E-BOOK

Beat

STUDIO ACOUSTICS

MONITORING TO INSULATION

PERFECT SOUND FOR EVERY STUDIO

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PERFECT SOUND

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Desktop and home studios are, in most cases, anything but acoustically optimal, which makes an objective evaluation of a mix extremely difficult. How can the most common acoustic problems, such as reflections, be dealt with? How can weaknesses in the room be found? In this special, we will not only show you how to optimize your room acoustics, but also which monitoring solutions are best suited to the room and your workflow and how modules and speakers are ideally placed. by J. Dicke, S. Hofmann, L. Rimbach, M. Scherer, M. Schumacher

Whoever sets up their own home studio nowadays usually does so in rooms that have to fulfill other, usually higher-level functions. Whether it is the studio corner in the study or the desktop studio on a desk in the bedroom - everywhere you have to make compromises in terms of space requirements and spatial sound. In practice, most rooms are right-angled, as this design is the most cost-effective on the one hand and guarantees universal usability on the other. Acoustically, however, this room shape is not very useful for producing, listening to and evaluating music. This is because strong reflections on the walls, standing waves or dominant room resonances lead to a distortion of the audio material.

So one usually tries to adapt the mix to the negative characteristics of the room and not - which would be much more sensible - to acoustically optimize the room so that a good mix is possible. In fact, in such a listening situation, one produces sonic errors that are complementary to the room acoustics. This means that the mix usually sounds rather "off" in an acoustically neutral environment. For reasonably serious work on your own music, it is therefore essential to create an acoustic environment that allows realistic listening, mixing and producing. The essential tasks are:

- Control of Standing Waves
- Reduction of Unwanted Reflexions
- Reduction of Room Resonances
- Reduction of Acoustic Disturbances

The Problem

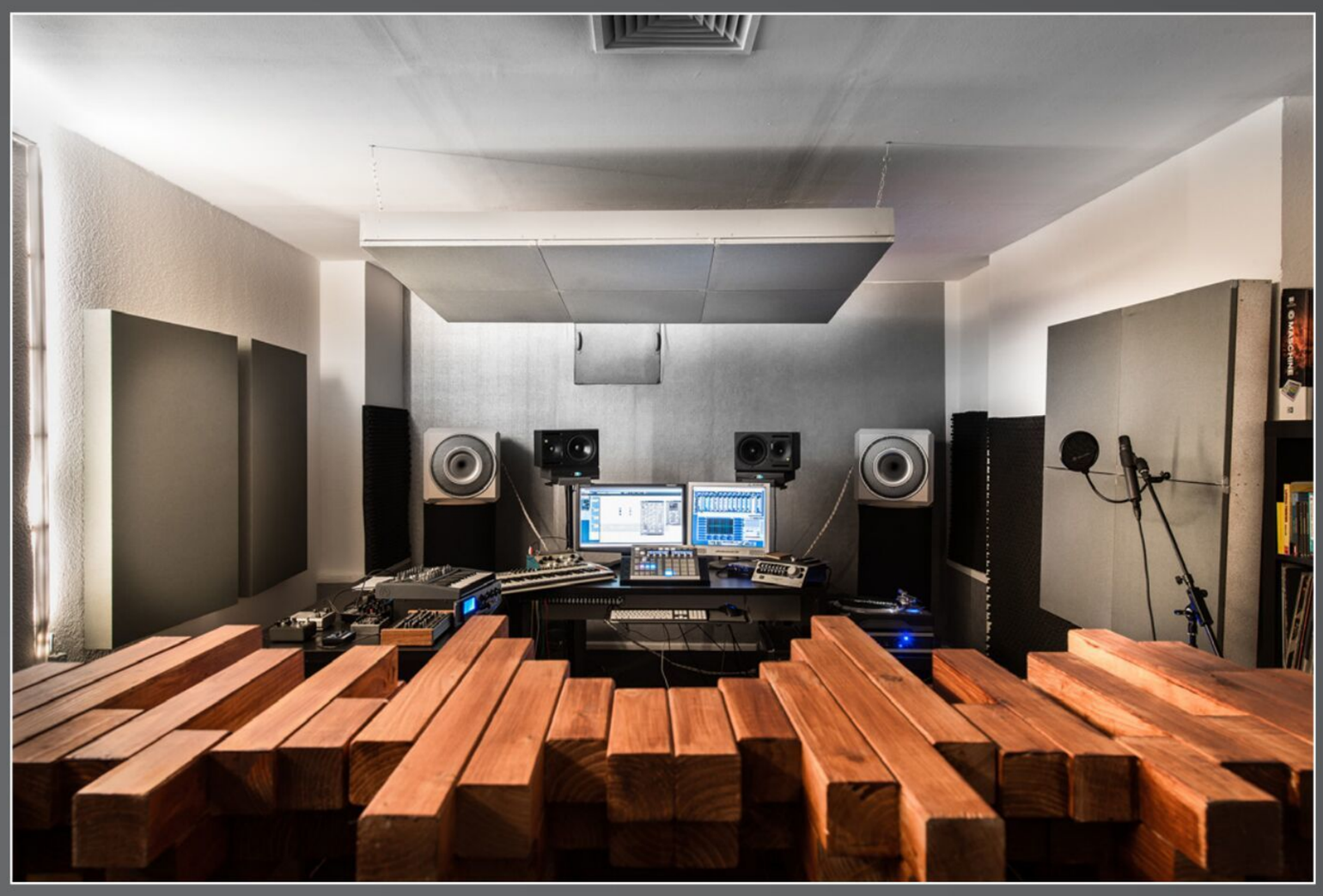
Usually, a lot of acoustic phenomena occur simultaneously in studio rooms in general, which affect the sound image at the listening position. Simplified, these can be summarized in the following three groups.

Room Resonances

In closed rooms, the sound waves generated by the listening monitors are reflected, absorbed, diffracted or scattered by the walls and objects in the room. Which of these phenomena occurs depends essentially on the ratio of wavelength to area and, thus, directly on the frequency. For a 20Hz bass wave with a wavelength of 17 meters, there will be hardly any obstacle in a normal living environment. A 1kHz test tone, on the other hand, will be reflected by an area larger than one meter. The resulting diffuse sound field in the room, therefore, has no uniformity with regard to its frequency distribution. At different points in the room, different frequencies are particularly prominent, while others are attenuated more strongly. It is clear that under such conditions a mixture at different positions in the room always sounds different. A correct judgement of the sound is, therefore, impossible.

Reverberation

The reverberation of a room is caused by the overlapping of reflections, each of which arrives at the listener with a certain delay due to the longer distances they have to travel. In addition to the volume of the room, this acoustic quantity is also determined by the absorption by interior surfaces. If - as is generally the case - electronically generated reverberation is used in the mix, it can no longer be separated from the room reverberation when listening to it. As a result, you will tend to work with less reverb in the mix; however, reverb is one of the most important effects for making mixes more spacious. Creating depth in a mix is therefore only possible if the reverb of the mix can be judged without any doubt.



Reflections

Reflections on the walls, ceiling and floor - in desktop studios as well as on tabletops, monitors or mixing consoles - cause noticeable sound coloration. The smaller the distance between the reflective surface and the listener, the more pronounced the elevations and cancellations, since the direct signal arrives almost simultaneously with the reflected signal. In certain frequency ranges, the sound effect known as flanging is produced. Reflections between parallel walls also produce flutter echoes. The constant back and forth tossing of sound waves creates a delay effect in the stereo image, which is particularly noticeable with percussive signals. In this case, a realistic spatial positioning of the signal and a reliable evaluation of the stereo panorama become almost impossible.

The Solution

To get the acoustic problems of a room under control, you can achieve good results, even on a small budget, if you follow a few basic tips. If you are dissatisfied with the results of your work, you should approach the analysis of the causes in as structured a manner as possible. The following applies: Keep your hands away from other equipment! If you can't get a halfway decent mix with the help of equalizers and compressors, all you need is a good monitoring system and the right room acoustics. Under no circumstances should you try to improve the result by using additional equipment. Instead, try to find out the deficits of your own room by listening comparisons and taking notes in other (neutral) studios. Here you can certainly consult several ears. Only then should one begin with the optimization of the acoustic room climate.

L.E.D.E.

If all reflections in the room are attenuated, the room usually sounds dull and dark. The resulting mix will then be very heavy on high frequencies. The control room concept developed by Don Davis in 1978, in which the front half of the room is acoustically damped, (i.e. reflections are avoided (Dead End), and the sound is diffusely reflected in the rear end of the room (Live End), achieves a controlled acoustic liveliness that is perceived as natural.

Monitor Setup

Before working on room acoustics, it is important to check the studio geometry. The studio should be as stereosymmetrical as possible (i.e. sound the same on the left and right). Ideally, the monitors should be positioned at a distance of 1.2 meters from each other (not lying down) and acoustically decoupled from the rest of the studio. It makes sense to provide the walls next to and behind the monitor boxes with absorber elements so that no disturbing reflections occur. The seating position should be in the middle between the two speakers. The tweeter is at ear level, the angle to the center axis of the listening position is 30 degrees, so all distances form an equilateral triangle.

Room Modes

The first step is to try to control the disturbing resonances in the room. For this purpose, the use of a broadband absorber at the front of the studio - as well as the installation of at least two bass traps - is suitable. Manufacturers like HOFA, Universal Acoustics, aixFOAM, Thomann and Music Store already offer corresponding modules at reasonable prices. The bass traps are usually placed in the corners of the room behind the monitors, two absorber elements are also mounted on the wall behind the monitors.

Flutter Echoes

Disturbing initial reflections on the side walls can be reduced by using absorbers. Since the reflection of sound waves is done according to the reflection laws known from optics, the position for these absorbers can be found simply by looking through a mirror on the wall, where the corresponding loudspeaker can be seen from the listening position. Alternatively, the use of heavy curtains can be tried; however, the absorption here is not quite as uniform as with acoustic panels.

Live End

To avoid standing waves, one must obviously also attenuate the reflections at the back of the room. However, the creation of a diffuse sound field by means of appropriate acoustic panels sounds more pleasant. So-called diffusors, therefore, only absorb a part of the sound waves and allow a controlled scattering. Alternatively, an irregularly filled record or book shelf, which should extend over a large part of the wall, can help here.

Conclusions

Thinking about your room acoustics in general is always a step in the right direction. However, if you want to seriously improve them, you will have to make compromises with regard to the furnishings and you will rarely be able to avoid the use of acoustic panels. Professional advice - especially in asymmetrical or problematic rooms - usually saves more than it costs. Thanks to the wide range of reasonably priced acoustic panels available, it is also possible to optimize the spatial sound with a limited budget.

Problems in the Home Studio

Even in smaller home studios, various acoustic phenomena impair the objective evaluation of the mix. On the one hand, the direct sound of the studio monitors is overlaid by the room's initial reflections, which leads to elevations and cancellations in the spectrum. When attempting to counteract the effects of the comb filter effect, the use of the desk equalizers will inevitably model notches in the spectrum, which, although they compensate for the lack of acoustics in your own studio, will exhibit complementary sonic errors under objective listening conditions. Moreover, if the speakers are placed close to the rear wall, this leads to an exaggeration in the bass range between three and nine dB. Reflections from opposite walls create unpleasant amplification in the frequency spectrum, so-called standing waves or room modes, which can build up to a booming sound, particularly in the bass range.

The flutter echoes thrown back and forth between the side walls also make it difficult to selectively locate individual instruments in the mix.

Problems in the Desktop Studio

Desktop studios are often multifunctional, so they must also serve other purposes than just music production. It is not unusual for the workplace to be banished to the corner of a room. Due to the room layout in desktop studios, one has to deal with different acoustic phenomena. Although direct sound is significantly louder than in the room due to the short listening distance, additional acoustic problems occur here due to the unfavorable positioning of the speakers, which significantly affects the frequency spectrum. If the monitor speakers are placed on a flat surface, usually a desk, the sound waves are reflected directly from this surface and reach the listener almost simultaneously with the direct sound. The comb filter effect is particularly pronounced in this case and is characterized by a flanger-like sound.

In addition, further reflections from the monitor, keyboard or mixing console color the sound. The small distance between the speakers also creates a stereo base that is spatially very restricted. Of course, disturbing initial reflections on the walls as well as standing waves and flutter echoes also occur in the desktop studio. These echoes further cloud the sound impression. Likewise, a bass boost and booming resonances are to be expected.

» Professional acoustic advice usually saves more than it costs. «

Problem Solutions

In order to create acoustics that are reasonably suitable for serious work, there is no getting around the use of absorbers in the home studio.

Whether you go straight to a professional product or experiment with do-it-yourself solutions, the conceptual approach always remains the same. The correct placement of the monitors creates good conditions for a targeted influence on the room acoustics: Ideally, the speakers should be positioned half a meter from the wall at a distance of about 1.2 meters from each other. The tweeters are at ear level, the speakers form an equilateral triangle with the listening position. Depending on the mounting, the use of Speaker Pads is recommended.

In order to effectively attenuate the bass, prevent excessive booming and make its reproduction as precise as possible, one starts by damping the reflections on the front wall and the corners of the room with broadband absorbers and bass traps. Depending on the geometry of the room and additional equipment in the room, the bass traps are placed in the front and rear two corners of the room. The acoustics should already appear much drier. Nevertheless, you will still be able to hear coloration due to the overlap with the side reflections. Here, heavy curtains with some distance to the wall can have the effect of diffusors. In order to keep the acoustic environment lively, you have to create a diffuse sound field by scattering the reflections on the back wall. This can be achieved, for example, by an untidy book or record shelf.

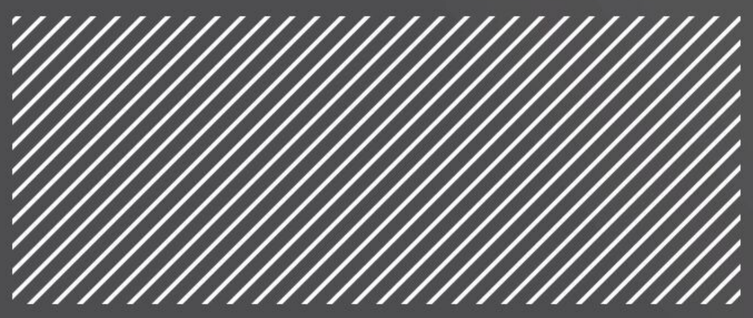
Small Room Acoustics Glossary

Absorption

When sound waves hit an obstacle, they penetrate it, are reflected or absorbed. This behavior depends on the frequency and, thus, directly on the wavelength of the sound wave. Absorption converts the sound energy into another form of energy (usually heat), which is acoustically irrelevant. Absorbers often only work particularly well in a certain frequency range, while the frequencies above and below are much less affected. Broadband absorbers, on the other hand, are effective over the entire spectrum.

Diffusion

In contrast to absorption, diffusors are used to achieve a uniform reflection of the sound waves distributed over as broad a frequency spectrum as possible in order to preserve the natural liveliness of the room. By a broad dispersion of the sound waves in the room, you can counteract the negative side-effects of reflection.



Reflection

The term reflection is used to refer to a wave that is reflected by a surface such as the walls, ceiling or floor of a room, but also by the equipment (mixing console). Similar to absorption, reflection is also frequency-dependent, so not all frequencies are reflected equally. This often results in sound coloration and flutter echoes between the studio walls.

Room Resonance

Room resonance describes an effect that occurs in closed rooms through the reflection and overlapping of sound waves. The waves reflected by the walls cause cancellations or amplifications in the frequency spectrum which, in turn, can lead to sound coloration and unpleasant exaggerations.

Standing Waves

Standing waves (also called room modes) result from the overlapping of two counter-rotating waves of the same frequency and amplitude. In the studio, they are usually created by the reflection of the sound wave on the wall opposite the speakers. If the distance between the walls is half or a multiple of the wavelength, over-emphasis can result in unpleasant, conspicuous coloration or even booming. The more evenly these resonances are distributed in the spectrum, the less disturbing room modes are felt. Above 300 Hz, standing waves no longer play an audible role due to the diffuse reverberation of the room.

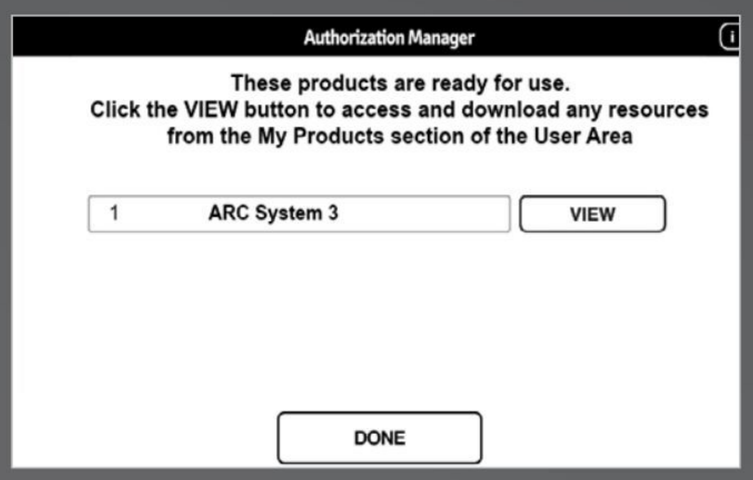
Flutter Echoes

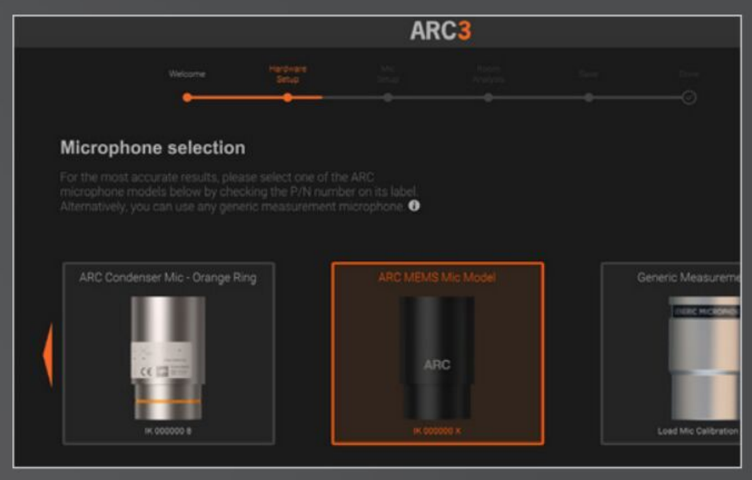
Flutter echoes usually build up between the side walls of the studio and are caused by initial reflections from the monitor speakers thrown back and forth between them. They are most clearly audible in percussive signals. Longer notes often cause standing waves with accompanying exaggerations in the frequency spectrum.

Reverberation Time (RT60)

The reverberation is created by overlapping the reflections in the room, each of which reaches the listener after a small delay. The reverberation time RT60 is the most important room acoustic parameter and is defined as the time span after which the sound has dropped by 60 dB once the sound source has been silenced. The reverberation has a considerable influence on the detail resolution of signals. The ideal reverberation time in control rooms should be below 0.3 seconds.

Hands On: Measuring the Studio with IK Multimedia ARC System 3





1 Correct Acoustic Defects

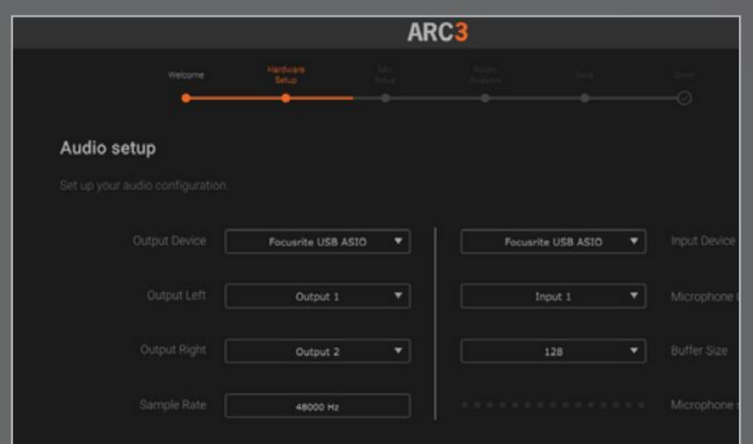
Before you can use the correction system, you must measure your studio room using the ARC3 software, a measuring microphone and your monitor speakers. The Authorization Manager from IK Multimedia will help you install the measurement software and plug-in. Start the software and carry out the following steps.

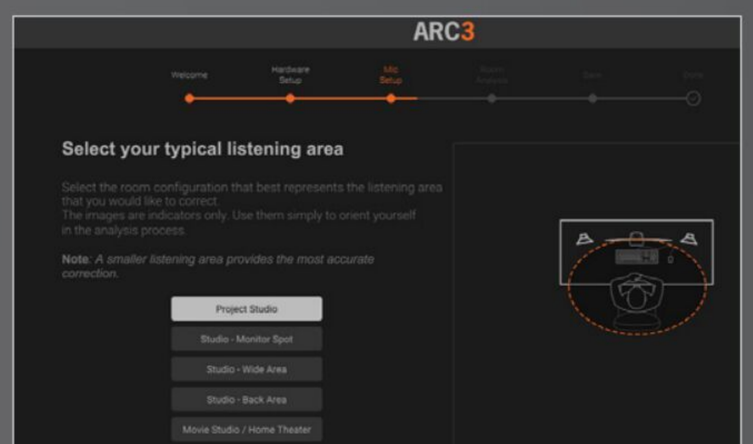
2 Preparation

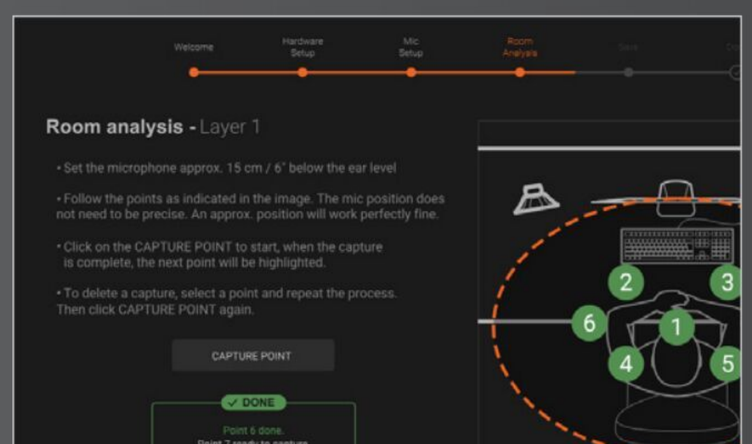
Plan on about 30 minutes for the measurement and use a period of time in which as little unwanted background noise as possible enters your studio - and you do not disturb anyone with the relatively obtrusive measurement sounds. For an exact measurement, we recommend a microphone stand, which you place at your listening position first.

3 Microphone

For the measurement, you need a measuring microphone - either from the bundle offered or from your own stock. Select the appropriate model or, in the case of a microphone from another manufacturer, load the corresponding calibration file into the software. Connect the microphone to your audio interface and activate the **phantom power**.







4 Audio Interface

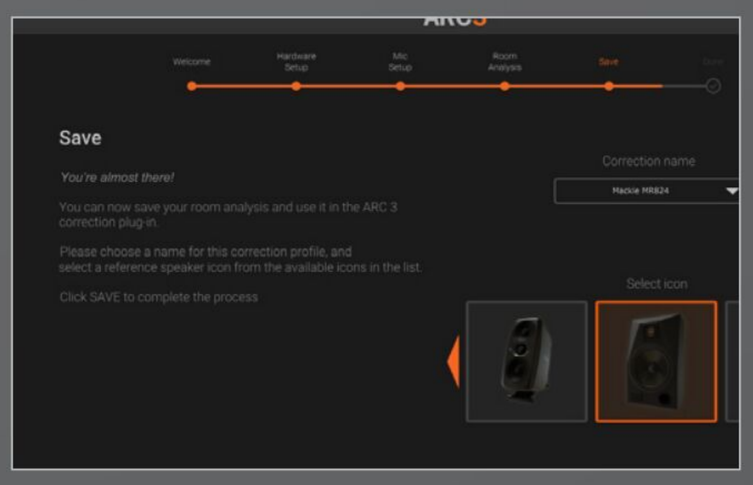
Adjust the monitor settings of your sound card so that the microphone input is not looped through to the output where your speakers are connected; otherwise, a feedback loop may occur. In the next step, select the channels of your sound card to which the speakers are connected as **Output** and the microphone input as **Input**.

5 Studio Choice

Choose a listening environment that best suits your studio type. A desktop studio with the speakers in the direct near field requires different settings than a recording room with a large mixing console and midfield monitor speakers placed on it. Follow the instructions in the software to correctly position and level the microphone and monitor.

6 Measuring

Before you start measuring the room, you should mark the **seven points** in the room shown in the figure, for instance, with gaffa tape crosses. This is because at these points you have to measure at three different heights; and always stand at the same place or place the microphone stand there. This is facilitated by the markings.



7 Integration

After successful measurement at all **21 points**, give the calibration file a meaningful name, such as a combination of studio and speaker name like Desktop Adam T5V. Then, start your DAW and load one of your projects or favorite tracks. Load the **plug-in** into the master channel and open it.

8 Simulation

In the **MEASUREMENT** menu, select the profile you created in the previous steps. **VIRTUAL MONITORING** allows you to simulate the sound of listening devices such as laptops, smartphones or hifi boxes instead of a linear ideal frequency curve. This allows you to try out how your mix would sound in the car, on a smartphone or in the living room.

9 Adaptation

The plug-in allows even more adjustments to your listening habits. With **Correction Type**, you can determine how much the software should correct the sound of the speakers and room towards a linear frequency response. With the two controls for **Low** and **High** Range, you can cut out frequency ranges if you only want to correct bass or treble.

Overview: Acoustic Elements

The Most Important Tools for the Best Sound

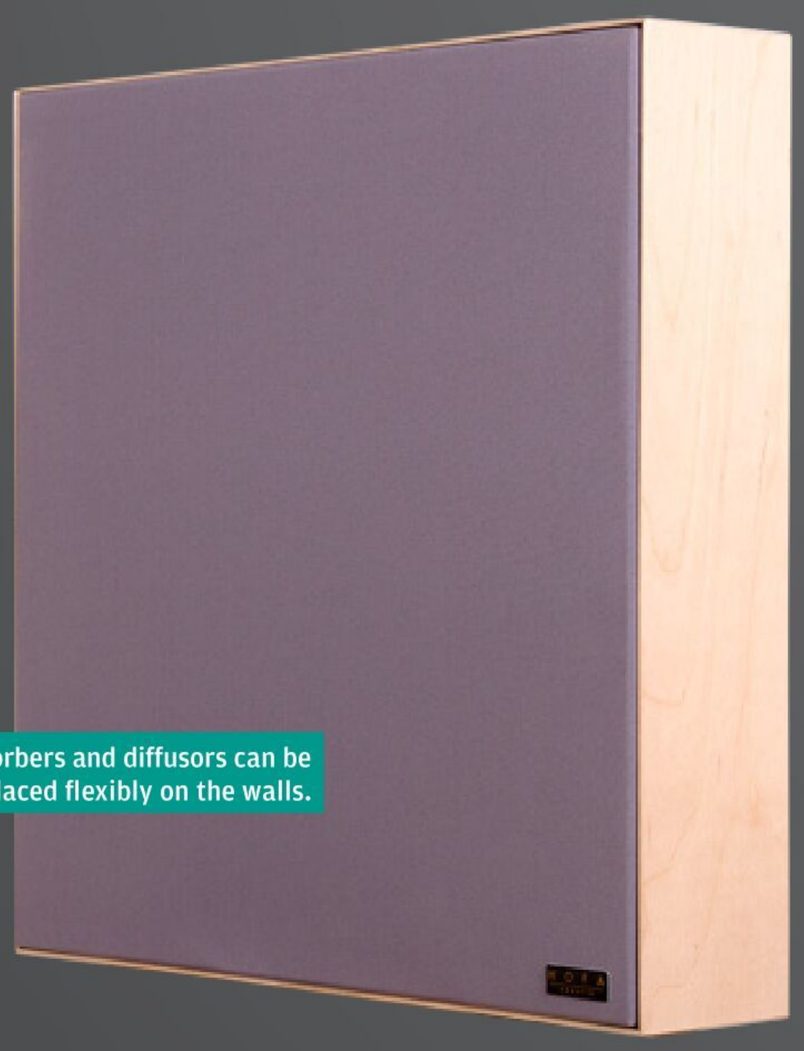
To start with, we would like to discuss a myth that has been haunting the forums of this world for a long time. "Absorbers can be used to isolate rooms." True to the phrase: "That's how you get along with the neighbors". But to achieve good sound insulation, other solutions are needed. Expensive room-in-room systems are the right solution here, but if you want to achieve optimal room acoustics to improve recordings and mixes, you should read this article.

Absorber:
Frequency Dampening

Absorbers are acoustic panels that are used to minimize flutter echoes, comb filtering and, as a bass trap, room modes, thus improving the listening situation, sound quality and speech intelligibility. Imagine a room with bare walls - and that your speaker integrates a firing mechanism that can fire balls at different speeds. First it hits a point on the wall, which is located on the opposite, rear side wall due to the slanted orientation of the speaker - keyword stereo triangle. Congratulations, you have just discovered an area with strong reflections. How nice it would be to place an absorber there that would prevent the bouncer from flying around and maybe even knocking over the expensive microphone!

But, while lighter balls move through the room with less energy, larger balls require more power from the speaker. So, an absorber for these low frequency ranges, uh...ball sizes, needs to have a higher absorption - you understand what we are getting at, don't you? In the field of room acoustics, absorbers are filled with acoustic foam, glass fiber, rock or mineral wool which, depending on their thickness, have an effect on different frequency ranges. Probably the most important factor, however, is the flow resistance of the material, which is expressed in the unit of length-related flow resistance - kPa s/m². The higher this value is, the less the absorber affects the bass frequencies.

If the density of the material is correct, the rule of thumb is that the thicker the absorber, the lower the absorbed frequencies. The size of an absorber is also decisive. Here, the rule of thumb is: the larger the surface area, the more energy can be extracted from the wave. For example, bass traps with a value of 5 or 6 kPa s/m² and a thickness of just 15 cm can strongly absorb frequencies around 80Hz - if you stand them in the corner with air space.



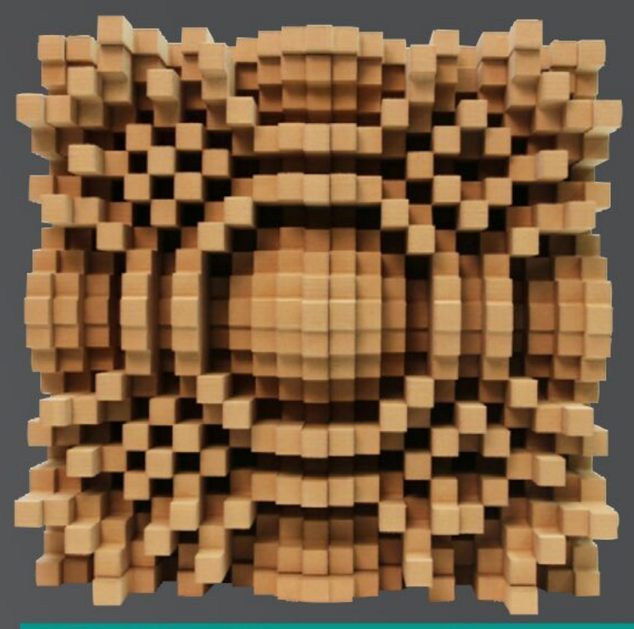
Thanks to exchangeable frames, HOFA absorbers and diffusors can be placed flexibly on the walls.

The GIK 242 Acoustic Absorber is already available at a price of 42 Euro (60x60cm, excluding VAT).

Diffusors: Distributing Sound in the Room

In order to understand diffusors, it is first necessary to understand what diffusion means in terms of room acoustics. In short, a diffusor diffuses sound waves in space to make it more difficult to locate them. If we assume an untreated room, a series of sound waves reflected from the wall will move in the same direction. They are reflected back to the listener - probably at the same time and from the same position. The bundling has remained the same in space and time.

If a good diffusor is placed at this very spot and the same sound wave is generated again, the sound is distributed evenly in different directions. A good diffusor also influences the temporal propagation. If the sound waves are reflected evenly in different directions, the distance of the different sound waves to the listener also changes. In the world of sound, distance equals time. The aim of a diffusor is to change the time, direction and intensity of sound waves and thus ensure that the reflected sound source can no longer be located. This is important in order to really hear only what comes out of the speakers in listening situations. By the way: there are diffusors that have a one-dimensional effect, that is, they distribute the sound to the left and right, and there are two-dimensional versions that also disperse the sound upwards and downwards.



The GIK Gotham Diffusor covers a wide frequency spectrum.

Bass Traps: Controlling Bass

The corners of a room in particular are the perfect retreat for bass frequencies. Here they feel especially comfortable and gather for extensive conversation. So-called bass traps are absorbers that have been specially developed to eliminate low frequency ranges. So bass traps for corners should have edge lengths of 30-40 cm.

By the way, there are also panels that concentrate exclusively on the low frequencies. For example, an integrated membrane throws all frequencies above 400 Hz back into the room, while the bass range is severely limited. Diffusors are often installed on the wall behind the listener. But even here, at least in professional studios, there are bass traps behind or between the diffusors to get the low frequencies under control.

The GIK TriTrap was designed to fit in every corner.

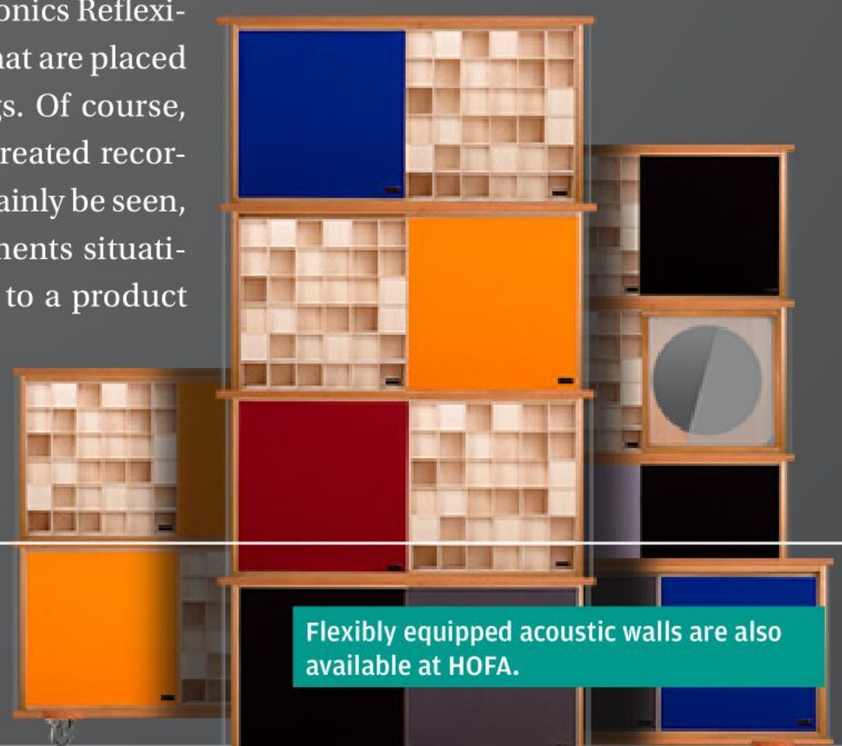
Special Tools: From Mobile to Minimal

In the world of room acoustics, too, there are various product genres that have emerged from the different needs of users. Not every recording enthusiast is able to mount acoustic panels on the wall of his rental apartment. There are various mobile solutions such as movable acoustic walls.

The GIK PIB (Portable Isolation Booth) is also interesting. This is a foldable acoustic wall that fits under any desk to save space. The inside is covered with absorbing material, while the outside can function as a diffusor if desired. Whether for vocal or instrumental recordings, the GIK PIB is an excellent mobile solution for the recording process.

Reflection Screens, such as the SE Electronics Reflexion Filter Pro, are portable sound absorbers that are placed behind the microphone for drier recordings. Of course, this does not work as well as in a perfectly treated recording room. Improvements can, however, certainly be seen, depending on the application and requirements situation. Finally, we would like to introduce you to a product that is a bit bizarre. The new Isovox 2 is a mobile vocal booth that surrounds the singer's head and can easily accommodate a microphone. Due to its size, doubts quickly arise as to whether such a small "room" has a positive effect on vocal recordings. In any case, we recommend that you test this product extensively before buying it, since opinions on its sonic characteristics differ quite widely.

The Isovox 2 is a special product for Vocal Recording.



Flexibly equipped acoustic walls are also available at HOFA.

The Sum of all Parts

Studio Acoustics is not Magic

Things like room sizes, wall material, room modes, reflections and the resulting standing waves can be easily explained in theory; however, it is rather the sum of the factors that makes it a complex subject. Fortunately, there are professionals for such cases that you can ask. We talked to Lukas Rimbach from GIK Acoustics about his workflow in optimizing studios and got some helpful tips.

***Beat /** Hi Lukas, classic recording studios in separate rooms are rather rare nowadays, but the number of home studios is increasing exorbitantly. No wonder, a laptop with a pair of monitor speakers is usually sufficient for producing. Has this changed the demands of your customers?*

Lukas / Of course, the trend has been going on for years, more and more professionals are furnishing rooms at home where they can work, of course, due to reduced budgets or simply because they want to work in their familiar environment. At the same time, the number of hobbyists has also increased. Since the beginning of the pandemic, many people have had to think about a home solution again - professional speakers, for example. So it is definitely noticeable that large recording studios are becoming increasingly rare.

***Beat /** How do their wishes differ today from those of the past? Are there more "in-house" problems to be solved so that their neighbors can play along?*

Lukas / A room in which one can work without disturbing others is a basic requirement. Actually, their wishes do not differ from those of the past. As a rule, the customers want to listen in as linear a way as possible and achieve the best possible results in the mixes and masters. What is much more often a topic today is the management of expectations.

What the hobbyist or semi-professional often fails to see is that the room is the heart of the recording studio. This is where most of the investments are made. Many people see room acoustics as a small addition that could be made, perhaps with a few hundred Euro. So you have to make clear that a reasonable room is the absolute basis for proper monitoring. The biggest challenge today compared to the past is communicating the topic and its importance.

***Beat /** You can do a lot of things wrong when it comes to acoustics. The classics are probably rooms that are simply too ambitiously equipped with far too many or unfavorably placed acoustic elements. How do you proceed when you acoustically optimize a room?*

Lukas / The absolute classic is actually the wrong material and that, in many ways, but this leads too far! In serious room acoustics, at least in control rooms, you always work to certain standards. Every control room needs corner bass traps, absorbers at the first reflection points, back wall bass traps and so on. What you adapt, depending on the problems, room dimensions and/or budget, are the products used. Here, it always depends on various factors - and experience plays an important role. The only rooms in which you can do something completely different are geometrically very strange rooms that would probably be better not used as a control room or studio.

***Beat /** Complex Topic: Room Modes. Why do they occur and what is your recipe against them?*

Lukas / Actually, it's not that complex; sound waves have a wavelength, a 50 Hz wave is 6.80 meters long... If these wavelengths correlate with the room dimensions, a room mode occurs, specifically, if half the wavelength no longer fits into the room dimension, a first order mode occurs. This room mode then causes a decay time of the respective frequency that is too long and, thus, under- or overemphasizes the frequency spectrum. The whole thing changes due to different phase relation depending on the position in the room, but the frequency always remains the same.

The simplest form of the room mode is the axial mode, which is formed between two room surfaces. This means between the front and back wall, the side walls and the ceiling and floor. This is also the most important form of the room mode, which causes us the most problems. So, if our room is 3.40 meters wide, it probably has a mode around 50 Hz between the side walls. This can only be predicted exactly if the walls are soundproof, for example, in isolated rooms or in cellars. In "normal" rooms, however, the modes are usually close enough to be able to identify them.

***Beat /** One of the biggest challenges in any studio are probably low frequencies and bass. How can problem frequencies be found and - above all - eliminated?*

Lukas / Apart from the calculation, all that remains is to measure the acoustics of the room. This has become really easy these days. You can get a useful measuring microphone at a very reasonable price; we recommend the freeware Room EQ Wizard. With such a measurement, you can analyze the room exactly and then determine room modes and bass problems accordingly. What' s always important is corner bass traps, because all modal problems find their beginning or end in the room corners! Here, we want to absorb the bass range over a wide frequency spectrum if possible.

Therefore, contrary to some claims, pressure-based bass traps are not the method of choice here! Porous absorbers based on mineral wool or other materials such as thermal hemp or polyester with a corresponding construction depth are just right here. What is important here is the correct so-called length-specific flow resistance. In addition, you can then combat modes that are particularly stubborn with tuned pressure absorbers. These must, however, be placed very specifically and are not easy to use.

www.gikacoustics.de

Pro-Insights: The Thing About the Low End

Stop the Rumors!

You start building a house with the foundation; the same applies to room acoustics. Room modes cause problems which partly affect the whole frequency spectrum. It is only when we get the bass range under control that we can really listen in a room in a reasonable way. The range above 200 Hz is quite easy to handle. Below that, it is much more difficult... Bass absorption is also the issue on which many commercial products fail. Partly because of wrong materials and partly because of dimensions that are too small. So what is the best way to approach the topic in a room? **by Lukas Rimbach**

When setting up or optimizing a studio, it makes sense to measure the room with a measuring microphone and software such as the free Room EQ Wizard. This gives you an overview of the problems, both by looking at the frequency response and the decay times, for example, in a waterfall diagram. Of course, we can also calculate modes, but the reality is often different due to thin walls, windows, doors or other factors.

The calculation is only correct for walls that are 100% soundproof. Besides, it is not always the case that every fashion that is theoretically there is a problem. In many cases, where the first axial mode (explanation see below) is quite low, it is excited so weakly depending on the speaker, that it has little or no influence. Now that we know what we're dealing with, we should start with corner bass traps; however, there are two persistent rumors that we want to put an end to:

1. Rumor: Flow Absorber are not effective below 100Hz.

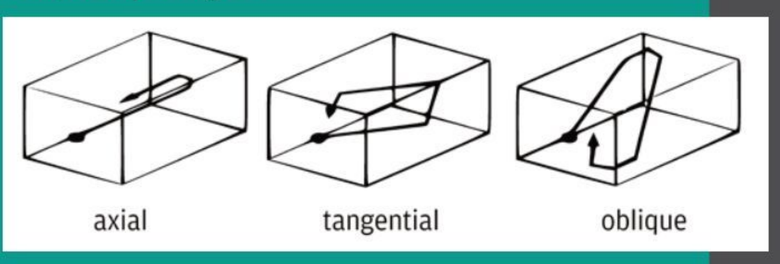
On the first point, a simple triangular corner bass trap made of mineral wool with an edge length of 40 cm works well up to 50 Hz, if the right material is used. Here, it depends mainly on the length-related flow resistance and also the density of the material. The great advantage of these products in the corners of the room is that they work over the entire relevant frequency spectrum, for example, from the lowest frequency to the upper mids, depending on the size of the room. But where does this rumor come from? I suspect there are two reasons for this. In semi-professional room acoustics, you often see foam-based corner bass traps. These are actually effective up to 100 Hz in the best case. Furthermore, mathematical examples often only assume full absorption, and the calculations are often based on less advantageous materials and outdated models. If I install many bass traps that still have an absorption coefficient of 0.5 at 40 Hz, this will, of course, still have an effect on this range.

2. Rumor: For the deep bass range, you have to work with pressure absorbers.

Pressure absorbers of any kind usually work in a narrow frequency range. Simply placing them blindly in the corners would, therefore, not be the most sensible approach. Instead, it is necessary to determine where the pressure zone is located for the respective frequency to which the pressure absorber has been tuned. I often use them, for instance, on the back wall in control rooms to dampen the axial mode between front and back wall. This is often very low and has a lot of energy and, therefore, a long decay time. Of course, they are also used on side walls or even very rarely on the ceiling. I hardly ever place them in corners. So tuned bass traps are more a supplement to porous bass traps in corners. In many cases they are not even necessary.

Clarified: What are room modes?

Room modes are created when sound is reflected from different surfaces in the room. There are three different types of modes that can be generated: axial, tangential and oblique room modes. Modes mainly occur in specific frequency ranges.



Axial room modes are the most pronounced and usually the only ones that are considered. Tangential and oblique modes have less effect, but occur much more often. A combination of tangential and oblique modes can be just as devastating as an axial space mode. They can cause both over- and under-emphasis in the frequency response. When two or more sound waves collide and have the same phase in a given frequency, overemphasis occurs. If the two waves are in opposite phase, they cancel each other out and underemphasis or even cancellation occurs.

To dampen room modes, sound energy is absorbed at one of the boundary surfaces to reduce reflections, thus, sound waves can add or cancel each other out less easily. Although they are not the ultimate solution, room corners are one of the best solutions for placing the absorbers because they meet at two or three ends of the room boundary. Sometimes, however, modes are created through the back wall of the room or the ceiling above your head.

Calculate room modes yourself?
www.amcoustics.com/tools/amroc

Eight Studio Monitors for Every Budget

FLUID AUDIO FX50

The Fluid Audio FX50 is an active monitor with a coaxial speaker. In coaxial technology, the mid and high-frequency speakers are positioned one behind the other on a radial axis. All audio material is thus radiated from one point. This results in precise imaging and location accuracy. In the middle of the 5-inch woofer, a 1-inch dome tweeter was installed in the cabinet. According to the manufacturer, the frequency response ranges from 49 Hz to 22 kHz. The Fluid Audio FX50 is perfectly suited as additional monitoring for home and professional studios. By the way: S-sounds in particular can be easily located with these speakers!

Manufacturer:
www.fluidaudio.com
www.hyperactive.de

Unit Price: 179 Euro

ADAM AUDIO T7V

An affordable example of its class is the Adam Audio T7V. Equipped with a 7-inch low-frequency driver and a U-ART ribb on tweeter, this 2-way near-field monitor is a real price-performance wonder. The street price is currently under 200 Euro. According to the manufacturer, the frequency range is 39 Hz-25 kHz. The crossover frequency of the drivers is 2.6 kHz. There are even two switches for adjusting the sound of the monitor. The metal rear panel of the T7V houses the bass reflex port as well as numerous controls and analog connections. The U-ART tweeter is equipped with a 20 W amplifier, while a 50 W amplifier drives the woofer. These speakers are the perfect choice for entering the world of recording or as another reference system in the studio.

Manufacturer:
www.adam-audio.com

Unit Price: 239 Euro

YAMAHA HS 8

The Yamaha HS 8 active near-field monitor is one of the best-selling studio speakers worldwide. This is understandable, since this 2-way system is available for just 262 Euro per unit. A 1-inch tweeter and an 8-inch woofer with separate power amplifiers form the heart of the system. They are built into a very well manufactured bass reflex cabinet.
In this design, the cabinet is not closed but has an opening - the so-called bass reflex channel. This results in an amplification of the bass frequencies.
Tone control can be done on the rear panel via the two EQ bands Room Control (bass) and High-Trim (treble). This speaker system is perfect for home studios and as a reference system in larger studios.

Manufacturer:
www.yamaha.com

Unit Price: 262 Euro

NUBERT NUPRO X-3000 RC

The Nubert Nupro X-3000 RC impresses with a neutral sound and an extensive connection section. These active near-field monitors have, among other things, two aux connectors (L+R), two SPDIF inputs, for CD players for example, a USB port to use the speakers as a high-quality computer audio interface, and an XLR/AES connector. In addition, these speakers were equipped with two optical inputs and an output for an optional subwoofer. Except for the power supply, the Nubert X-3000 RC also works without cables. Several Nubert speakers can be connected via a master-slave circuit and can also connect to players such as smartphones via Bluetooth (AptX HD & AAC support). The signal processing is, as far as technically possible, digital. By the way: Thanks to the so-called "X-Room Calibration", a room calibration is possible via Smartphone App on iPhones and iPads (Android to follow).

Manufacturer: www.nubert.de

Unit Price: 628 Euro

NEUMANN KH 120 A

Designed as an active 2-way near-field monitor, the Neumann KH 120 A impresses with a neutral and precise sound image. For adaptation to the respective room, bass and treble can be attenuated via a switch on the rear panel. When placed on a table or on the meterbridge of a mixing console, an integrated low-mid filter reduces the negative effect of surface reflections. The front logo lights up white during normal operation, while the intervention of the internal protection circuits is indicated by a red light. The Neumann KH 120 A is particularly suitable for use in small rooms and studios. In conjunction with the Neumann KH 750 DSP subwoofer, the frequency range shown here can easily be extended.

Manufacturer:
www.neumann.com

Unit Price: 649 Euro

FOCAL TRIO6 BE

The Focal Trio 6 Be is actually a 3-way loudspeaker with a 1-inch tweeter, a 5-inch woofer and an 8-inch subwoofer. A special feature, however, is that the speaker can also be operated as a 2-way system by switching to the so-called FOCUS mode. That makes this active mid- and near-field monitor a 3- and 2-way system in one housing. So you get a fast and effective solution for A/B comparison with a speaker system. The Trio6 Be can be used either vertically or horizontally. A rotatable acoustic baffle made of aluminum allows the adjustment of woofer and tweeter for the desired orientation. The baffle can be rotated in steps of 90° for a total of 360°.

Manufacturer:
www.focal.com
sound-service.eu

Unit Price: 2,945 Euro

PSI A23-M

"100% analog" is the advertising message from PSI Audio for the PSI A23-M active 3-way monitor. No DSPs are used here - the circuitry is completely analog. Designed for midfield use, a completely self-developed center driver was installed. In any case, the speakers offer first-class results in terms of sound pressure, linearity and distortion. Thanks to the rotatable device on which the high and midrange drivers are located, this studio speaker can easily be placed vertically. Nearly all components are handmade in their Swiss headquarters. A tweeter, also handmade, ensures crystal clear highs during playback. The electronic unit is closed and magnetically shielded. The frequency spectrum ranges from 34 Hz to 23 kHz, while the crossover between the center driver and the woofers and tweeters is at 620 Hz and 3.2 kHz.
The high quality workmanship, the linear sound image, as well as a warm sound with a very good stereo and depth staggering, make these monitors an excellent companion for recording, mixing and mastering sessions.

Manufacturer:
www.psiaudio.de
www.audiowerk.eu

Unit Price: 4,953 Euro

ESI UNIK 08+

The ESI uniK 08+ is a 2-way system. Both the built-in 8-inch woofer with Kevlar cone and the magnetostatic tweeter, which by the way has a very low mass, are each powered by a 70 watt amplifier. The crossover frequency here is 3.2 kHz. The frequency range extends from 37 Hz to 25 kHz. Four rubberized and height-adjustable feet ensure a firm stand, while the three "Character", "Low" and "High" controls allow users to adjust to the room. On the back of the cabinet is a bass reflex port, which can be closed if necessary using the foam strips supplied. The speaker sounds rich and powerful. The sound image can confidently be described as homogeneous.

Manufacturer:
www.esi-audio.de
www.hyperactive.de

Unit Price: 321 Euro

Talking with Kevin Zuccaro

Monitoring in Studio

When it comes to sound in the studio, damping elements and acoustic optimization are only half the story. After all, what good is the best preparation if the speakers simply do not sound good in the end or are even placed in the wrong position? We met with Fluid Audio founder and developer Kevin Zuccaro and learned a lot about monitoring.

Beat / We are glad that you have found time for us! What are the most important characteristics of good speakers for you?

Kevin / I've heard many people say that the more linear the frequency response is, the better the speaker sounds. But I think that is a very superficial statement because, in my career, I have heard loudspeakers with a straight frequency response that sounded just awful. But I have also heard speakers with terrible frequency measurements that actually sounded incredibly good. So what is going on here?

It has a lot to do with the phase relationship between the loudspeaker drivers and how well they are integrated with the crossover. It also has a lot to do with whether or not the subwoofer is well integrated into the listening environment. If the polarity or phase is not set correctly, then the loudspeaker drivers will somehow fight with each other and create cancellations in the playback instead of summing. After all, you need good frequency summation right near the crossover frequency. If the tuning is correct here, you will get exactly what is generally called good imaging. Speakers that have these qualities will sound "deeper" than an enclosure with a speaker inside. This allows for better mixing and creating a sense of depth, be it for instruments or reverb tails and such.

Beat / There are many different monitors and sound comes out of each one. How do they differ from each other, particularly those from Fluid Audio?

Kevin / In the lower price ranges, speakers differ mainly in their features such as functions, connections and control options. One model focuses on one feature, another model has a different feature. When we launched our first model, the F5, there was no other monitor in that price range that had a slider on the front panel for convenient volume control. So we gave our monitor a fader on the front. This was a unique selling point at the time, but it was only one of relatively few ways to stand out a bit.

So we took a more drastic approach with the FX8 by rethinking the design and placing the tweeter in the middle of the woofer. This coaxial design not only made the normally large 8" speaker cabinet more compact, but also turned the monitor into a point sound source - with all the benefits. This means that the entire sound signal, from low to high frequencies, is on the same axis, and the woofer and tweeter are not 20 cm or even 25 cm apart. The result is a much more symmetrical radiation pattern and also makes the speaker much more phase coherent.

Beat / A major issue is the placement of the monitor speakers. Actually, there is only one correct position, namely the placement in an isosceles triangle. But what do you do if the studio doesn't have the space for it or you have to put the speakers on a table or desk?

Kevin / I think that the vertical placement is at least as important as the isosceles triangle (or horizontal) placement. If the monitors are positioned below ear level, the tweeter's frequency response will drop before it can reach the ear. So, to ensure that the full frequency range of the speakers can be heard, it is important to set up the monitors so that the tweeters are at ear level.

That's why we launched our desktop stands DS5 and DS8, for example, because people are well aware of this fact. That's pretty much the most important aspect, but of course you shouldn't forget the space. The back and side walls must not be too close or they will create bass waves and/or reflections that can have a significant negative impact on the sound. If you have the necessary space, you can, of course, position the monitors in an isosceles triangle.

www.fluidaudio.com

Win now at the Beat November Giveaway: The big Fluid Production Bundle

The coaxial studio monitors FX50 convince with a balanced sound image that also reveals weaknesses in the mix. The most striking feature of the FX series is the coaxial built-in tweeter, which is not - as often found - a horn tweeter but a dome tweeter. And the computer-calculated cabinet shape not only looks extremely cool, but also decisively optimizes the dispersion characteristics of the speakers. The audio interface SRI-2 is also a monitor controller for two pairs of speakers and scores with a very wide dynamic range. The first-class Class A microphone preamplifiers with 48V phantom power and the transparent sounding A/D converters guarantee accurate detail in every recording.

Take part and win the bundle at www.beat.de/giveaways. Good luck!

Start playing.

Ableton

Hands-On: Acoustic Treatment, Part 1

How to Calibrate Your Studio correctly

If you want to take your studio, and with it your mixes, to the next level, the acoustic optimization of the listening position is an extremely important component. Based on the acoustic treatment of a project studio, which was realized mainly with panels from Browne Acoustics, we show you which steps are necessary and what exactly has to be taken care of.

1 The Empty Room

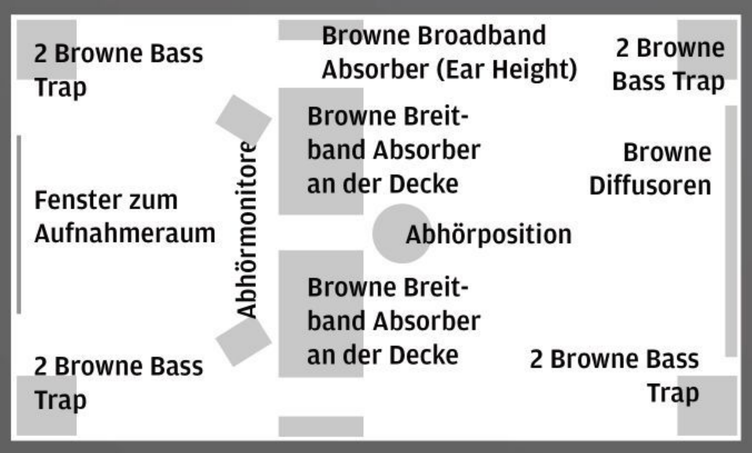
In an empty, acoustically untreated room, reflections from the room walls distort the sound impression at the listening position. For this reason, a well-balanced, natural sonic image with a reduced reverberation time, especially in the bass and mid-range, is to be achieved through the targeted use of acoustic panels. How this is achieved in practice is demonstrated with products from Browne Acoustics.

2 Panel Overview

Basically, there are three different types of panels in the form of broadband absorbers, bass absorbers and diffusors. The former serve to attenuate the widest possible frequency spectrum. So-called bass traps, that is, bass absorbers with a higher material thickness, can be used to supplement these in a targeted manner. Diffusors provide additional sound dispersion and, thus, a more natural sound.

3 Broadband Absorbers

The basic principle of Browne absorbers is that sound waves are absorbed by a soft material of sufficient thickness (at least 14 cm). In a wooden frame there is special mineral wool wrapped in foil, which is covered with fabric at the front. A wooden plate on the back also functions as a panel absorber and extends the already wide absorption range even further downwards.



4 Bass Absorber

The construction principle of the Browne bass trap is the same, except for the back plate, which is omitted due to the high material thickness that is required at this point anyway. The rule of thumb is: low frequencies can only be effectively countered by using thicker material - the thicker, the more effective. Therefore Browne Acoustics uses a massive 50 x 50 cm footprint and 114.5 cm height in this case.

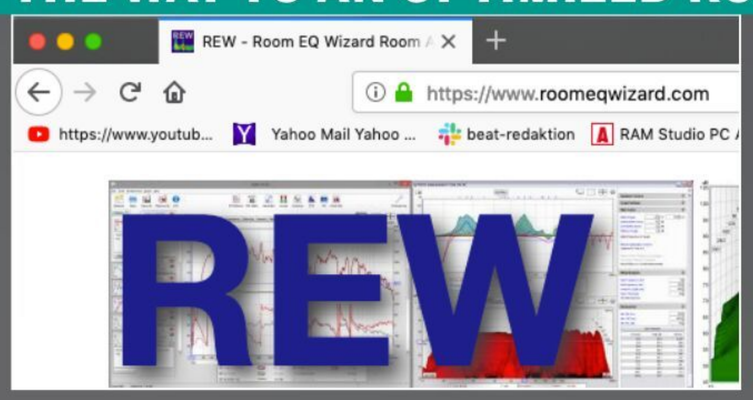
5 Diffusor

In order to achieve a natural sonic image, sound dispersing diffusors play an important role - this is especially true for larger control rooms. Browne Acoustics' diffusor uses louvers of different heights to disperse the reflections of incident waves. Rooms treated in this way appear larger, and disturbing flutter echoes can be completely eliminated.

6 Basics: Installation

Broadband absorbers are used on the wall surfaces, on the back of the room opposite the loudspeakers, and on ceilings and side walls. Bass traps are placed in every corner of the room - ideally reaching from floor to ceiling. Diffusors mounted on the ceiling directly above the listening position and on the walls prevent flutter echoes and provide a more defined sound.

THE WAY TO AN OPTIMIZED ROOM



1 Room EQ Wizard

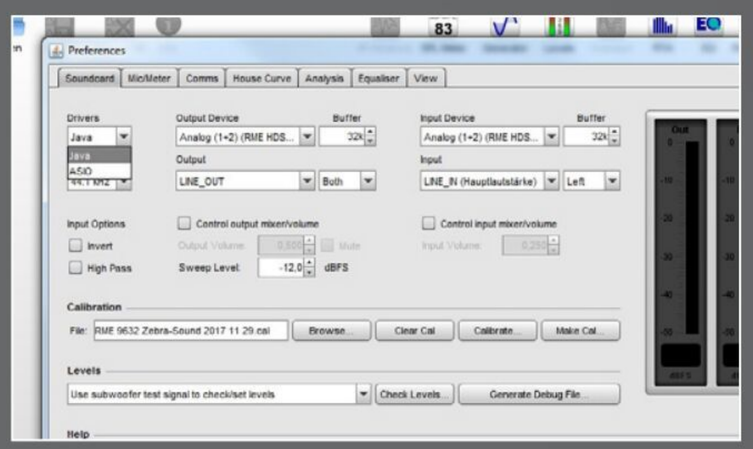
The first step on the way to an acoustically optimized room is the analysis of its sound characteristics using the free Room EQ Wizard software and a measurement microphone. In this way, problem areas can be identified and included in the panel planning. To do this, we download the REQ software from www.roomeqwizard.com and get a suitable measurement microphone.

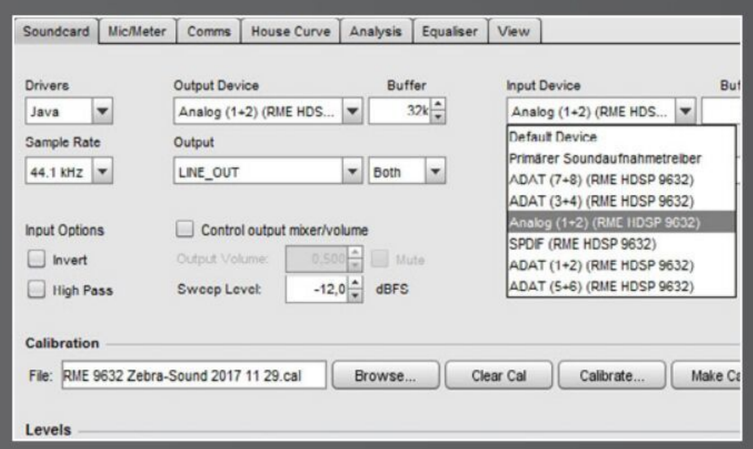
2 The Measurement Mic

If you do not have a suitable, neutral mic preamp, the miniDSP UMIK-1 USB condenser measurement microphone is recommended on the Room EQ Wizard homepage. If, on the other hand, a suitable preamp is available, cheaper measurement microphones such as the Superlux ECM999 will suffice. We already have an adequate measurement microphone available and start preparing for the measurement.

3 Basic Conditions

At the time of the first measurement, the room should already contain all the interior furnishings which, together with the room acoustic panels from Browne Acoustics, will later form the final design of the room. This includes carpets, studio table, studio monitors, computer screen and, if necessary, 19-inch racks and any other furnishings that influence the room acoustics.





4 Wiring the Soundcard

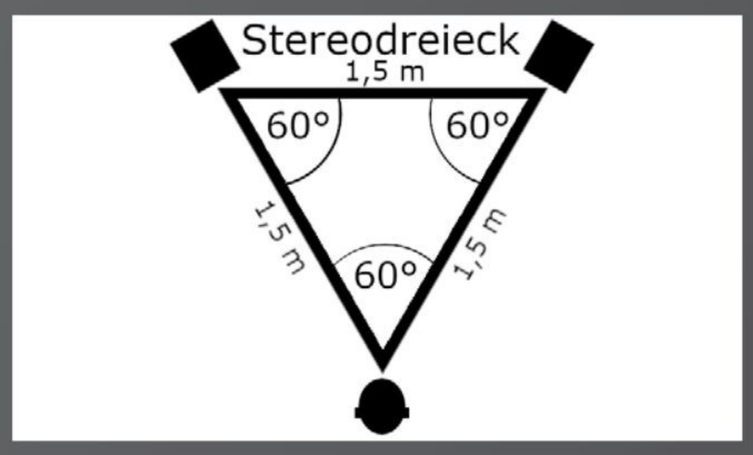
Before the measurement, we have to calibrate REW for the audio interface used and first select the **Java** entry in the **Preferences** under **Drivers**. Then we set the output volume on the interface or monitor controller to zero to avoid feedback. After that, we connect one of the inputs to an output of the audio interface. Now we continue with the calibration.

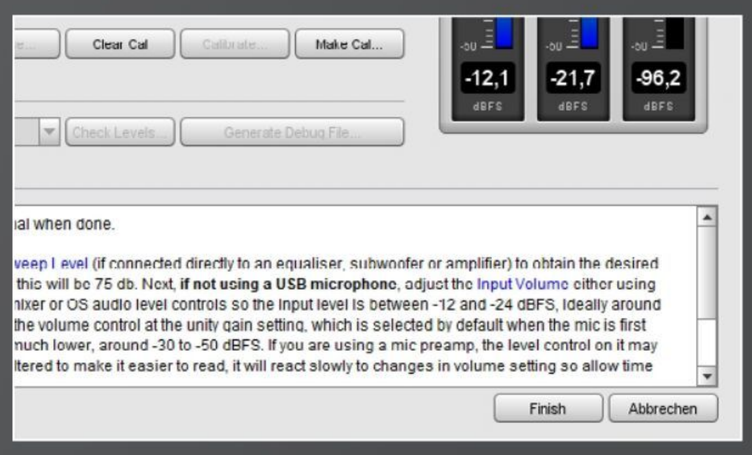
5 Calibration Preparation

Now we select the corresponding interface input under **Output Device + Output** and the connected interface output under **Input Device + Input** in the **Preferences** on the **Soundcard** tab. Then we press the **Calibrate** button and confirm the established loop connection by pressing the **Next** button at the bottom of the REW window. Another click on **Next** starts a connection test.

6 Calibration Test

To do this, the program sends a test tone through the loop connection just established between the input and output of the audio interface. If the connection is correct, the input and output level meters should be clearly visible. Both levels should be as congruent as possible and should not differ by more than 6 dB. If there is a larger deviation, we have to readjust manually.





7 Mic Setup

If everything fits, we click **Next** again and the calibration starts. Afterwards, we save the created calibration file via the **Make Cal...** button to a safe location. With freshly calibrated REW software, we continue with the measurement. To do this, we connect the measurement microphone and preamp with the input just used and ensure the connection of the audio interface to the speakers.

8 Measurement Mic Setup

For a correct measurement at our listening position, we set up the microphone where we sit on our chair in front of the studio monitors (keyword: stereo triangle). There, we place the microphone upright on a microphone stand, the capsule up and at the height of our ears. Then we select **Use main speaker test signal**... and check the connection with the **Check Levels** button.

9 Perform Measurement

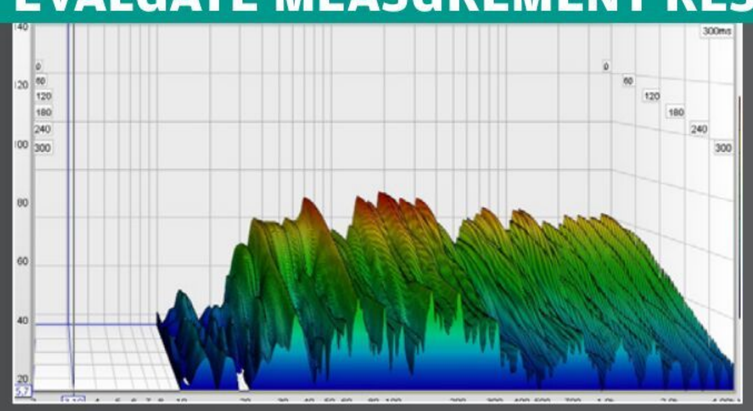
Now you can hear test noise from the loudspeakers. This signal, picked up by the measuring microphone, is adjusted at the mic preamp so that it lies between -12 and -24 dB. If everything fits, we press **Finish**. Finally, we leave the direct sound field of the studio monitors, start the sweep measurement in the **Measurements** window by pressing the **Start Measuring** button and save it.

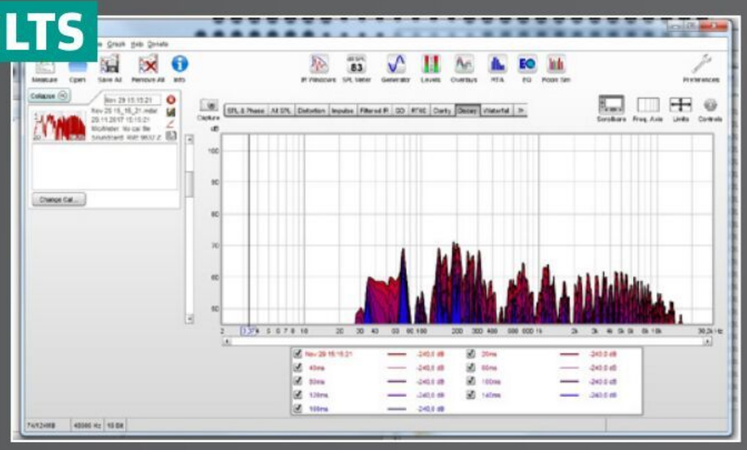
Hands-On: Acoustic Treatment, Part 2

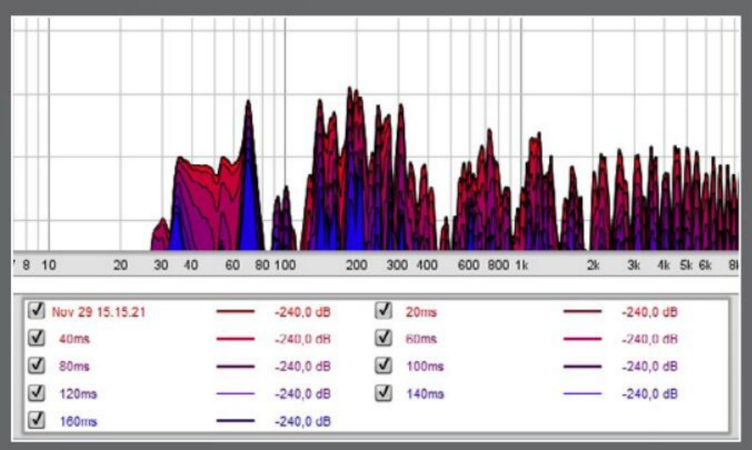
Optimization with Insulation Elements

After we learned the basics of room acoustic elements in Part 1 and measured our mixing area with the measuring microphone and the software Room EQ Wizard, Part 2 is about the correct interpretation of the measurement results. Finally, the resulting and most effective installation of acoustic panels from the Browne Acoustics range is presented.

EVALUATE MEASUREMENT RESULTS







1 Understand Readings

After the measuring process, REW presents us the measuring results in the form of a three-dimensional frequency-response diagram. Its X-axis shows us not only the frequency response of the room impulse response, but also the level on the Y-axis. In addition, the Z-axis shows us the corresponding decay and reverberation time, which is a significant evaluation criterion for our room.

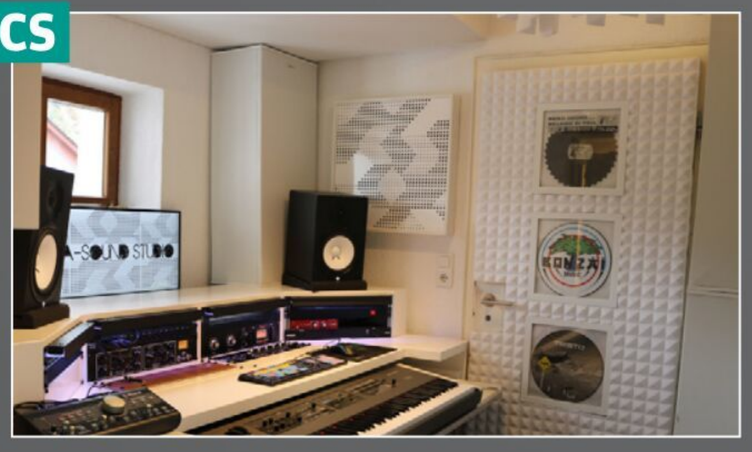
2 The Decay Time Matters

In the waterfall diagram, as well as in the **2D-Decay** view of the first measurement of the acoustically untreated room, the levels of the individual peak areas initially drop evenly. Ergo, our goal is not only to reduce the input peak value; we also want to reduce the input signal level. And we also want to achieve a significantly faster level drop, i.e. a reduction of the reverberation time, with suitable acoustic treatments.

3 Conclusions

The decay view shows very clearly where room modes are present - for example at about 70 Hz or even in the range around 200 Hz. In short: As is typical for small rooms, too much bass is the biggest problem in our case. That's why we have to treat the bass range first and foremost with as many panels as possible in order to optimize the sound there - loosely based on the principle "a lot helps a lot".

ACOUSTIC OPTIMIZATION WITH PANELS FROM BROWNE ACOUSTICS



1 Tame Bass

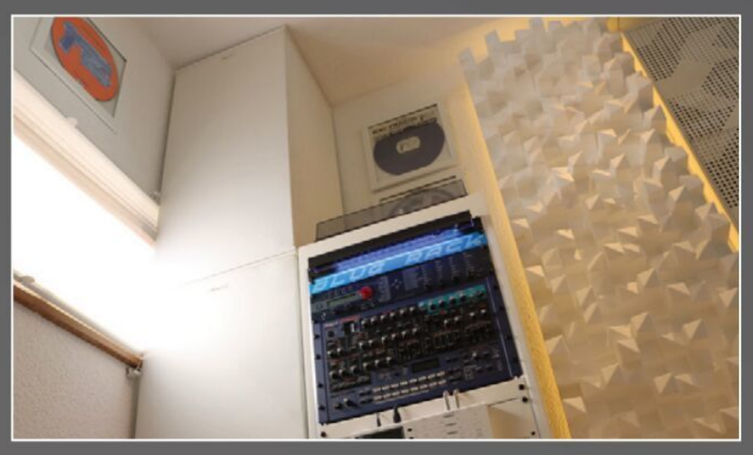
Accordingly, we plan to install as many Browne bass traps as possible for all room corners. The trick: thanks to their size and adequate material filling, the bass traps are really effective even below 100 Hz. Due to the limited space, we have to accept small size reductions in a few places and, therefore, special dimensions; but the result is not significantly reduced.

2 Compromises

To be more precise, we have to allow for smaller dimensions in three corners. To the right of our sitting position is the entrance door. So when the door is open, there is not enough room for the standard factory-made footprint of 50 x 50 cm of the bass trap next to it. So we have to reduce the size to 40 x 50 cm, which has little effect on the effectiveness of the bass trap.

3 As Many as Possible

There is also less space behind the studio monitors for the bass straps that are placed there on the production desk. At this point, we decided on a depth of 50 to 30 cm so that it fits. Otherwise, we can go wild in terms of dimensions and cover the two back corners of the room at full room height with two bass traps on top of each other.



4 Bass Traps to the Ceiling

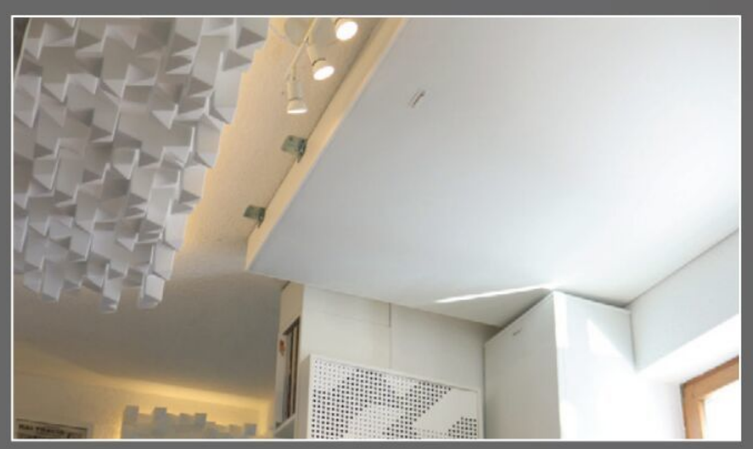
There, we stack two Browne bass traps on top of each other to cover the complete corner areas that are in the direct sound field of the studio monitors. To make sure that the "bass towers" fit under the ceiling, we only have to order the upper absorbers with a height that is 5 cm lower. Now that we should have the bass problems under control, it's time to install the broadband absorbers.

5 Broadband Absorbers

First, we treat almost the entire back wall with a total of six Browne broadband absorbers with the standard dimensions of 51 x 100 x 14.7 cm. Remember: From the rear wall directly opposite the speakers, the direct sound is immediately reflected. In combination with the rear basstrap towers, the armada of six on the rear wall now ensures maximum sound absorption.

6 Daylight vs Absorbers

In front of us, there is a window between the studio monitors. We deliberately leave this area free to preserve the beautiful view of the Rhine. Acoustically, this does not pose a problem in view of the acoustic measures already taken and further acoustic measures planned. We continue in the front ceiling area, which we cover with a Browne broadband absorber with a special size of 1.93 x 1.2 m.

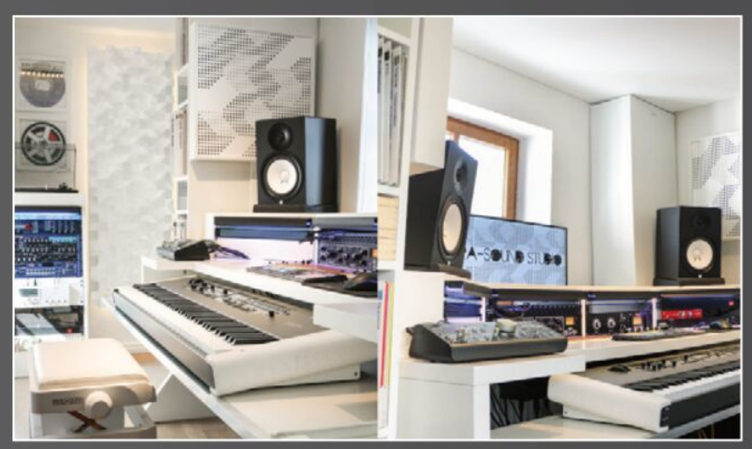


7 Ceiling Treatment

The ceiling area directly above the studio monitors should not be neglected under any circumstances. Basically, either the entire ceiling can be fitted with absorbers or the area above the listening position can be covered with diffusor elements instead of absorbers. Particularly in larger control rooms, this measure ensures a more natural sound image due to the dispersion of reflections at more distant locations.

8 Ceiling Combination

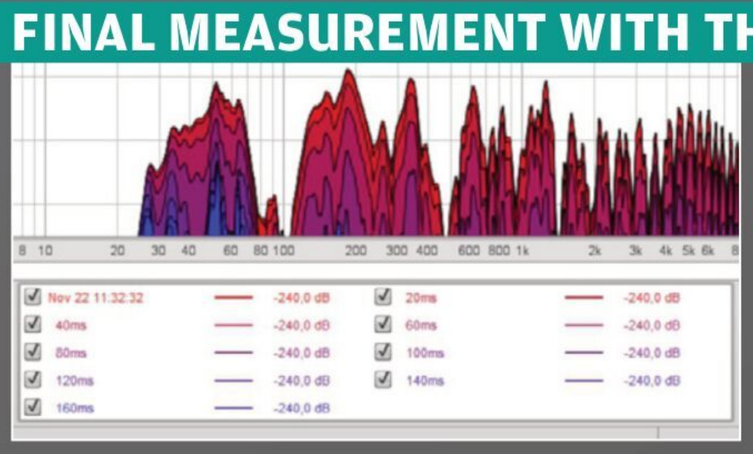
Since we already have some diffusor plates from Artnovion [1] in our inventory, we include them in our concept at this point. We not only make use their diffusion potential, but the working atmosphere also benefits from the futuristic skyline look. It goes without saying that, without existing diffusors, corresponding panels from Browne would take over these tasks.



9 Final Polish

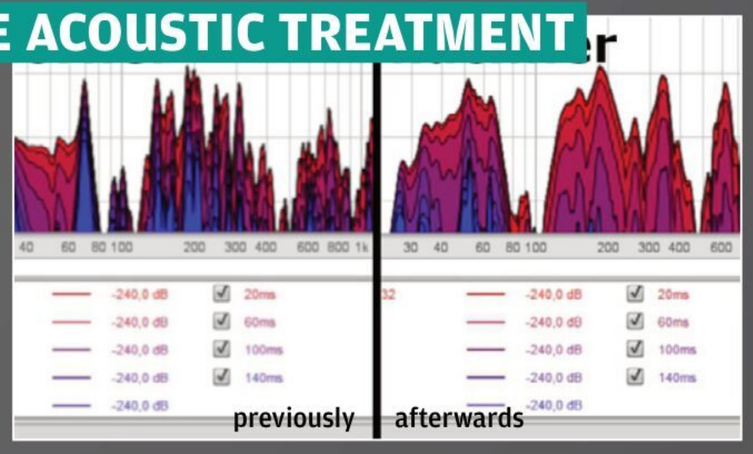
Finally, we cover the entrance door with commercially available acoustic foam in pyramid design to defuse this area as much as possible. The final design touch is provided by a printed picture on one of the broadband absorbers at the back, other already existing Artnovion panels in specially built frames and picture vinyls on free wall surfaces and on the door.

FINAL MEASUREMENT WITH THE ACOUSTIC TREATMENT



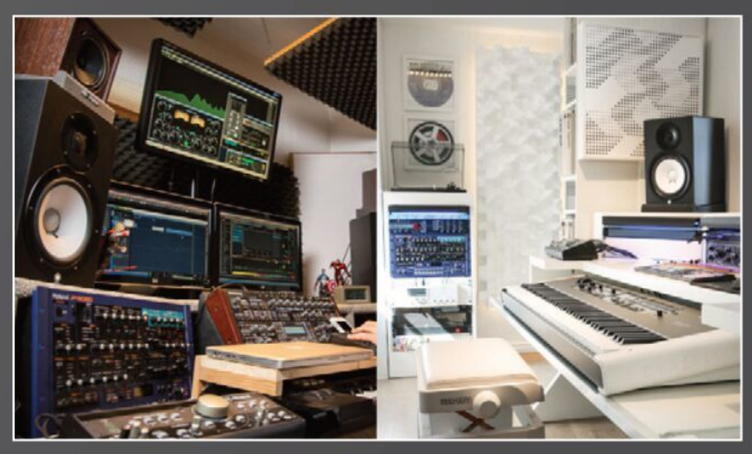
1 Better Measurements

Now that our room is fully acoustically treated, we again perform a REW measurement at our listening position. In comparison to our first measurement before the re-equipment, the **Decay** diagram shows a significant decrease in decay time, especially in the mentioned problem areas. This is clearly visible in the decrease of the longest, blue colored reverberation time regions.



2 Bass Absorption Wins

While the decay time of the first measurement in these ranges at 70 Hz in the bass and in the lower mids between 120 and 300 Hz was still comparatively high, we are now in a consistently optimal range. According to common standards, a reverberation time of 200 to 400 ms maximum should be achieved in listening rooms, which we have succeeded in achieving - according to the new measurements.



3 Target Achieved!

The most important thing at the end is the sound, which is much better than before. While the old equipment with foam and self-made modules was too bass-heavy and very dry on top, now everything sounds much more natural. The bass, in particular, sounds much more balanced, with pleasant mids and highs that allow for even better mixing. The listening experience is rounded off by the new, bright room sound.

[1] artnovion.com

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Kassian Alexander Goukassian (kg@falkemedia.de)

Chief Editor:
Marco Scherer (m.scherer@falkemedia.de)

Managing Editor:
Mario Schumacher (ms@beat.de)

Editors:
Sascha Blach, Johannes Dicke, Tobias Fischer, Vera Schumacher, Jan Wilking, Matthias Sauer, Stefan Hofmann, Paul Marx, Matthias Basedow, Philipp Sterczewski

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