

# Improve Your Listening Experience



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# Introduction

A good rule of business is to reinvest about 10 to 15 percent of your profits each year back into your business. For those of us who use our studios for our main source of income, we can easily calculate our profits and then we can prioritize our wishlist. For those who are just getting started, going through an audio education program, or working on audio as a hobby it's a little more difficult to decide the best places to invest in your studio. Definitely spend some time and money getting things that inspire you—whether that is a cool microphone or LED ceiling lighting, or just a comfy chair. Don't skimp on the monitoring system, which means getting some speakers and/or headphones that you can trust and setting up and tuning your room properly. You don't have to spend a lot of money on your monitors or headphones as there are many great affordable options.

This eBook covers many of the questions that should be at the top of your list, whether you are just starting out, or deciding how to spend that 10% of your profit on improving your setup.

“There is always room for improvement in our game”

Virgil van Dijk

# The Five Best Things To Spend Money on for Your Studio

by Eli Krantzberg

The subject of how best to spend your money to improve your productions will be different for everyone. Maybe you are a weekend warrior who wants to jam with friends every Friday night, or perhaps you are running a post-production business with clients coming by regularly. Maybe you are recording bands in a large space or beat making in your bedroom. Do you see what I am getting at? Everyone has unique needs. Sure, we all want better monitors, microphones, preamps, interfaces, computers, plug-ins, et cetera. In this blog, I'll focus on a handful of aspects of enhancing your production workflow that will benefit anyone and everyone. Things that will make us more creative, productive and richer, regardless of end-game business goals or the gear we may or may not already have or that we lust after.



# I. Reflections Aren't Just In Mirrors

The biggest mistake we make when setting up new studios is underestimating the importance of **room acoustics**. Acoustics affect the quality of what we hear more than our particular choice of monitors, microphones, preamps, or converters. Fortunately, this problem need not be an expensive one to solve.

One of the most noticeable problems in small room acoustics tends to be in the bass response. Commercial bass traps are readily available from companies like [Auralex](#) and [GIK](#). Bass traps are often placed in corners, so they remain out of your way, and they smooth out the lumpy low end problems that lead to poor translation and muddy or lean low frequencies in your mixes.

Whenever sound is generated in a room, part of the sound travels directly to your ears (or microphone) and part of the sound bounces off the surfaces of the room and then reaches your ears (or microphone). These reflections, which follow the direct signal by only a few milliseconds, are called **first reflections** and these reflections combine with the direct sound and affect the overall frequency balance and clarity of the sound.

Variables like the size and shape of the room and the nature of the reflective surfaces determine how the reflected sound will interact with the direct sound.

[Auralex](#), among many other companies, sells a wide range of absorption panels for this purpose. Don't overdo it, though, as too much absorption can make a room sound "dead." A certain amount of reflections are necessary to keep things sounding natural and open, but some rooms can be more dead than others.

Small vocal booths, for instance, can be made much more dead (less reflective) than larger performance areas for recording acoustic instruments. Control rooms should be a mixture of reflective areas and dead areas, following the **live-end-dead-end principles**. Be sure to review our [article](#) on killing those first reflections in your control room!

Acoustic [diffusers](#) work in conjunction with absorption panels by scattering reflections, so sound doesn't get focused directly back to any specific area. **Diffusion** helps retain a natural sense of space and a smooth frequency response. Strategically placed bookshelves, for instance, can act as low-cost natural diffusers. The uneven nature of the surfaces forces a random sort of dispersion of acoustic reflections. Companies like [GIK Acoustics](#), among others, manufacture decorative acoustic diffuser panels based on established acoustic theory.

[Ceiling clouds](#) help reduce unwanted reflections from the ceiling. A modest amount of money spent on a combination of absorber panels, diffusers, and **ceiling clouds** goes a long way to tracking and monitoring in more neutral environments. Online acoustic planning and analysis programs are available from many acoustic companies, like this one from [GIK](#) or this one from [Auralex](#).

## II. Make Good Monitors Sound Great



Now that your room is acoustically treated, it's essential to calibrate your monitors so they work optimally with the unique frequency response curve of your studio space. Most modern speakers include some **onboard DSP** to compensate for things like reflections due to walls or corners behind or close to the speakers. These simple EQs are often just coarse two- or three-position dipswitch adjustments. While useful, these EQ controls don't compare with accurately calibrating your monitors using software-based analysis and correction like that in Sonarworks Reference.

[Reference 4](#) from Sonarworks calibrates, or “tunes” your monitors to your room. It does this by taking a series of acoustic measurements around the listening area and calculating a correction curve so that you can mix on your monitors with confidence. Your monitors are, in effect, unaffected by the frequency dips and boosts that are inherent and unique to your studio.

Besides frequency issues, many studios have simple-to-fix problems like unbalanced volume between left and right speakers. Be sure not to just set the dial to what looks like the same setting on your monitors, but also measure the volume using an **SPL meter** or room correction software to make sure your levels are perfectly matched. A much more subtle problem occurs when the left and right speakers have slight timing differences and the sound that reaches your ears is not perfectly in phase between the left and right channels.

[Reference 4](#) software corrects this problem, as well as channel volume matching and overall frequency response.

Utilizing room correction software like [Reference 4](#) ensures that your mixes will translate consistently when played back in other environments and listening conditions. We may not be able to control the listening conditions that our mixes are played back in, but [Reference 4](#) allows us to trust the environment where we produce and mix our music.

## III. Ergonomics

We spend a lot of time in our studios—most of it seated in front of our screens and monitors. The chair we sit in is undoubtedly THE most used piece of gear in our studios. In addition to creating in it, we also often eat and even fall asleep in it. A good chair is crucial not only to our comfort but our health as well.

Those of us over forty will surely know what I am talking about. For those younger producers, enjoy your healthy backs and arms while you still can. Buy yourself a good; make that a GREAT chair. In 20 years you will look at that chair as the best purchase you've ever made.

A good studio chair needs to be comfortable, adjustable, and mobile, since we need to move around while we are working to reach patch bays, outboard gear, etc. Most importantly, we need a chair to support our backs and arms. Good posture is critical to preventing back injuries, as well as carpal tunnel and tendonitis-related problems. An adjustable armrest is vital to ensure your arms are at a 90° angle with your keyboard. Excellent support for your back goes a long way not only in keeping you comfortable during long editing or mixing sessions but also in keeping you pain-free twenty years from now. You can find a list of recommended studio chairs in this article from [Music Industry How To](#).

## IV. Upgrade Your Skills

Your room is sounding great, your speakers are calibrated, and you are comfortably set up to create music. Now what? Education would be a wise place to invest in for yourself. The value of expanding your knowledge applies not only to our creative lives but to life in general. Never before in history have we had such good tools for creating music, as readily available, and as affordable than now. But we have to learn how to use these tools in order to get the best out of them and out of ourselves.

The Internet is full of information about using your favorite music-making hardware and software. Some of it is good and some of it is not so good. Some of it is just plain wrong. Do yourself a favor and invest in professionally authored and **curated training materials** from one of many respected online resources like [Groove3](#). These days, videos are ubiquitous. YouTube can be hit-and-miss not only in terms of quality but also in continuity. You may pick up some useful tips, but you may miss out on some important fundamentals.



Services like Goove3.com and Puremix.com host industry professionals and skilled educators who share their techniques and knowledge in structured, organized and complete courses that cover all the bases. Whether you want to learn the basics of using your DAW, how to get the most from the latest plug-ins, how to track instruments, how to tap into your creativity or advanced mixing strategies, it's all there. For those who prefer reading, Groove3 also provides access to Hal Leonard's curated production library in easy-to-use digital ebook form.

Online education centers are not particularly expensive in the grand scheme of things and will help you bring your skills up to a professional level much more quickly than endlessly trolling through YouTube. Many services provide subscription plans or à la carte viewing options.





# V. Listen, Listen, Listen

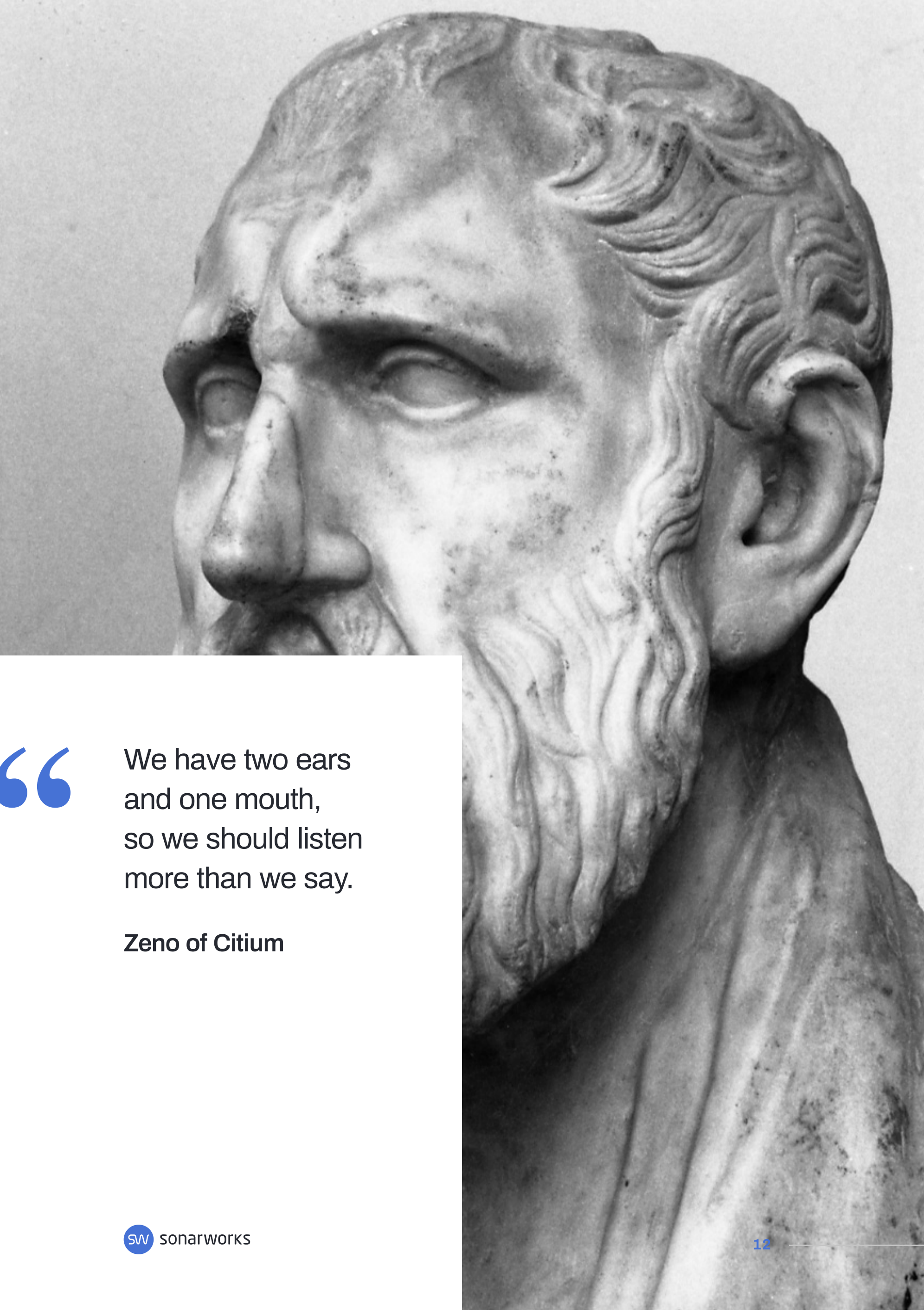
So, you've got your room and monitors optimized, you're comfortably set up and you're up to speed with all your hardware and software. What's next?

Being creatives, we all need to derive inspiration from somewhere. Artists look at paintings. Authors read books. **Musicians listen to music.** Spend some money on a good streaming subscription and access the best music in the world. Given that we all strive to create high-quality material, it's worth paying a few extra dollars for a premium service like [Tidal](#) or [Qobuz](#), where you can stream music at high resolution.

Most importantly, make sure to set aside time for listening. Given that streaming services make content easily downloadable to your mobile devices, it's easy to listen away from the studio. I enjoy listening when going on long walks. I get back to the studio with my creative juices flowing, full of ideas to try out.

Listening to music stimulates not just musical ideas, but production ideas, too. Old music, new music, it doesn't matter – they all have production aesthetics unique to their era and provide jumping-off points to inspire you to navigate specific roadblocks or bottlenecks in your creativity.

The tools to create great music and great productions have never been so abundant to so many. These investment suggestions will help you get the most out of whatever means you have to work with. Whether it is a beat-up old guitar and an SM57 or a fully decked out Pro Tools HDX rig with the best vintage gear available, we all have the tools to create memorable music. Get comfortable, get inspired and get productive!



“

We have two ears  
and one mouth,  
so we should listen  
more than we say.

**Zeno of Citium**

# Is Room Correction Effective?

by Adam Kagan

## The Question

I often get asked if digital room correction or room EQ is necessary for a given studio or listening room. My answer is that a professional tool, like **Sonarworks Reference 4**, will almost certainly improve your listening experience. The next questions that come up involve speaker choice, room treatment, and the fundamental fact that **“you can’t fix acoustic problems with electronics.”** Let me address these issues the way I would discuss this with a client. Don’t worry, this explanation involves no math and will explain why room equalization is effective at improving your listening environment.

First, allow me to present an analogy that everyone can relate to. We can assume that every new automobile can drive safely, comfortably and efficiently on a reasonable road in decent weather conditions. When we drive on bumpy or slippery roads the comfort and even the safety of our ride will be compromised. A simple improvement would be to upgrade our tires or shock absorbers. While stock windshield wipers are useable, for severe rain or sleet better windshield wipers will provide a much safer ride than basic or worn-out wipers. Compared to the entire car, the windshield wipers represent perhaps one-thousandth of the cost of the car but provide a measurable difference in the experience we have driving the car.



When we are purchasing a studio monitor system, we shop like we do for a car. We want something that is well made at our desired price-point. We want styling that suits our personal taste and we want confidence in the ability of speakers to produce accurate, enjoyable audio. Like modern autos, most modern modestly-priced speakers perform extremely well, with low distortion and excellent frequency response. Also like cars, **speakers interact with the environment** in which they are used, and small improvements, like upgrading your auto's windshield wipers, will yield a noticeable improvement in your experience.

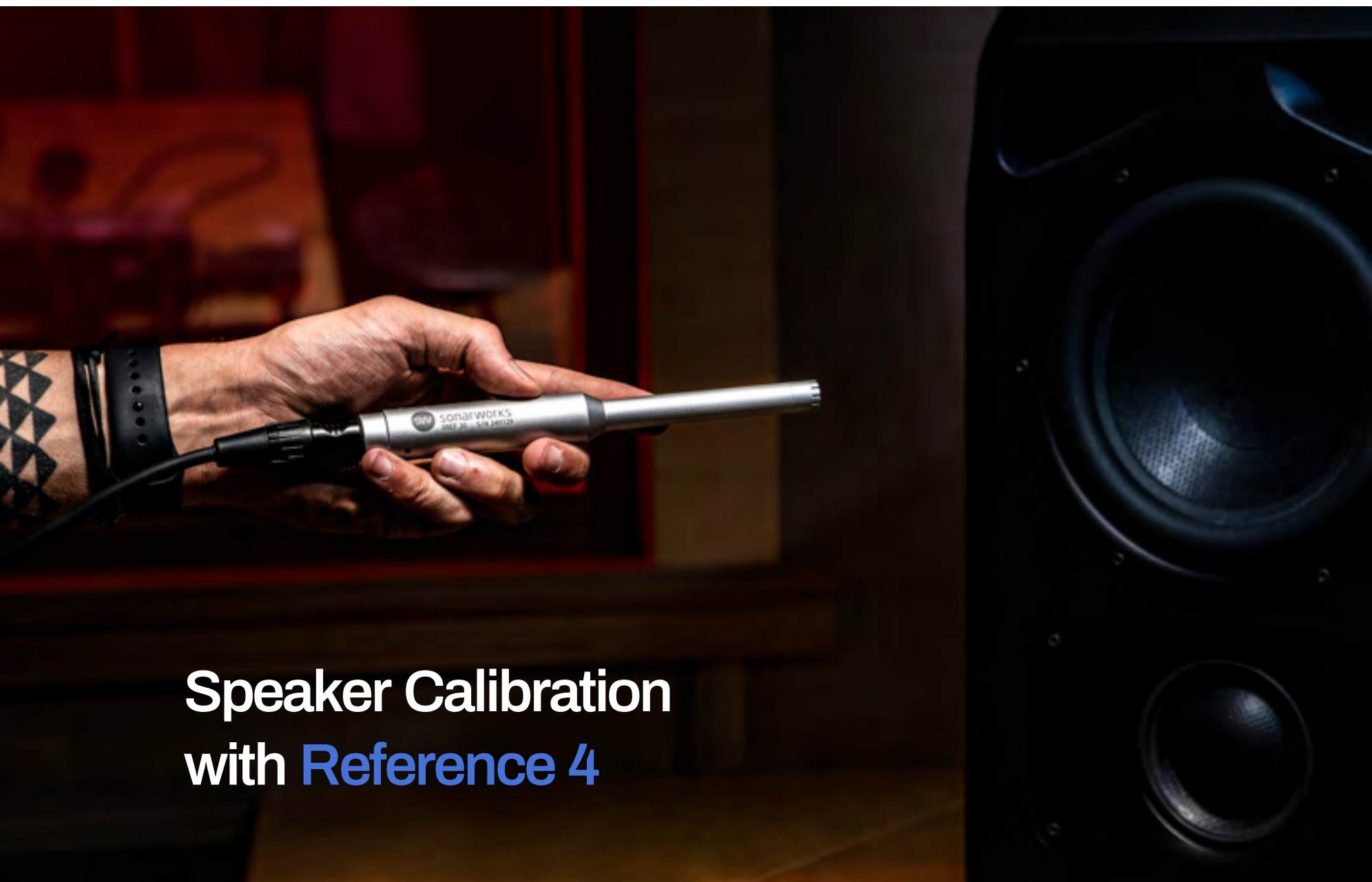
Professional monitors are designed and measured to perform exceptionally well in a perfect environment, like a free field or anechoic room. A set of monitors placed in your office, garage, or spare bedroom will no longer sound like the ideal speakers you purchased. The monitors produce the sound they claim to produce, but the room affects what we actually hear. You have created a new system that includes the speakers, the room's acoustics and the electronics of your entire monitor chain.

## Physical Room Correction

Every room and physical setup presents a unique sonic environment and we need to deal with certain acoustic problems to get even a reasonable sound out of our monitor system. For instance, the interaction of the speaker with the front wall of your studio will always create a dip in frequency response at some relatively low frequency. This particular problem will always exist to some extent in every room and with every set of monitors. It can only be improved by moving the speakers relative to the front wall and by proper application of bass trapping. No amount of EQ will fix this “bass suckout” problem because no matter how much energy you add at the problem frequency, the room dimensions will still provide the same amount of cancellation.

Other acoustic issues, like first reflections, proper listening position, and speaker-listener geometry also need to be taken care of in the physical realm. Move your chair, angle the speakers properly, and place absorbers and diffusers in the necessary positions. Too little **bass trapping** can also allow low frequencies to ring, or last longer than they should, which will smear the clarity of the low-end of your mixes. Proper setup and acoustic treatment minimizes the effect that the room has on the sound of our monitors.

Once the speakers and room are set up properly and optimized as much as is practical, there may still be some problems that we haven't fixed. The remaining acoustic problems relate to our limited amount of space, money or simply the original construction of our building. These problems will be a fact of life no matter what speakers or corrections we can realistically apply, so we've done the best we can—returning to our analogy we have the best car we can afford.



## Speaker Calibration with **Reference 4**

# Digital Room Correction

Digital room correction now comes into play to add the finishing touches that really polish the sound of the system. Like upgraded windshield wipers and better tires, several small changes in the performance of your system add up to a much-improved listening experience. Below are some of the improvements that you can expect from room correction software.

Sonarworks [Reference 4](#) measures the frequency response of your system at thousands of frequencies—not like your grandfather's  $\frac{1}{3}$  octave analyzer—and can create **thousands of tiny adjustments** that correct the frequency response variations of speaker drivers, crossover designs, and even small variations in room shape and treatments.

Every electronic component in your audio gear has a specific operating tolerance and if we have ten components, each with a 5% tolerance, the variation from the ideal can be quite noticeable.

Sonarworks [Reference 4](#) will measure and adjust for the real-world performance of your entire monitor chain.

[Reference 4](#) will improve the stereo image by correcting the **timing and volume** differences between your listening position and the left and right speakers down to the hundredth of a millisecond and a tenth of a dB for each channel. Beyond the accuracy of a tape measure and a volume knob, this alignment will really solidify your center image and highlight the stereo placement of panned sounds.

As we mentioned earlier, the position of your speakers relative to the front wall will create a dip in certain low frequencies of our bass. Interestingly, while room EQ can't solve this bass suckout, Sonarworks' **minimum or linear phase EQ** can effectively tame peaks in the room response. Lowering these peaks, especially in the low frequencies, can really help flatten out the bass response.



Keep in mind, also, that our studio spaces are constantly changing environments. We might get a new sofa or new window treatments. We might add an extra chair or a new equipment rack. You might finally set up that modular analog synth that is the size of a grade-school whiteboard. Besides these obvious physical changes, you may change your monitor controller, interface or even the audio cables to your monitors. All these tiny changes add up to real differences in what we hear.

Wear and tear on your monitors can be expected, especially if you play your music loud at times. Speakers break in and break down and even electronic components in amplifiers and crossovers will age and start coloring your sound. Our brain gets used to changes that happen gradually and we may not notice small changes in our system's performance. Be aware that while fresh measurements may look very close to the old measurements several one percent changes add up to noticeable difference!

Ultimately, I recommend that you measure your room every three or four months and measure again whenever you make changes to your room's layout or furnishings.

## Keep It In Perspective

Ultimately the most important thing about our room is what the audio sounds like. Room correction, like Sonarworks Reference 4, provides more than enough polish and improvement to a monitor system to easily justify the time and cost. Clean your windows to the sonic world and help your monitors sound their best!

“

As long as  
my music is real,  
it's no limit to how  
many ears I can  
grab.

**Kendrick Lamar**



# Do I Really Need a Measurement Microphone?

by Adam Kagan



## Sonarworks XREF 20

As thoughtful consumers, we try to make informed choices which often include a cost-benefit analysis as part of our decision-making process. When deciding to purchase slightly more expensive tires for our car, we try to determine the benefits vs cost. Do the more expensive tires provide a better ride, better wear or more safety? Often in the studio world, we wish to demo something to see how it works in our particular environment to help us decide on a purchase.

Demoing an audio product usually requires a bit of investment in time to install software, rewire our setup or in money to purchase a piece of equipment that facilitates demoing some particular device. Recently I wanted to demo Nuendo 10.5 software and realized that I needed to purchase a USB e-Licenser in order to run the demo. The same is true for iLok protected products. A similar situation exists with needing extra speaker cables to demo a second set of monitors or needing a second mic stand or cable to easily A-B two microphones. Usually, the cost of the extra devices is minimal compared to the proposed investment and often the extra device is useful in other ways—that extra mic stand or cable will eventually get used.

Sonarworks provides a free 21-day trial of their software, which allows trying the software with your current headphones and gives you plenty of time to run through all options in the software. However, if you would like to demo Sonarworks Reference room correction software, you will need to **measure your monitors and create a calibration profile**, or EQ correction curve, for your room. The recommended Sonarworks XREF microphone comes bundled with certain products and is also available for purchase for \$69 (USD), but, unfortunately, does not come free with a 21-day software trial.

## Mic Choices

Ultimately the most important thing about our room is what the audio sounds like. Room correction, like Sonarworks Reference 4, provides more than enough polish and improvement to a monitor system to easily justify the time and cost. Clean your windows to the sonic world and help your monitors sound their best!



Let's take a minute to explore what measurement microphones are and why most microphones are not suitable for accurate measurements. To begin with, our ears behave more like omnidirectional (pressure sensitive) microphones than uni-directional microphones, so we want to think about using omni mics for our measurements. We want our measurement mic to have an extremely **flat frequency response from at least 20Hz to well over 20kHz**.

Measurement microphones utilize small capsules (8mm or so) for an accurate high-frequency response and a polar pattern that remains consistent at all frequencies. Large-diaphragm mics become increasingly directional (narrow focus) at high frequencies and almost omni at low frequencies. Studio microphones, especially those with large diaphragms ( $\geq 27\text{mm}$ ) may have flattering characteristics for recording but do not work well for accurate measurements.



Measurement microphones range in price from under \$50 to a few thousand dollars, however, even inexpensive measurement microphones can perform accurate frequency measurements. More expensive measurement mics, like those from Earthworks or NTi, will have lower distortion, lower noise, higher sensitivity, and better build quality. Also, less expensive mic may use electret condenser elements, instead of true condenser elements and electrets may lose accuracy over years of use.

MXL 603S



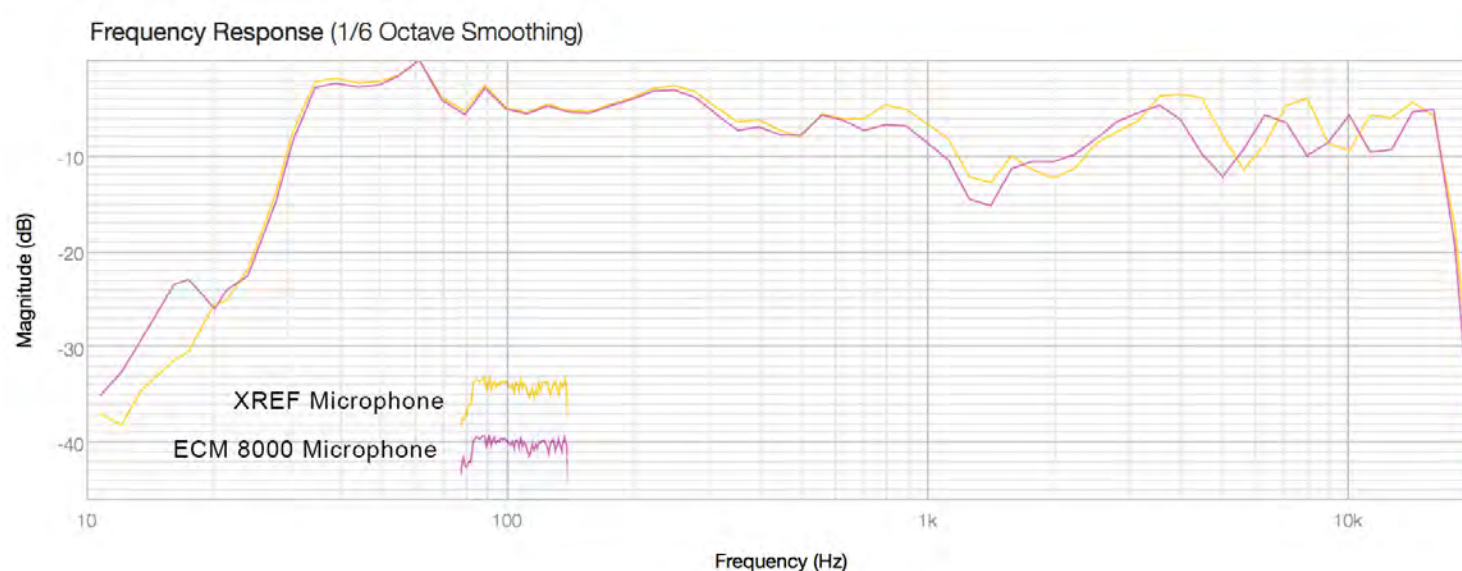
## Earthworks M50

All respectable measurement microphones come with a unique calibration profile, or measurement file, that provides your measurement software with the exact frequency response of your particular mic. This profile is used to subtract out the measurement error from the test data. After-market microphone calibrations can be performed by companies like [Cross Spectrum Labs](#) and calibration profiles can be generated should you require a calibration file for any microphone.



# Measuring Up

In the examples below, I used Fuzzmeasure (<https://www.rodetest.com>) software to measure and compare different microphones. The graph below shows a **Sonarworks XREF 20** measurement microphone along with a **Behringer ECM 8000** measurement microphone that I bought used on EBAY a few years ago. I played Fuzzmeasure's sweep tone through uncorrected studio monitors and the image below compares the two microphones' frequency responses to each other.

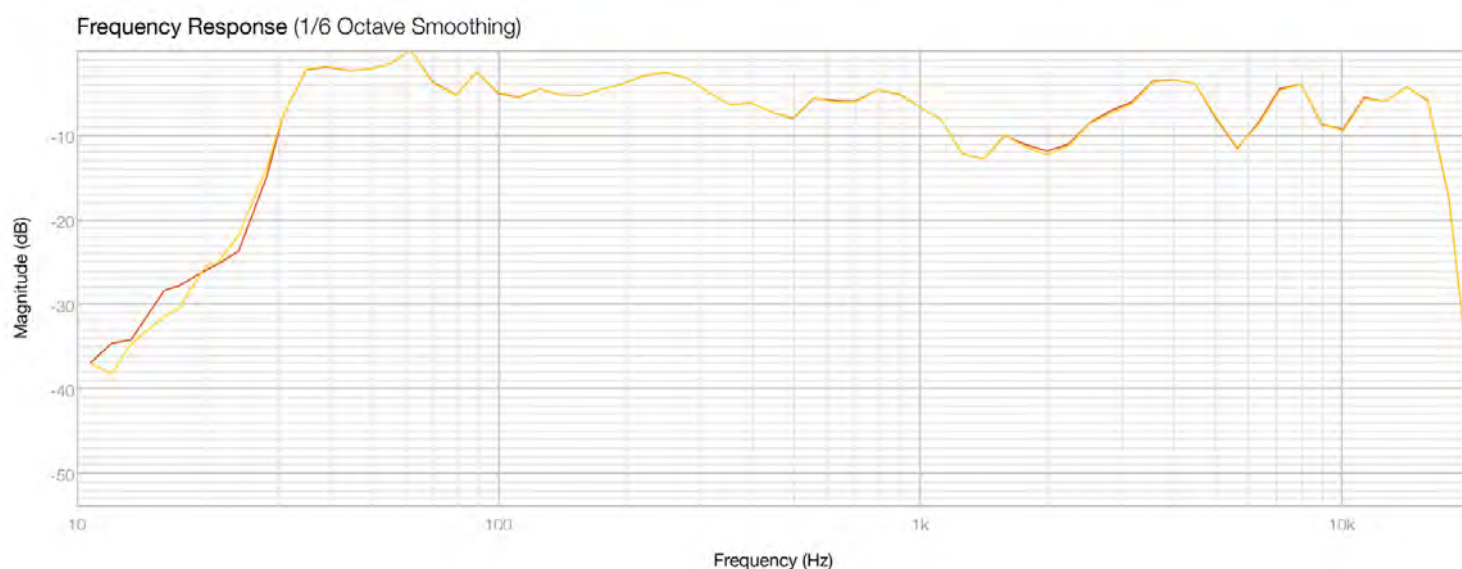


The graphic shows that the Sonarworks XREF and the Behringer ECM 8000 match very well below 600Hz, but above 600Hz, differences of up to 5dB can be seen. In practice, both of these mics come with a calibration profile that will mostly correct these discrepancies. The XREF mic comes with a profile that is generated from that specific mic (with a specific serial number) while the Behringer measurement mic's profile is based on average tests of several mics and not the specific mic you are using.

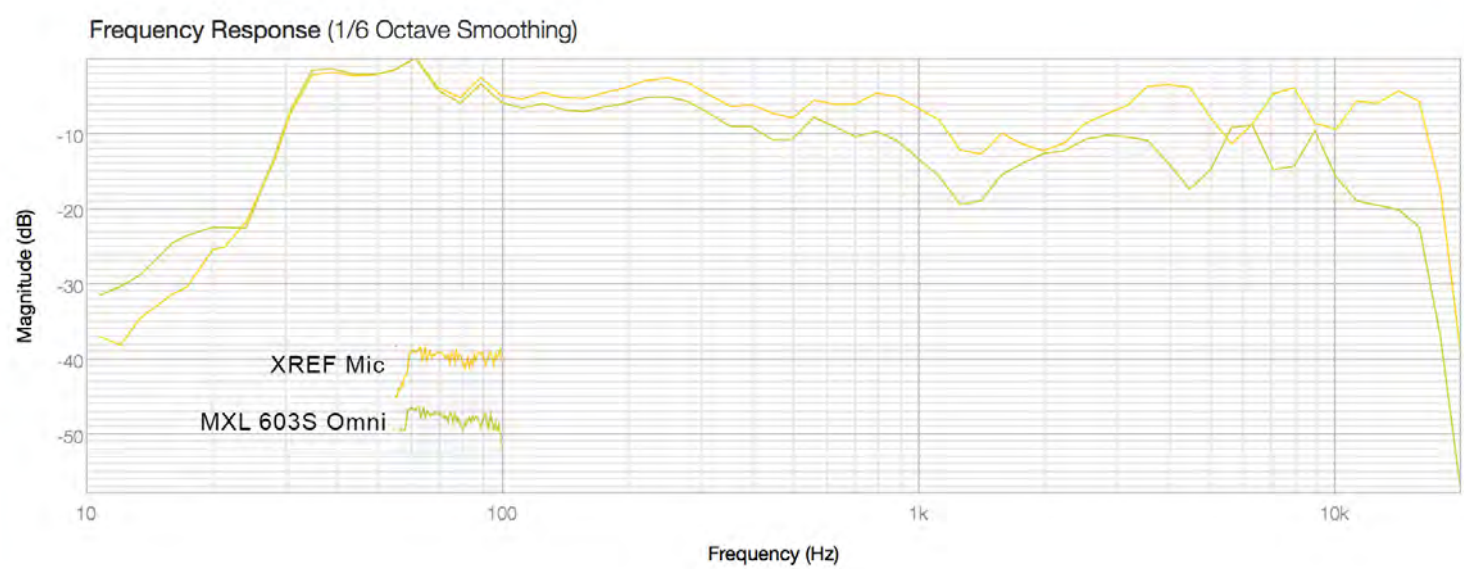
Additionally, when measuring your room, Sonarworks Reference Measurement software takes more than 25 measurements around the listening area and averages the room measurement. That way small measurement errors become even less significant. Even without applying their calibration files, both of these mics perform extremely well, especially in the critical low-frequency region.

To investigate the possibility of using some common studio mics, I tried some small diaphragm microphones from my locker. I mainly tried **omnidirectional mics**, but I threw in some cardioid capsules for comparison. Notice that my graphs display  $\frac{1}{6}$  octave smoothing. Most audio marketing specifications use  $\frac{1}{3}$  octave smoothing for speakers and microphones.  $\frac{1}{3}$  octave smoothing is not really accurate enough to show what's really going on. Room response is often viewed at resolutions as high as 1/48th octave. I want to show a reasonable amount of detail in these graphs, so I've chosen  $\frac{1}{6}$  octave smoothing for these examples. Note: See the sidebar at the end of this article for more on smoothing.

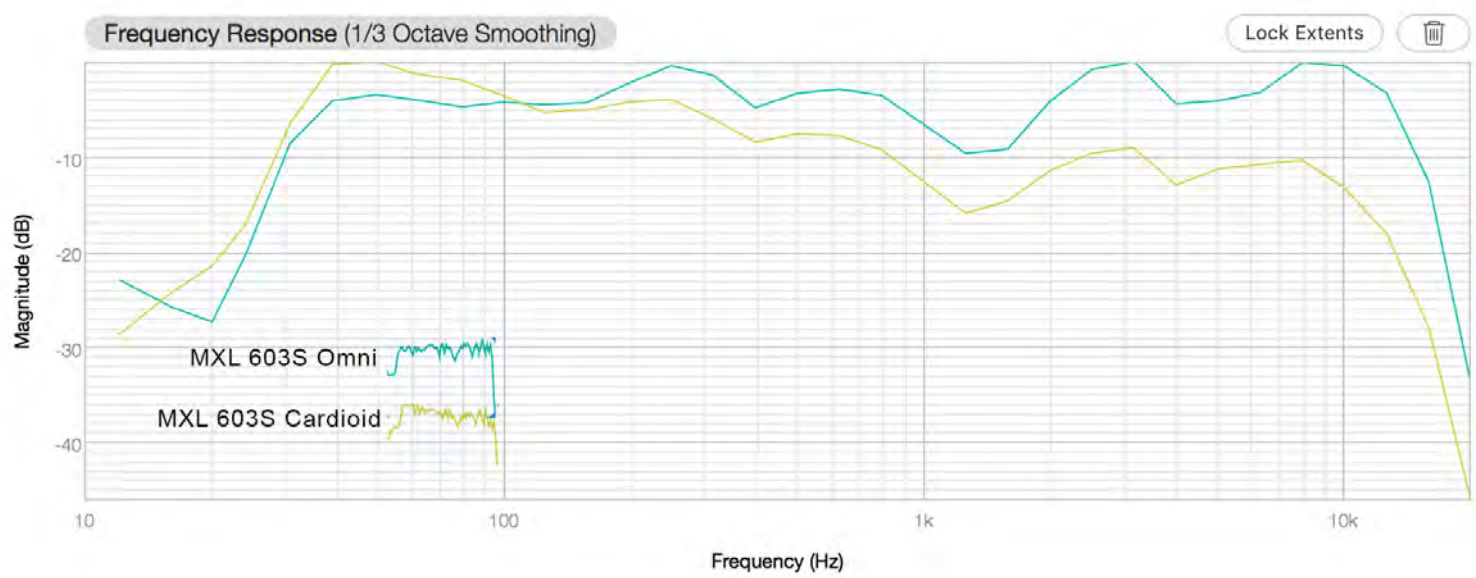
To check the accuracy of my test setup, I mounted the Sonarworks XREF mic on a mic stand where my head would typically be and measured the XREF mic twice, about 5 minutes apart. This overlay shows that the test setup is repeatable. Above 20Hz, the two traces are virtually identical.



Next, I tested the XREF 20 against an MXL 603S with an omni capsule. The MXL veers away from the XREF above 100Hz. The differences in these mics show that the MXL may provide reliable low-frequency measurements, but we can't be sure about the highs.



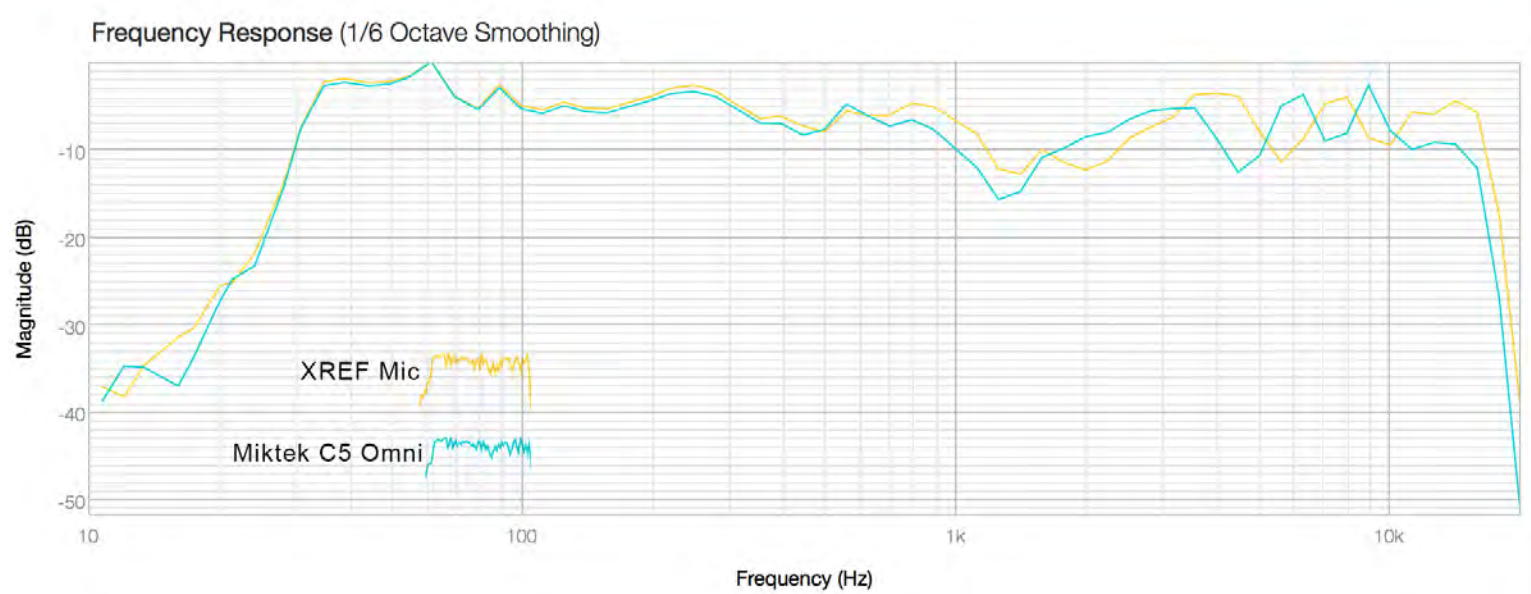
Since many of us have mainly **cardioid microphones**, I wanted to show the difference in frequency response between omni and cardioid mics of the same model. Here is a comparison of the MXL 603S with both a cardioid and an omni capsule.



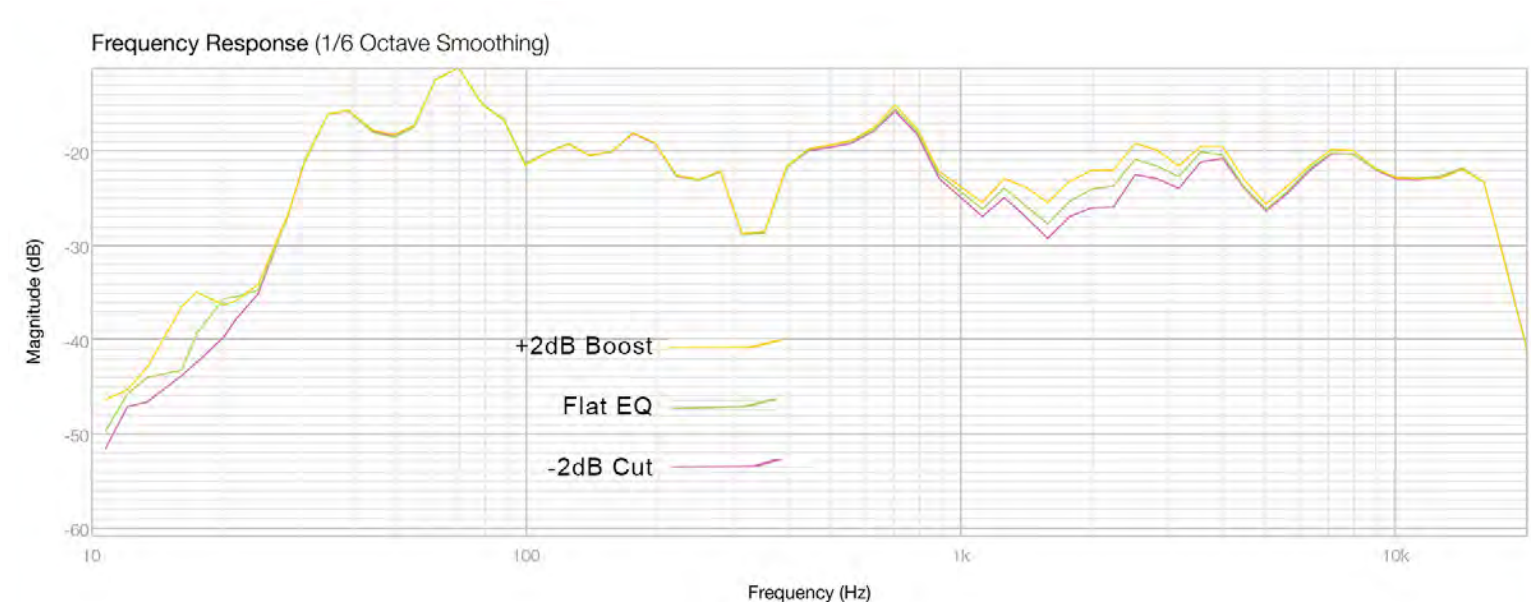
Clearly, the two MXL mics have opposing frequency tilts, so using one mic versus the other as a measurement microphone will yield drastically different results. I tried this same test with other brands and omni and cardioid mics of the same models followed similar trends as above.



Here is a comparison of the XREF to the **Miktek C5** with an omni capsule. In this test, the C5 and XREF 20 behaved very similarly below 1kHz, followed a similar contour up to 4kHz and then showed opposing measurements. The Miktek C5 would be better than an MXL 603S for measurements but above 3kHz this C5 may not be much more trustworthy.



I also wanted to verify that the measurement mics accurately captured small changes in frequency response, so I applied a 2 dB cut and boost at 2kHz and took three measurements with each mic. All the mics I tested correctly tracked the changes in EQ. The measurements below were made with an **Ashman SOM50** SuperOmni microphone.



From these images and descriptions, you can take away that each mic can accurately capture changes in frequency response, so it can, indeed, create a measurement of sorts. Measuring changes, however, will never tell us when our monitor response is flat. I wouldn't recommend that any mic, except a calibrated measurement mic, be used to tune your room or even audition Sonarworks software.

An analogy to that would be frying some food in peanut oil because olive oil is too expensive and you just want to see if it works. Of course, the peanut oil will work to fry the food, but the flavor will be nothing like the flavor of frying olive oil. Using any old mic to test Sonarworks will show you that the software records measurements of your and can create a curve, but that curve is based on inaccurate measurements and will likely not be an improvement to your existing problems.

# Measurement Mic Wins!

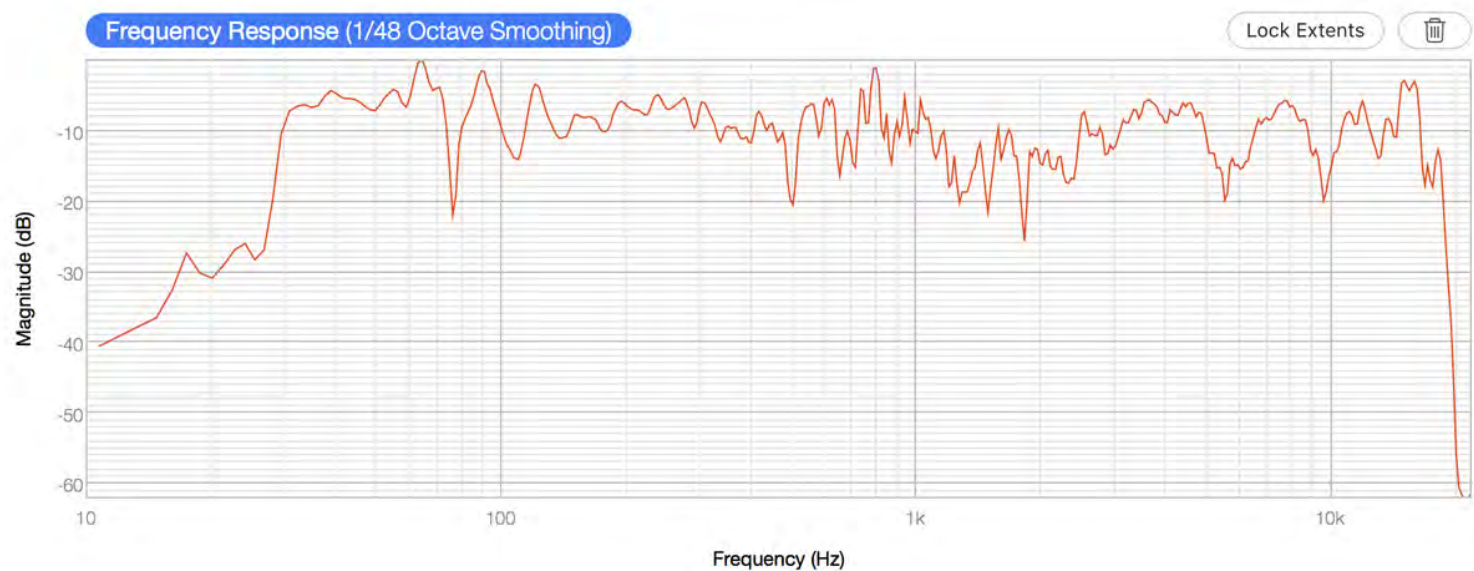
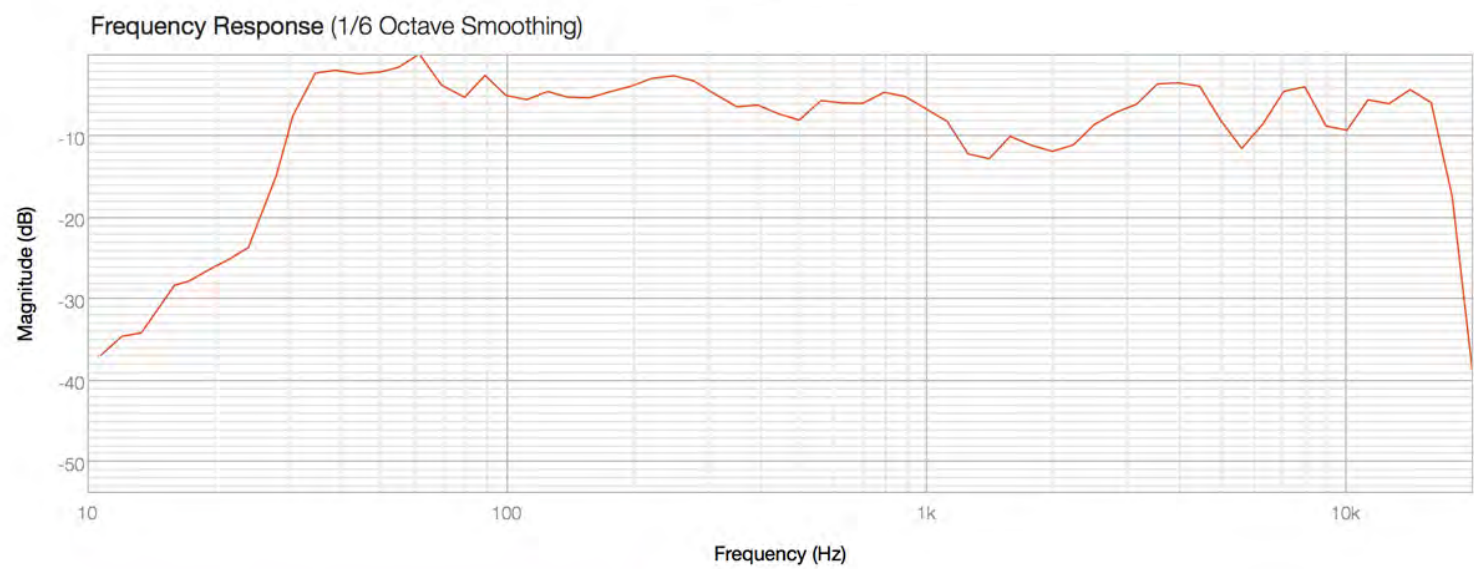
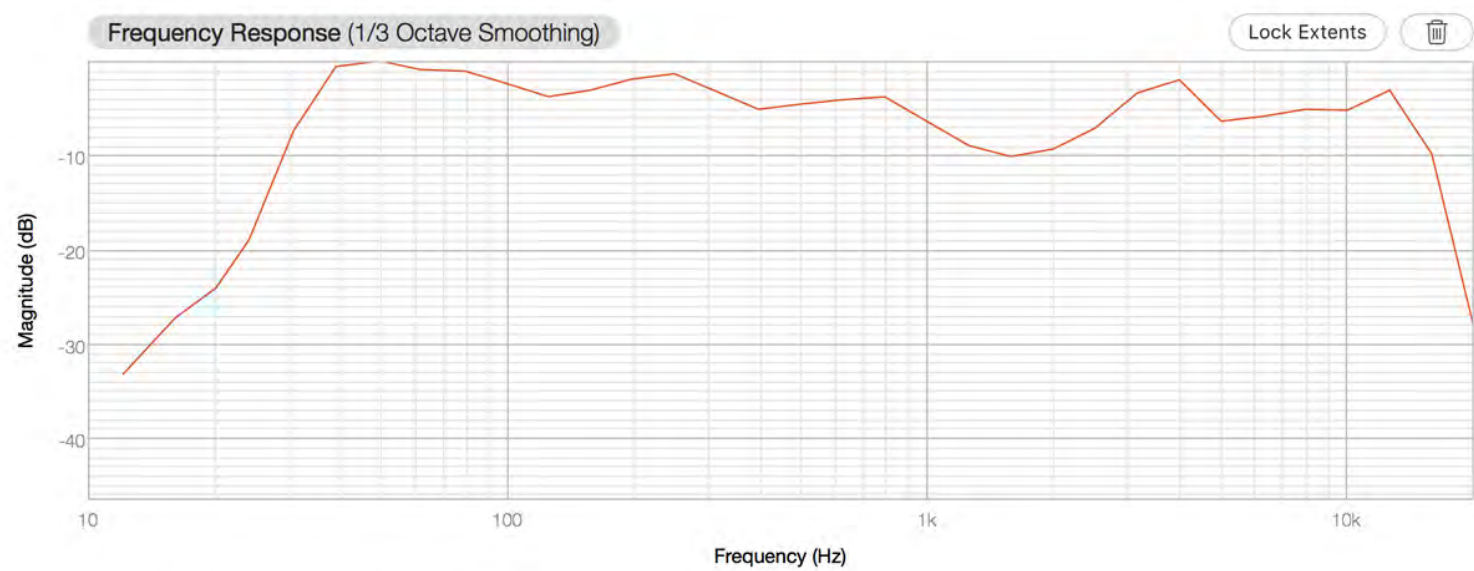
Don't skimp on using a true measurement mic to test your room or even to audition room correction software. Buy an inexpensive calibrated mic and if you decide you don't need to keep the mic, put it up for sale and someone will surely buy it. Pro-Tools-Expert.com surveyed that 59% of their production community "cannot live without speaker calibration software in their studio." Download a demo of Sonarworks software and if you intend to try the software on headphones, you're good to go. If, however, you want to measure and calibrate your speakers, please borrow or buy a calibrated mic and try it for real. I don't think you'll be disappointed.

# Smoothing and how it hides data.

The graphs below all represent the same measurement but have different smoothing applied. 1/48 octave smoothing divides each octave into 48 measurements. 1/3 octave smoothing only divides each octave into three measurements, so we don't know what happens between those measurements. Comb filtering and audio anomalies often have very narrow bandwidths with large amplitude changes. A deep notch that is 1/6 octave wide at 80Hz may not show on a 1/3 octave chart but will wreak havoc with frequencies around the notes of D#2, E2 and F2—the open low E-string on the acoustic guitar or the open D string on the bass guitar.

Take a look at the three graphs below to see how smoothing hides some very ugly dips in the frequency response. Notice the almost 20 dB dip at 74Hz on the bottom graph that is completely smoothed over in the top graph. The 1/3 octave graph would lead us to believe that there is no frequency dip around 70Hz when we can clearly see the dip in the 1/48 octave graph.





# Key Takeaways

- ☐ Kill First Reflections
- ☐ Apply correction with Sonarworks Reference software
- ☐ Get comfortable in your space!
- ☐ Invest in your own education and development
- ☐ Spend time listening to other artists for the enjoyment and also to develop your art
  
- ☐ Follow manufacturers' recommendations for monitor setup
- ☐ Spend the time to get your room acoustically sound before applying correction
- ☐ After proper room and speaker setup, further corrections using software like Sonarworks
- ☐ Reference 4 will provide the best possible listening environment

# Key Takeaways

- ☐ Dedicated measurement mics come with a calibration profile that makes them much more accurate than an off-the-shelf mic
- ☐ Measurements are often smoothed to  $\frac{1}{3}$  octave, which simplifies the graph to a point where important data may be ‘rounded off’ and not represented properly



## 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.

**Click to Try Reference 4 for Free**

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