

# The Dolby Guide to Home Theater Sound

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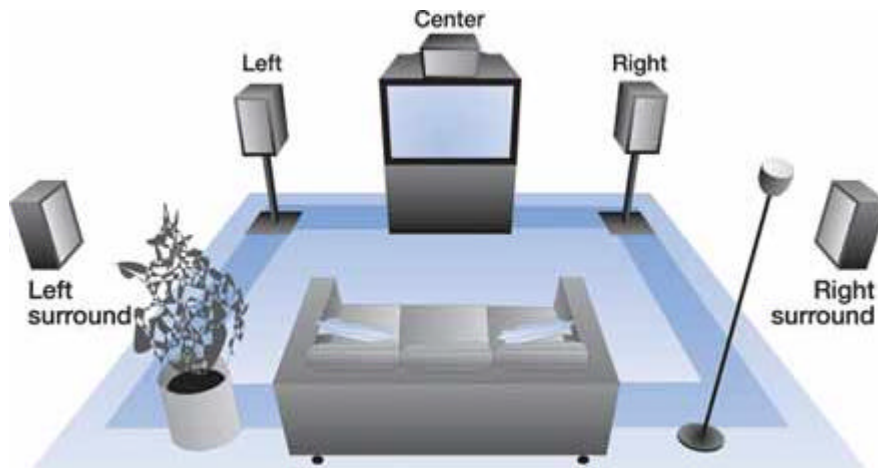
## 1. Introduction

### 1.1 What is a home theater?

A home theater is an audio/video playback system that approximates in your home the experience of seeing—and hearing—a film in a cinema. Setting up a home theater can be as simple as adding a compact surround sound system to the TV set in your family room, or as complex as building a dedicated viewing room equipped with elaborate built-in speakers, massive amplifiers, and a big-screen front-projection TV system.

## 1.2 Surround sound makes the difference

Surround sound, which is what turns conventional TV viewing into home theater, originates from program material such as DVDs that have multichannel soundtracks. The multiple channels are reproduced by three speakers across the front of the viewing area, and surround speakers to either side (*Figure 1*). The result is sound that transports you into the world of you're watching; you feel less like a passive viewer and more like an active participant.



*Figure 1: A home theater system features three speakers across the front of the viewing area plus surround speakers to either side.*

## 1.3 Dolby Digital: the sound of home theater today

The leading surround sound technology today is Dolby Digital. It is a method of compacting digital audio so that high-quality multichannel soundtracks can be easily carried via digital discs and broadcasts.

Soundtracks encoded in Dolby Digital come to you via DVDs, digital television (DTV) broadcasts, and digital satellite and cable transmissions. Dolby Digital decoding is licensed by Dolby Laboratories to manufacturers of home playback equipment. Programs with Dolby Digital soundtracks and playback equipment with Dolby Digital decoding are usually identified with the



## 1.4 What is "5.1" surround sound?

Dolby Digital brings 5.1-channel surround sound into your home. It provides five full-range audio channels: three for speakers at the front and two for surround speakers at the sides. A sixth, low-frequency effects (LFE) channel carries those deep bass sound effects you feel more than hear. Because it covers only about one-tenth of the audible range, the LFE channel is called a ".1" channel. Its low bass sounds can be channeled to the subwoofer in the home theater system, if it has one, or to any other speakers in the system that can reproduce low bass.

A newer variation of Dolby Digital, called Surround EX, encodes Dolby Digital program material with a third surround channel that can be decoded at the listener's option for playback over additional surround speakers placed behind the viewers (*Figure 2*). Surround EX program material is fully compatible with regular Dolby Digital 5.1 playback (the additional center rear information is split between the left and right surround channels).

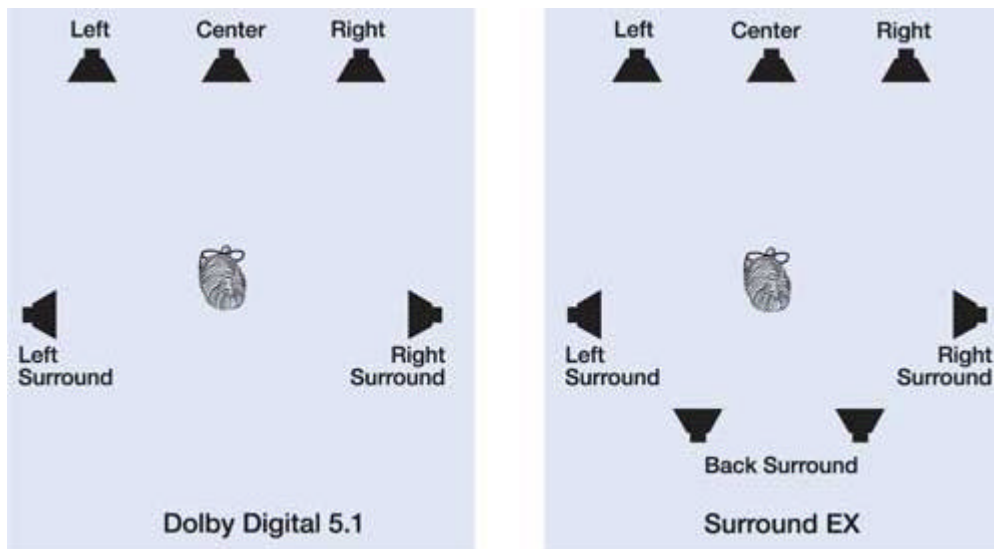


Figure 2: Standard Dolby Digital vs. Surround EX.

## 1.5 Surround from VHS tapes and regular TV

Prior to the advent of digital audio, Dolby Laboratories developed a way of delivering four-channel surround sound from stereo VHS tapes, TV shows, video games, and other analog sources. Called Dolby Surround, it encodes four channels of information (left, right, center, and a single surround channel) onto regular stereo soundtracks. The four original channels can be reconstructed upon playback by means of a Dolby Surround Pro Logic decoder, which is included in virtually all home theater systems, including those that also have 5.1-channel Dolby Digital decoding.

More recently, Dolby Laboratories introduced an improved decoding process called Dolby Surround Pro Logic II. It provides a listening experience more like Dolby Digital 5.1, by deriving five channels, including two full-range surround channels, not only from programs encoded in Dolby Surround, such as movie videos, but also from regular stereo material, such as music CDs. The result is improved spatiality and more accurate localization of sounds on Dolby Surround material, and an enveloping, lifelike soundfield on regular stereo recordings.

Program material encoded in Dolby Surround is usually identified with a


 or  logo. Playback equipment with Dolby Surround Pro Logic
 
 or Pro Logic II decoding is identified with a  logo respectively.

## 2. Choosing your home theater sound system

This Guide assumes you are putting together a new home theater sound system from scratch. If you are converting an existing analog Dolby Surround system to Dolby Digital, you will find helpful information in Frequently Asked Questions about Dolby Digital in the Home, located under Home Theater at [www.dolby.com](http://www.dolby.com).

While we can help you get the most out of your home theater system, Dolby Laboratories cannot make specific equipment recommendations. However, you can rest assured that all products

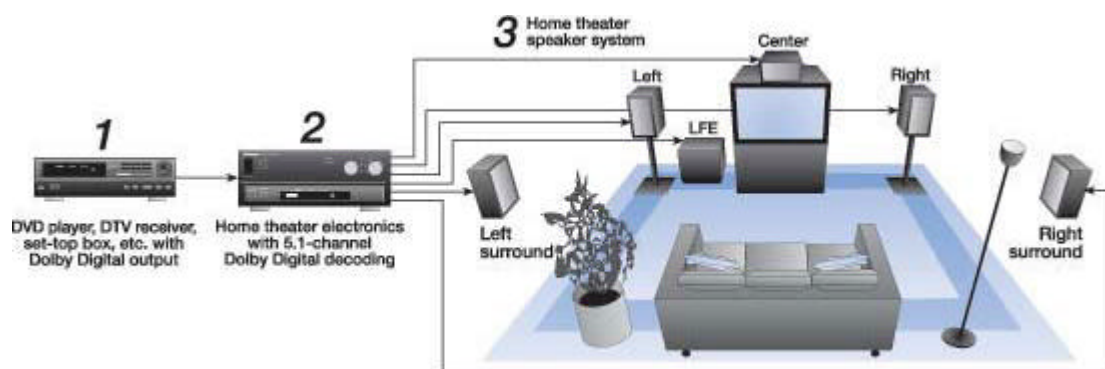
licensed to incorporate Dolby Digital decoding meet Dolby Laboratories' high performance standards.

For specific product recommendations, consult the various publications that test home theater products, and/or home entertainment equipment retailers.

## 2.1 Your home theater: it's as easy as 1, 2, 3

1. To play Dolby Digital programming, you need one or more program sources equipped with a Dolby Digital output, such as a DVD player, digital television (DTV) receiver, digital satellite set-top box, and/or a digital cable set-top box. To play Dolby Surround programming, all you need are regular analog stereo sources, such as a conventional TV receiver, VHS deck, satellite receiver, or cable box.
2. To decode surround sound programming, you need an A/V receiver or other playback electronics that incorporates a 5.1-channel Dolby Digital decoder for programming with Dolby Digital soundtracks, and a Dolby Surround Pro Logic or Pro Logic II decoder for analog Dolby Surround soundtracks.
3. To hear Dolby Digital and Dolby Surround soundtracks, you need five speakers (six, if you use a subwoofer), and the same number of amplifier channels in the playback electronics.

Put these basic elements together with your television set and you have a home theater, like the one shown in *Figure 3*.



*Figure 3: A basic home theater system equipped for 5.1-channel Dolby Digital playback (optional subwoofer shown).*

## 2.2 The simplest solution: "home theater in a box"

Many audio manufacturers offer complete, integrated home theater sound systems. Because the equipment is often compact enough to fit into a single shipping carton, this kind of system is sometimes referred to as a "home theater in a box."

These uncomplicated, cost-effective systems supply the necessary playback electronics, including Dolby Digital decoding, along with a multichannel speaker system typically consisting of five small satellite units and a compact subwoofer.

The electronics may be contained in a simple A/V receiver to which you connect your program sources and the speakers, or built right into one of the speakers (usually the subwoofer). There are also systems that combine a DVD player and the system electronics in one compact unit, to which you connect the speakers.

Regardless of configuration, a "home theater in a box" can be a practical, good-sounding solution, particularly if you're on a limited budget or short on space.

## 2.3 The A/V receiver route

If you're looking for higher-quality sound, and/or prefer to choose among components from different manufacturers, consider a system similar to the one illustrated above in *Figure 3*. This consists of one or more Dolby Digital and Dolby Surround program sources; an A/V receiver that integrates all electronics-control circuitry, Dolby Digital 5.1 and Dolby Surround Pro Logic decoding, multiple amplifiers, and a radio tuner-in one convenient unit; and a home theater speaker system consisting of five satellite units plus a subwoofer.

## 2.4 The high end

Specialty audio manufacturers offer a wide range of high-performance home theater products, including elaborate, software-based sound processor units; ultra-powerful amplifiers; and sophisticated speaker systems. If you are contemplating a high-end system, we suggest you consult a specialist retailer/installer, such as one affiliated with the Custom Electronics Design and Installation Association (CEDIA), which is active in the US, Europe, Australia, and South America, among other areas ([www.cedia.org](http://www.cedia.org)).

## 2.5 About DVD-Audio

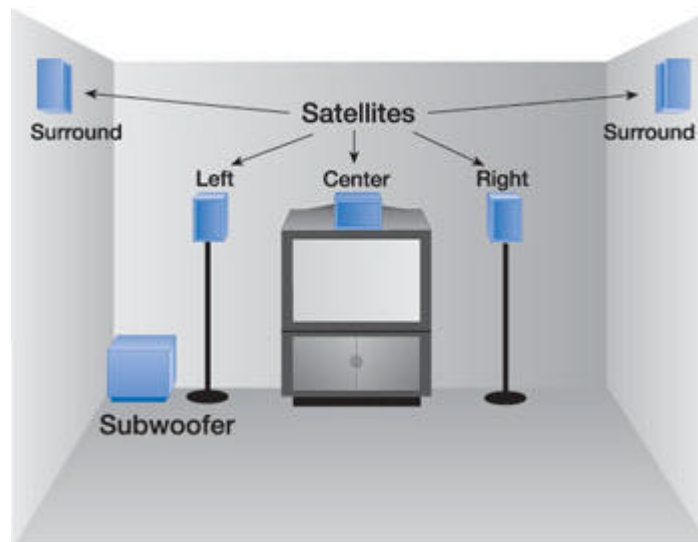
DVD-Audio is a variation of the DVD format that provides superb high-resolution music recordings going well beyond the limits of CDs. DVD-Audio music programs can be recorded with up to six discrete channels of surround sound, making them ideal for playback over a home theater system.

To play multichannel high-resolution DVD-Audio programs, you need a DVD-Audio player, most of which also play DVD-Video discs. In addition, your receiver or other audio controller unit must have a six-channel analog input. This is because DVD-Audio players internally decode the high-resolution programs on DVD-Audio discs to as many as six analog output channels.

If you are unsure about committing to the new DVD-Audio format, we recommend that you choose a receiver or controller that has a six-channel input, which allows you to easily add a DVD-Audio player at a later time. In the meantime, almost all DVD-Audio discs include a Dolby Digital 5.1-channel version of the program in addition to the high-resolution version. This means you can play these discs on a DVD-Video player with standard-resolution surround sound, and purchase a DVD-Audio player later to "unlock" their high-resolution programs.

## 2.6 About home theater speakers

Most speaker manufacturers offer complete home theater systems, usually based on a satellite/subwoofer configuration (see *Figure 4*). These integrated systems make choosing and installing a home theater system much easier than it used to be, and often provide higher performance for the dollar than a random assembly of individual component speakers.



*Figure 4: Satellite/subwoofer systems are easy to install, take up little space, and provide good value.*

Satellite/subwoofer systems take advantage of the fact that the lowest bass frequencies are non-directional, which means the ear cannot readily detect where bass sounds are coming from. As a result, these systems channel the low bass to a dedicated bass speaker called a subwoofer. The subwoofer can usually be tucked out of the way, because its placement is not critical to reproducing the directionality of the original sound.

Because they are not required to reproduce low bass, the satellite speakers can be compact, making them less intrusive and easier to place. Many systems use identical satellites for the left, center, right, and surround channels. This means that all speakers have the same timbre, or tonal characteristic, which is desirable in a home theater system. Other systems provide identical satellites for left, center, and right, but the surround units may be somewhat different, usually with respect to their radiating characteristic. Nevertheless, the surround speakers should still be timbre-matched to the front speakers.

Of course, there are excellent alternatives to satellite systems. For example, you can create a home theater system using larger, full-range tower speakers for the front left and right channels, or for both the front and the surround channels. Their manufacturers usually provide well-matched center and surround speaker options. Some of today's tower speakers have built-in powered subwoofers, making them particularly suitable for a home theater.

If you do assemble a home theater speaker system from individual speaker units, as opposed to a satellite system, it is best to use models from the same manufacturer for the sake of timbre-matching, and to follow the manufacturer's advice for mixing and matching their models. Also, be sure that all front speakers are magnetically shielded to prevent interference with the television's picture (in general, speakers designated specifically for the front channels of a home theater are shielded).

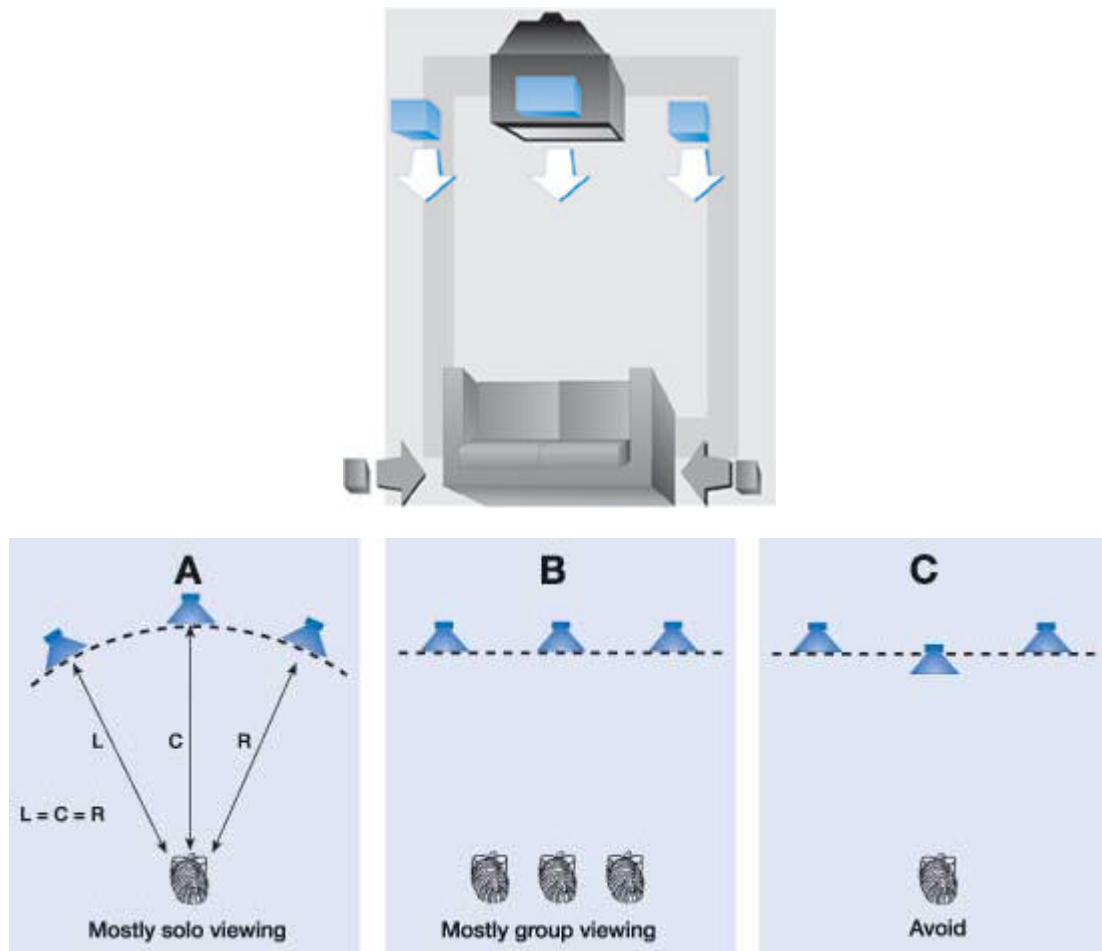
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## 3. Speaker placement

### 3.1 Front speaker placement

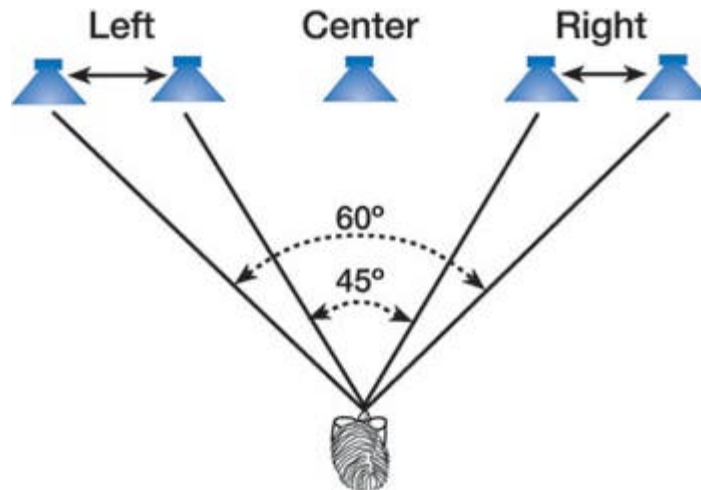
The front speakers should be arrayed across the front of the viewing area, as shown in *Figure 5*. If you plan mostly solo viewing, arrange the speakers as shown so that your seating position is

equidistant from the left, center, and right speakers (**A**). If your system is used mostly for group viewing, arrange the speakers in a straight line (**B**). In any case, avoid placing the center speaker closer to the viewers than the left and right speakers (**C**).



*Figure 5: Front speaker placement.*

The left and right speakers should include an angle of from 45 to 60 degrees with the center-most viewer, as shown in *Figure 6*. An angle nearer to 45 degrees is preferred if you use your system mostly to watch movies, as it approximates the circumstances under which film soundtracks are mixed and monitored. A wider angle, with the left and right speakers further apart, is recommended if you use your system for music listening more often than watching movies.



*Figure 6: Use the narrower angle if you mostly watch movies, and the wider angle if you mostly listen to music.*

Finally, the three front speakers should be as close as possible to the same height, at or near ear level (*Figure 7*). Because it is often easiest to place the center speaker on top of the TV set at a fixed height, consider mounting the left and right speakers on adjustable stands so that you can match their height to that of the center speaker.

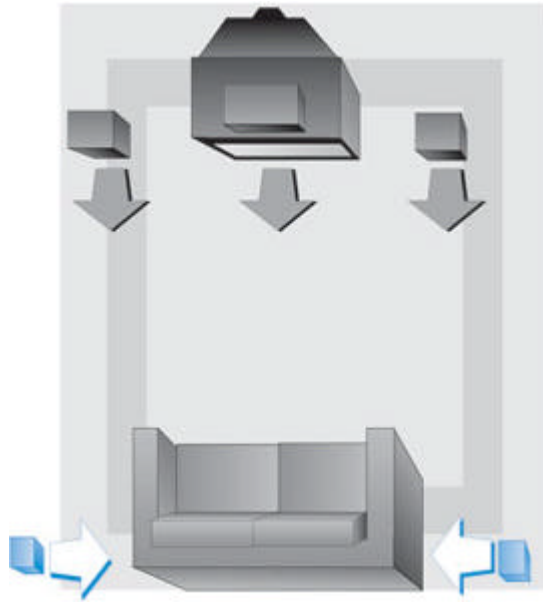


*Figure 7: Adjustable stands for the left and right speakers can make it easier to achieve the same height as the center speaker.*

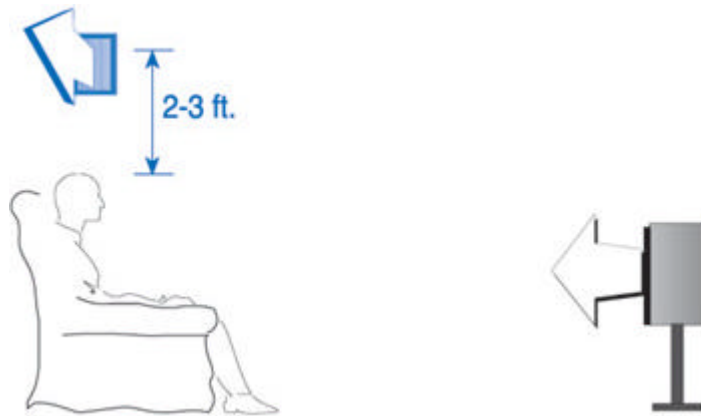
### 3.2 Preferred surround speaker placement

The surround speakers should be placed alongside and slightly to the rear of (but not behind) the prime seating position (*Figure 8*); well above ear level, to help minimize localization effects (*Figure 9*); and aimed directly across the listening area, not down at the listeners (*Figure 10*). This arrangement creates a diffuse, enveloping surround soundfield throughout the listening area, like that in cinemas and in the dubbing theaters where soundtracks are mixed. If the speakers are too far forward, you won't get sufficient rearward effect, and if the speakers are too far back, there will be a loss of envelopment and integration of the surround information with the whole soundfield.





**Figure 8:** Place the surround speakers alongside and slightly to the rear of the seating area.



**Figure 9:** Install the surrounds two to three feet above listeners.

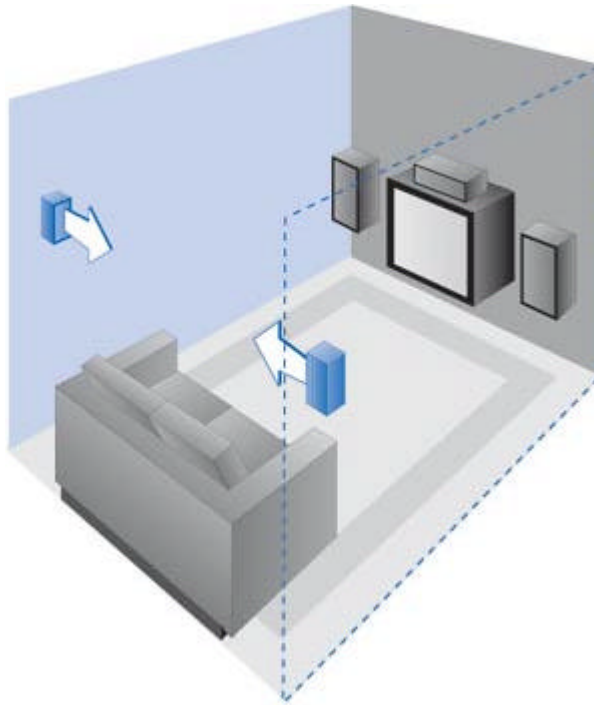


Figure 10: Aim the surrounds straight across, not down at, the listening area.

### 3.3 Alternative surround speaker placement alternatives

Of course, not every home theater installation has sidewalls in just the right place to mount surround speakers. If this is your situation, consider the following alternatives.

Generally, placing surround speakers on the wall directly behind the listeners is not preferred. But when there's no alternative, there are several mounting techniques you can try, as shown in Figure 11. Mount them well above ear level, and try aiming them at each other (A), towards the front (B), or to reflect off the sidewalls (C and D). Experiment with placing and aiming the speakers until the surround soundfield seems to envelop you, rather than coming from behind.

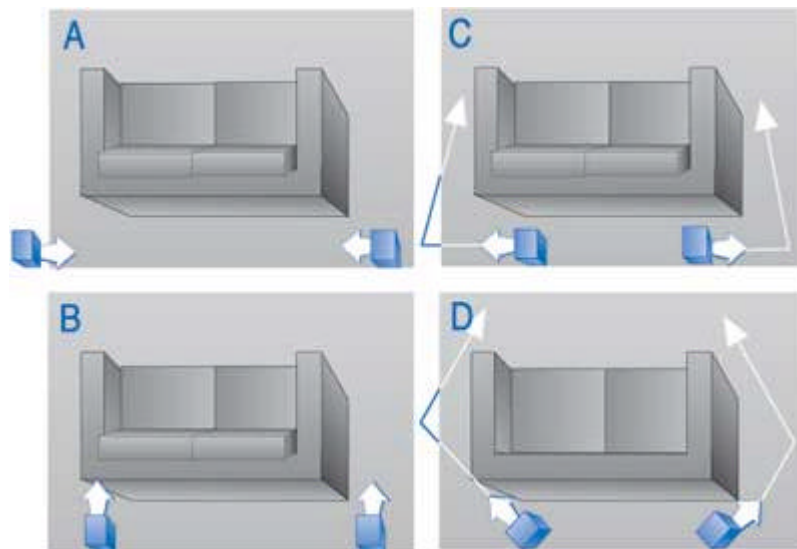
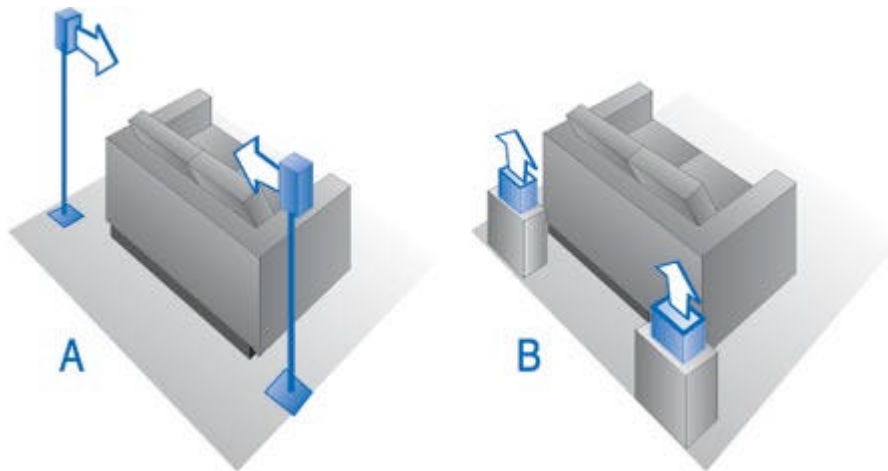


Figure 11: Placing surround speakers on the rear wall.

Alternatives to wall placement are shown in *Figure 12*. Mounting the surround speakers on stands above ear level (A) to either side gives much the same effect as sidewall mounting. You can also try placing them to the sides or rear aimed upwards, either right on the floor, or, preferably, raised a couple of feet off the floor (B).

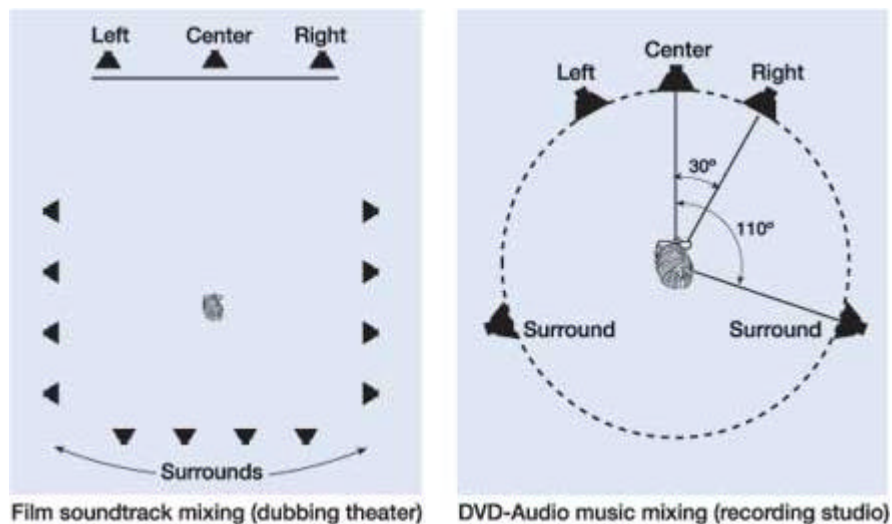


*Figure 12: Speaker stands or small tables can substitute for wall-mounting surround speakers.*

### 3.4 Surround placement for DVD-Audio listening

The multichannel music programs on DVD-Audio discs are mixed under different circumstances from movie soundtracks. Films are mixed in large rooms called dubbing theaters that are sized and configured like actual cinemas, while DVD-Audio music programs are typically mixed in much smaller recording studios.

As shown in *Figure 13*, dubbing theaters (and cinemas) use multiple surround speakers arranged along the sides and rear, mounted high to create a diffuse, enveloping surround soundfield. The advice we've given so far for placing surround speakers is aimed at duplicating this effect at home. In most DVD-Audio mixing facilities, however, there are five identical speakers arranged at ear level in a circle around the mixer.



*Figure 13: Film soundtracks and DVD-Audio music programs are mixed under different conditions.*

Chances are that you will be pleased by the sound of multichannel DVD-Audio programs with your surround speakers optimally placed for movie playback. However, if you wish to more closely replicate what mixers hear when preparing music for DVD-Audio releases, you have two

choices. One is to effect a compromise by lowering your surround speakers to a height of four or five feet from the floor to split the difference between the diffuseness desired for film sound and the more direct radiation preferred for surround sound music.

The other alternative is to install and switch between two pairs of surround speakers, one optimized for film playback, and the other, identical to the front speakers, placed at ear level for optimum DVD-Audio playback. This purist (and potentially costly) approach is facilitated on some A/V receiver models by the inclusion of connections and switching for two pairs of surround speakers. However, while this approach may optimize the effect for a listener in the center "sweet spot," those seated off-center may hear too much of one surround speaker or the other.

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## 4. Installation and operation tips

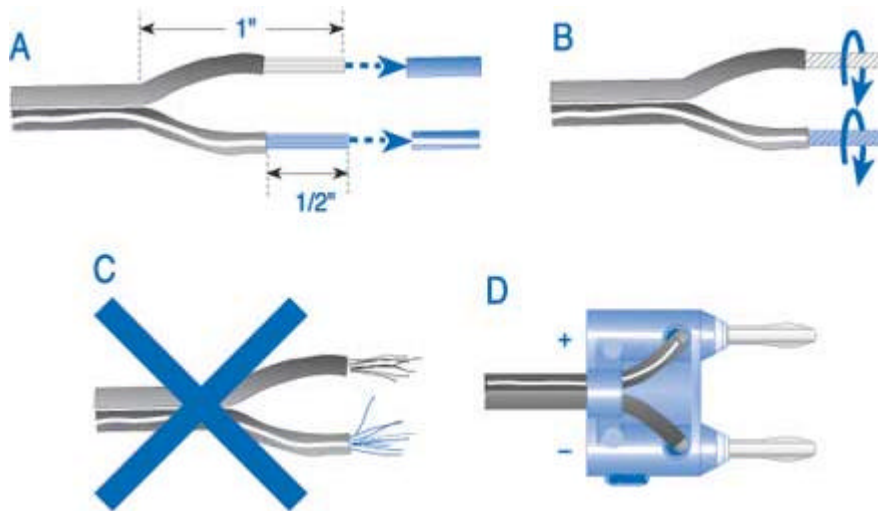
### 4.1 The room

The sound of your home theater system is critically affected by your room's acoustics. These tips are designed to help you achieve more satisfying performance. However, if you have severe acoustical problems, consider consulting a professional home theater installer for customized assistance.

- Too many bare surfaces can cause reflections that add harshness to the sound or muddy the dialogue; try adding carpeting and/or drapes to keep them in check.
- If you have a choice of rooms, avoid those that are perfectly square, or that have one dimension exactly twice another; they can aggravate resonances that color the sound.
- If possible, center the seating area between the sidewalls on which you mount the surround speakers.
- The closer a speaker is placed to intersecting room surfaces-corner, wall and ceiling, wall and floor-the stronger its bass output (possibly too strong in some cases).

### 4.2 Speaker wiring

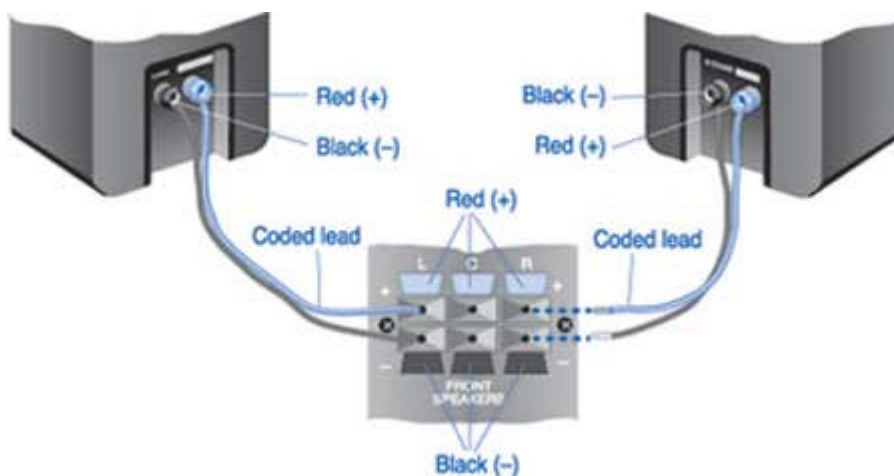
Prepare speaker wires by stripping their ends (**A**), then twisting the bared strands tightly together (**B**) to prevent shorts across terminals (**C**). Or, if speaker and amplifier/receiver terminals permit, use banana plugs to ensure solid connections (**D**).



*Figure 14: Proper speaker wire preparation will ensure optimum performance and prevent future problems.*

### 4.3 Speaker polarity

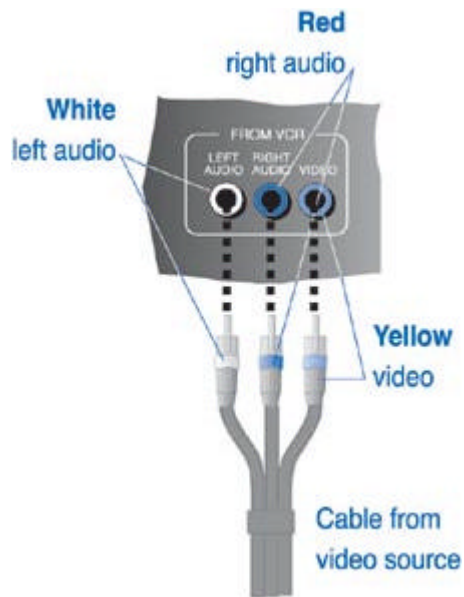
As shown in *Figure 15*, connect the "+" and "-" terminals (usually red and black, respectively) on each amplifier channel to the corresponding terminals on each speaker. To make this easier, speaker cable is coded with a bead or stripe down one lead's insulation, and/or with different color wires. Connected identically, all speakers will operate "in phase," with their cones moving back and forth together. "Out of phase" connections, while doing no electrical harm, muddy spatial effects and weaken bass.



*Figure 15: Maintaining consistent polarity for all speaker connections ensures fullest bass response and unambiguous sound localization.*

### 4.4 Analog audio/video connections

Use good-quality shielded cables, and be sure plugs are fully inserted into jacks. Follow the color code used on most connectors and cables to prevent confusion.



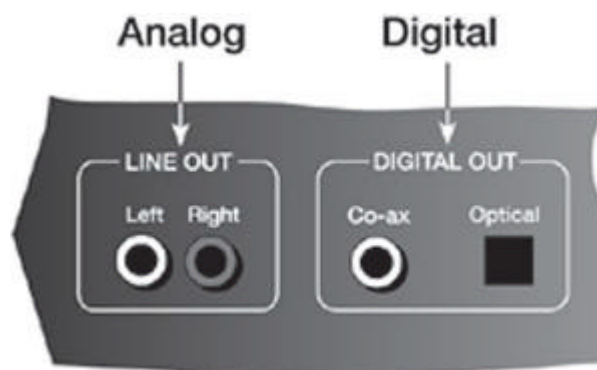
*Figure 16: When making analog audio/and video connections, be sure to follow the color code.*

## 4.5 Digital audio connections

Most products capable of playing or receiving programs with Dolby Digital soundtracks, such as DVD-Video players, have a stereo analog output, plus at least one digital output. Some units let you choose between two types of digital output, coaxial or optical, as shown in *Figure 17*.

The analog outputs are for connection to a conventional stereo or analog home theater system. For 5.1-channel Dolby Digital playback, you need to connect the unit's digital output to an appropriate digital input of your 5.1-channel playback system. The digital output passes through Dolby Digital 5.1 soundtracks for decoding by your playback system's 5.1-channel Dolby Digital decoder.

If your system components allow you to choose between two types of digital connector, note that both have identical audio performance. Under some circumstances, however, very long coaxial cables can be more susceptible to radio frequency (RF) interference than optical cables. Because optical cables are more expensive, try coaxial cables first and switch to optical only if you encounter problems.



*Figure 17: Some digital program sources, including many DVD player models, provide two types of digital audio output, as well as an analog stereo output.*

## 4.6 Bass management

Receivers and other units that incorporate Dolby Digital 5.1-channel decoding provide a feature called Bass Management, which allows you to distribute low bass just to those speakers in your system that can handle it. By keeping low bass out of the other speakers, such as small satellites, the system will be able to play louder with less distortion.

If you have a typical home theater speaker system with a subwoofer and five small satellites, select the mode that sends *all* bass—from the main channels as well as from the low-frequency effects (".1") channel—to the subwoofer. If you have some other speaker configuration, check your receiver's owner's manual for the Bass Management option suited to your particular system.

## 4.7 Delay adjustments

Because the surround speakers in a home theater system are usually closer to viewers than the front speakers, both Dolby Digital and Dolby Surround Pro Logic decoders provide a split-second electronic delay of the surround channels.

In the case of Dolby Digital, the delay ensures that the sound from the surround and front speakers arrive simultaneously. For Dolby Surround Pro Logic, which has less inherent channel separation than Dolby Digital, a slightly longer delay ensures that sound from the surrounds arrives just *after* sound from the front speakers. This delay makes it difficult to detect any leakage of sounds that should come only from the front, such as dialogue, into the surround speakers.

While your system may provide the option of adjusting these delays, and in some cases a delay for the center speaker as well, the default settings provide proper performance in most cases. If you wish to optimize the settings, many receivers and processors allow you to do so through an onscreen menu, which asks you to enter the distance from your listening position to each speaker, and then automatically calculates the proper delays for you.

If your system allows you to adjust delays arbitrarily, without an onscreen menu requiring you to enter distances to the speakers, you will find information on making the adjustments properly in [Frequently Asked Questions about Dolby Digital in the Home](#), located under Home Theater at [www.dolby.com](http://www.dolby.com). Improper delay settings can have an adverse effect on the sound of your system.

## 4.8 Channel balance

Systems with Dolby Digital and Dolby Pro Logic decoding feature a test signal generator for balancing the channels. As the signal moves from channel to channel, you adjust the balance controls until each channel plays at the same volume. You can do this by ear if you wish, but it's better to use a sound pressure level meter, such as the relatively inexpensive Radio Shack 33-2050.

Even though you should adjust the surround channels to be as loud as the others on the test signal, you'll find that on actual program material the surround level is much lower than the front much of the time. Film sound mixers in particular use surround mostly for subtle atmospherics and ambience, and only rarely for special effects. A good surround mix doesn't call attention to itself; if it did, it would soon become tiresome.

## 4.9 Processing enhancements

In addition to Dolby Digital and Dolby Surround Pro Logic decoding, some systems offer the option of switching on additional processing enhancements. Some, such as THX-licensed processes ([www.thx.com](http://www.thx.com)), are intended to make your home theater sound more like a movie theater or the dubbing theaters in which movie soundtracks are mixed. Others are intended to provide special acoustic effects on stereo music (for example, "Hall," "Jazz Club," and other

venue modes). In general, critical listeners find that some of these enhancements work well, while others sound artificial.

#### **4.10 Regular stereo programming**

Many stereo recordings and TV broadcast soundtracks contain natural ambience that a Dolby Surround Pro Logic or Pro Logic II decoder treats much like surround sound. We suggest that you try leaving the decoder on when listening to stereo material.

On some material, particularly dialogue-intensive TV shows, original Pro Logic can provide a pleasant, more cinematic effect. On music-only recordings, however, it may reduce the stereo width across the front more than you like. Pro Logic II, on the other hand, can provide a wide, astonishingly life-like soundstage with accurate localization on all kinds of material, since it was specifically designed to extract five-channel sound from both surround encoded and conventional stereo recordings.

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### **5 For more information**

The Dolby Laboratories website, [www.dolby.com](http://www.dolby.com), is a useful source of information not only on home theater, but also on film and broadcast sound. If you have any specific questions, please email [info@dolby.com](mailto:info@dolby.com).