



Dolby Atmos[®] Enabled Speaker Technology

October 2016

INTRODUCTION TO DOLBY ATMOS

Today, leading Hollywood movies, including Academy Award® winners, are presented in Dolby Atmos®. Introduced to the cinema in 2012, this new sound technology expands filmmakers' creative freedom to design movie soundtracks with unprecedented realism and precision. With Dolby Atmos, content creators can precisely place and move sounds almost anywhere, including overhead, to create an immersive, multidimensional listening experience.

This revolutionary experience is now available for your home. It will produce audio like nothing you've ever heard in a home theater. And you'll get a great immersive entertainment experience no matter what kind of Dolby Atmos home theater setup you have because the technology automatically adapts and scales the soundtrack to take full advantage of the number and location of speakers in your home entertainment system.

The dimension of height—hearing sounds coming from above you—is key to the Dolby Atmos experience. Reproducing overhead sounds requires new thinking about home theater design. In this white paper, we'll explain how you can use Dolby Atmos enabled speaker technology to build a system capable of reproducing overhead sound, even if you're not able to install speakers in the ceiling of your home theater.

Do I have to replace all of my current speakers to build a Dolby Atmos system?

No. Many people now have systems with a subwoofer and either five or seven speakers positioned at about ear level. Many of these speakers will work without a problem in a Dolby Atmos system.

One caveat: dipole speakers are not recommended for listener-level and surround speakers. This is because the highly diffuse nature of dipole speakers interrupts the localization and separation required to accurately place sound within the listening space.

Overhead sound is a vital contributor to the Dolby Atmos experience. Most current home theaters aren't capable of producing overhead sound, but there are a number of options for adding this capability to any room.

How do I get sound coming from above?

The obvious answer is to install speakers in the ceiling. If you choose this option, the overhead speakers should be timbre matched, power matched, and frequency matched as close as possible to your primary listener-level speakers. For ceilings less than 14 feet (4.3 meters) in height, you should choose a speaker with a wide (+/- 45 degree) dispersion pattern. Above 14 feet (4.3 meters), a speaker with a normal dispersion pattern should suffice.

But installing overhead speakers may not be practical or desirable for you. Installing speakers overhead and running the necessary wiring can be expensive and time consuming. If you rent your home, the property owner may not allow it. And if your ceiling

is made of a material such as concrete, plaster, or brick, installing speakers into the ceiling is virtually impossible. Finally, you may not like the appearance of overhead speakers in your home.

How can I get overhead sound if I don't mount speakers overhead?

The solution is Dolby Atmos enabled speakers. Employing a combination of unique physical speaker design and special signal processing, Dolby Atmos enabled speakers allow you to experience overhead sounds from speakers that are placed at the same level as traditional speakers or slightly above. These new speakers direct sound upward to reflect off the ceiling, as Figure 1 shows, to create a faithful reproduction of audio coming from above.

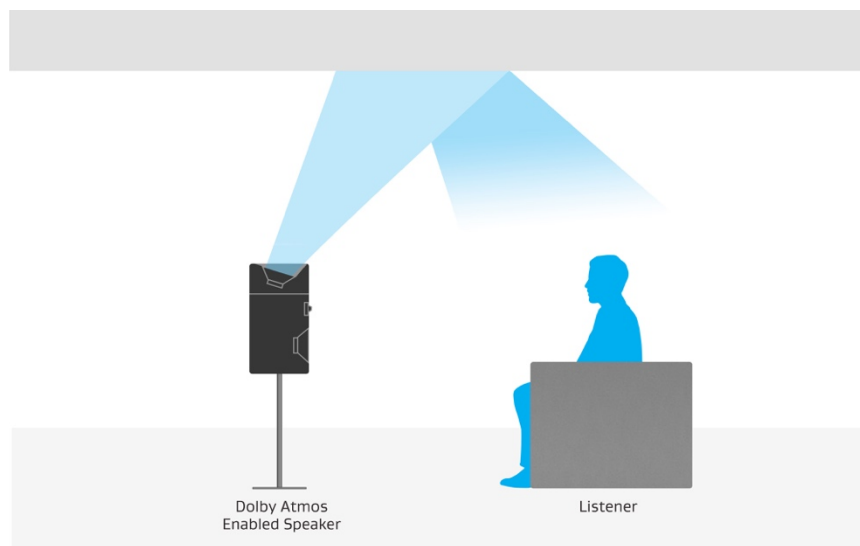


Figure 1: Dolby Atmos enabled speakers fire sound upward to reflect off the ceiling, creating exceptionally lifelike overhead sound.

You can purchase integrated speakers that combine traditional front-firing speakers with upward-firing Dolby Atmos enabled drivers in one cabinet. Or, if you don't want to replace your current speakers, you can purchase add-on speaker modules equipped with Dolby Atmos enabled speaker technology. You can place the add-on modules on top of or nearby your existing speakers.

Will I always get better Dolby Atmos sound with overhead speakers?

Dolby Atmos enabled speakers produce slightly diffuse overhead audio that is quite lifelike and, in some cases, preferable to the sound that comes from overhead speakers.

If your ceiling is lower than 8 feet (2.4 meters), overhead speakers—even with wide dispersion patterns—may be too close to the listener's position. The audio may be distracting because you'll hear exactly which speaker is producing the sound instead of feeling immersed in an

atmosphere in which sounds occur naturally overhead.

In this environment, Dolby Atmos enabled speakers are the better choice for reproducing the immersive overhead Dolby Atmos sound you would hear in a movie theatre, where overhead speakers are located high in the auditorium and create a more diffuse soundfield. Audio experts agree that the overhead layer of sound produced by Dolby Atmos enabled speakers can be preferable to the sound originating from overhead speakers.

Can I combine Dolby Atmos enabled speakers with overhead speakers?

The same signal and content from your receiver can go to either overhead speakers or Dolby Atmos enabled speakers. In fact, Dolby Atmos enabled speakers can also be combined with overhead speakers in a home theater environment to produce a highly immersive listening experience.

Why would you combine overhead and Dolby Atmos enabled speakers? Perhaps you have two speakers already installed in your ceiling, but you want to add an additional pair of overhead speakers. You don't desire to drill holes in your ceiling and try to feed speaker wire through your walls or, worse, hang the wires on the surface of your walls and ceiling. In that case, you can add two Dolby Atmos enabled speakers and get detailed overhead sound without going to the trouble of installing new speakers in your ceiling.

You'll hear the same overhead sounds whether you're using overhead speakers, Dolby Atmos enabled speakers, or a hybrid combination of the two.

How does Dolby Atmos enabled speaker technology work?

Dolby Atmos enabled speaker technology produces overhead sounds through a combination of psychoacoustic signal processing, precise angling of the speaker drivers, and specific directivity requirements. Dolby provides these requirements to manufacturers to ensure that their certified speakers will perform properly in a Dolby Atmos system for the home. Importantly, these requirements are flexible enough to allow manufacturers to incorporate and maintain their unique sonic and industrial design philosophies when developing their own brand of Dolby Atmos enabled speakers.

Dolby Atmos enabled speakers do not rely on virtualized processing. That means you don't have to sit in a specific spot to get the full Dolby Atmos effect.

Here are more details about the most important aspects of Dolby Atmos enabled technology.

Psychoacoustic signal processing

Based on an understanding of how the brain interprets sound, Dolby Atmos enabled speakers modify select audio frequencies to reinforce the sense of sound coming from above. This filtering is also applied to any sound that may leak horizontally from the speaker cabinet to further amplify the perception of sound coming from above.

Speaker directivity and angling

Most speakers have a wide diffuse pattern. This is not an ideal design for a Dolby Atmos enabled speaker where the majority of the middle- and high-frequency energy should be directed to the ceiling. Dolby performs comprehensive testing on Dolby Atmos enabled speakers to insure that the majority of the sound is focused on the ceiling and not leaked horizontally to the listening position.

Dolby Atmos enabled speakers are designed to fire their acoustic energy upward rather than directly at you. Dolby has calculated the best angle for the upward-firing element based on where most people place their floor-mounted tower and stand-mounted speakers.

As a result, your brain experiences the sound coming from overhead rather than from the speaker itself. A crossover network and bass management is built into Dolby Atmos enabled speakers, complemented by signal processing in the audio/video receiver (AVR).

Will Dolby Atmos enabled speakers work in my room?

Dolby Atmos enabled speakers can produce an incredibly immersive Dolby Atmos experience in many kinds of rooms. You'll get the best sound if your ceiling is flat (not vaulted or angled) and made of an acoustically reflective material, such as drywall, plaster, concrete, or wood. Dolby designed the technology for rooms with ceiling heights of 7.5 to 12 feet (2.3 to 3.66 meters), but listening tests indicate that the system is quite robust and you can hear incredible overhead sound in rooms with ceilings as high as 14 feet (4.3 meters), though the effect may become more diffuse in rooms with higher ceilings.

Recessed lighting fixtures, chandeliers, crown molding, and heating or air conditioning vents in your ceiling do not noticeably interfere with the Dolby Atmos experience.

What are the different types of Dolby Atmos enabled speakers?

There are two types of Dolby Atmos enabled speakers: integrated speakers and add-on speaker modules.

Integrated speakers

Integrated speakers include a traditional front-firing speaker and an upward-firing Dolby Atmos enabled speaker in the same speaker cabinet, as shown in Figure 2. The Dolby Atmos enabled speaker is housed in a separate sealed section of the speaker cabinet and has its own set of binding post inputs or jacks. Integrated speakers are great if you're considering purchasing new main or surround speakers.

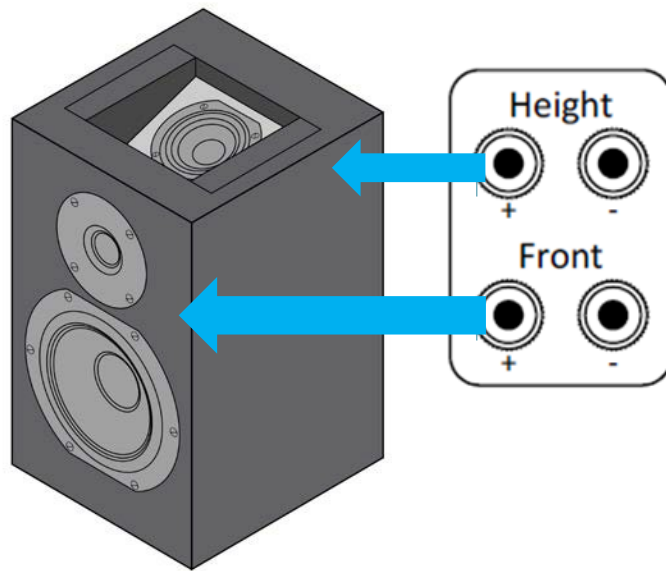


Figure 2: Dolby Atmos enabled integrated speakers include both traditional front-firing and upward-firing drivers. Both sets of speakers have their own binding posts to connect to dedicated outputs on your AVR.

Add-on modules

Manufacturers are also offering Dolby Atmos enabled speakers built into separate cabinets, as shown in Figure 3. These are ideal if you already have primary speakers and you are satisfied with their performance. By adding separate Dolby Atmos enabled add-on modules, you can get a multidimensional Dolby Atmos experience while keeping your existing equipment. You can place the add-on modules on top of your existing speakers or nearby on another surface.

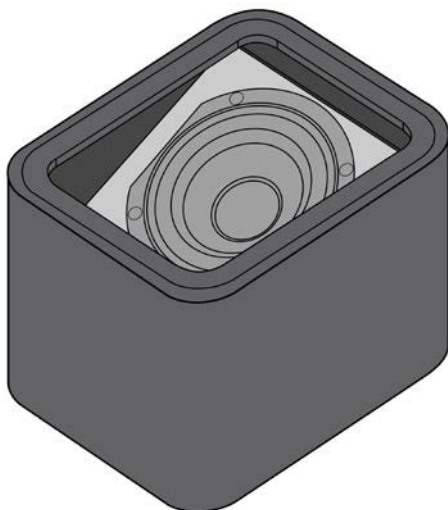


Figure 3: Dolby Atmos enabled add-on modules include only upward-firing elements. You can place them on top of your traditional front-firing speakers or on another surface near them.

How many Dolby Atmos enabled speakers do I need, and how should I set them up?

Dolby recommends that you use four Dolby Atmos enabled speakers when possible. Use of four speakers will make the placement of overhead sounds more accurate, and you'll get better resolution and more precise, realistic sounds as an object—such as a helicopter—passes overhead in a video. As noted previously, two of the speakers (whether they are integrated speakers or add-on modules) should be located on top of or adjacent to the front left and front right speaker locations of your system. The other two should be positioned in the surround sound speaker locations. If you have a 7.1 system, you would locate the Dolby Atmos enabled speakers on or near your back surround speakers.

If you opt to use only two Dolby Atmos enabled speakers, you'll still get a very immersive experience, with sounds moving overhead. Place the Dolby Atmos enabled speakers at the front left and front right speaker locations.

For optimum performance, place your speakers at or slightly above the level of your ears when you're seated. Don't place the Dolby Atmos enabled speakers higher than half the height of your wall. Make sure the speakers are at least 3 feet (0.9 meter) away from you, ideally 5 feet (1.5 meters) or more. If you're using add-on modules, place them either on top of your front and surround (ideally, rear surround speakers in a 7.1 system) speakers or within 3 feet (0.9 meter) of those speakers.

How should I describe my setup?

With the debut of Dolby Atmos, there is a new way to refer to surround sound speaker configurations (see the "Dolby Atmos for the Home Theater" white paper for more details). It is based on the standard terminology (stereo, 5.1, and 7.1) but adds a new integer at the end to specify the number of height speakers you employ (for example, 7.1.4) in your system.

Figures 4 through 6 show the most common speaker layouts in a Dolby Atmos system for home theater.

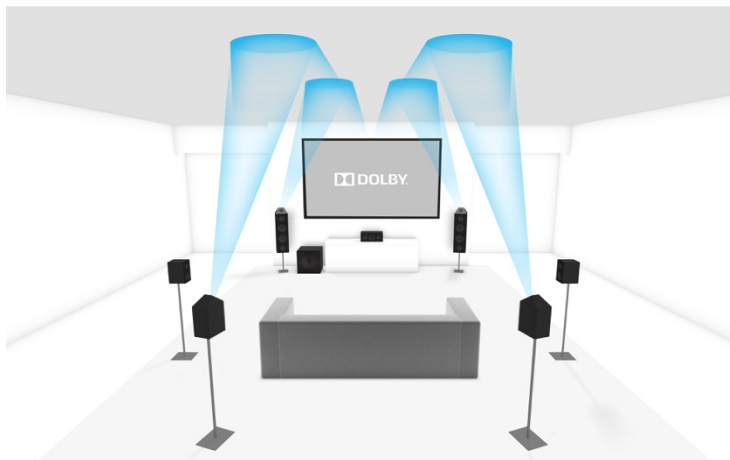


Figure 4: A traditional 7.1 speaker layout with four Dolby Atmos enabled speakers (7.1.4).



Figure 5: A traditional 5.1 speaker layout with four Dolby Atmos enabled speakers (5.1.4).



Figure 6: A traditional 5.1 speaker layout with two Dolby Atmos enabled speakers (5.1.2).

How do I connect my Dolby Atmos enabled speakers to my AVR?

Many AVRs that support Dolby Atmos have speaker connections labeled HEIGHT, as in Figure 7. (Some AVRs do not use that label, but they allow you to assign terminals for the height outputs. This can be done in the setup menu of the AVR.) Connect your Dolby Atmos enabled speakers to those outputs. If you're employing four Dolby Atmos enabled speakers (or think you might in the future), you need an AVR that can support four height outputs.



Figure 7: Rear panel of a 7.2.2 AVR. Height speaker connections are on the right.

Conclusion

With Dolby Atmos enabled technology, you can experience the overhead sound that is a cornerstone of Dolby Atmos, and you can do it conveniently and efficiently, with products that complement your existing home theater system, look great, and won't break the bank. Dolby Atmos enabled speakers are popular with home entertainment enthusiasts because they provide the flexibility needed to create a Dolby Atmos system in virtually any home.

The configurations noted herein are illustrative. Dolby recommends that any overhead speaker installation be performed by professional installers with experience in installing overhead speakers.

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