

*(Freely adapted from “Home Theater Primer” by Car Audio and Electronics)*

## Home Theater Primer

### Surround Sound Basics

Surround sound is a type of audio system that allows sounds to originate from all areas of the viewing (or listening) position. As you probably already know, in movies – as in real life, when there is action going on there are sounds coming from all directions. Even if all the action is directly in front of you, there are other sounds that are reflected off of the surfaces to your sides and behind. When watching movies, especially action packed movies, there are even more sounds which originate from behind the camera position. To more accurately convey the cinematic experience, film makers use multiple sound channels to make you feel like you are in the middle of the action. To make the movie as realistic as possible, surround sound systems use three or more speakers located in different positions in your viewing room.

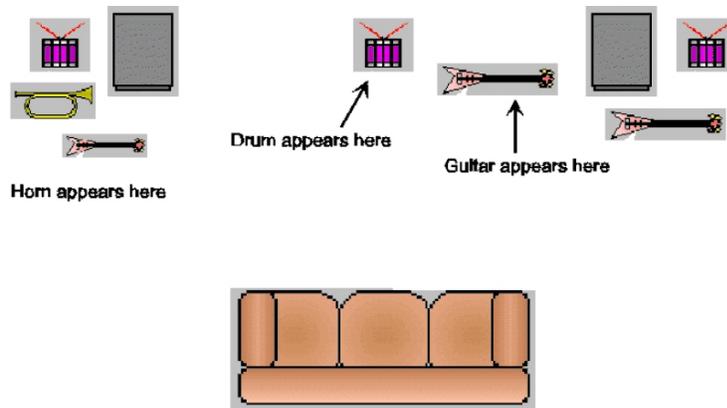
### Mono Sound

Older TVs had a single, small speaker for audio reproduction so all the sound had to come from the one source – not very realistic.

### Stereo Sound

A stereo signal gives a more realistic soundstage because it’s composed of two independent (left and right) channels. The left and right channels are generally similar but not identical. The two channels are used to give the sound a sense of volume, that is, width and depth. If your listening (viewing) position is centered between the left and right speakers, and one instrument or voice is produced in only the left channel, it will seem to originate from the left side. If a sound is only slightly louder in one of the channels, it will seem to originate slightly toward the speaker which is reproducing the louder sound. If the content of both channels is the same, the sound will appear to come from a location midway between the speakers even though there is no physical speaker in that position. The two-speaker stereo system works well as long as you are listening from a position directly in front of and centered between the two speakers. As you move away from this position, the sound “image” will not be as accurate. However, the amount of space -- that is, the volume -- in which the imaging remains good does depend on the type of speakers in use.

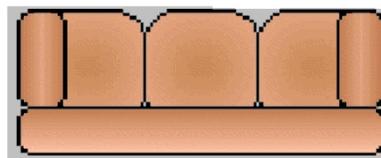
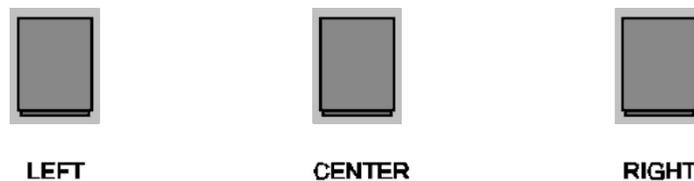
In the diagram below, there are only two speakers. If the drum is played equally loud in both channels, it will appear to centered between the speakers. Since the horn is in only the left channel, it will seem to come from the left.



In this image, the guitar is louder in the right channel, but is also audible (although at a lower level) in the left channel. This will cause it to appear to come from the right of center but not from the far right. The drum still appears to originate from the center and the horn still seems to come from the far left.

### Simple Three-channel Front Imaging

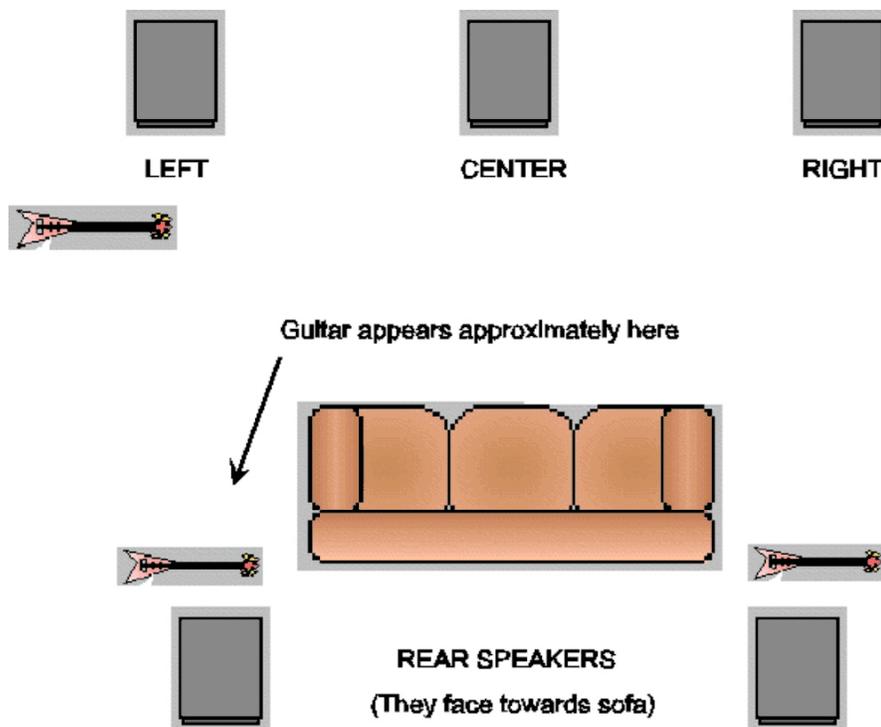
Since everyone cannot be seated in the best position for good stereo imaging, adding a center channel speaker will provide a more solid center image. This center speaker would ideally be placed in the center of the TV screen and this can be done with projection TV systems. For other types, the center speaker is usually placed just above the screen center. Now it's unnecessary for any of the center channel sound to come from either the left or right speaker. If you are seated "off center" there will still be a strong center image and most of the actor's dialogue will come from the center speaker. So the next step beyond stereo sound in complexity, cost and realism is adding a front, center speaker and another power amplifier.



## Four-channel Surround Sound

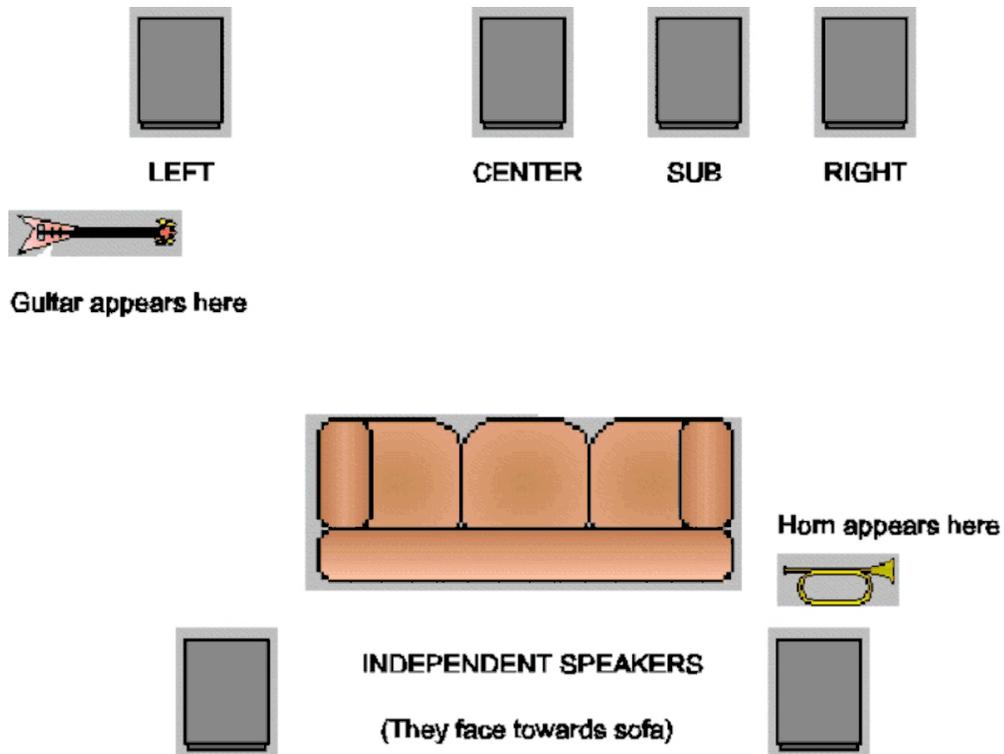
To once again increase the size (width and depth) of the soundstage, you need to have some sound coming from the sides and/or from behind. So we can add a fourth speaker and power amplifier directly behind the listening position, that is, behind the sofa. Optionally, you can use two speakers (and two power amps) placed a couple of feet to the left and right of center. Using two speakers may make it easier to balance the overall sound in the viewing (listening) room. Everything has a price. Adding more sound channels, that is, speakers makes balancing the sound more difficult.

This diagram shows how the guitar's image is projected to the left and slightly behind you when it is reproduced by the front left and by a lesser amount in the rear speaker or speakers. Even if two speakers are used, the audio signals going to them are the same, that is, the rear speaker or speakers are mono. Hence, the rear imaging isn't ideal but it's a step up from a "front only" system.



### 5.1 Channel Digital Surround

This type of surround can reproduce six completely independent channels of audio. Five of the channels are full frequency range and the “.1” channel is for the subwoofer. In this type of surround, the independent channels give a more realistic soundstage. The sound can appear to come from any of the five full range speakers and by sending signals to a combination of the speakers, the sound can seem to come from any place in the room. So we have again stepped up to more realism but at the cost of more complexity and more expense.



In a 5.1 channel system, you can see that the imaging can be more precise. The guitar, which is reproduced by the left front speaker only, seems to originate from the left front of the listening room. The horn, which is reproduced by the right rear speaker appears to originate from that part of the room. This combination of speakers can make virtually any sound appear to originate from virtually any part of the room. The subwoofer placement is usually not critical because our ability to hear low frequency sounds is not directional. Placing the subwoofer in a corner often produces more bass while placement in the center (in front of the sofa) may result in less bass.

## 7.1 Channel Digital Surround

Now we're up to eight independent audio channels: seven are full frequency range and the ".1" is again the subwoofer. Two additional speakers are needed: one at each side of the listening room. 7.1 is the next attempt to improve realism but whether it's of practical use to anyone other than audio equipment manufacturers remains to be seen. I have looked at my collection of DVD movies and none of them have 7.1 surround sound (most have 5.1).

As more audio channels are added it becomes increasingly difficult to balance the sound field in the listening room. A 5.1 system has six volume controls and a 7.1 system has eight. Some manufacturers, such as Marantz and Yamaha, have added an automatic balancing feature to their Home Theater Receivers/Processors. They furnish a microphone and cable which is plugged into a calibration connector on the receiver. The microphone is placed at the listening position (for example, the center of the sofa) and the receiver generates a test sound from the speakers. This

sound is picked up by the microphone and is used to automatically set all the volume controls. I have not evaluated any of these systems so I don't know how well they work – but it is certainly a good idea!

## Home Theater “Jargon”

When you pick up a printed catalog or visit a web site you are immediately confronted with lots of strange terms such as Dolby Digital, DTS, Dolby Pro Logic, AC-3, THX and the like. And as home theater technology evolves, the amount of jargon will only increase. I'll briefly define these terms so you will have some idea of what they mean. Generally, you won't need to be especially concerned about them; just pick the level of realism that you want (or can afford) and buy an appropriate system. No matter what you buy, there will be something “better” on the market in a month or two. And it's useful to remember that a 30 year old hammer can drive nails just as well as a new one!

**AC-3:** a type of 5.1 channel digital surround

**Circle Surround 6.1 (CS2):** a 6.1 channel digital surround

**Dolby Digital:** another type of 5.1 channel digital surround

**Dolby Digital-EX:** an “expanded” Dolby Digital system (could be 6.1 or 7.1)

**Dolby Digital 6.1:** a 6.1 channel digital surround

**Dolby Pro-Logic:** four-channel surround sound

**Dolby Pro-Logic II:** another 5.1 channel digital surround

**Dolby Pro-Logic IIx:** an “expanded” Dolby Pro-Logic system (could be 6.1 or 7.1)

**DTS:** another 5.1 channel digital surround

**DTS-ES:** an “expanded” DTS system (could be 6.1 or 7.1)

**THX:** THX certification means a home theater system meets Lucasfilm, Ltd. surround sound standards.