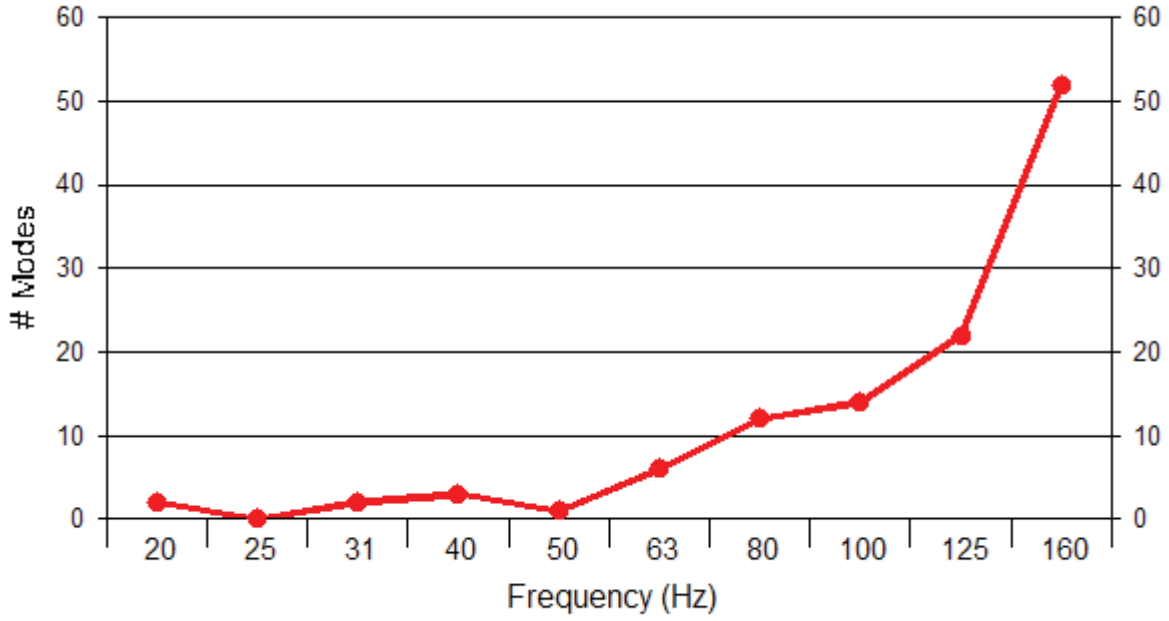
The Dimensions of Your Room

Mode Analysis Report

Understanding the acoustical nature of your listening room begins by analyzing the dimensions. While room dimensions should not be used solely to determine the suitability of a room for quality sound reproduction, room dimensions can reveal some potential problems. Good sound is possible in any room, even a room displaying poor modal distribution. Achieving good sound becomes a more challenging task though when the room dimensions do not evenly support all bass 1/3 octaves. In this analysis we focus on discovering which bass frequencies resonate in the room.

Resonant frequencies, called modes, are present in every room. Our first goal is to find out what modes are at work, we then begin learning if we can expect a neutral sounding room or a room injecting its own imprint on all of our music. Achieving uniform modal distribution means that the spacing between modes is relatively even with each 1/3 octave band occupied by a mode. Uneven modal distribution means that there are either too many or not enough modes in some of the 1/3 octave bass bands. This "mode analysis" uses the "Modes per 1/3 Octave" chart combined with a detailed modal calculation to analyse predicted bass smoothness. Use both to gain an idea of your rooms true modal character.

Modes per 1/3 Octave



Scenario: Height: 7.08 ft Width: 18.92 ft Length: 27.00 ft

Bands based upon standard spacing

Dimensional Analysis Plot: This simple looking graph reveals much about the sonic character of your room. Mathematically, it is a graphical representation of the total number of modes which occur in your room per fraction of an octave. This graph illustrates that the room uniformly creates bass modes when each successive fraction of an octave contains an equal or an increasing number of modes as the previous. Translation, a good room has modes in every 1/3 octave. A desirable dimensional analysis curve shows each band level always increasing or at least remaining constant. Any decrease in the number of modes, a retrograde sloped increment, indicates a frequency band without the proper modal support. In most cases, this causes some problems in achieving smooth bass, but depending on the scenario, it can be a significant nuisance. This is the real secret to a good room dimension ratio; Seeing how the height, width, and length effect the modal distribution by displaying this curve and by understanding modal coincidences. Modal Coincidences: A well designed room uses dimensions that do not create multiple modes at or near the same frequencies. While room modes are beneficial by enhancing low frequency energy in a room, coincident modes exagerate this enhancement at specific frequencies. Our target is to have the enhancement of bass to occur at many frequencies evenly. We therefore want to minimize the number of coincident modes, particularily at the very low frequencies below 100 Hz. Modes that are coincident are marked by an "X" on the Mode charts.

mode analysis continued from previous page

Axial Modes

Freq (Hz)	p	q	r	Type	Wave(ft)	Spacing	Coin
20.90	1	0	0	Axial	54.08		
21.70	1	0	0	*Axial	52.07	0.04	X
29.83	0	1	0	*Axial	37.88	0.27	
29.83	0	1	0	Axial	37.88	0.00	X
41.79	2	0	0	Axial	27.04	0.29	
43.40	2	0	0	*Axial	26.04	0.04	X
59.66	0	2	0	*Axial	18.94	0.27	
59.66	0	2	0	Axial	18.94	0.00	X
62.69	3	0	0	Axial	18.03	0.05	
65.10	3	0	0	*Axial	17.36	0.04	X
79.64	0	0	1	*Axial	14.19	0.18	
79.64	0	0	1	Axial	14.19	0.00	X
83.59	4	0	0	Axial	13.52	0.05	
86.80	4	0	0	*Axial	13.02	0.04	X
89.49	0	3	0	*Axial	12.63	0.03	X
89.49	0	3	0	Axial	12.63	0.00	X
104.48	5	0	0	Axial	10.82	0.14	
108.50	5	0	0	*Axial	10.41	0.04	X
119.32	0	4	0	*Axial	9.47	0.09	
119.32	0	4	0	Axial	9.47	0.00	X
125.38	6	0	0	Axial	9.01	0.05	
130.21	6	0	0	*Axial	8.68	0.04	X
146.27	7	0	0	Axial	7.73	0.11	
149.14	0	5	0	*Axial	7.58	0.02	X
149.14	0	5	0	Axial	7.58	0.00	X
151.91	7	0	0	*Axial	7.44	0.02	X
159.28	0	0	2	*Axial	7.09	0.05	
159.28	0	0	2	Axial	7.09	0.00	X
167.17	8	0	0	Axial	6.76	0.05	
173.61	8	0	0	*Axial	6.51	0.04	X
178.97	0	6	0	*Axial	6.31	0.03	X
178.97	0	6	0	Axial	6.31	0.00	X
188.07	9	0	0	Axial	6.01	0.05	
195.31	9	0	0	*Axial	5.79	0.04	X
208.80	0	7	0	*Axial	5.41	0.06	
208.80	0	7	0	Axial	5.41	0.00	X
208.96	10	0	0	Axial	5.41	0.00	X
217.01	10	0	0	*Axial	5.21	0.04	X

All Modes

Freq (Hz)	p	q	r	Type	Wave(ft)	Spacing	Coin
20.90	1	0	0	Axial	54.08		
21.70	1	0	0	*Axial	52.07	0.04	
29.83	0	1	0	*Axial	37.88	0.27	
29.83	0	1	0	Axial	37.88	0.00	X
36.42	1	1	0	Tangential	31.03	0.18	
41.79	2	0	0	Axial	27.04	0.13	
43.40	2	0	0	*Axial	26.04	0.04	
51.35	2	1	0	Tangential	22.01	0.15	
59.66	0	2	0	*Axial	18.94	0.14	
59.66	0	2	0	Axial	18.94	0.00	X
62.69	3	0	0	Axial	18.03	0.05	
63.21	1	2	0	Tangential	17.88	0.01	
65.10	3	0	0	*Axial	17.36	0.03	
69.42	3	1	0	Tangential	16.28	0.06	
72.84	2	2	0	Tangential	15.51	0.05	
79.64	0	0	1	*Axial	14.19	0.09	
79.64	0	0	1	Axial	14.19	0.00	X
82.34	1	0	1	Tangential	13.72	0.03	
83.59	4	0	0	Axial	13.52	0.01	
85.04	0	1	1	Tangential	13.29	0.02	
86.54	3	2	0	Tangential	13.06	0.02	
86.80	4	0	0	*Axial	13.02	0.00	X
87.57	1	1	1	Oblique	12.90	0.01	
88.75	4	1	0	Tangential	12.73	0.01	
89.49	0	3	0	*Axial	12.63	0.01	
89.49	0	3	0	Axial	12.63	0.00	X
89.94	2	0	1	Tangential	12.56	0.01	
91.89	1	3	0	Tangential	12.30	0.02	
94.76	2	1	1	Oblique	11.93	0.03	
98.76	2	3	0	Tangential	11.44	0.04	
99.51	0	2	1	Tangential	11.36	0.01	
101.35	3	0	1	Tangential	11.15	0.02	
101.68	1	2	1	Oblique	11.11	0.00	X
102.69	4	2	0	Tangential	11.00	0.01	
104.48	5	0	0	Axial	10.82	0.02	
105.65	3	1	1	Oblique	10.70	0.01	
107.93	2	2	1	Oblique	10.47	0.02	
108.50	5	0	0	*Axial	10.41	0.01	

System Performance Report Card

Acoustical Analysis Report

HAA Acoustic Performance Review for Home Theater

HAA definition of a System: The chain of components from source through amplification, speakers and finally including the last critical link in the chain; the listening room. All are part of the final performance picture and are integral components of the system. This analysis report focuses on the room component of the system and how well the other components are integrated into balanced properly designed home theater.

This section of your report represents the cumulative scoring of the acoustical performance of your home theater in the five sound quality categories. Achievement of these goals defines success in a properly designed system. It's important to note that a complete picture of sound quality is only attainable by the completion of the entire Acoustic Performance Review process including both the Design and Calibration checklists. Design problems outlined during the ADR may be minimized by a detailed calibration during the ACR process. Achievement of a perfect score is rare.

Clarity

Initial Score: C Final Score: Inc

Clarity is the prime acoustical quality because its perfection depends on the successful attainment of all other goals. Of paramount importance is dialogue intelligibility in movies, but one must be able to understand musical lyrics, detect quiet background details, and sense realism for acoustical sounds. Elements that affect this goal are varied including equipment quality, room reverberation levels, ambient noise levels, and listener position among others. Clarity is paramount in defining the performance of a home theater system.

Focus

Initial Score: C Final Score: Inc

The ability to precisely locate each reproduced sonic cue or image in a three-dimensional space is defined as acoustical focus. Recordings contain many such images superimposed side to side and front to back in every direction for 360 degrees around the listener. A system is said to have pin-point focus if, from the perspective of the listener, each of these images is properly sized, precisely located, and not wandering. Good focus also provides that individual images be easily distinguishable from amongst others within the limits of the recordings quality.

Envelopement

Initial Score: B Final Score: Inc

An audio system should reproduce virtual images of each recorded sound presenting the listener with its apparent source location in a three-dimensional space. Each sonic image relates a part of the recorded event and together these sounds compose a wrap-around soundstage that envelopes the listener. Proper envelopment requires that the soundstage be seamless for 360 degrees without interruption by holes or hot spots caused by speaker level imbalance or poor placement. While envelopment requires three-dimensional imaging of all sonic cues, of pivotal importance is the realistic recreation of the ambient sound field of the recorded venue. Focused sounds become more realistic as they move side to side and front to back with the backdrop of the ambient sounds of the intended venue.

Dynamics

Initial Score: C Final Score: Inc

Dynamics is simply defined as the difference between the softest and loudest sounds reproducible by a sound system. While much emphasis is placed on the loudness side, it can be shown that the audibility of the softest sounds is an equal measure of system performance. Among the acoustical requirements for proper envelopment, focus and clarity is the necessity of hearing the sonic cues relating these qualities. If they are overwhelmed by excessive ambient noise or reverberation in a room, they are not properly audible. At a minimum, a system must be capable of reproducing loud passages with ease and without excess while soft sounds remain easily audible.

Response

Initial Score: C Final Score: Inc

The frequency response of a system is a measurement of the relative levels of all reproduced audio frequencies. The smoothness of response can be observed in a variety of ways; as improper tonal balance including boomy bass, excessive treble, improper musical timbre, or a general lack of realism. Factors of importance include selection of high quality components, and proper system set-up including (in a small room) proper listener position, speaker position, and correct use of equalization. At a minimum, the system must be non-fatiguing all sound levels, articulate and faithful to the original signal.

The Design of Your System

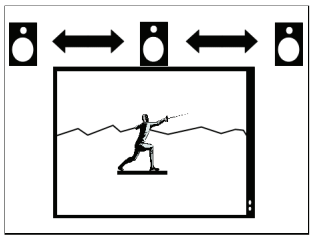
Acoustical Analysis Report

Acoustic Design Review (ADR) continued from previous page

Element *3*

Front center speaker should be centered between left and right front speakers on center axis with primary listening position.

Score: **A**

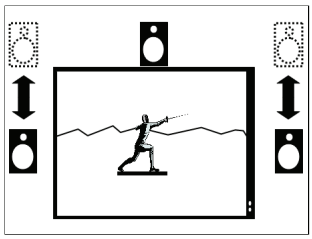


The placement of the center speaker midway between the right and the left has more than a visual benefit. The recreation of the original post production soundstage requires the duplication of the original monitor alignments. Proper placement of images within the soundstage for video alignment and sonic accuracy depends on this symmetry. Also, one of the center channels prime goals is to allow a correct perspective of the soundstage for all listeners even if off axis out of the so-called sweet spot.

Element *4*

Front LCR speakers are placed at similar height (+/- 2 feet between tweeter/midrange center point).

Score: **A**

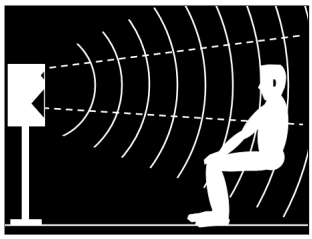


Humans hear sound differently depending on the height of the sonic source. Speakers placed a different heights will present different apparent tonal qualities and thus provide a discontinuity across the soundstage. In worst cases, the imaging is all but destroyed. One of the requirements of a well matched audio system is tonal matching of speakers. Failure to keep the presentation height of the front channels similar defeats this important goal.

Element *5*

Front LCR speakers tweeter/midrange center point is positioned near the listeners ear level.

Score: **A**

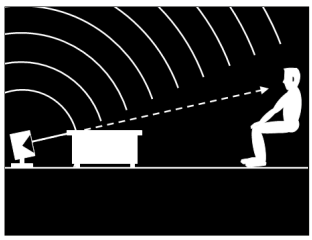


The most accurate presentation of sound for most speakers occurs when the acoustical center of the speaker is positioned at ear level. Extreme positions above and below ear level are considered less than optimal. The result is that listeners listen to the off-axis sound of the speakers where response is often sub-par. Extreme deviations such as speakers placed near the ceiling or floor can be acceptable, though not optimal, if the speakers are properly angled down/up toward the listener's ears.

Element *6*

Front center speaker is visible from all listening locations (unobstructed direct sound), accepting any acoustically transparent coverings.

Score: **B**



The direct sound of a speaker contains the essence of focus, and clarity. These are two qualities customers pay dearly for when purchasing high end audio gear. Blocking speakers from visual view also blocks its direct sound. Listeners hear indirect reflections and are not experiencing the highest levels of clarity. The speaker must have a clear path to all listeners' ears to provide even a minimal level of performance.

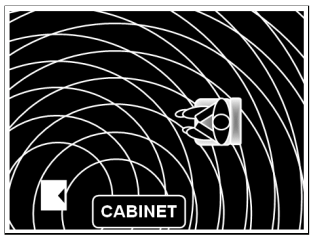
RECOMMENDATION: Make sure granite coffee table is not blocking center channel since it will need to be placed below the screen near the floor angled up toward listeners.

Element *19*

Front LCR speaker sound paths are unobstructed, clear of furnishings or objects other than the walls within 180 degrees and 4 feet of speaker face.

Score: **A**

The presentation of sound from the Left, Center, and Right (LCR) speakers if balanced and undistorted creates a three-dimensional soundstage for the audience. Reflections of sound from walls or nearby object act to disrupt the accuracy of that presentation. Objects, furnishings, and even plants act to create diffraction ripples in the waves even if not completely blocking the direct sound path. An open and uncluttered area between the speaker and the listener is best.

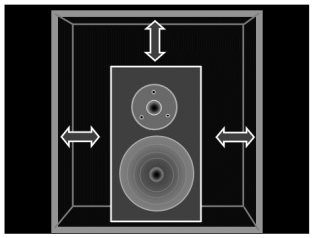


Element *20*

Front LCR speakers are not placed inside of encasements or enclosures or steps have been taken to sufficiently control resonance and diffraction.

Score: **A**

Any cubby holes or enclosures present in a sound room create opportunities for resonance. Installing a speaker inside such a cavity simply accentuates the problem. Speakers have finely tuned response curves that become heavily distorted when emitting sound from within such an encasement. Deadening the air space with sound absorbing material or isolating the front drivers from the encasement by an air tight baffle will significantly reduce unwanted resonance. In addition, at no time is it appropriate to use rear ported or rear firing speakers in such an enclosure.

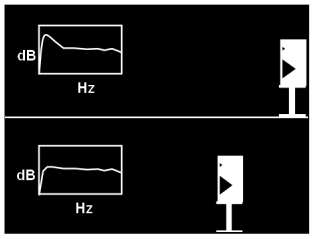


Element *21*

Front LCR speakers are set away from the rooms walls or response is optimized for near wall/ceiling installation internally or by equalization.

Score: **A**

The phenomenon known as "Boundary Gain" results from placing a low frequency speaker near a solid wall. It results in the accentuation of low frequency sound energy. In-wall speakers, box speakers built into walls and speakers pushed against walls are subject to the effect. In many cases, speaker manufacturers design response compensation into the speaker's crossover. In other cases, the speaker must be pulled away from the wall or electronically equalized to correct this response distortion.

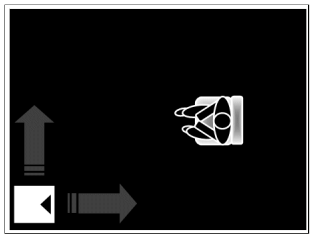


Element *22*

Subwoofer(s) placement allows for positional equalization techniques and/or parametric equalization is employed to smooth response.

Score: **B**

Uneven bass response means too much or too little bass at various frequencies and often simultaneously different responses for each listener in the room. This distortion results in a lack of articulation and clarity and at worst, the result is often fatiguing. In either event, it ruins the performance potential for a high end sound system. Optimizing the location of the speaker and listener in the room and the correct use of parametric equalization is the key to solving the problem.



RECOMMENDATION: May need to employ additional parametric equalization to deal with rigid boundary walls.