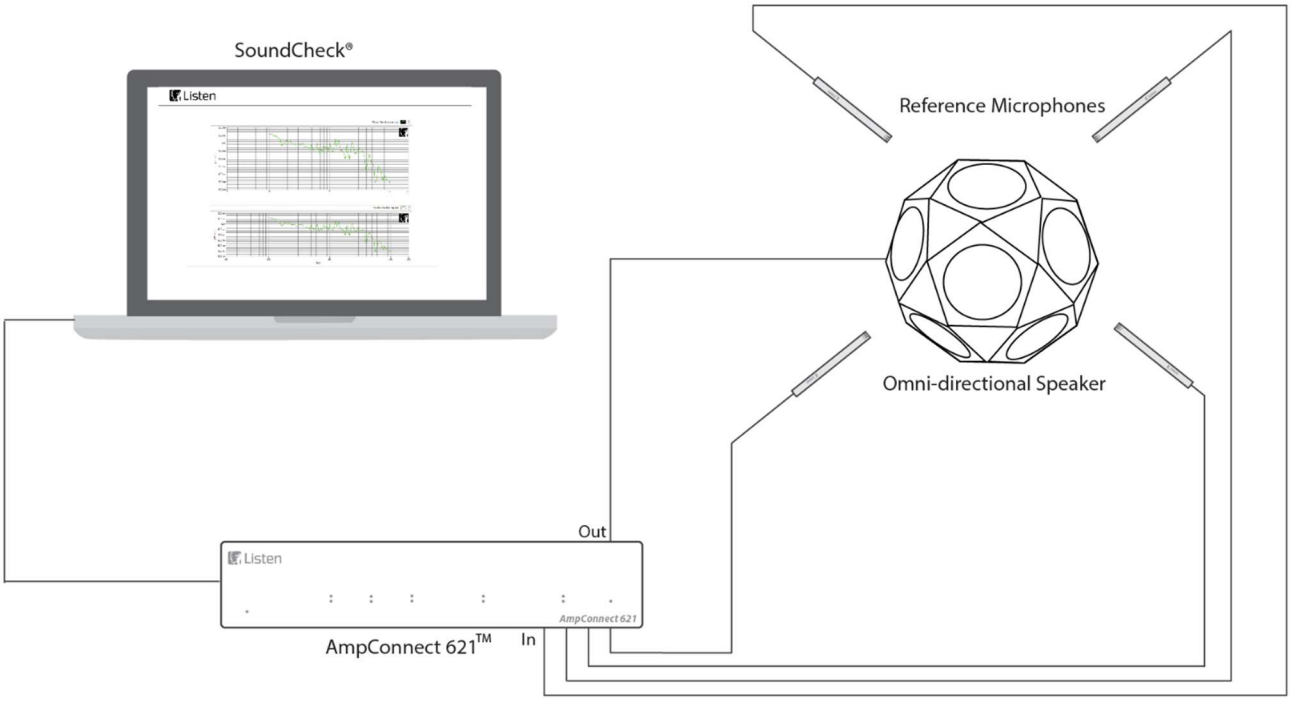
Hardware Setup & Calibration

1. Calibrate the amplifier according to the directions in the SoundCheck manual
2. Connect the output of the amplifier to the loudspeaker
3. Connect the SCM microphone to inputs 1-4 of the AmpConnect 621 using an adequate cable length for your measurement space
4. Calibrate the microphones according to the instructions in the SoundCheck manual
5. Place the loudspeaker and microphones in the positions of the respective source and listening positions you wish to emulate. Refer to ISO 3382-1:2009 for specific instructions depending on the type of space you are trying to measure.

Note: There is an AmpConnect 621 message step at the beginning of the sequence that is used to configure the first 4 inputs for use with SCMs and enable audio output from the first BNC output. This can be removed if you are using a different interface.

You are ready to start the sequence.

System diagram



Sequence Logic

Type	Step Name	#	Out	In
Mes	AmpConnect 621	1		
Mes	Operator Dialog	2		
Rec	Recall demo curves	3		
Mes	Enter Test Level	4		
Sti	TSR log sweep	5	Source Speaker	Mic 1 Mic 2
Acq	Play & Record	6	Source Speaker	Mic 3 Mic 4
Ana	Room Acoustics	7		
Pos	Average T20 Curve	8		
Pos	Average T30 Curve	9		
Pos	Average T60 Curve	10		
Pos	Average C7 Curve	11		
Pos	Average C50 Curve	12		
Pos	Average C80 Curve	13		
Dis	Individual RT Curves	14		
Dis	Individual Clarity Curves	15		
Dis	Average RT & Clarity Curves	16		

Further sequence development

This sequence has been designed to be easy to use while still outputting a variety of data. Modification possibilities include:

- Add display steps to observe the impulse response waveforms and backwards integrated impulse response for more insight into the room behavior.
- Modify the sequence to use more microphones.
- Double the Sweep Rate of the stimulus to increase the signal to noise ratio if you are having trouble achieving a T60 value. If you do so, make sure you also adjust the Windowing in the Time tab of the analysis step accordingly.