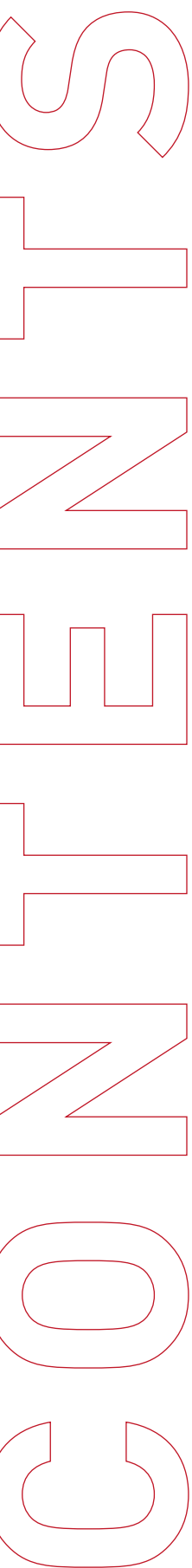




IMMERSIVE AUDIO :

AN EXPERT GUIDE

Focusrite Group



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I N T R O

Immersive audio (also known as spatial audio or 3D audio) is a technology that creates a three-dimensional sound environment for the listener. Traditional stereo or surround sound systems typically arrange sound in a two-dimensional space around the listener. Immersive audio places sound around them. It allows for a more realistic and engaging auditory experience as sounds can come from any direction: above, below, and all around the listener.

D U C T I O N

Key features of immersive audio include:

- **Height channels:** In addition to left, right, and surround channels, height channels add a vertical dimension to the sound.
- **Object-based audio:** Instead of assigning sounds to specific channels, sounds are treated as objects that can be placed anywhere in three-dimensional space.
- **Head-tracking:** Some immersive audio systems (including Apple's AirPods Pro earbuds) use sensors to track the listener's head movements and adjust the sound accordingly to maintain spatial accuracy.

This expert guide from Focusrite Group provides an overview of essential platforms and applications of immersive audio, particularly for music. The guide also reviews immersive audio careers and discusses how and where they are consumed.

P L A T F O R M S

Various applications use immersive audio—including virtual reality (VR), augmented reality (AR), gaming, cinema, and music production—to provide a more lifelike and enveloping sound experience. Today's most widely adopted immersive audio delivery platforms are proprietary technologies from Sony, Dolby, and Apple.

Sony 360

Sony 360 REALITY AUDIO

Sony's "360 spatial sound technology" enables listeners to build and experience immersive audio on various platforms, content, and devices. Sony has developed tools for mixing audio in a 360-degree spherical shape to give listeners a sense of full immersion in the musical experience. The Sony 360 WalkMix Creator is the main tool.

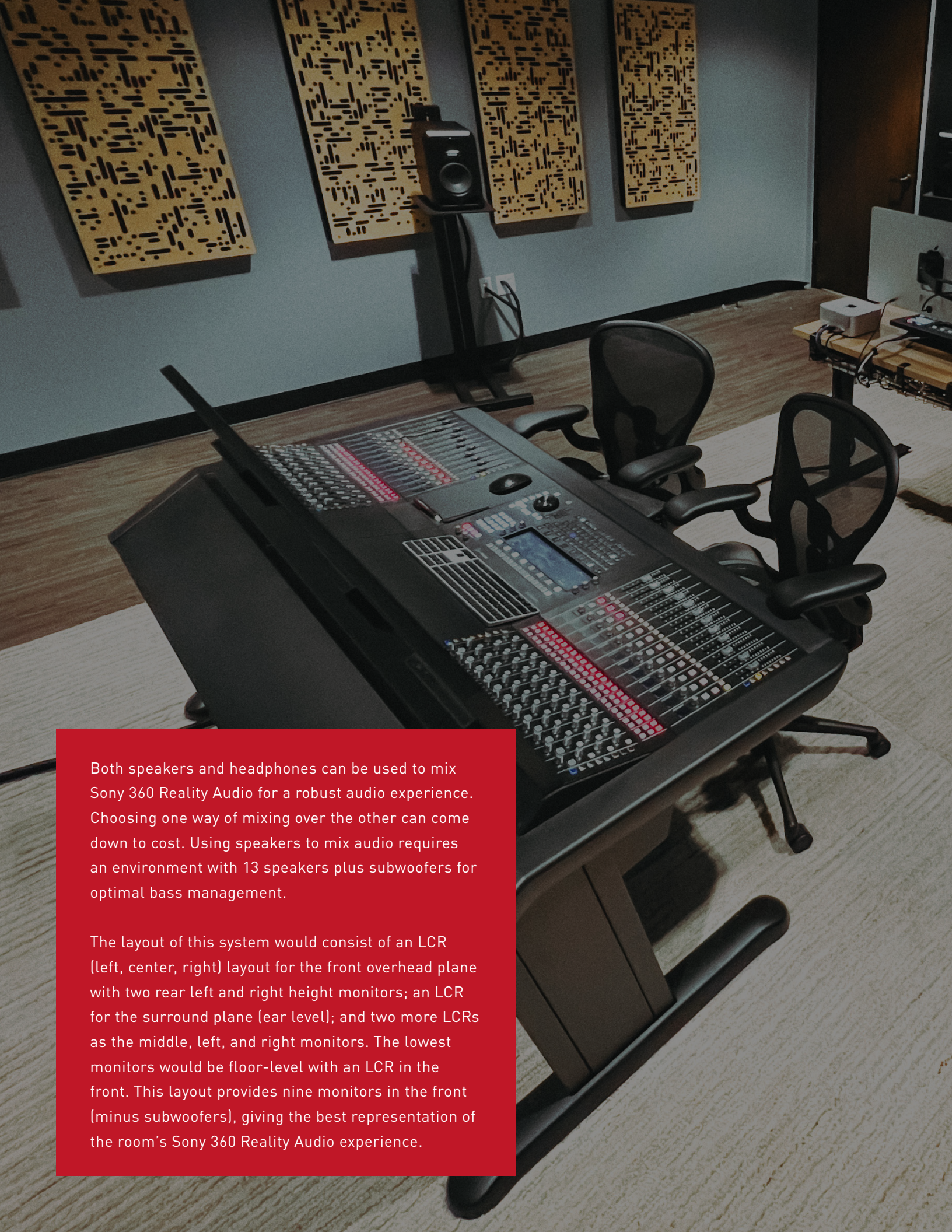
WalkMix Creator is a plugin that creates a spherical space to place audio as objects or groups in a 360-degree sphere. It can be used widely in many digital audio workstations (DAWs), including Ableton Live™ 11, Logic Pro, Cubase 11, Nuendo 11, Pro Tools, Sequoia 16, Studio One 5, and more.

HOW TO MIX USING

Mixing is achieved by using groups and objects within WalkMix. Here is an overview of how to work with objects when mixing.

- To change the color of an object or group of objects, select the object or group and click "Color" in the properties pane.
- To change the Gain by object or by group, select the object or group. In the Properties pane, click and drag the Gain parameter up to increase it or down to decrease it.
- To move an object, click on it in the 3D, top-down, or perspective view and drag it to your desired position.
- To edit the speaker layout, use the Settings pane. You can also toggle the display of your speaker layout in the editing views by clicking the speaker icon above the viewport.
- To increase or decrease Elevation and Azimuth:
 - Select an object or group in either of the viewports or via the objects list. Then, click and drag up to increase that value or drag down to decrease.
 - You can also click the Track, Elevation, Azimuth, or Gain values and type the value you want to adjust. One click allows you to type a value, and a click and drag lets you increase or decrease it.

WALKMIX CREATOR



Both speakers and headphones can be used to mix Sony 360 Reality Audio for a robust audio experience. Choosing one way of mixing over the other can come down to cost. Using speakers to mix audio requires an environment with 13 speakers plus subwoofers for optimal bass management.

The layout of this system would consist of an LCR (left, center, right) layout for the front overhead plane with two rear left and right height monitors; an LCR for the surround plane (ear level); and two more LCRs as the middle, left, and right monitors. The lowest monitors would be floor-level with an LCR in the front. This layout provides nine monitors in the front (minus subwoofers), giving the best representation of the room's Sony 360 Reality Audio experience.



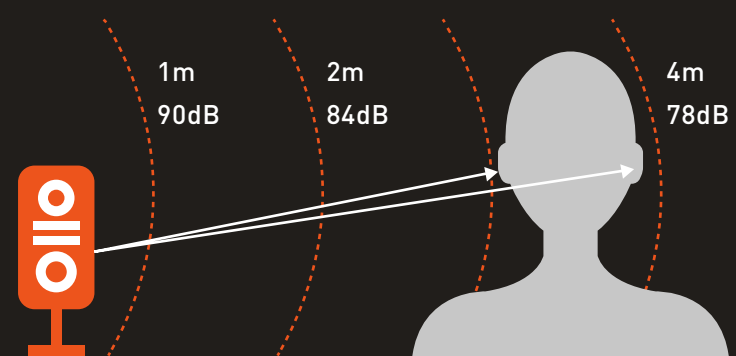
Sony 360 Virtual Mixing Environment

Another option is using headphones and the Sony 360 Virtual Mixing Environment. Sony 360 VME is a spatial sound technology that reproduces the acoustic environment of a sound mixing studio with a seating capacity of over 300 in a pair of headphones with professional-level precision. It is designed to accurately reproduce the acoustic field of an immersive audio studio with multiple speakers through headphones using proprietary measurement technology.

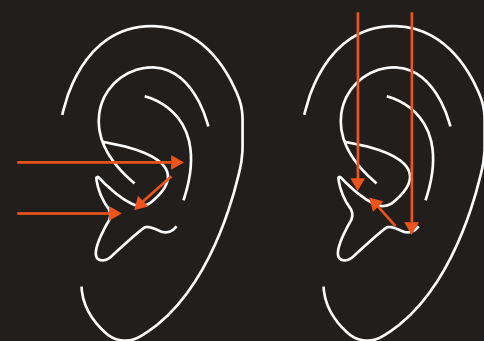
Sony 360 VME is personalized using the listener's "Head-Related Transfer Functions" in the binaural processing. Listeners locate the sound source based on differences in the arrival time and volume of a sound reaching their left and right ears. Even when listening to sound from the same source, the shape of the listener's ear and other factors changes what they hear. The HRTF expresses these change characteristics to reproduce an acoustic field with multiple loudspeakers (i.e., a sound mixing room) in a pair of headphones.

INFORMATION CONTAINED IN THE HRTF

Differences in the arrival time and volume of a sound reaching the left and right ears



Sound frequency characteristic by arrival direction



D O L B Y
A T M O S

This technology allows musicians and engineers to mix just as effectively using headphones as they would using speakers with the WalkMix Creator tool.

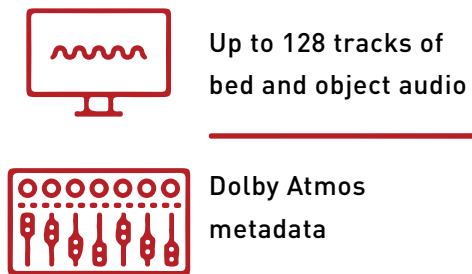
Dolby Atmos is an immersive audio format that allows creatives full control over sound. They can place sound exactly where they want it to go for a more realistic and immersive audio experience.

Whether listening to music, movies, or gaming, Dolby Atmos provides the listener with a deeper spatial sound so they hear and feel more.

GETTING STARTED WITH DOLBY ATMOS

The key parts of a Dolby Atmos mixing system are a compatible **DAW**, the **Dolby Atmos Renderer**, and a compatible **monitoring system**.

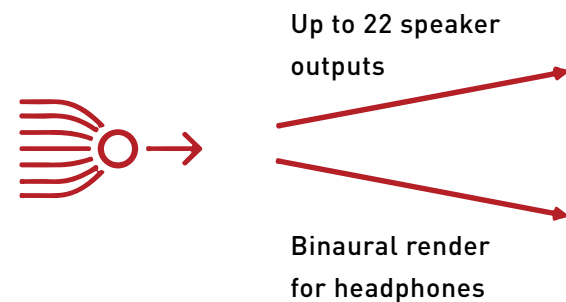
Digital Audio Workstation



Create your mix in selected DAWs

Use 3D panning to position your tracks

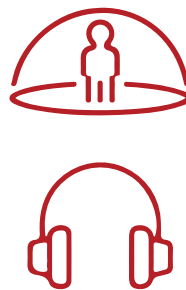
Dolby Atmos Renderer



Converts your object-based mix for monitoring

Renderer can be built-in to selected DAWs

Monitoring System



Maximum speaker outputs and binaural rendering support is dependent on renderer version

DIGITAL AUDIO WORKSTATION (DAWS)

Compatible DAWs for Dolby Atmos feature different levels of ability and integration. Some DAWs require the Dolby Atmos Renderer to be linked to the DAW, while others include full Dolby Atmos internal rendering. Dolby Atmos Music Panner (which comes with the Dolby Atmos Renderer) is commonly used to support DAWs that don't feature native immersive panning.

The following table lists compatible DAWs.

| | Integrated Panning | Dolby Atmos Music Panner (MacOS Only) | Integrated Renderer |
|------------------------------------------|--------------------|---------------------------------------|---------------------|
| Ableton Live | No | Yes | No |
| Apple Logic Pro | Yes | Yes | Yes |
| Avid Pro Tools (Studio and Ultimate) | Yes | Yes | Yes |
| Blackmagic Design DaVinci Resolve Studio | Yes | Yes | Yes |
| Fiedler Audio Dolby Atmos Composer* | Yes | No | Yes |
| Merging Technologies Pyramix Premium | Yes | No | No |
| PreSonus Studio One | Yes | Yes | Yes |
| Steinberg Nuendo | Yes | Yes | Yes |
| Steinberg Cubase | Yes | No | Yes |

*Fiedler Audio Dolby Atmos Composer is a plug-in-based panner and renderer with Mac/PC support and compatibility with several DAWs not listed above.

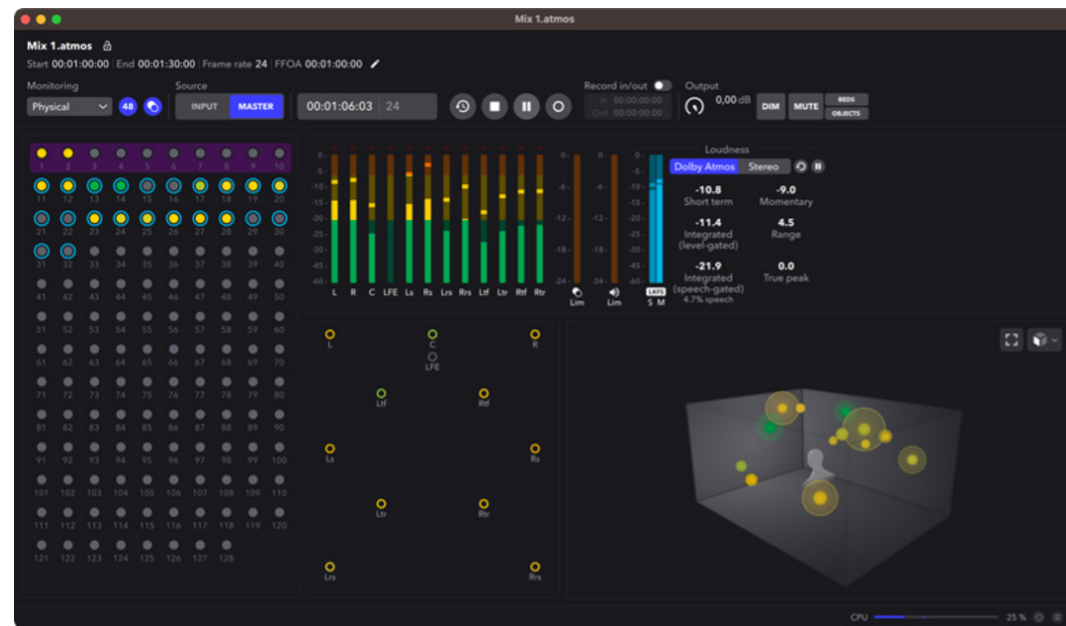
*Taken from Dolby Professional "Getting Started with Dolby Atmos Music" site

DOLBY ATMOS RENDERER

Dolby Atmos Renderer is the software that monitors the mix and creates the master files. The Renderer is available in two ways:

DOLBY ATMOS RENDERER APPLICATION that can run alongside the MacOS DAW software through audio connected via Core Audio using the Dolby Audio Bridge or for Windows PC through a dedicated workstation. Audio I/O via Dante or MADI allows audio to travel between the DAW and the Dolby Atmos Renderer on the separate workstation.

DAWS WITH INTEGRATED RENDERING featuring natively built-in Dolby Atmos rendering do not require additional software to create mixes. However, DAW internal rendering may not include all the features and benefits of the Dolby Atmos Renderer application, so users may still want to have this available.



The Dolby Atmos Renderer application

MONITORING SYSTEMS AND SPEAKERS

Dolby Atmos is designed for flexibility by allowing users to create within an object-based format.

AUDIO INTERFACE

Properly routing Dolby Atmos beds and objects requires an audio interface with at least 12 main outputs. This provides the minimum number of outputs for a 7.1.4 speaker layout (which we'll cover in the next section) and an additional headphone output to monitor the binaural Dolby Atmos mix from the Renderer.

The Red 16Line, Focusrite's thunderbolt interface, has 18 analog outputs (which would more than cover the outputs needed for 9.1.6). Two headphone outputs on the front panel enable users to route the binaural Dolby Atmos mix and have a separate output for Apple's Spatial Audio reference.

Another option would be to build a more expandable system. Using the RedNet PCIeNX card with a RedNet A16RMKII provides 16 channels of I/O for a configuration up to 9.1.6. The RedNet PCIeNX card has 128 channels of I/O, allowing the addition of a RedNet AM2 for headphone monitoring.

SPEAKERS

The minimum requirement for a Dolby Atmos speaker setup is 7.1.4. The first number refers to the number of ear-level speakers in the system (i.e., seven speakers). The second number refers to the number of subwoofer speakers, and the last number refers to the number of height speakers (speakers above ear-level listening). We'll dive into this further in the Room Design section.

While a 7.1.4 speaker system is the minimum recommendation, many professional studios leverage a 9.1.6 speaker system for playback. The main difference between a 9.1.6 speaker layout and a 7.1.4 layout is the use of "wides." A 9.1.6 placement adds two speakers directly outside the perimeter of the left and right speakers, which helps define the wider imaging between the left/right and the surround speakers.

One example of a 7.1.4 system would be using seven ADAM A7Vs for the surround speakers, two ADAM Sub 12s for the sub-channel, and four A4Vs for the height speakers. This is an excellent system for a small to medium-sized room. A larger room could have nine ADAM S3Vs for the surround speakers, two ADAM Sub 15s, and six ADAM S2Vs for the height speakers. The size of the room ultimately determines which monitors should be used.

With a proper understanding of the software and hardware required to work properly in an immersive environment, you may decide to build an immersive room to work in.

Seven steps must be considered when designing a studio space for Dolby Atmos work. We have covered some of these in the previous sections, but designing a room requires other important considerations.

R O O M

The seven steps to designing a Dolby Atmos mix room are:

1. Define the room dimensions.
2. Define the mix position.
3. Position the ear-level speakers.
4. Position the overhead speakers.
5. Position the subwoofer(s) and consider bass-management options.
6. Choose speaker models.
7. Choose audio interface(s) and consider speaker management requirements.

USING DARDT

The Dolby Audio Room Design Tool (DARDT) automatically places speakers at the optimum angles within specified dimensions. Speaker positions can then be adjusted as required by altering the X, Y, and Z coordinates. These coordinates refer to the position of the speaker baffle.

D E S I G N

If any specified speaker locations fall outside the recommended angular and placement tolerances, the cell's color will turn yellow, and a feedback hover message will be available.

Once the speaker positions are established, the "Design Printout" tab will show auto-generated room plans to assist with final speaker positioning.

The DARDT can be accessed here:

https://professionalsupport.dolby.com/s/article/The-Dolby-Atmos-Room-Design-Tool?language=en_US

DOLBY ATMOS

POSITION THE LFE AND CONSIDER BASS MANAGEMENT OPTIONS

The **low-frequency effects (LFE) channel** is a dedicated channel with one or more associated subwoofers to ensure adequate reproduction of bass content. Every Dolby Atmos mix room requires it as the “1” in the speaker layout (i.e., 7.1.4).

Bass management is the process of redirecting low-frequency energy from non–full-range speakers (i.e., speakers with no bass response down to 40 Hz) to a subwoofer. The subwoofer can be either the LFE channel subwoofer or one or more dedicated bass-management subwoofer speakers or both LFE and bass-managed subwoofers.

Bass management is recommended for all non–full-range speakers. It is typically used for the overhead and ear-level surround speakers (which are often slightly smaller speaker models) but can also be used for the left, right, and center speakers.

There are no set rules for where to place subwoofer cabinets. An acoustician should be consulted to test where the subwoofers perform best in the room. For subwoofer cabinets used for the LFE channel, the front wall (halfway between the center and either side) is usually a good starting point, but again there are no rules.

ROOM CALIBRATION

Room calibration helps ensure consistent sound across all the speakers in the room so that a sound object moving around the sound field will sound the same regardless of its position in the room. It also helps ensure proper translation of mixes between different environments from different mixing rooms back to commercial playback systems and devices.

Again, before calibrating a room, it’s best to consult a professional acoustician, room design company, or audio tuning professional to tune your room properly.

Here are some links to additional documentation and recommendations to assist with room calibration and tuning for the immersive space:

- [Dolby Atmos Music Room Calibration FAQs](#)
- [Dolby Atmos Music Room Configuration](#)
- [Dolby Atmos Home Entertainment + Music Studio Technical Guidelines](#)

[This section is taken from the Dolby document, “How to Design a Dolby Atmos Mix Room” v1.0, last edited March 2024 and Dolby Professional Services room calibration webpage]



DELIVERING YOUR DOLBY ATMOS PROJECT FOR RELEASE

Before delivering your completed Dolby Atmos project, make sure to complete proper quality control (QC) for your mixes to ensure they sound the way you want listeners to hear them.

Regardless of platform, submitting a completed Dolby Atmos project for general release to a music digital service provider (DSP) requires specific key deliverables:

- All deliverables will be an ADM BWF file that conforms to the Dolby Atmos Master ADM profile, which can be found online here.
- All deliverables must use 24-bit PCM resolution at a sampling rate of 48 kHz. For projects created at 96 kHz, a DAMF (Dolby Atmos Master File) should be used if delivering for archiving.
- Audio in the LFE channel should be band-limited using a low-pass filter with a cut-off frequency between 100 and 150 Hz.
- The number of PCM channels must not exceed 128.
- For individual tracks and albums, all deliverables must achieve an integrated Dolby Atmos loudness not exceeding -18 LKFS. A tolerance of +/- 0.1 LKFS is permitted due to differences that can be introduced by the measurement process.
- For albums, integrated loudness must be measured on each individual track (not the overall album). Again, each track should not exceed -18 LKFS.

Here are some helpful links to additional information about delivering Dolby Atmos music projects:

- [Dolby Atmos Music Master Delivery Specification](#)
- [Apple Music: Delivering Dolby Atmos Audio](#)

DELIVERING FOR APPLE MUSIC

When delivering a project for release on Apple Music, there are additional considerations to consider when preparing music for release.

Apple applies its own immersive sound technology to the Dolby Atmos deliverable called "Spatial Audio." Apple's Spatial Audio technology uses sensors in the accelerometers and gyroscopes inside Apple's AirPods Pro and AirPods Max. These sensors track a listener's head movements, and the data is used to create a virtual space based on those movements. This process is specific to the binaural render of a project; it does not apply to the discrete speaker playback deliverable.

To experience immersive music, listeners must ensure their playback devices (from headphones to speaker systems) can correctly decode and play the format.

More information about using spatial audio with other audio providers can be found online:

- [Apple Music Dolby Atmos and Spatial Audio](#)
- [Tidal and Dolby Atmos](#)
- [Amazon Music and Spatial Audio](#)

DOLBY ATMOS

DOLBY ATMOS

Renderer Settings

There are a few ways to configure settings in the Dolby Renderer integral for mixing. There are also multiple settings for the Trim and Down mix setting page. Recommended settings for these pages are usually found in the label delivery spec guides (which can be found on their respective websites).

BEST

Dolby Atmos Binaural Settings allow mixers control over the perceived depth of elements in the binaural headphone mix, which listeners experience on Tidal and Amazon. There are four settings for each bed position and object: Off, Mid, Near, and Far. These settings correspond to the amount of binauralization (depth) applied to that element. "Off" has no binauralization, while "Far" has the most. After panning, these settings provide additional tools to make an element seem closer or farther away from the listener.

PRACTICES



Mix Tips and Techniques

Here are a few additional values to keep in mind while mixing and creating deliverables in Dolby Atmos:

- All tracks within a project must be at the same frame rate.
- All audio must be 24-bit linear pulse code modulation (LPCM) at 48 kHz.
- Dolby Atmos files should conform and be synced with the stereo reference files for the same project.
- Integrated loudness should not exceed -18 LKFS measured (per ITU-R BS. 1770-4).
- True-peak level should not exceed -1 dB TP measured (per ITU-R BS. 1770-4).
- The difference between the stereo source and immersive source durations must be less than or equal to 50 milliseconds.

We recommend setting up a way to monitor the stereo master, full Atmos speaker mix, 2.0 re-render, binaural re-renders, and the Apple Spatial Audio. This will ensure translation to the different DSPs and playback mediums.

It's also important to note how panning positions translate to headphones, especially with Apple Spatial Audio. Front LR is just that in Atmos: they are in front of you, panned slightly left and right. The widest pan positions are the side speakers. Comparing this to stereo, panning an element to the side speakers will achieve a similar result as hard panning left and right in stereo.



SESSION PREP GUIDE

When starting a session, some practices will help you meet all delivery requirements. First, import all the stems and stereo master. Then, align the stems exactly to the stereo master. You may need to decrease the stems' level up to 10 dB to have a good starting point to meet the -18 LKFS requirement.

At this point, decide which elements will stay in the bed and which elements will function as objects.

Typically, static elements will remain in the bed, and elements that will be automated around the room will become objects. Elements that could become objects include vocal spins and throws, vocal delays, synths, guitar lines, and any transitional element from one section of a song to another (like cymbal swells and risers).

Compare how the stems feel and sound compared to the stereo master. They may need to be "glued" back together to feel like the original mix. Having those foundational elements (compression, EQ, limiting, etc.) in the bed allows you to process them like a traditional stereo mix. This can be extremely helpful depending on the genre and the amount of mix bus processing completed in the stereo mix.

Next, compare the stems and stereo master to match the stems' levels to the stereo master while also monitoring the 2.0 re-render. This helps ensure that the levels of the elements in the Dolby Atmos mix are similar to the stereo master. Then, pan the objects around the room. The volume of elements will change as you pan around the room, so you may need to compensate to achieve a similar mix as the stereo master.

For creative panning choices, keep the drums, bass, and other foundational elements of the mix in the front LR speakers. Then, gradually spread things out across the room. Vocals tend to stay in the front LR speakers. Electric guitars may cover more of the room by panning them further back, off the front LR speakers. Height speakers are an effective way to immerse the listener. When considering which elements to pan, consider ones that don't contain too much low-frequency information (like higher-pitched synth sounds, pedal steel, and some vocal effects). Reference other Dolby Atmos mixes to get a feel for how elements are panned and, most importantly, reference the stereo master. Mixers usually complete the Dolby Atmos session after the stereo mix and stereo master are completed and approved.

DELIVERY PLATFORMS

Some well-adopted platforms for delivering immersive audio include:

- Virtual reality (VR) headsets
 - Devices like Oculus Rift, HTC VIVE, PlayStation VR, and Valve Index
 - Provide a fully immersive audiovisual experience with head-tracking capabilities
- Headphones and earbuds
 - Specialized spatial audio headphones like the Sennheiser AMBEO, Apple AirPods Pro and AirPods Max, and Sony WH-1000XM4
 - Use head-tracking and binaural rendering to deliver 3D audio
- Smartphones and tablets
 - Devices with support for spatial audio playback, like Apple iPhones and iPads with Dolby Atmos
 - Enable immersive audio through built-in speakers or connected headphones
- Music streaming services
 - Services such as Tidal, Apple Music, and Amazon Music HD
 - Provide tracks mixed in spatial audio formats like Dolby Atmos Music and Sony 360 Reality Audio

These platforms enable listeners and professionals to experience and produce immersive audio content, enhancing the realism and depth of sound in various applications.

CAREERS

IN

IMMERSIVE

AUDIO

Working in the immersive audio field involves a blend of technical, creative, and scientific skills. Here are some common careers in this field:

- Audio engineer/technician
 - Responsible for setting up, operating, and maintaining audio equipment
 - Specializes in recording, mixing, and mastering immersive audio content
- Sound designer
 - Creates and manipulates audio elements for immersive experiences
 - Works on sound effects, ambiance, and other audio components for games, virtual reality (VR), augmented reality (AR), and films
- Audio programmer/developer
 - Develops software and tools for creating and implementing immersive audio
 - Works on audio engines for games, VR, AR, and other interactive media
- Acoustic engineer
 - Studies and applies principles of acoustics to design sound systems and environments
 - Works on optimizing the spatial audio experience in different settings
- Audio research scientist
 - Researches new techniques and technologies in spatial audio
 - Works in academia, research labs, or company R&D departments
- VR/AR audio specialist
 - Focuses on integrating and optimizing audio in virtual and augmented reality applications
 - Ensures realistic and immersive soundscapes for interactive environments
- Game audio designer
 - Specializes in creating immersive audio experiences for video games
 - Works closely with game developers to implement spatial audio
- Audio content creator/producer:
 - Produces immersive audio content for various media, including podcasts, music, and interactive experiences
 - Supervises the creative process from concept to final product
- Immersive audio educator/trainer
 - Teaches and trains individuals in the techniques and technologies of immersive audio
 - Works in educational institutions or conducts workshops and seminars

HOW IMMERSIVE AUDIO IS CONSUMED

Today, more than 2.5 billion playback systems and devices are capable of decoding and playing back music created and mixed in immersive. This number continues to grow: devices ranging from AVR systems and soundbars to mobile devices and even automobiles are being enabled alongside digital streaming providers to support playback of immersive formats.

While this guide includes expert audio engineers' views on what you need to know to understand and begin developing skills in immersive audio, there's much more to experience and learn.

Seek out a Dolby Atmos, Sony 360 studio, or demonstration room at a music and audio retailer. Visit local campuses with Dolby Atmos or Sony 360 music listening rooms, or a Dolby theater to watch and listen to a film. Or use headphones or earbuds that support Spatial Audio.

To learn more, visit:

- [Focusrite](#)
- [ADAM Audio](#)
- [Apple Spatial Audio](#)
- [Dolby Atmos](#)
- [Sony 360 Reality Audio](#)

AUTHORS

Joseph Chudyk,

GRAMMY-award-winning mix engineer
and Nazareth University professor

Dave Rieley,

Universal Music Group-certified Atmos
mix engineer

Focusrite Group