M-AUDIO

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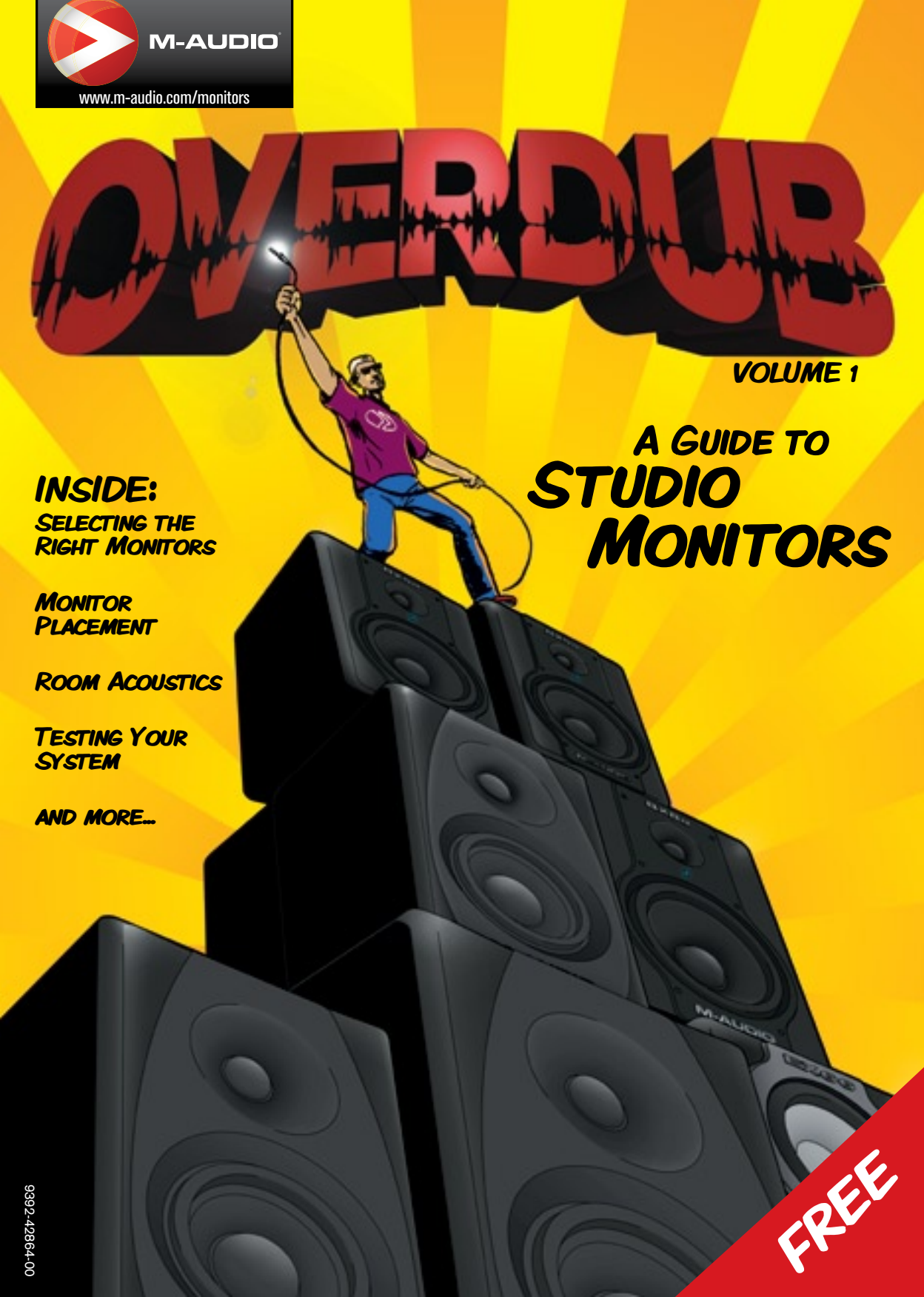
OVERDUB

VOLUME 1

A Guide to Studio Monitors

INSIDE:

- Selecting the Right Monitors
- Monitor Placement
- Room Acoustics
- Testing Your System
- and more...



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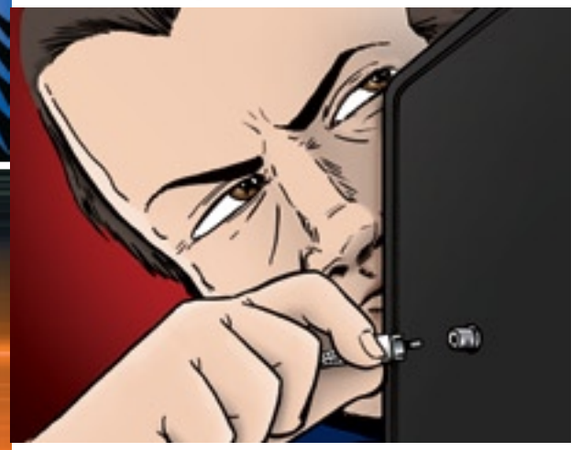
OVERDUB

A Guide to Studio Monitors

Why would anyone need directions for setting up reference monitors? Just put them on your desk, and you're done, right? Well, it turns out that reference monitors are actually one of the most important and influential elements of your studio, and can really make or break the performance of your whole setup. It's not that you have to spend a lot of money on them—with a good knowledge of monitoring fundamentals and a little bit of experimentation, you can put together an accurate system on any budget.



It can be extremely frustrating to spend hours slaving over the perfect mix—only to find that it sounds horrible in your car, living room or another studio. A good monitoring system can prevent this by helping you to produce mixes that are clear, balanced and translate well across a broad range of speaker systems. This issue of Overdub covers the most important points you need to consider when choosing and setting up monitors for your studio. This information will assist you in making educated buying decisions and, most importantly, help you achieve a professional reference standard that will further your artistic endeavors.

What Makes a Good Monitoring System?

Whether you are recording, mixing or mastering, your monitors are your primary and most important point of reference. Good studio monitors should let you hear exactly what's been recorded. In other words, monitors need to demonstrate a relatively flat frequency curve, instead of boosting certain frequencies to make music sound more pleasing to the ear. They should also be rugged enough to withstand the demands of the project studio—providing an accurate, uncolored response at a wide range of volume levels.

The quality of your speakers, combined with various room characteristics, can make the difference between a good mix and a bad one. Therefore, you should consider the following factors when setting up studio monitors:

- Monitor selection
- Monitor placement
- Room acoustics

How Do I Select the Right Monitors?

Choosing the right reference monitors largely depends on how you plan to use them. Singer/songwriters may be fine with a compact set of 5" monitors, while urban/hip-hop producers will likely choose a larger monitor plus a subwoofer to achieve greater bass response. Most studio owners need a stereo configuration, but a surround sound setup may be necessary if you produce sound for TV, film or games.

Since the monitoring system plays such a crucial role in the studio, it's important to get high-quality monitors that fit your needs. It's always better to visit your local dealer and listen to a few different models before deciding.

When test-driving studio monitors, listen to a recording that you're familiar with, and ask yourself:

- Does the bass sound tight and controlled, or uneven and muddy?
- Does the stereo field sound sufficiently wide, allowing you to hear the separation between instruments?
- Are the high-end frequencies smooth and crisp, or harsh and fatiguing?
- Do I hear details in the mix that I've never heard before?

Using a Subwoofer

As a growing number of subwoofers are used in car stereos, home theaters and desktop audio systems, it's vital that you hear the ultra-low bass frequencies in your tracks. Adding a subwoofer to your system can make a big difference in bass output. By carefully tuning the sub with the stereo mix, the low end is naturally extended in a way that fills out the sound, without adding a boom or unnatural low end. When properly integrated, a subwoofer can improve your overall monitoring experience by translating the extreme low end of the frequency spectrum (see Apendix B).

TIP

Some subwoofers—such as the M-Audio® Studiophile® BX10s—include a footswitch for bypassing sub output. This makes it easy to judge how the mix will sound on systems with and without a subwoofer.

To learn more about how to choose the right monitor system for your needs, please see Appendix A for information about monitor components and Appendix C to compare the entire range of M-Audio monitors at a glance.

Choosing the right studio monitors is the first step in creating a proper listening environment. The next factor to consider is proper monitor placement.

Monitor Placement

The "location, location, location" cliché doesn't just apply to the real estate market. It's equally (if not more) applicable to the subject of loudspeakers and room acoustics. Strategic monitor placement is one of the most important factors in getting your sound right—and it's simpler than you might think. Proper placement means choosing the best possible arrangement for your desk, speakers and other studio equipment.

When it comes to monitor placement, you've probably heard a lot of talk about the "sweet spot." This refers to sitting in the middle position between the two speakers, where the stereo image is optimized. The sweet spot lets you hear a true representation of the music so you can make accurate judgments while recording and mixing. When positioning your monitors, observe the following guidelines to maximize the sweet spot and enjoy better performance from your monitoring setup.

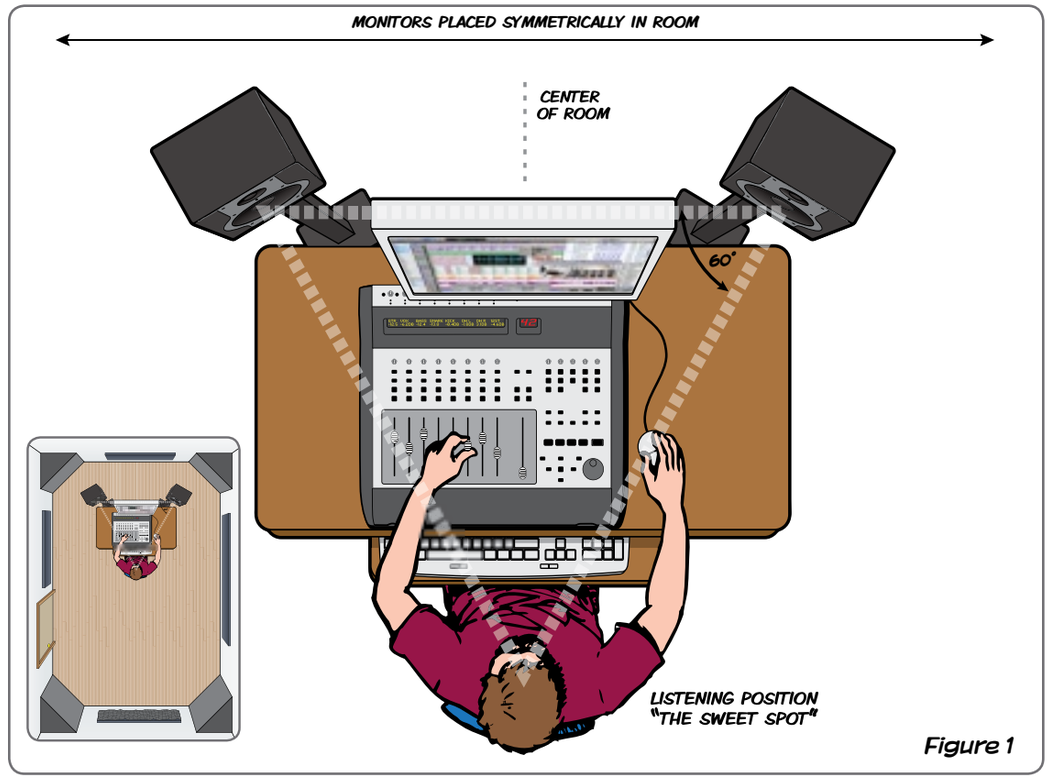


Figure 1

Guidlines for Positioning Monitors

Align your speakers in an equilateral triangle from the listening position

When mixing, it's important to sit as closely as possible to the center of the sweet spot. Select a comfortable seating position and angle each monitor to accurately face that position. The "toe-in" angle of each speaker should be carefully arranged at an equilateral triangle to the listener. (Note: Some multi-driver reference monitors, such as the M-Audio EX66, deliver an extra-wide dispersion field and might not need to be "toed-in.").

Place monitors symmetrically within the room

Try to achieve symmetry in the room when setting up monitors. For example, if the left speaker is three feet from the back wall and four feet from the side wall, place the right speaker the same way (if possible) in order to give each speaker a similar acoustic environment. By centering the listening position along a wall, your system will maintain better low-frequency clarity. In a rectangular room, the best sound can be obtained by orienting the console and loudspeakers into the room's long dimension. This gives the low-frequency waves enough time to develop before hitting the rear wall (see figure 1).

Distance from back wall should be different than distance from side wall

It's always better to place the monitor a different distance from the back wall than from the side wall. In other words, if your monitors are two feet from the back wall, make sure they're not also two feet from the side walls.

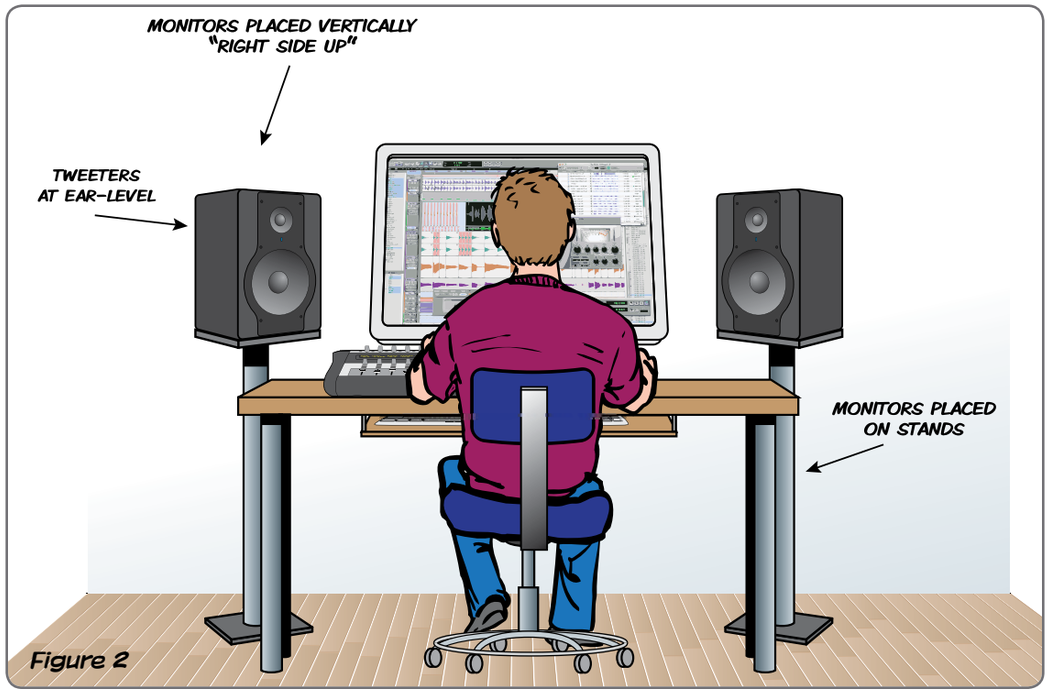


Figure 2

Place monitors vertically (or "right-side" up)

Although it may be tempting to place your monitors on their sides, this can significantly degrade the stereo image. Place the monitors vertically to get the best stereo representation (see figure 2).

Use monitor stands whenever possible

When you place speakers on a mixing console or desk, sound waves bounce off the flat surface before reaching your ears—degrading the tonal balance, clarity and image localization. Placing monitors on stands will prevent early reflections from interfering with your mix. (However, if this isn't practical, it's generally acceptable to carefully position your speakers on the desk or mixing surface.)

> **TIP** Placing foam pads underneath the speakers will help prevent resonance vibrations from interfering with the mix.

Tweeters should be at ear level

It's important to place the monitors so the tweeters are at the same height as your ears (see figure 2).

Avoid placing monitors in corners

This helps prevent bass buildups that occur naturally at boundary and corner locations.

Place monitors at least 8–12" from the wall

This prevents sound waves from bouncing off the wall and reflecting back towards you (see figure 3). When using monitors that contain bass reflex ports, make sure there is enough space to prevent air flow obstructions.

Figure 3

Using acoustic space controls

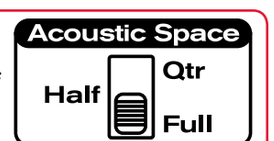
In an ideal setup, your reference monitors would be placed well away from corners and wall surfaces. Unfortunately, for many small project studios, this is far easier said than done. If space is tight, consider purchasing monitors with built-in Acoustic Space Control switches (such as the M-Audio EX66). These special switches activate EQ changes that compensate for different monitor placements.

Full-space:
away from walls and corners

Half-space:
up against a wall or placed on a mixing console

Quarter-space:
placed in a corner or on shelves near a wall

M-Audio EX66 Acoustic Space Control switches



By choosing the correct space control settings for your environment, you can make up for less-than-ideal monitor placement.

Fine-tuning your speaker placement

Finding the correct monitor placement requires time and patience. After setting up your monitors, test your setup by listening to a CD you are familiar with. Try moving your monitors around until you find a placement that provides balanced sound and a wide sweet spot.

While sitting in the sweet spot, adjust the speaker volumes equally. Make sure that if you hear a volume difference between speakers, there is a corresponding difference in the main output VU or display meters.

> **TIP** You can also balance the volume levels by using a centrally placed SPL meter (you'd be surprised at how many affordable SPL meters pop up in an eBay search).

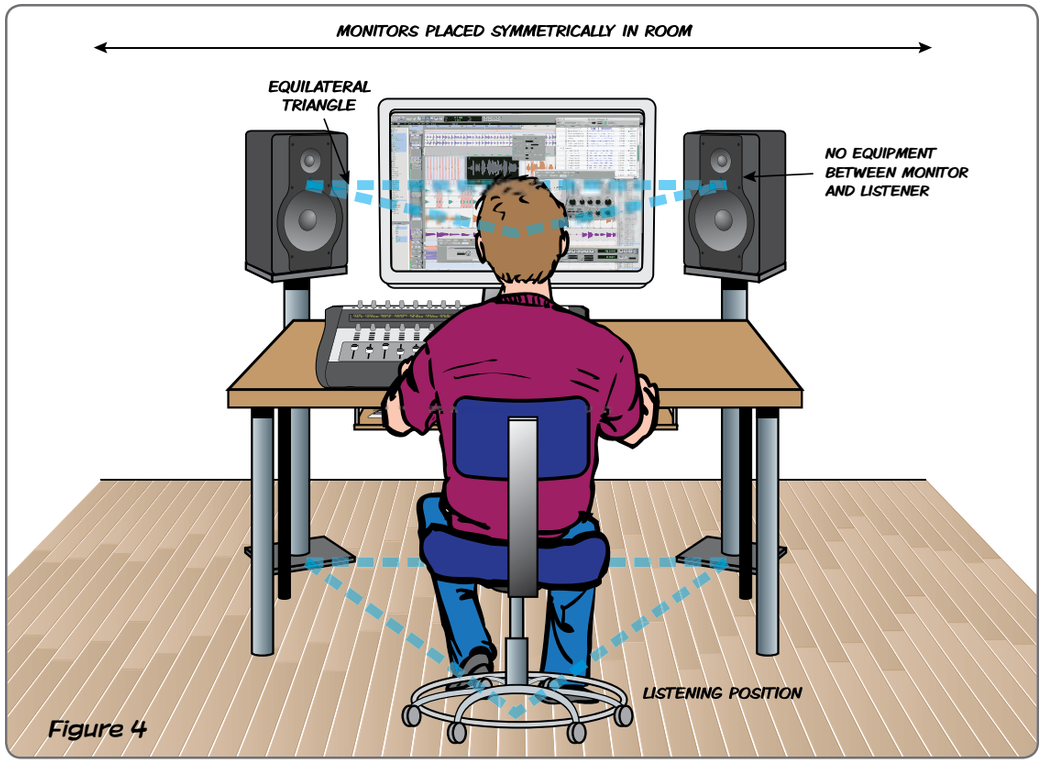


Figure 4

It may seem obvious, but don't put stuff in front of your monitors once they're set up. If there are any computer screens, equipment racks or other gear between you and your monitors, it's going to affect the way you hear the music (see figure 4).

Subwoofer Placement

If you use a subwoofer, its placement can make a huge difference in bass response. You should always place the subwoofer on the floor—never on a table or speaker stand. One theory suggests that the best position for a subwoofer in a 2-channel system is on the floor halfway between your left and right monitors, with its front facing forward and pointing in the same direction as the main monitors. From there, you can adjust the subwoofer's position until it is most "correct."

Another method of sub placement involves putting the subwoofer on the chair in your listening position. With only the subwoofer active, play some music with substantial bass frequencies (pink noise works great too). Crawl around the floor of your room and listen for a place where the sound is "fullest" but also "tight" sounding. Wherever that is—bingo!—that's where your subwoofer will go. If you want to be more precise, use an SPL meter instead of your ears and perform the same exercise. (If you use an SPL meter, make sure you play pink noise as the test signal and observe where the spectral response is smoothest and has the greatest low-frequency extension.)

> **TIP** Please note that because low-frequency signals radiate omnidirectionally, you may find that the best location sonically for your subwoofer is quite inconvienient—like in an area of your studio with a lot of foot traffic. If this is the case, you can simply flip the Phase switch on your subwoofer and repeat the exercise, hoping for a more convenient outcome.

Room Acoustics

Just like light bounces off a mirror, sound waves travel around the room before reaching your ears (See figure 5). Some sound frequencies get reinforced, while others get suppressed, the result of which causes alteration in the sound's overall character. Any boundary surface (back wall, side wall, ceiling, etc.) can cause problematic reflections, so you should think about the reflective properties of the room when setting up your monitors. You can greatly improve the accuracy of your monitoring system by neutralizing the strongest reflections in a room.

Most people use a spare bedroom or other rectangular space for their project studio. Unfortunately, rooms with parallel walls often give rise to a phenomenon known as "standing waves" (also known as room modes). These occur when sound reflects off of parallel surfaces and travels back upon its own path, causing phase cancellations that interfere with a room's amplitude response. Although this type of setup can pose difficulties, it is possible to turn a rectangular room into an accurate monitoring space. You can minimize reflections and improve the listening experience by analyzing the sonic characteristics of the room and making adjustments.

> **TIP** Everything we hear is a combination of direct sound and reflected sound. In the studio, sound wave reflections can boost certain frequencies while cutting others. By sitting closer to the speakers, you will hear more of the direct sound and fewer reflections. (Remember to maintain the equilateral triangle arrangement when changing your listening position.)

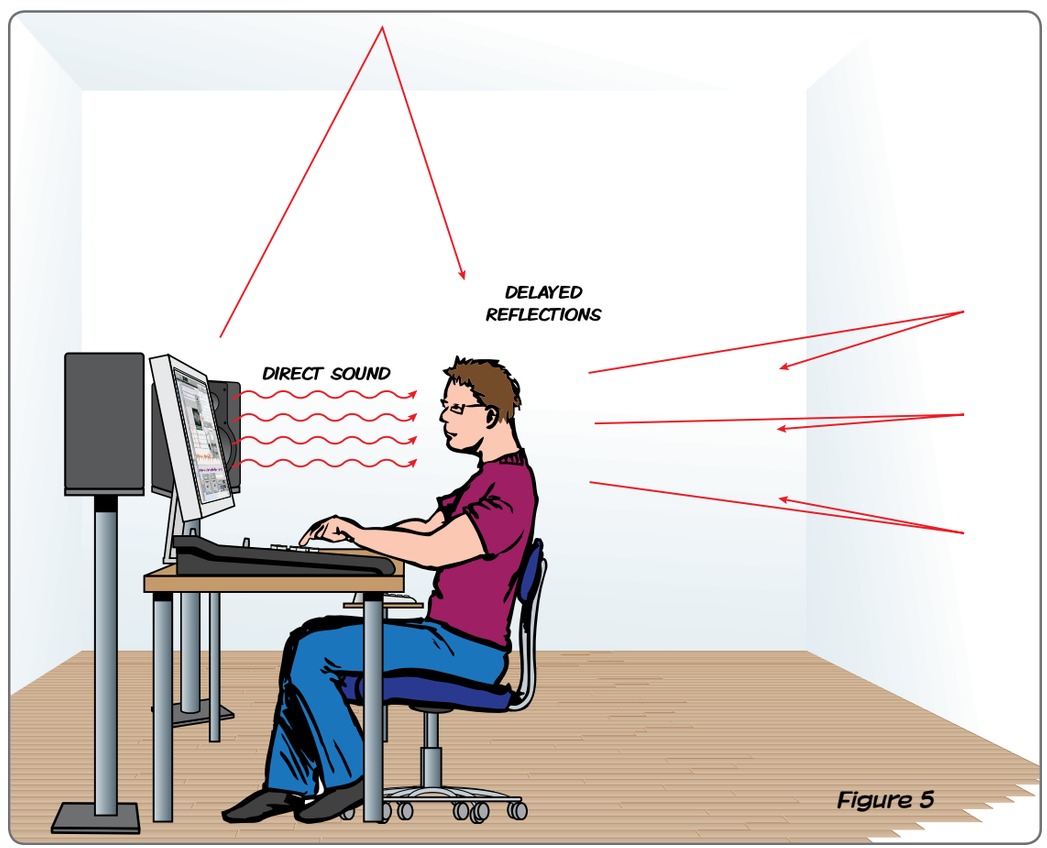


Figure 5

Using Acoustical Treatment

Every room needs some sort of acoustical treatment. Sometimes this can be accomplished by carefully placing couches, bookshelves and other items in the room. In most cases however, it will be necessary to use sound absorption and diffusion materials. Appropriate acoustical treatment can reduce frequency reflections and smooth out the reverberation characteristics of a room—preventing insidious reflections from reaching the listening position.

Absorption

The primary goal of absorption is not to soundproof a room, but to neutralize the most troublesome reflections. Dense porous materials—such as heavy cloth, fiberglass and acoustical foam—absorb mid- and high-frequency sound. It's easy to attach these materials to walls and ceilings to tame multiple room reflections and/or dampen reflections. Generally speaking, two inches of acoustical foam is effective for absorbing frequencies above 500Hz—while four-inch foam will work all the way down to 250Hz.

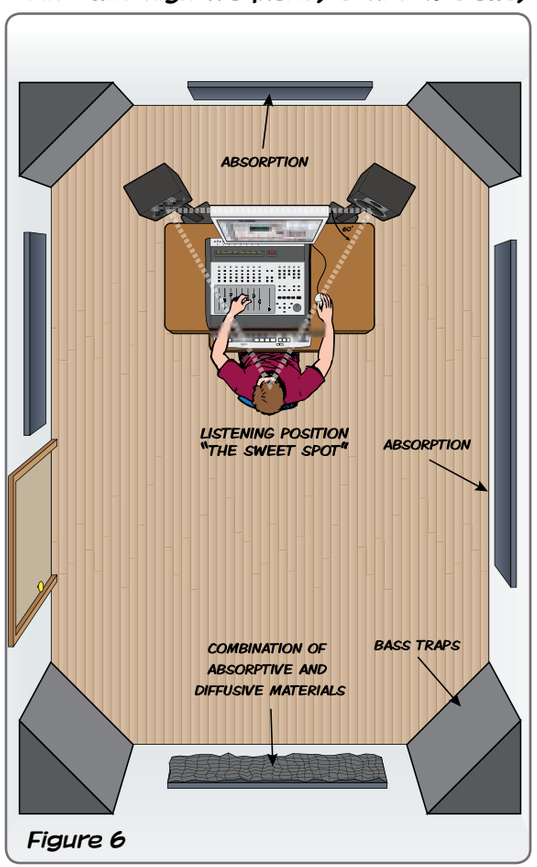


Figure 6

First, examine the potential reflection points in your monitoring environment. Are there any nearby surfaces that could reflect sound back towards the listening position? The most troublesome surfaces are usually the side walls, rear wall and wall behind the speakers (see figure 6). These areas should be treated with absorptive materials.

> **TIP** You can construct portable absorption surfaces by mounting acoustical foam onto plywood boards. These can be placed 4-6 inches from the walls—improving your studio acoustics without permanently altering the walls. You can even rearrange the boards to form a temporary isolation booth for recording vocals.

Dealing with Bass Frequencies

Uneven bass response can be a major problem for many project studio owners. Bass frequencies tend to build up in corners and boundary points, so the central listening position often suffers from a lack of bass clarity.

Bass frequencies behave differently than mids and highs, so treating the room for low-end response requires unique treatment methods. Materials that absorb high frequencies often provide little resistance to the low-frequency end of the spectrum (and vice versa). In order to properly handle low frequencies, most rooms need to be controlled with bass traps.

Bass traps employ special absorptive materials that reduce the resonance of low frequencies. You can absorb a large portion of undesired bass frequencies by placing these devices in corners, room boundaries or free-standing spots.

> **TIP** You can make an inexpensive, temporary bass trap by wrapping layers of carpet and/or carpet padding around a framework of suitable size, such as a bookcase or wooden frame. Mounting the frame on wheels allows easy positioning.

> If your monitoring system is boosting or cutting low frequencies, your mixes are going to suffer. You can test the frequency response of your room by listening to a series of test tones available at www.m-audio.com/overdub. Your monitors should play back each test tone at a relatively consistent volume level (within +/- 5dB). Pay special attention to the frequencies below 200Hz. Use an SPL meter to make sure the volume between test tones is consistent. Make adjustments to your speaker placement and room acoustics until the frequency response throughout the 20Hz-200Hz frequency range is consistent.

Diffusion

If your room is rather small (less than 10' x 10'), you can achieve good results using a few carefully placed absorptive panels. For larger rooms however, you may need sound wave diffusers. Diffusers are acoustical boundaries or panels that reflect the sound wave back at various angles, thereby breaking up the troublesome standing waves. Diffusers can be attached to the wall and/or ceiling boundaries—helping to redirect reflections away from the central listening position. Using diffusion can reduce a condition known as flutter echo and can smooth out the reverberation characteristics of a room by building further and more complex acoustical pathways (See figure 8).

> **TIP** You can diffuse sound waves by setting up a wall of tall bookcases filled with absorbent and irregularly shaped objects (See figure 7).

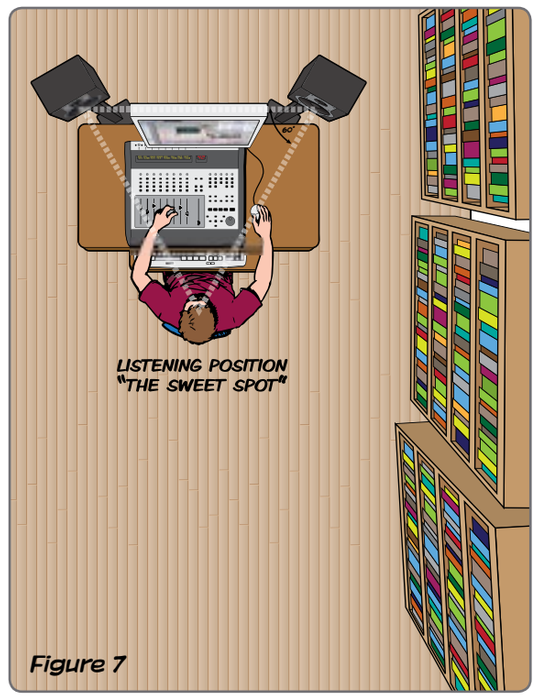
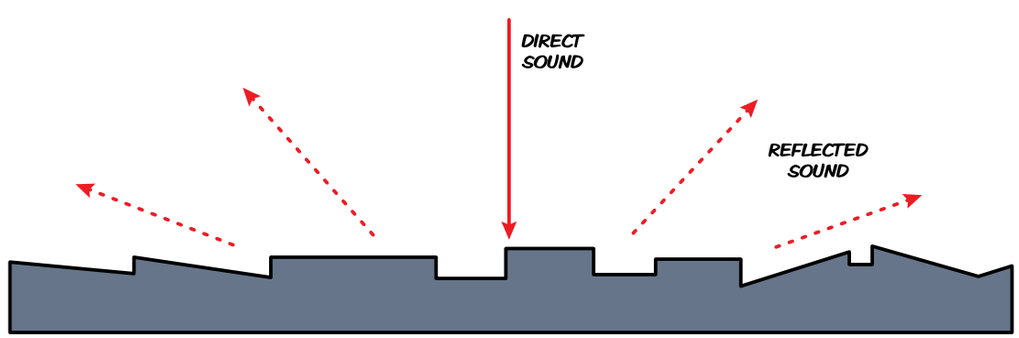


Figure 7

Figure 8

DIFFUSION PANELS REFLECT SOUND WAVES AT VARIOUS ANGLES, HELPING TO PREVENT STANDING WAVES.



Testing Your System

After trying these techniques, re-test your room by listening to songs you already know. Consider making a compilation of short sections of professionally mixed songs that exhibit exemplary production standards. Try tweaking the placement of your monitors to find a position that provides even response throughout the audio spectrum. By sitting closer to the speakers, you will hear more of the direct sound.

A Note About System Levels...

When monitoring at loud levels, our ears can easily perceive the extreme high and low frequencies in the mix. However, when the mix is played back at lower levels, our ears are much less sensitive to these frequencies. As a result, the mix sounds different when played loudly. Although it can be tempting to crank your monitors, always remember that exposure to high sound pressure levels can be damaging to your hearing. Try to limit your monitoring output to between 75-90dB SPL. A good rule of thumb is that if you have to shout to communicate in a room, you're monitoring too loudly.

Conclusion

As you can see, there are many factors involved when preparing an environment for reference monitoring. The entire process can be summarized in the following steps:

- Select the reference monitors that are best for your needs.
- Determine the optimal listening position in your studio.
- Set up your monitor placement according to the directions published in this guide.
- Identify surfaces in the room that are causing unwanted reflections.
- Treat those areas with acoustical foam or other absorptive materials.
- Use bass traps to tune the low-end response of your room.
- Use diffusers to redirect reflections away from the central listening position.
- Test your monitoring system, making any necessary adjustments.

Ultimately, your ears are your most important monitoring equipment. If you know your room well (including limitations and imperfections), you can create mixes that translate well across a broad range of systems.

Studio Accessories Recommended Manufacturers

Monitor Stands

- Ultimate Support
  www.ultimatesupport.com
- Raxxess
  www.raxxess.com

Cables

- Monster
  www.monstercable.com
- Hosa
  www.hosatech.com

Acoustic Treatment

- Auralex
  www.auralex.com
- Primacoustic
  www.primacoustic.com

Studio Furniture

- Omnirax
  www.omnirax.com
- Middle Atlantic Products
  www.middleatlantic.com

SPL Meters

- RadioShack
  www.radioshack.com

Want more tips and tricks on how to optimize your studio? Visit www.m-audio.com/overdub.

Appendix A—Monitor Components

Choosing the right reference monitors can be difficult, especially with so many choices and models available. Understanding the basic speaker components can help you decide what will best suit your needs.

Cabinet Enclosure

Cabinet design has a great impact on how sound is transmitted from the drivers. The cabinet material should be as non-resonant as possible to prevent sound coloration. Sturdy medium-density fiberboard (MDF) and plywood are materials that are commonly used in cabinet construction.

- Air-suspension enclosure
  An airtight system that seals in air from the outside environment. This system generally provides strong, tight bass response, which often rolls off at the extreme low end.
- Bass reflex enclosure
  A vented-box design that makes use of a tuned bass porthole, designed into the front or rear of the speaker enclosure. This acts as a tuned resonator, boosting the extreme low-end output.

Driver

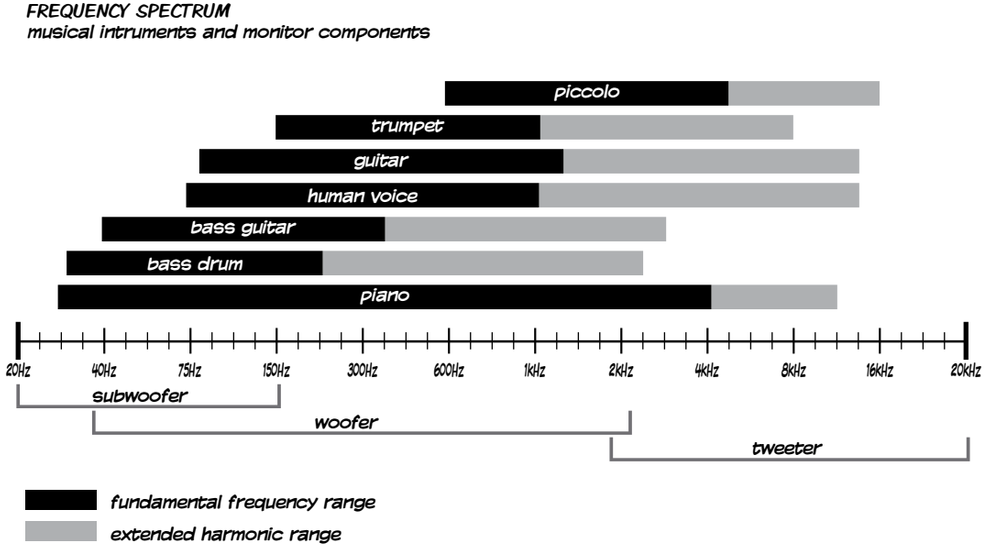
This is the part of the monitor that actually produces sound waves. It's important to choose monitors that have well-designed drivers built from high-quality materials.

- Tweeter
  A tweeter is a driver that produces high frequencies. High-quality tweeters are often constructed from substances like silk, titanium, aluminum and beryllium.
- Woofer
  A woofer is a driver that produces low frequencies. Woofers require more driver movement and therefore a higher amount of power amplification. Low-frequency drivers are typically constructed from resilient materials such as Kevlar, polypropylene or mylar.

Electronics

- Power amp
  A device that converts the incoming line-level signal into a high-energy signal. Amplifiers with a higher wattage rating produce a higher sound output. Powered reference monitors have a power amp section built right into the enclosure, while passive monitors need a separate outboard power amp.
- Crossover (also referred to as a Network)
  Prevents signals outside a certain frequency range from being applied to its assigned driver. This optimizes speaker performance by routing high- and low-frequency signals to different drivers, ensuring the drivers are asked to deliver only the frequencies they are most efficient at reproducing.
- Bi-amplification
  The practice of utilizing two power amplifiers to drive the woofer and tweeter separately. The incoming signal is split into two bands by means of a crossover, and each amplifier handles the frequency range.
- Acoustic space controls
  Acoustic space controls activate a shelving filter to attenuate certain frequencies, helping to compensate for different speaker placements and room environments.

Appendix B—Musical Instrument and Reference Monitor Spectrum



Appendix C—M-Audio Reference Monitor Comparison Chart


Studiophile AV 40


BX5a Deluxe


BX8a Deluxe


BX10s


EX66

LF Driver	4" poly-coated paper cone	5" Kevlar	8" Kevlar	10" composite	(2) 6" composite
HF Driver	1" silk	1" silk	1 1/4" silk	N/A	1" titanium
Power	20 watts	40 watts low-frequency 30 watts high-frequency	70 watts low-frequency 60 watts high-frequency	240 watts	100 watts low-frequency 100 watts high-frequency
Frequency response	85Hz-20kHz	56Hz-22kHz	40Hz-22kHz	20Hz-200Hz	37Hz-20kHz
Crossover frequency	2.7kHz	3kHz	2.2kHz	50-200Hz sweepable	2.56kHz
Cabinet	vinyl-laminated MDF	vinyl-laminated MDF	vinyl-laminated MDF	vinyl-laminated MDF	painted high acoustic efficiency MDF

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