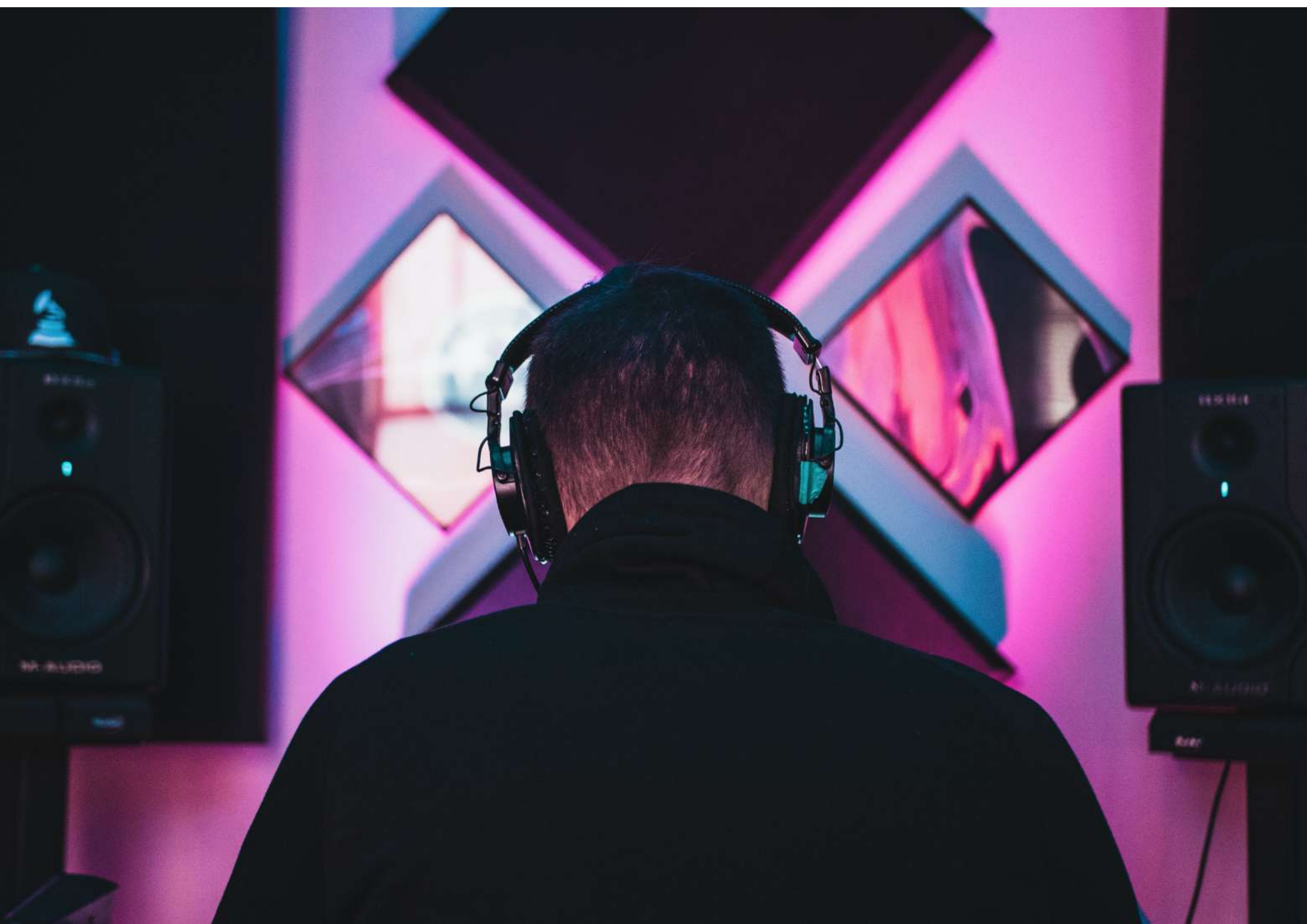


# Mix Your Low-End Like a Pro



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# Introduction

Low frequencies provide the foundation, size, and create the power of a great mix. Many of us struggle to achieve what we feel is the perfect low-end. Great bottom is a combination of arrangement, production elements, and, of course, proper mixing technique. Regardless of the stage of production, though, we have to trust our monitors and have a sense of how low-end should sound and feel.

The articles in this book guide you to the skills of creating accurate bass that transfers well to a wide range of listening situations, from headphones to car stereos to concert P.A. systems. I would also argue that spending a considerable amount of time listening to music on the system where you produce, mix, and master will bring you much closer to understanding how low-end sounds and feels. Learning how full your room or headphones feels seems elusive, but that is how everyone senses low-end, so you just need to train yourself to be aware of how much is too little and how much is too much.

The first section of this book focuses on getting your acoustics dialed in so that the bass you feel is accurate and the second part reviews some useful techniques to help nail the bottom down.

“Everything living has a rhythm.  
Do you feel your music?”

Michael Jackson

# Why Does My Bass Sound Wrong?

by Tiki Horea

In this article, Tiki sums up the basics of optimizing treatment that will keep your bass frequencies clean and tight. A listening environment with clean, accurate low-end is the first step towards creating mixes that achieve the bottom you crave! - AK

Generally, a poor monitoring setup is a major culprit behind failing to produce goosebumps-inducing mixes. Sometimes it's your skills, but we won't be covering that in this article.

Once you properly set up your monitors, you'll find your work will improve by leaps and bounds. But wait, there's more!

- You'll spend a lot less time checking your mixes on other systems
- You'll trust what comes out of the speakers and stop second-guessing your creative decisions

Before we move on, I want to let you in on a little secret: you can't get your room to be perfectly "flat." This is only possible in extreme laboratory conditions like the crazy room at the [Microsoft Audio Labs](#). What's important for us is to minimize the acoustic peaks and valleys our rooms naturally exhibit.



Once you've discovered (or admitted) that your listening environment needs improving, the first thing you think of is buying new speakers, right? Or maybe you think about acoustic treatment? However, the first step in your journey to improving your room should be correctly positioning your speakers for your listening position. Acoustic treatment comes later.

Speakers are similar to microphones in that moving your speakers even a couple of inches can drastically change what's coming out of them.

Here are a few ideas for how to best position your speakers. Make sure you have a tape measure at hand.

a) **Have the speakers fire along the length of the room.**

This gives the low frequencies more space to develop, which usually leads to a flatter frequency response and less destructive reflections from the rear wall.

b) **Place your speakers at an equal distance from the side walls.**

The same applies to your listening position. Symmetry is important for stereo imaging.

c) **Your head and speakers should form an equilateral triangle.**

The distance between (just behind) your head and each speaker, and the distance between the speakers themselves should all have to be the same—around 67 inches (108cm) is a good starting point.

d) **Some speakers are made to be placed flat, while others are designed to stand up.**

You can find the recommended alignment for your monitors in the manual. Be sure to check out our [blog post](#) on horizontal vs. vertical speaker placement.

e) **Set your speaker height so that the tweeters are at ear level.**

High frequencies are directional. This means that if the speakers are lower, higher, or at a less-than-ideal angle than your ears, what you'll hear won't be accurate. You can use foam wedges to tilt your speakers so the tweeters fire directly at your ears.

f) **Place your monitors on stands.**

Wedges, isolation pads, and other doodads (including Genelec's rubbery support) rarely fully decouple the speakers and the desk. This can lead to the desk vibrating at certain frequencies, muddying up what you hear. Stands also allow for easily experimenting with monitor placement.

g) **The 38% Rule**

In a rectangular room, the ideal place for the listening position is 38% of the distance from the front wall to the back wall. In an ideal world, this location would provide the flattest low-frequency response.

Please bear in mind that points **a** and **g** apply to rectangular rooms. If your room is of a different shape, attempt to set up your room as symmetrical as possible. If you have a sofa, make sure it's centered in the room. If you have a bookcase, try placing it behind the sofa, so it will act as a diffuser. If a window is on the long wall, cover it up with an acoustic panel supported by a stand or hook above the window. Place an identical panel on the wall opposite the window to make the room symmetrical. Don't forget that the back of a door may be a good spot for an absorber, too. You get the idea.

The distance between the front wall and the speakers also needs to be taken into consideration. Speakers are more omnidirectional at low frequencies, meaning that bass sound waves radiate in all directions. The low-frequency sound waves radiate from your speakers and bounce off the front wall back towards you.

When these reflections combine with the direct sound from the speaker, they create acoustic interference, causing nulls or dip in the frequency response. This phenomenon is called speaker-boundary interference response (SBIR).

# Place your speakers as close as possible to the front wall.

Flush mounting, or mounting the speaker in soffits inside the front wall, is usually done in higher budget commercial studios. For typical home studios, the next best option is placing your speakers close to the front wall.

As the speakers are placed closer to the wall, the cancellation notch in your frequency response moves higher in the frequency spectrum. This is fantastic news because higher frequencies are more directional, meaning they radiate less energy backward. Also, they are much more easily managed with standard acoustic treatment.

In most cases, a gap of 8 inches (around 20cm) or less between your speakers and the wall is a good starting point to reduce the coloration caused by SBIR. However, it's best to check your speakers' specifications for what the manufacturer recommends as the minimum distance. Rear-firing ports may require you to leave a few centimeters of space behind your monitors.

At these close distances, 4-inch thick broadband acoustic panels will help control the cancellation problems. Bear in mind that as the distance between the speaker and the wall increases, the problem frequencies become lower and bass treatment becomes more complicated.

One caveat to placing your speakers close to the front wall is that there will be a bass boost. However, this can easily be fixed by using the Boundary EQ (half-space position) provided by many speakers.

# SUBWOOFERS

When it comes to the placement of the subwoofers, there are a few guidelines you should follow. These apply to you if you're using 1 subwoofer:

- Most subwoofers are designed to sit close to a wall, so you can place it about 1.5 feet (45-46 cm) from the wall. Avoid distances greater than 23.5 inches (60 cm) from the front wall.
- Try placing the sub along an imaginary arc that traces a circle through the front speakers and the sub.
- Due to standing wave issues, move the sub slightly away from the middle axis of the room (slightly off-center).
- Try out "The Crawl" method of placing the subwoofer (explained in the sidebar)

A subwoofer is not for making low frequencies louder, but for extending the low-frequency range of your monitor system. Therefore you want a smooth transition between your subwoofer and your main speakers. Most nearfield monitors start rolling off between 45 and 70 Hz and a sub can extend the bass to 30 Hz or lower.

If you are only mixing music or stereo program material, you can find the proper crossover point by ear or with the aid of an SPL meter. Simply play a scale of bass notes with a clean bass synth patch from C1 (33 Hz) up to A2 (110 Hz) and adjust your crossover point to create most even representation of all the notes. If you find a considerable dip or boost around the crossover point, you can adjust the crossover frequency and try flipping the polarity of the subwoofer to see if the response becomes smoother.

For those who regularly mix or produce surround sound content, like 5.1, 7.1, or ATMOS, the LFE channel subwoofer setup requires very specific consideration and calibration. That setup is beyond the scope

of this article, but a good starting point would be the [EBU Tech 3343 guidelines](#), among many other post-production resources.

If you only have one sub, follow these steps:

- a) **Set** the volume of the sub to fill out the lowest octaves.
- b) **Adjust** the crossover on the sub for a smooth transition between the sub and main.
- c) **Experiment** with the phase adjustment on the sub.

*If all the steps above fail, re-adjust the sub position and repeat them.*

With two subs you have the advantage of placing the subs in an arrangement that excites more room modes and creates a more even bass response than one sub. Setting up two subs, however, increases the complexity of the entire system. Follow the instructions for one sub, but set the two subs symmetrically in the room and be sure to adjust their crossovers, levels, and phase identically to maintain an even response.

**The Crawl.** One common method for finding an ideal position for a subwoofer in a music or home theater setup is to place the subwoofer in your normal listening position and then crawl around the room to find the location where the sub feels smooth in well-integrated with the main speakers. Now move the sub to this location and you should have an excellent starting point.

# BASS TRAPS

Some people seem to be afraid of acoustics. I mean, it is a complex subject, but so is almost everything we deal with. Fortunately, you don't have to go super deep into acoustics to drastically improve the sound of your studio.

I want to warn you against buying 2 commercially available types of acoustic treatment:

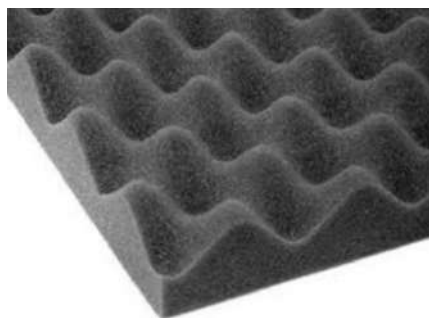
a) Triangular foam wedges



These are not bass traps. They are too shallow to affect low frequencies below about 200 Hz. They do absorb mids and highs, but you'd be using porous absorbers for that anyway.

They don't offer very good diffusion, either, since diffusion requires solid surfaces to effectively reflect sound waves and these surfaces are porous.

a) Eggcrate-shaped foam panels



These only absorb high frequencies. They're not dense enough, nor are they thick enough to be able to absorb low-mid or low frequencies. This means you'll get rid of some/most of the flutter echo in your room and that's the extent of what they'll help you with.

Your best bet is thick broadband absorbers, which start absorbing bass only if they're at least 6 inches (16cm) thick. For frequencies below 125 Hz, 8 inches or more is required.



There are 4 locations in your room where you want to place broadband absorbers.

Yes, you're right, the 4 corners. Low frequencies tend to 'pool' in the corners of your room, so traps placed in the corners are very efficient and space-saving.

Place the panels 45° diagonally across corners. This will create a deeper trap because air adds to the effectiveness of your treatment.

You should start with the corners closest to your speakers. Following that, add identical panels on the opposite 2 corners.

Important: make sure the air gap is no larger than the depth of the core material. So, if you have 10 inches (25.5cm) of Rockwool in your acoustic panel, the gap between the wall and the panel shouldn't be larger than 10 inches.

So! You've placed your speakers properly, set your sub(s) to work optimally with your speakers, you've treated your room (then you played with your monitors' positions a bit more)...what's next?

Get [Sonarworks' Reference](#). Seriously. It's been one of the best investments I've made in my life. **Period.**

Get the Studio version and you'll improve the frequency response of your speakers and headphones. You also get Systemwide, which lets you apply the same correction across your whole system, so you can listen to music or watch movies with the same correction as when you mix. This is extremely important because your ears learn how your environment sounds even when you're relaxing. That's true multitasking!





“

“You just go with the flow because life is just all about how you feel.”

**Post Malone**

# It's All About The Bass

by Barry Rudolph

Interpreting and making practical use of the graphical results from measuring programs like Sonarworks' Reference 4 Measure or AV Nirvana's Room EQ Wizard (REW) requires a basic understanding of acoustic physics and the way sound behaves in your particular room. Identifying the problems that stand in the way of attaining an accurate music monitoring system is a continuous learning process that is worthwhile to pursue.

The purpose of this article is to teach you to look at a room's frequency response curve and determine the likely causes of the frequency problems revealed by the analysis. You can then improve the room's acoustics the room to flatten out the frequency response before refining the sound with software like Reference 4. Read on to learn to interpret this information that is already provided by your room correction software.

## Room Acoustics Reviewed

### **The Physical Constraints Of Small Rooms**

Small rooms used for home or project studios are typically a converted spare bedroom or car garage. These rooms usually measure in the range of between 2.5m to 3.5m wide by 1.7m to 3m high by 3.6 to 7.7m long. Finished ceiling height in the US is typically 8-feet (2.5m) and 2.2m in the U.K.

Acousticians define a small room as a space whose acoustics are dominated by the detrimental effects of room modes that are also known as "standing waves" because they seem to stand still in



certain locations in the room. In contrast, large rooms and spaces like concert halls or indoor arenas, the reflectivity of the space—the reverberant field dominates the acoustics.

**Room modes** are caused by sound waves bouncing back and forth between parallel floors, ceilings, front and rear walls, and between the left and right sidewalls and then back at the listening position. These reflections arrive later in time than the direct sound and mix with it. At a particular frequency, when the reflected sound is in phase with the direct sound, a peak in volume called an anti-node is produced. Just by changing the sound's frequency or physically moving the listening position, the same direct sound and reflected sound could be out-of-phase producing a dip in volume called a node.

The exact frequencies and locations in the room where nodes and anti-nodes exist depend on the room's physical dimensions—the length, height, and width.

## How Room Modes Work

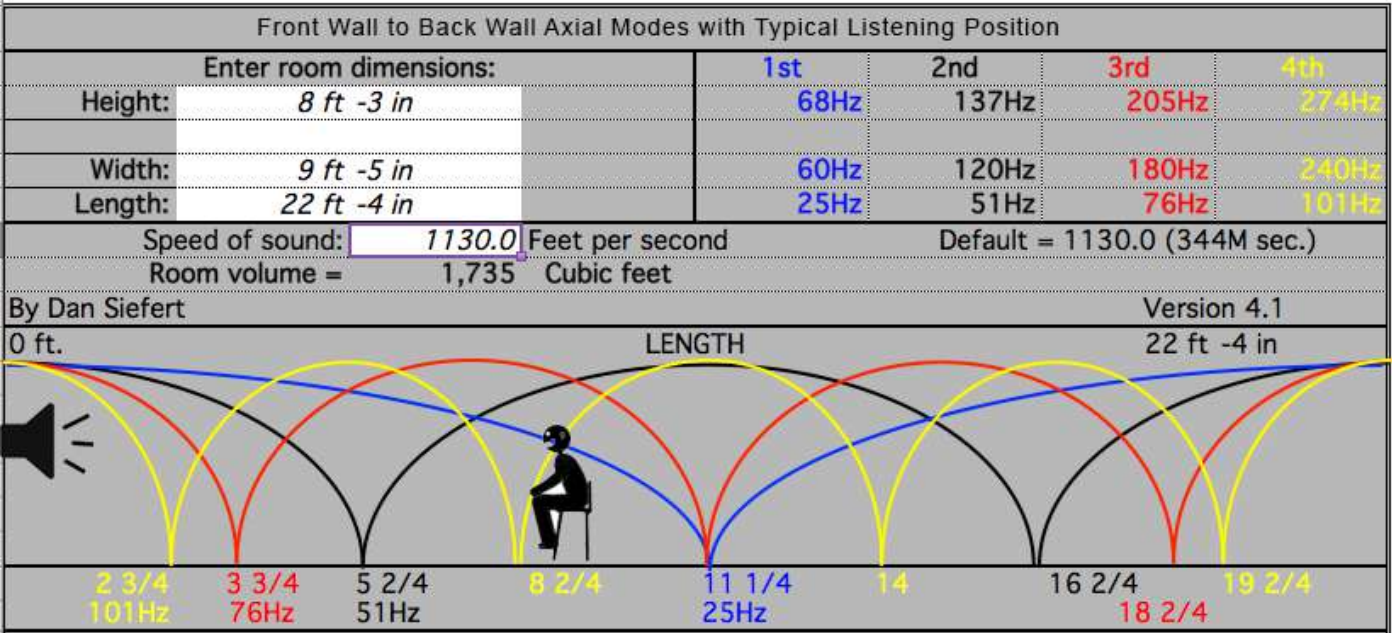
In every room, there are about 80 different room modes present at any given moment produced by reflections coming from all three of the room's boundaries—the floor, ceiling, and walls. To muddle things further, there are three kinds of modes.

- **Axial room modes** are the strongest modes and are caused by two waves traveling in opposite directions and reflecting off of parallel walls—front-to-back, side-to-side, or floor-to-ceiling.
- **Tangential room modes** are formed by waves that reflect off two sets of parallel walls (four walls or two walls, floor, and ceiling). They have half of the energy of the axial modes.
- **Oblique room modes** involve eight traveling waves reflecting from all the boundaries in a room. Oblique room modes have only one-fourth of the energy of axial modes.

Acousticians are most concerned with the strongest **axial modes** because they make up 50% of the total energy of all the modes.

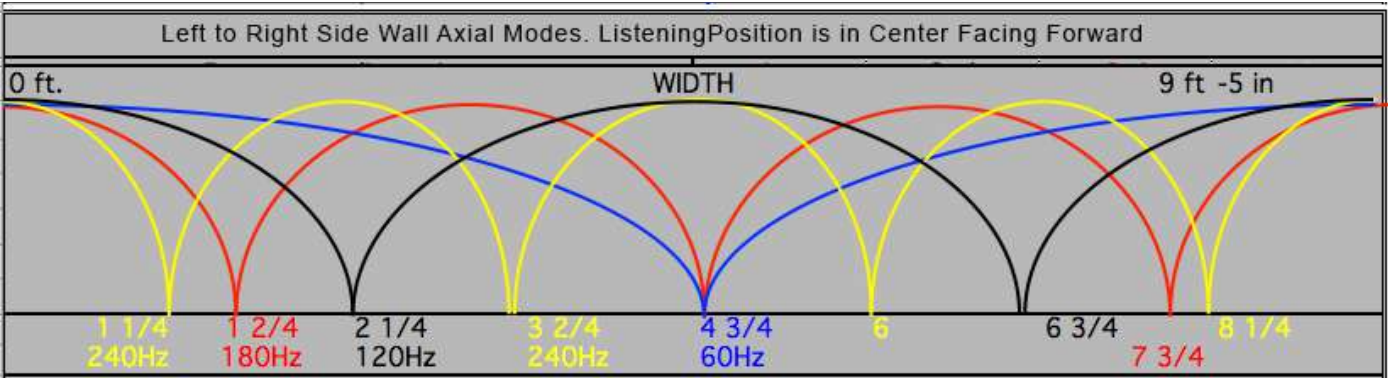
Figures 1a, 1b and 1c are from [Dan Siefert's room mode calculator](#) (provided by Harman) and show the frequencies and relative locations of the nodes and anti-nodes of the first four multiples of the 1st axial room modes in a room. This particular room measures: 22.4-ft (6.82m) long X 9.4-ft (2.86m) wide X 8.25-ft (2.5m) high. The room's three dimensions are each shown, starting from the left and going to the right with color-coding for: the 1st room mode (blue), the 2nd room mode (black) whose frequency is two times the first, the 3rd (red) mode at three times the first, and the 4th (yellow) mode that's four times the first.

Fig. 1a



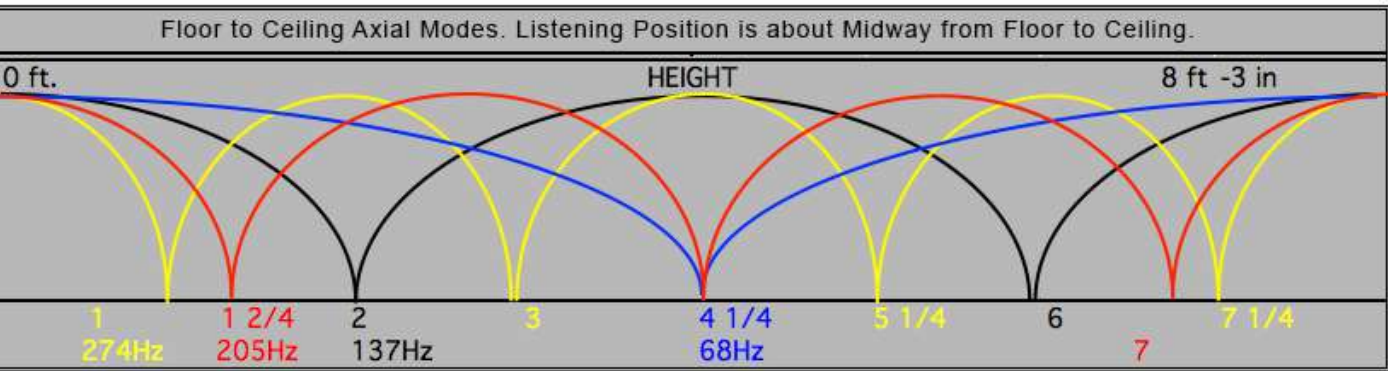
This image displays the **axial modes** that exist between the front wall (left side of image) and the rear wall (right side of image). We can see where the energy is highest and lowest for the frequencies of 25Hz, 50Hz, 76Hz, and 101Hz. The listening position is shown at 38% from the front wall to the rear wall. This listening position is not located exactly in any node or anti-node.

Fig. 1b



This image displays the **axial modes** that exist between the left and right side walls of the room described above. We can see where the energy is highest and lowest for the frequencies of 60Hz, 120Hz, 180Hz, and 240Hz. The listening position is in the center of the room, at the nodes of 60Hz (blue trace) and 180Hz (red trace) and the anti-nodes of 120Hz (black trace) and 240Hz (yellow trace).

Fig. 1c



This image displays the **axial modes** that exist between the floor (left side of image) and the ceiling (right side of image) of the room described above. We can see where the energy is highest and lowest for the frequencies of 68Hz, 137Hz, 205Hz, and 274Hz. The listening position is about midway between the floor and ceiling, at the nodes of 68Hz (blue trace), 205Hz (red trace), and the anti-node of 137Hz (black trace) and 274Hz (yellow trace).

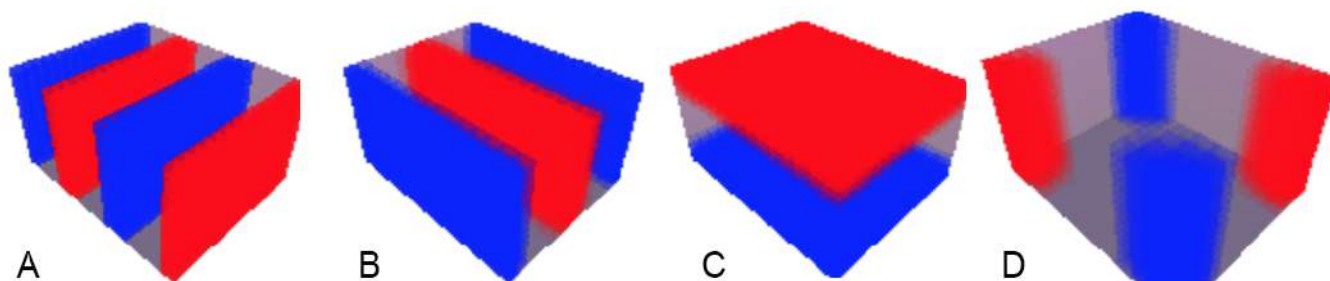
## Observations

All room modes peak at boundaries—the floor, ceiling, or walls as shown far left and right in this chart. This is the reason why when you stand near a wall or especially in the corner of a room, the pressure buildup is intense. The 1st room mode (blue) has just one node at 50% of its length dimension with the 2nd room mode (black) peaking at the same location.

Notice on each graph where any nodes or anti-nodes meet at the same location. The exact location(s) in the room where you would hear these phenomena is completely predictable and must be considered when setting up a room for critical listening. Using these room mode tools is a simple way to predict where modes will exist.

Below in Fig. 2 are some 3-D room mode visualizations created by the [AMcoustics room mode calculator](#).

Fig. 2



Here we see modes of a room with the dimension of 15 feet long, 12 feet wide and 8 feet high. Red and blue shapes both indicate areas of maximum loudness at the given frequency (nodes). Image A shows an axial mode at 112Hz, B an **axial mode** at 94Hz, C an **axial mode** at 70Hz, and D shows a **tangential mode** at 60Hz.



# Modal Measurements in the Real World

Now that we have some theory behind us and we know how to use mode calculators to predict our room's problems, let's go the other way and electronically measure our room to see what the real-world frequency graph we generate tells us about our acoustic environment. We can use this information to help effectively treat our room.

All the following graphs for this article were done in my Tones 4 \$ Studios using a Sonarworks' calibrated measurement microphone. Some graphs were created using the free [Room EQ Wizard](#) (REW) software and some were created using Sonarworks' Reference 4 Measurement software. The stereo monitors are Kali Audio IN-8 three-way coincident monitors spaced 40-inches (1.02m) apart measured center-to-center.

Before attempting an accurate and realistic measurement of your room using, you should always close all doors and windows to your room. Any doors to other rooms, closets, hallways, and windows should be shut.

## Schroeder Frequency

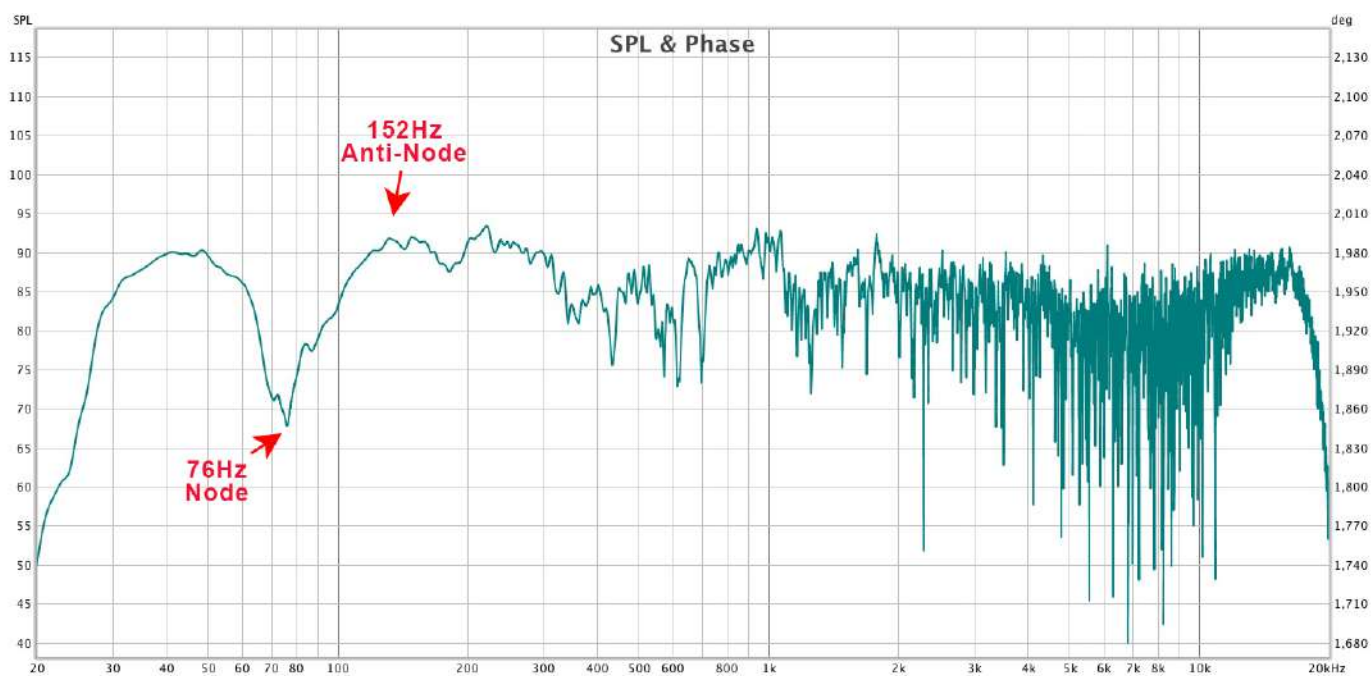
Think of your room divided into two frequency ranges at a point called the **Schroeder frequency**. For most small rooms, the Schroeder Frequency is somewhere between 200 and 500Hz. Below the Schroeder frequency, the entire room acts as a resonant cavity with low-frequency sound waves bouncing around creating nodes and anti-nodes. This low-frequency sound energy propagates in "waves" and is modal. Above Schroeder, higher frequency sound behaves like "rays" as if lasers are reflecting around the room.



## Focus on the Lows

Take a look at Fig. 3 and notice the gigantic dip at about 76Hz. This REW screenshot depicts the first **axial room mode** dip caused by reflections back and forth from the floor to the ceiling at the listening position. At about 152Hz, the second room mode frequency, there is an anti-node or peak. Unless you plan to move to another room or add bass trapping, you will have to live with that ceiling room mode. Having a 10 or 12-foot ceiling would be a practical luxury for a home studio!

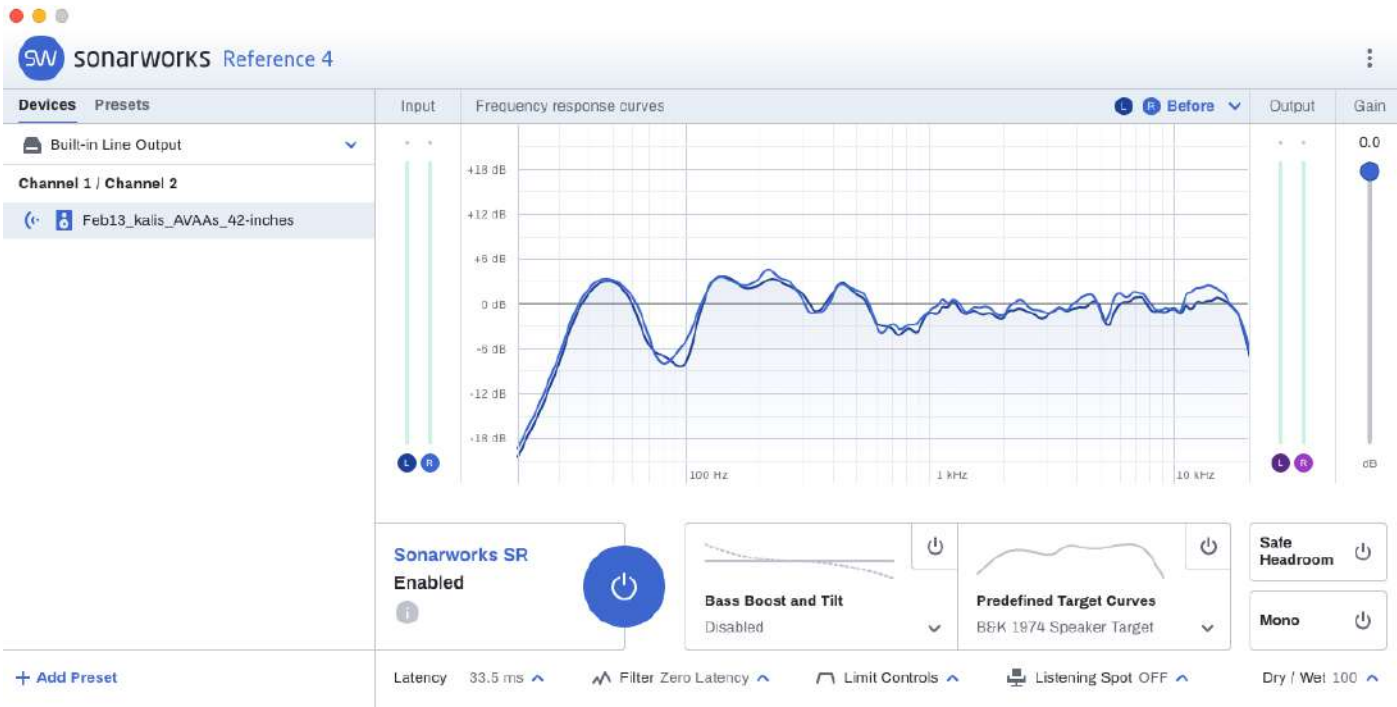
Fig. 3.



This Room EQ Wizard SPL graph shows 1/48th octave smoothing, which looks a little crazy. While extremely accurate, we often simplify these graphs to display 1/3 octave smoothing, as shown later.

Fig. 4 shows the Sonarworks Reference 4 measurement of the same room and we see the same two aforementioned modal issues. Somewhat smoother than the REW measurement, both measurements indicate my Speaker Boundary Interference Responses.

Fig. 4



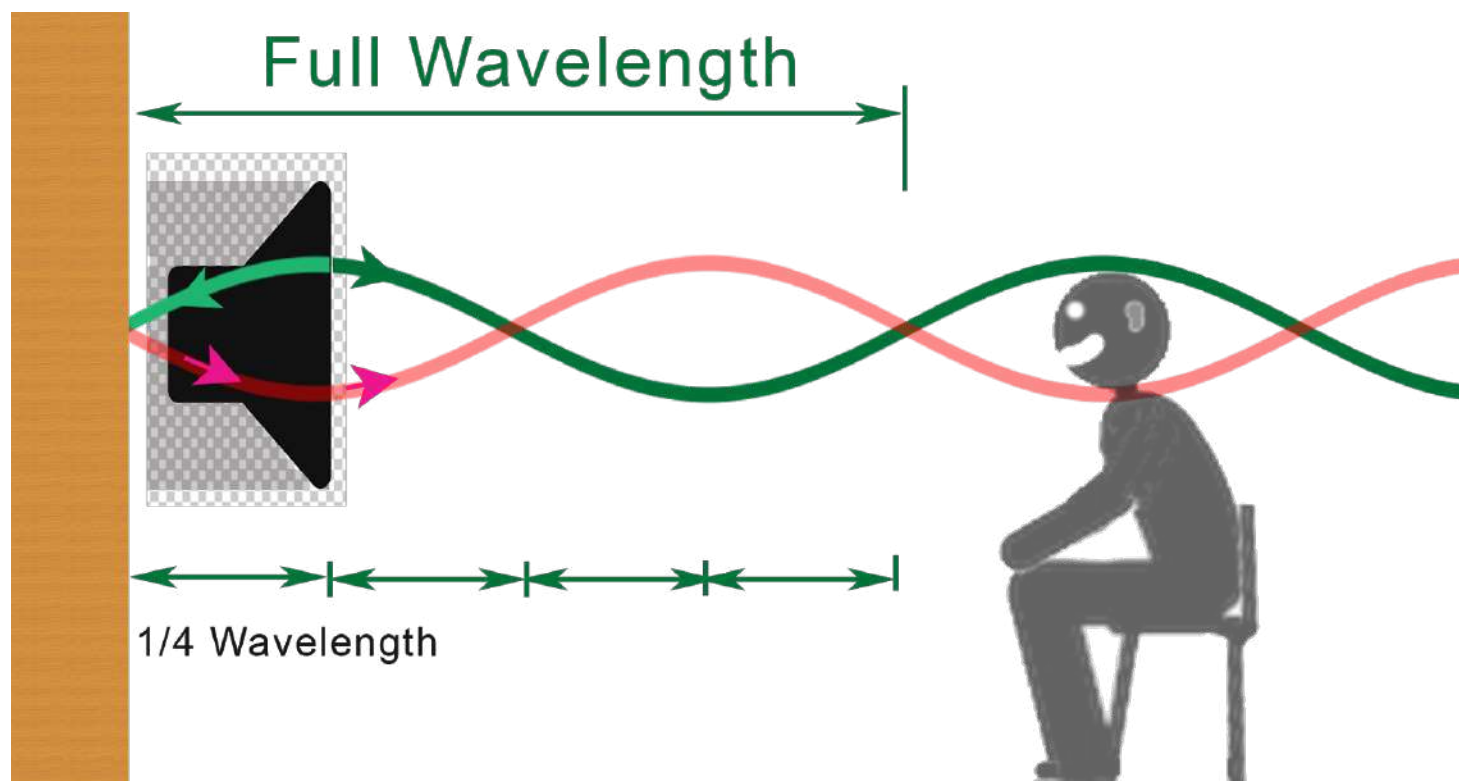
This Sonarworks Reference 4 graph shows **1/3rd octave smoothing** and we can still see the modal dips at 76Hz and 150Hz. Remember the response above about 300Hz will not be treated as modal problems.

# Where do the Dips in Level Come From?

Low frequencies emanate from your monitor in an omnidirectional and spherical pattern and strike all boundaries and reflect back to the speaker and of course, the rest of the room.

Called **Speaker Boundary Interference Response**, if your monitors are  $1/4$  of a wavelength of a given frequency away from a boundary—a wall, floor, or ceiling, the total round trip path, to and from that boundary, is a half wavelength. So just like the 50% location in the previously shown 1st room mode graph, there will be a cancellation at the front of the speaker cabinet—a dip at that frequency. At integer multiples of the frequency, you will have alternating reinforcements and cancellations that affect the frequency response of your very expensive studio monitors. See fig. 5.

Fig. 5



Here we see a low-frequency soundwave that reflects off the front wall and combines back with the original wave. At the front of the speaker and again at the listener's head, we see the waves cancel each other and cause dips in level (nodes) at that particular fr

## Practical Considerations for Low-Frequency Modes

Home studios have domestic and practical considerations for sure. If you have space and can move the monitors further away from the side and front walls, the frequencies of reinforcement and cancellation will go lower and/or possibly be less intrusive. For instance, a distance of 85cm from the front wall to the front of your monitors will cause a node at 100Hz, while moving the speakers to 170cm drops the node down to 50Hz. Keep in mind that this cancellation can not be corrected with room EQ. No matter how much we boost that frequency, the room mode will always subtract an equal amount.

Looking back at Fig. 3, the range between 300 and 800Hz is very "choppy" with peaks and dips that are caused by the reflections from the sidewalls 90cm away and the front wall just behind the speakers about 75cm away. I can change the location of the monitors; maybe further away from the sidewalls and closer to the front wall but there are practical limitations.

As an example: my studio room is only 2.87m wide, but I cannot move the speakers too much closer together or I'll lose stereo width and imaging. For now, I'm at 40-inches or 1.02m apart (measured center-to-center of the woofers) and I'm already not too happy with the lack of stereo imaging and width!

I'll change it soon but this points out that some issues we have to live with. Knowing these acoustic issues exist is extremely important for making careful judgments during mixing and recording.

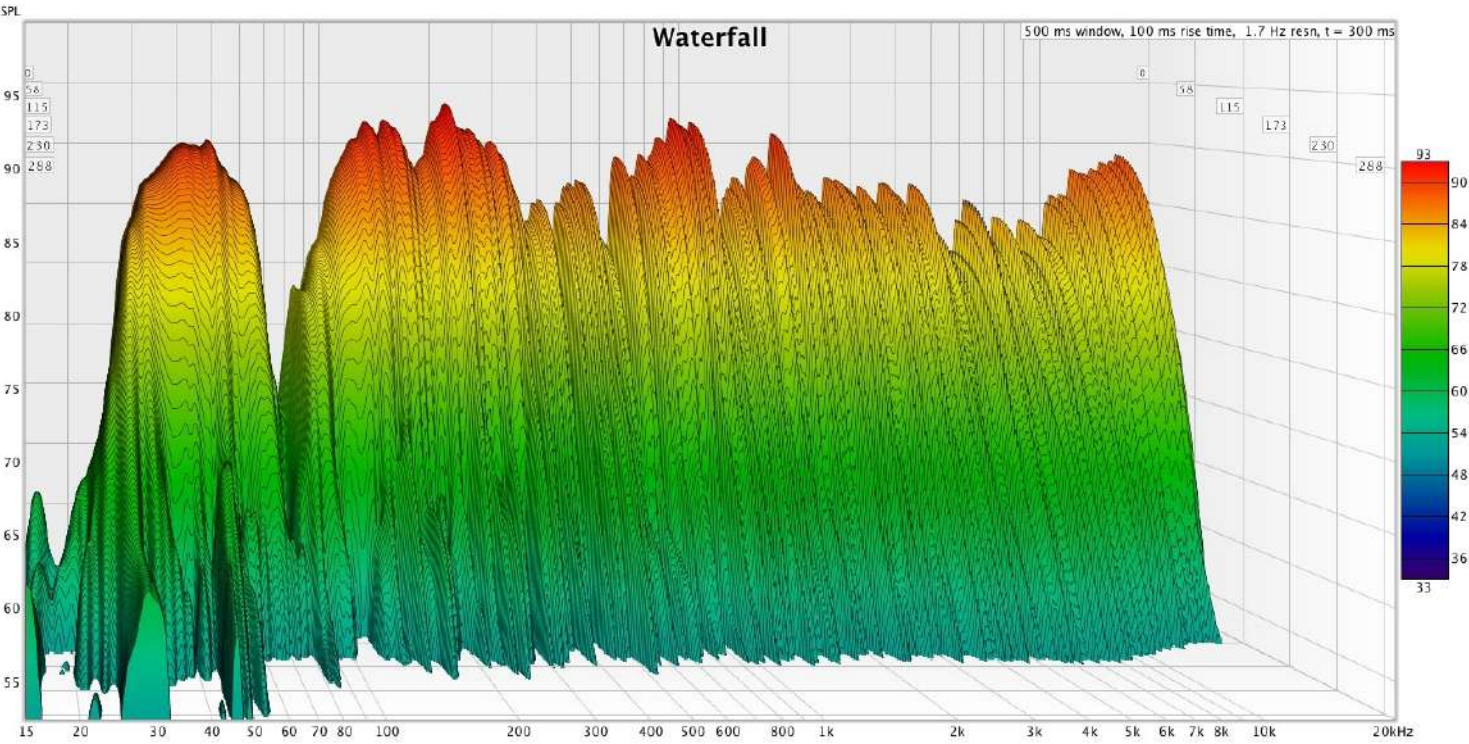
Experiment and measuring is the best way to determine the best compromise. I would recommend developing a routine: measure first with Sonarworks then make ONE single change such as moving the monitors further away from the sidewalls. Measure again and assess the sonic changes. Never make more than one change because you might not be able to know which changes were for the better or worst.



## Above the Schroeder Frequency

Fig.6 is called a waterfall graph and shows amplitude (y-axis), frequency (x-axis), and decay time in milliseconds (z-axis). Above 1kHz my small room is fairly smooth and Fig. 4 from Sonarworks confirms this. This is because my room is heavily damped with **broadband absorption panels**—some as thick as 10-inches.

Fig. 6



Reflections off my hard desktop and computer monitor can cause reflections and comb filtering that interfere with good stereo imaging. For that reason my monitors are positioned high enough on Sound Anchor stands to look over my computer monitor and small desktop speakers. I also have my 29-inch wide LG computer monitor resting directly on the desktop and tilted back at a steep angle to get out of the way of the sound coming from the monitors behind it. I've covered the back of the monitor with absorptive material to reduce reflections off of it plus my desktop surface is covered with thin rubber shelf liner to reduce high-frequency reflections off of it to my ears at the listening position.

## Why Setup Is Super Important

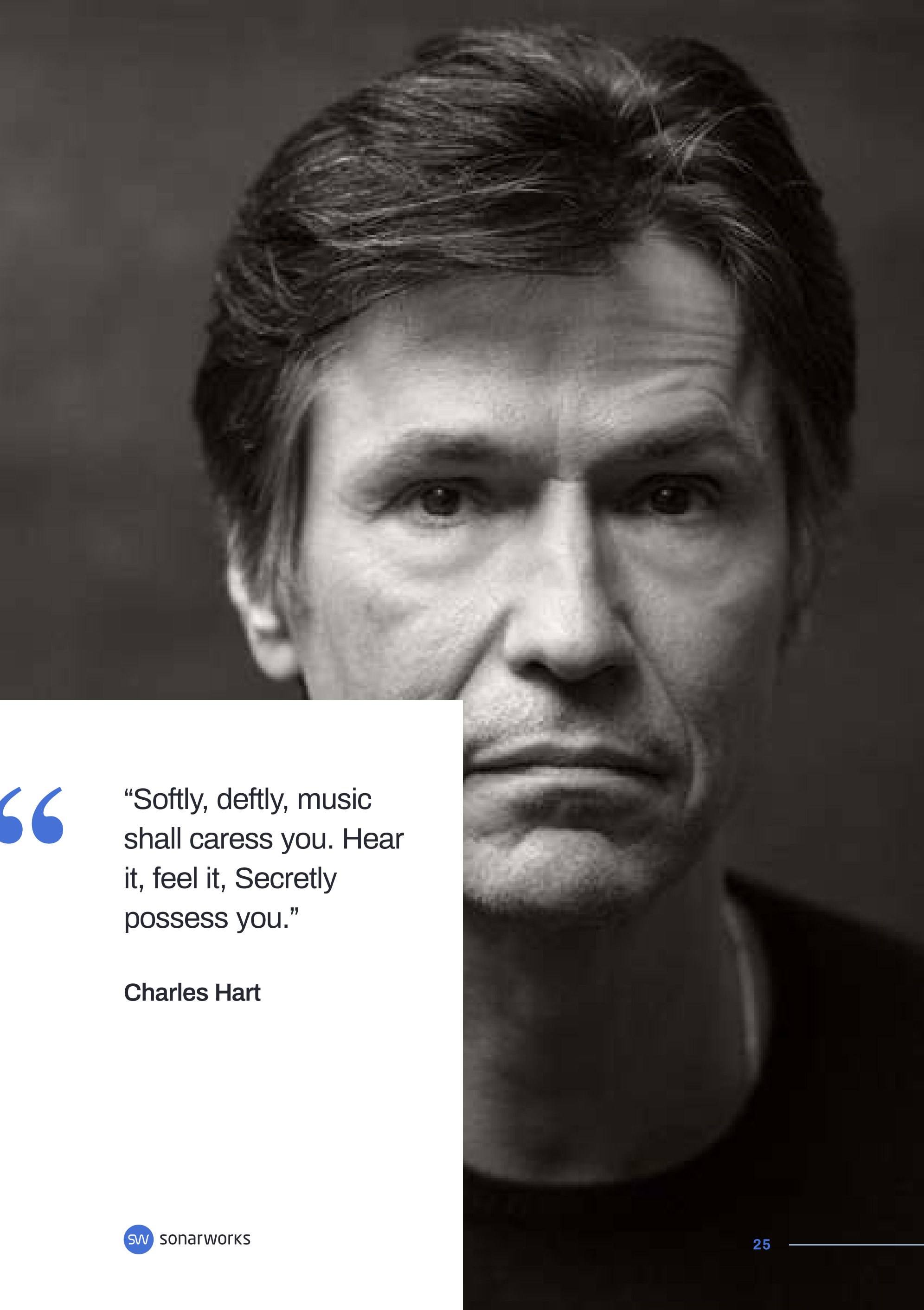
Your monitor's height from the floor, the distance between them, how far away they are from the front wall, the sidewalls, and the listening position have everything to do with maximizing your monitors' sound in your room. An optimized setup of both the listening position and the location of your monitors is the important first step to **minimize the impact of room modes**. This should be done before using Sonarworks room correction plus this knowledge will foster more effective acoustic treatment deployment, (bass traps, absorption panels, and diffusers) in your room.

After room treatments are installed and working, then run Sonarworks 4 to get that last 10% of acoustic perfection. When your room acoustics are dialed in, SW doesn't have to work as hard to get your room to sound super!

While a program like [Room EQ Wizard](#) (REW) measures how your speakers sound in your room from a single listening position, Sonarworks Reference 4 directs you to move the mic and measure from many points around the listening position to obtain more information about the entire listening space between the monitors and the listening position.

The goal with Sonarworks is to **measure and correct** your monitors as they reproduce sound in your own room. The raw measurement results WILL NEVER BE the same as your monitors measured at the factory. Factory speaker specifications are measured in anechoic chambers where there are no detrimental room acoustics. Buying very expensive monitors with near-perfect specifications is no guarantee they will sound their best in your room.

By knowing the limitations of both your room's size and your monitors, you'll better understand the reason why your mixes sound a certain way inside of your room and then different outside of your room.



“

“Softly, deftly, music  
shall caress you. Hear  
it, feel it, Secretly  
possess you.”

**Charles Hart**



# Great Sounding Mixes on Small Speakers

by Eli Krantzberg

Apple's iPod is as foreign to my ten-year-old neighbor as my grandfather's Victrola was to me. Music listening habits and technologies have changed dramatically over the decades. Back in my day, we listened to records and eventually cassettes and CDs on our home hi-fi stereo systems. Clean-sounding receivers or amplifiers and highly-spec'd speakers with decent-sized woofers for your home system was the gold standard.

Shortly after the turn of the millennium, iPods and earbuds became ubiquitous. Lossy mp3 audio became the new norm, as did Sonos systems, our ever-present smartphone and laptop speakers, and all kinds of convenient and inexpensive consumer-grade Bluetooth® playback devices. Obviously, these portable, inexpensive playback devices trade convenience for sonics, and today's portable systems sound only remotely as good as the aforementioned home hi-fi systems. Therein lies our mixing problem.

We have over sixty years of know-how when it comes to mixing for traditional hi-fi home stereo setups, but mixing for playback on laptops, smartphones, and other relatively lo-fi (or at least limited-fi) playback devices requires special considerations. We've never had to mix for so many disparate-sounding listening devices, so let's dive into how we can mix our music to ensure it will sound good on this vast range of playback systems.



Apple revolutionized the music listening experience with its line of ultra-compact iPods, which debuted in 2001. (L-R) Scroll-wheel iPod, iPod Shuffle, iPod Nano. These devices can hold up to 160GB—up to 40,000 songs as mp3s—in a device smaller than a modern smartphone.

## Small Is The New Big

Conventional wisdom dictates using high quality, full-range monitors for mixing in a pro-quality studio. A bigger woofer means more accurate low-end, and a higher power rating means better the dynamic range. However, the simplest way to ensure your mixes will translate well on small speakers is to... wait for it..... mix on small speakers!

I'm not suggesting you dump your \$2,000 reference monitors, but how about adding a pair of inexpensive multimedia speakers to your setup? I use IK Multimedia iLoud Micro Monitors as my alternate reference speakers. Really, any consumer-level product will do. Don't worry about their frequency range too much; the crappier, the better. Use a monitor controller to switch between speaker systems as you work. I'll switch my DAWs audio output to the built-in speakers on my iMac (or whatever speakers I have plugged into the computer's audio output) to check my mixes.

The limited frequency response and dynamic range of smaller speakers will help you make sure those booming 808 kick drums that shake the floor on your mains still have a presence when those sub frequencies aren't present. Listening volume, in addition to frequency range, is another factor when mixing for smaller systems. You won't get as much volume, or room-filling sound, out of your laptop or smartphone speakers as compared to your studio monitors, or even a decent car stereo.

## Music Lives in the Midrange and the Middle

Mixing at lower volumes is a simple and trusted workflow. Ensure all elements in the mix work the way you want when monitored at different playback levels. The Fletcher Munson curve plays an important role. The brain doesn't interpret volume and frequency response linearly so when listening at low volume levels, our brain focuses mainly on the midrange. While at louder levels, we perceive the low and high end as louder. Monitoring at lower volumes, allows our brains to focus on the midrange. And as the saying goes, music lives in the midrange! [Read [this article](#) for some review on this topic - ed.]

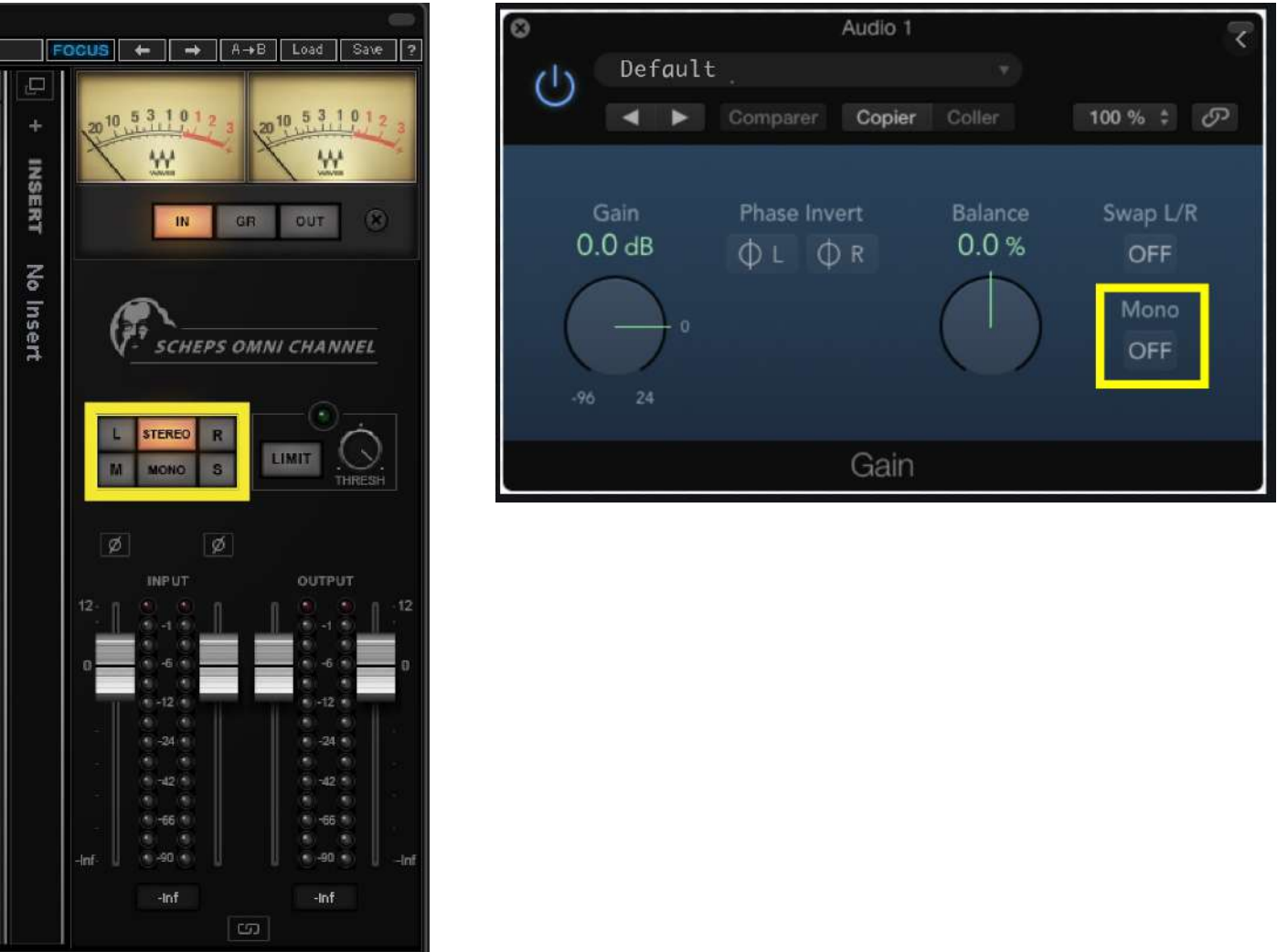
Also related to the perception of your mix balances, occasionally shift your listening position when mixing—the frequency balance changes when you are outside of the sweet spot. Listening from the sides, or even outside your room, provides a fresh perspective on your mix, with a different perceived frequency balance.

“I’ll walk out of the control room and listen to it right outside the door. It’s interesting to hear what it sounds like through the crack in the door. Things pop out.”

Joe Chiccarelli

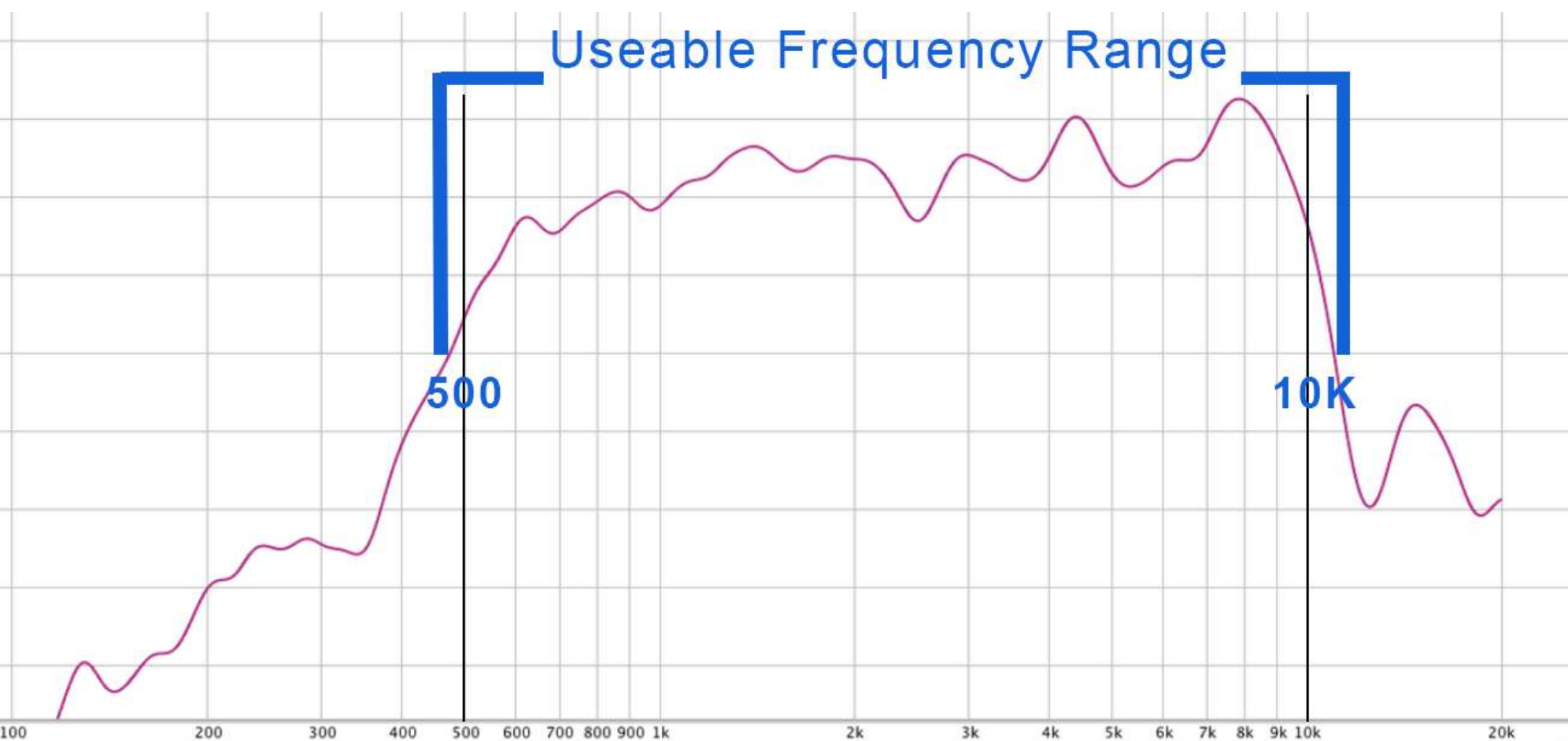
(Excerpt from Owsinski. “The Mixing Engineer's Handbook, 3rd ed.”)

It is also useful to sum to mono often while mixing as well. Although technically playing back through two speakers, the stereo separation on smartphones and laptop speakers is either non-existent or artificially enhanced. Single device Bluetooth and Sonos speakers often sum the signal together for you. If your DAW doesn’t have a convenient way to monitor in mono, the output section of something like the Scheps Omni Channel from Waves provides easy toggling between mono/stereo.



# Focusing on the Midrange

Headphones, Bluetooth, laptop, and smartphone speakers all have different usable frequency ranges. Midrange, however, is the common element and also our focus. If you are mixing on full-range monitors, it can be useful to restrict the frequency range to approximate the sound of these compromised playback devices.



The typical frequency response of an iPhone 7 Plus, with both speakers playing. Measured from a typical listening position. The frequency response drops off quickly below 600Hz and above 9KHz, leaving the best-case usable frequency response approximately 500Hz - 10KHz. [Source: [Arve](#)]

One useful strategy is to monitor with some high and low pass filtering on your mix bus or monitor path. Almost any decent EQ can do this. To simulate smaller systems, set your bandpass to the range between 400Hz and 6KHz. Remember to set your filters just outside this range



if you're using gentle filter slopes (  $\leq 12\text{dB/octave}$ ), or closer to the actual values if the roll-off is steep (  $>12\text{dB/octave}$ ). See the image below.



## Treating the Low-End with EQ and Harmonics

We typically boost the low-end EQ on bass and kick drum channels to give them extra body. This won't work when played back on smaller speakers, so when mixing bass, instead of boosting in the  $< 80\text{ Hz}$  range, focus the EQ a bit higher to bring out the higher harmonics of the bass. In most pop-based styles (EDM, HipHop, R&B, etc.), it is useful to double, or even triple, the bass line with sounds that have different harmonic content. Try combining a sub-bass track for the extreme lows, a buzzy higher octave track to emphasize attack and articulation, and a punchy mid-range track for punch and body. Carefully blending multiple tracks like these permits you to optimize the clarity of the bass on all types of speakers.

Kick drums similarly rely on a boosted low end for emphasis. As an alternative, try adding a bit of distortion to the low end of your kick drum to generate harmonics at higher partials. The higher harmonics create the illusion that the fundamental is actually heard when there is little or no actual representation of those low frequencies. Bass enhancers, like the Waves MaxxBass processor, is one example of a plugin specifically designed to create the aural perception of these missing low-frequency fundamentals.



Waves MaxxBass and Brainworx bx\_boom! provide simple controls to add clarity and punch to kicks and bass instruments, even on small speakers.

If mixing a sub kick (like an 808 boom) with nothing much above 400 Hz or so, layer it or another kick that has more attack, or even add a hi-hat sample. Adding some click in the 5KHz range to a kick adds presence and clarity to a kick, even when you can't feel or hear the low frequencies.



# Dynamic Strategies

To generate low end a speaker needs to move air. One of the fundamental limitations of small speakers is that their cones are not large enough to move air. If there is too much dynamic range in the music, these speakers simply distort or bottom out. It is for this reason that heavily-compressed music, with very little dynamic range, generally sounds clear and powerful on small speakers.

Tasteful compression and limiting are your friends. You don't need to be heavy-handed and simply squash everything. As discussed in our blog about [serial compression](#), it is almost always better to use multiple stages of compression and limiting along your signal flow.

A useful technique to add clarity and impact to low-end instruments is to create parallel bus compression. Parallel compression can be applied to kick, bass, various subgroups, or even an entire mix. The idea is to add in some click and crunch and mix that in to support the unaffected signal. Adding harmonic distortion to a parallel bus is also effective at bringing out upper harmonics, provided the distortion does not become too apparent.

Frequency splitting is also useful for kicks, or basses that have extremely low frequencies. To use frequency splitting, create two sends and two return channels, and insert a steep high-pass filter on one aux return and a low-pass filter on the other. On one channel, filter out everything above 100Hz and on the other, filter out everything below 100Hz. Together, these two channels should sound the same as your original track.

Now Bring down the low-frequency aux, so you only hear the high-end of the signal. Add some saturation to excite the harmonics and some compression to even out the presence and mix the high and low aux channels together to create a sound with substantial low end and midrange clarity that will punch through on small speakers.

## BETTER MIXES ON HEADPHONES



Here we see a Logic setup with 2 Fabfilter EQs splitting an 808 boom into high and low channels. Soundtoys' Little Radiator and McDSP's Analog Channel plugins provide harmonic distortion and saturation to enhance the high-frequency portion of the 808, while the sub-portion remains clean.

Multiband processing is another option. Rather than use sends and mixer tracks, try some multiband saturation to enhance specific areas of the frequency range. For example, Izotope's [Ozone 9 Suite](#) provides multiband exciter, tape, and compression modules suitable for this task. Blue Cat's [MB-7 Multiband Mixer](#) allows you to create up to 7 frequency bands that can be individually processed with built-in effects of 3rd party processors.



Ozone 9 multiband Exciter, set to process only the 100Hz – 600Hz range. Note the high and low bands' Amount sliders are set to 0.

## Summing it Up

No matter what, optimizing a mix for small speakers will always entail a certain degree of compromise. Placing high and low pass filtering on your mix bus is a great way to approximate what the sound will be like on small speakers. Don't expect huge 808 kicks or thundering bass lines from an iPhone speaker. Ultimately we want a mix that sounds great on full-range speakers, yet doesn't lose any important musical elements on the small systems. And don't forget to bypass your mix bus filtering and mono switch before you bounce the mix!

“Music happens to be an art form that  
transcends language.”

Herbie Hancock

# How To Maintain Consistency In Your Sound Between Releases

By Tom Frampton

While this article covers more than low-end, the tips here pertain especially well to checking how the bass elements of your mix compare to other mixes. Tom Frampton, from Mastering the Mix, explains two plugins that he has developed which assist you in maintaining consistency and analyzing your mixes, masters, and raw tracks. REFERENCE is a sophisticated plugin that allows you to compare your full mix to other reference mixes, comparing loudness, eq, and dynamics throughout the mix or in specific frequency bands. MIXROOM compares individual tracks, subgroups, or stems to reference tracks to see how you may better treat elements inside your mix.

Picture a new fan who finds your music on Spotify. They get pulled in by one of your awesome songs and decide to check out more of your material. This is the moment where you can make a new fan fall in love with your sound. But, to achieve a distinctive sound that characterizes your productions, there needs to be a level of consistency.



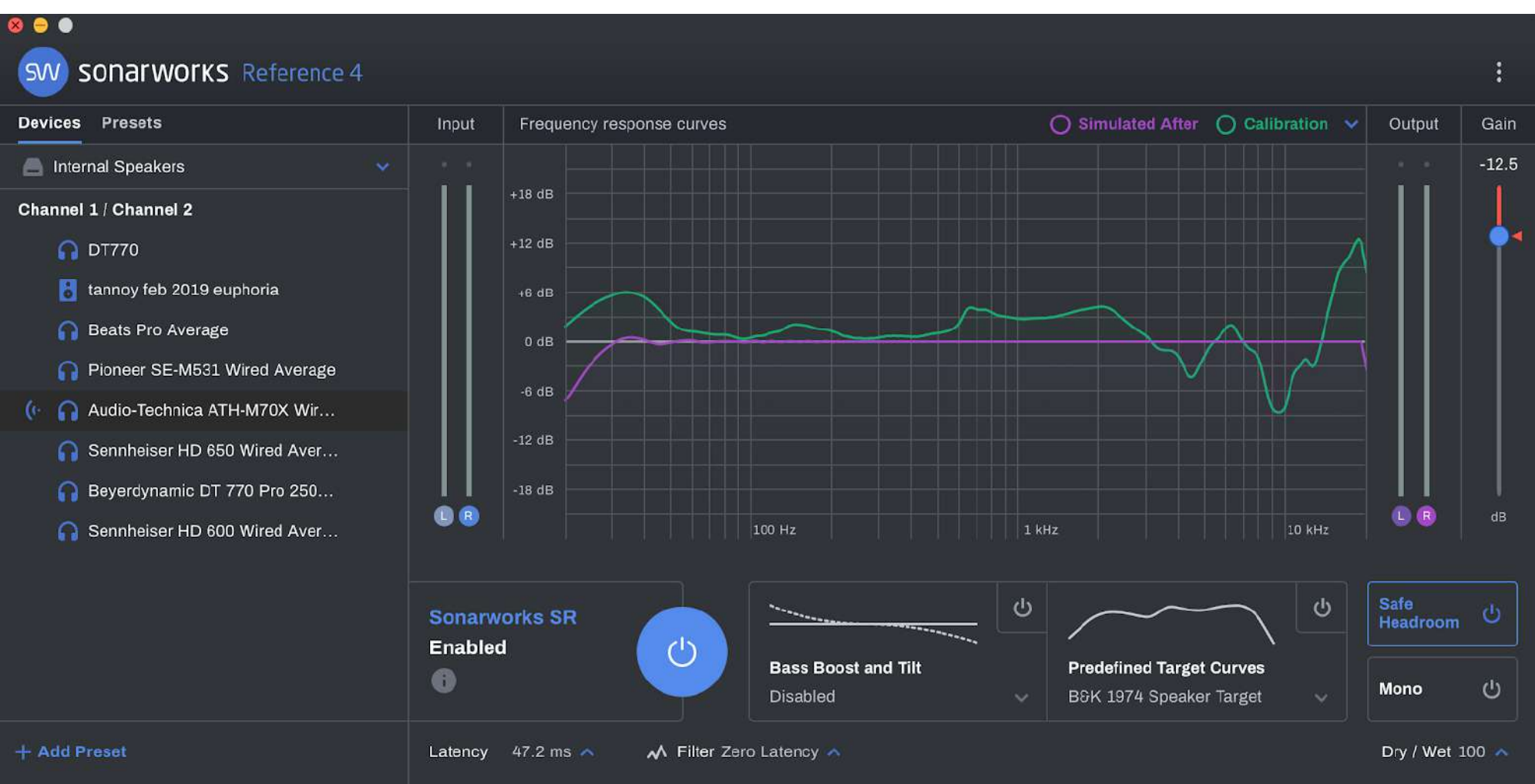
This can be particularly difficult when you’re using different recording spaces/equipment, different synth patches, different vocalists, etc. It’s great to have elements of variation in your productions, but glaring changes can throw your listener off. In this post, I’ll explain a bulletproof way of maintaining consistency between your releases.

# Know Your Playback Environment

Getting to know the quirks of your monitoring system is crucial to effective decision making. You’ll experience your songs differently through monitors, through headphones, in the car, and in a club.

If your monitors and studio space are bass-heavy, you might dial back the bass in your mix or master too much to compensate. When you play the track in the car, the mix will feel weak.

Establish a consistent playback environment when you’re making music and understand how your mix will translate when heard on different systems. I use Sonarworks Reference 4 to give me a neutral listening experience in my studio in order to minimize the difference in sound between my various playback systems. This allows me to make subjectively good mixing decisions that I can trust.



# Use Your Previous Releases As Reference Tracks

Using your best sounding previous releases as reference tracks is a great way to set the balance between the various elements in your mix. It might sound simple, but the loudness of the kick, snare, vocals, synths, etc in the context of the whole mix is the foundation of consistency (and great sounding mixes!).

Fire up an instance of the [REFERENCE](#) plugin by Mastering The Mix, load up your three of your best sounding previous releases, set the mode to 'FREE', and loop the choruses of your reference tracks by clicking and dragging on the waveform, then Control+Click on the loop to select it.

Now loop the chorus of the track you're working on and hear how it compares to your existing songs by clicking the central Original/Reference button. Monitor the full mix, but try to listen to how the individual elements are balanced in the context of the other instruments. Is the kick too loud? Are the vocals too bright?

The white level lines at the bottom of the display will show you the difference in the overall tonal balance between the track you're working on and previous releases. If the white line drops below the central 0dB line, that frequency range is quieter in your track than your reference, and you may decide to turn it up to keep the sound consistent.



1. Load 3 of your best sounding tracks.
2. Set mode to Free.
3. Create loops.
4. Toggle between to hear difference.
5. White level line is below central 0dB showing that the track i'm working on needs a boost in the mids to match my selected reference track.

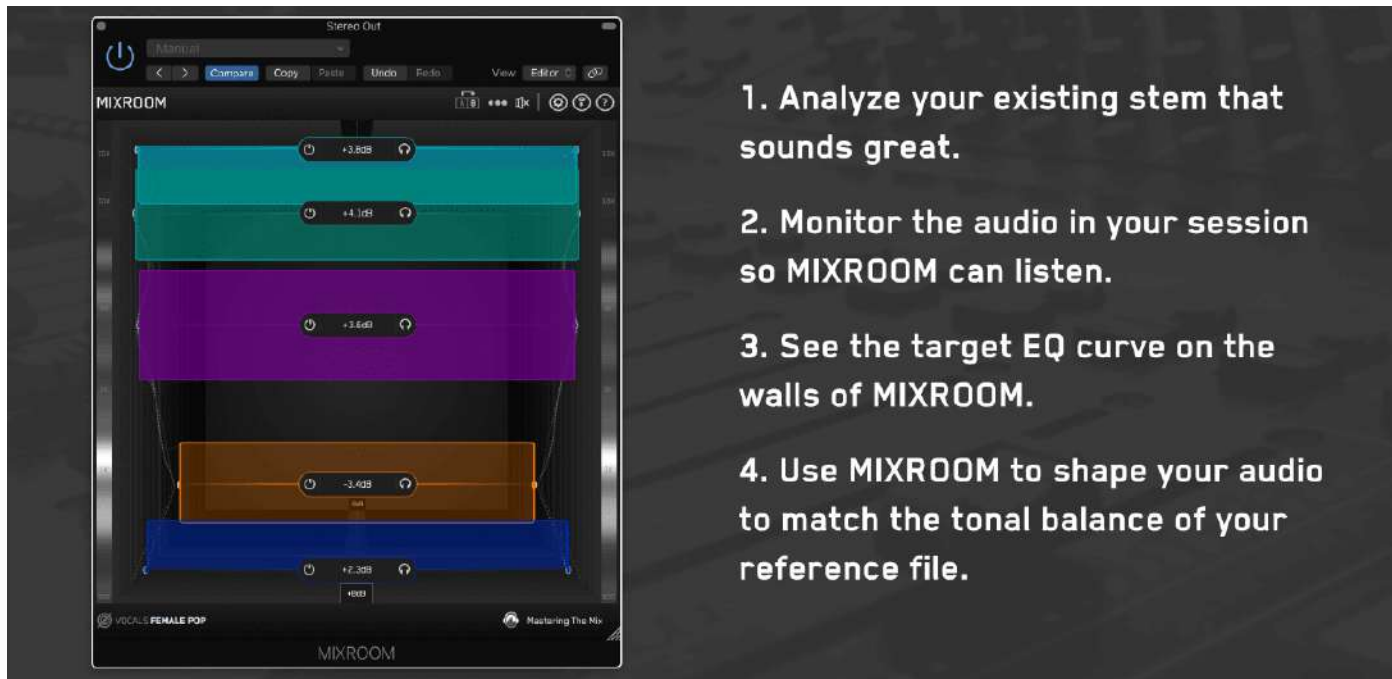
Note: if you're working on a mix, but comparing your track to released final masters, be sure to use the instant level match feature in REFERENCE. This will ensure that the difference in loudness doesn't make you believe that the released reference tracks have a fuller low-end and more clarity in the high-end. This can lead to very poor mixing decisions that can take a long time to fix

## EQ Matching Based On How The Human Ear Perceives Tonal Balance

REFERENCE is perfect for an overview of balancing your overall sound, but what about individual channels? Let's say you released a track with an awesome female vocalist and loved how it sounded. Now, you've got a new track with a different female vocalist and you want to try and get a similar brightness, body, bite, and clarity.

Trying to match how the 'peaks' look in an EQ is a fruitless endeavor as they don't correspond well to how humans experience the balance of frequencies.

With [MIXROOM](#), by Mastering The Mix, you can analyze a file (such as that awesome vocal stem from a previous release) then preview your new vocal to generate a target EQ curve. This target EQ curve guides you to what EQ is needed to get your new vocal sounding more like that existing vocal stem.



This is a methodical and reliable way to keep your sound consistent, and it works great whether you're working on a vocal, instruments, buses, or even mastering your song.

## Conclusion

Help your audience recognize your sound by keeping it consistent across your releases. Try the techniques explained in this post to help you establish your sonic branding. Be sure to check out the plugins from [Mastering The Mix](#)!



# Key Takeaways

- ☐ Set up your monitors to achieve the best monitoring environment
- ☐ If you use a subwoofer, optimize its placement with the Crawl technique
- ☐ Apply proper acoustic treatments, including appropriately sized bass trapping
- ☐ A little knowledge about how room modes work can lead to better room setup
- ☐ Room response graphs can tell you information about your room that might not hear
- ☐ Be sure to re-test your room with Sonarworks Measure or Room EQ Wizard after making adjustments to your acoustic treatment to validate your progress
- ☐ Improving the low-end clarity of your mix pertains to small speakers as much as large systems
- ☐ Try production techniques that bring out the higher harmonics in your bass tones
- ☐ There are tools available to help analyze and compare your mixes/masters to other tracks in various frequency ranges to help find flaws in your own mixes
- ☐ Spend time listening to and feeling music in your environment and learn how those feelings translate outside of your room





## If you're looking to get the best out of your studio, then try this...

The same know-how we've used to make this e-book can be used to vastly improve your monitoring. Our Reference 4 calibration software makes your headphones and monitors coloration free, so you can hear what's really happening in your mix.

Sonarworks Reference 4 uses acoustic measurements and applies them to your headphones and monitors, so any tonal coloration is reversed. The result is a clear picture of your work, so you can focus on doing what you love!

Available in major DAW plug-in formats and as a standalone Systemwide app Reference 4 is already used in more than 45 000 studios worldwide.

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