

**SYNTHESIS<sup>®</sup>**

**JBL**

SYNTHESIS<sup>®</sup> FOUR  
**S4VC, S4HC**  
**& S4Ai**  
FLUSH-MOUNT  
LOUDSPEAKERS

OWNER'S AND INSTALLER'S  
MANUAL

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## INTRODUCTION

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Thank you for purchasing JBL Synthesis® Four flush-mount home theater loudspeakers. These products represent the synthesis of everything that JBL® has learned about the emotional power of audio and video in more than sixty years of preeminence in the field. They set new benchmarks in the use of “high technology” and provide you with the experience of being in the world’s greatest movie houses and concert halls – right at home! JBL Synthesis Four speaker systems feature the following:

**THX ULTRA2™-LICENSED HOME AUDIO SYSTEM:** When used with a THX® controller and amplifiers, your speaker system will deliver a state-of-the-art THX home theater experience to your living room. You will hear in your home exactly what the director and sound engineer heard in the recording studio. The system will reproduce the audio flawlessly and without distortion.

**FLUSH-MOUNT APPEARANCE:** The S4Ai, S4VC and S4HC are designed to fit flush to your wall surface. Designers and interior decorators will be pleased by their hidden appearance and stunning performance.

**PURE-TITANIUM, HIGH-FREQUENCY TRANSDUCER DOME:** The pure-titanium diaphragms with neodymium magnet structures are ultralight to accurately reproduce lightning-fast sounds – such as cymbal crashes – yet extremely rigid to eliminate distortion and ear fatigue.

**ELLIPTICAL OBLATE SPHEROIDAL™ (EOS) WAVEGUIDE:** First developed for our JBL Professional LSR studio monitors, this unique structure enables Synthesis Four Series speakers to evenly disperse high frequencies, creating precise imaging over a wide listening area.

**PURE-TITANIUM, INVERTED-DOME, MIDRANGE TRANSDUCERS (S4VC, S4HC):** The midrange drivers seamlessly complement the titanium-dome tweeter and offer nearly perfect piston motion, which eliminates the uncontrollable flexing found in conventional cones. The inverted dome is driven precisely at its center, which cancels resonances inherent in cone materials. The result is ruler-flat frequency response beyond the crossover point.

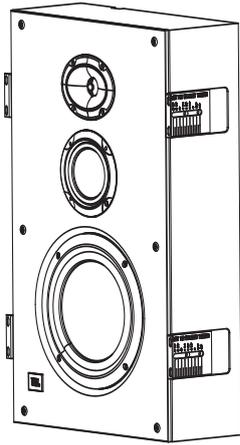
**TITANIUM-ALLOY, INVERTED-DOME, LOW-FREQUENCY TRANSDUCERS (S4VC, S4HC):** The low-frequency drivers deliver precise, undistorted bass reproduction that matches the titanium tweeter and midrange. The powerful neodymium magnet provides its own video shielding, allowing for flexible placement near video monitors. Cast-aluminum frames remain rigid even at the highest volumes, avoiding the distortion found in some other speaker designs. The aluminum doesn’t affect the magnetic field, so driver movement is precise.

**COMMON VOICING:** Synthesis Four uses common voicing across the front three channels. Since identical drivers are used, each speaker has the same tonal qualities; thus, as a sound is panned from one side to the other, there will be no change in timbre.

**MAGNETIC SHIELDING:** All front speakers are magnetically shielded, allowing you to place them near video monitors without generating interference or distorting the picture. (S4Ai is not magnetically shielded.)

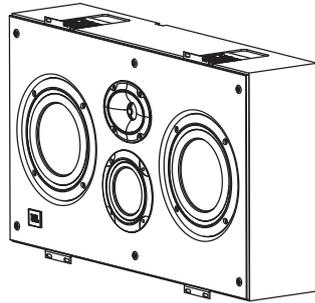
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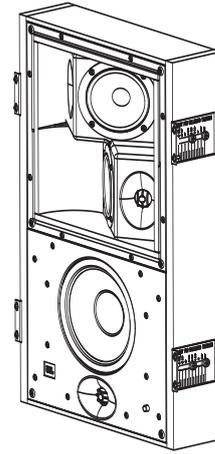
One S4VC vertical channel flush-mount loudspeaker

or

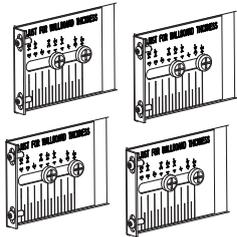


One S4HC horizontal channel flush-mount loudspeaker

or



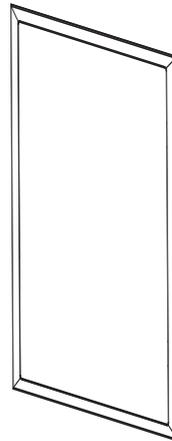
One S4Ai multipole ambient flush-mount loudspeaker



Four mounting L-brackets with eight 1/4-20 x 3/4" screws



Eight 8-32 x 1/2" screws for speaker installation



One grille with grille frame

# SPEAKER PLACEMENT

Positioning your loudspeakers properly is critical in order to achieve the sonic performance of a home theater. Please read the following section and the "Fine-Tuning Your Audio System" section for guidance in correct and optimal placement.

**LEFT AND RIGHT SPEAKERS:** If you have purchased a Synthesis Four Digital Home Theater System, then the model S4VC will serve as your front left and right main speakers.

Since the left and right speakers have been designed for maximum localization of sound, they should be placed with the center of the speakers at about the same height on screen as the actors would be, to aid in the illusion that the actors' voices are coming directly from their on-screen images. Ideally, the speakers will be placed about 45 degrees apart from each other, viewed from the listening position, so that the distance between the speakers is the same as each speaker's distance from the listener (see Figure 1).

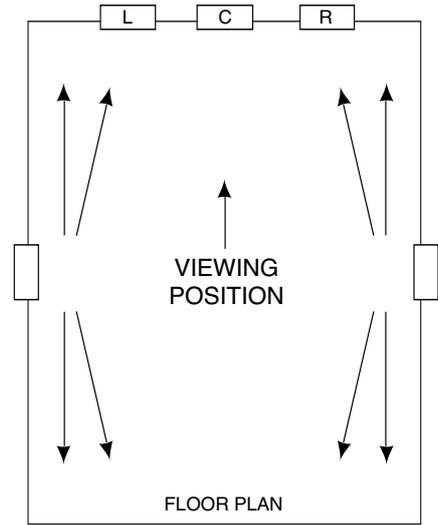


Figure 1. 5.1-Channel system

## CENTER CHANNEL SPEAKERS

**S4VC:** If you have purchased the vertical channel speaker (model S4VC) for the center position, be sure to place it vertically during installation in order to take advantage of its sound-dispersion characteristics. If you mount it horizontally, it will not provide the correct dispersion pattern. If the speaker is being used with a perforated projection screen, it should be mounted behind the center of the screen (see Figure 2). If a nonperforated projection screen, plasma display or other fixed video device is being used in the installation, the preferred center speaker is the model S4HC (below).

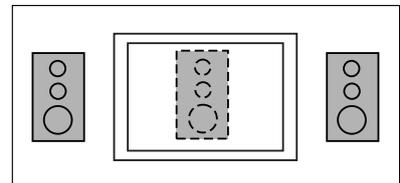


Figure 2.

**S4HC:** If you have purchased the horizontal channel speaker (model S4HC) for the center position, be sure to position it horizontally during installation in order to take advantage of its sound-dispersion characteristics. If you mount it vertically, it will not provide the correct dispersion pattern. Although the preferred speaker model to be used with a perforated projection screen is the vertical model S4VC (above), the S4HC horizontal speaker may be used instead and should be mounted behind the center of the screen. If a nonperforated projection screen, plasma display or other fixed video device is being used in the installation, then the recommended location is directly below and as close as possible to the video display (see Figure 3), although the inverse of this method will work also.

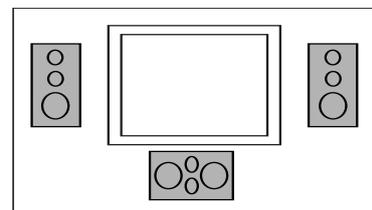


Figure 3.

# SPEAKER PLACEMENT

## NOTE:

It is extremely important to place the tweeter/mid-bass arrays for each of the center, left and right speakers at the same height. The EOS waveguide containing the tweeter in the center channel speaker should be no more than two feet higher or lower than those in the left and right speakers. This preserves the “localization integrity” of “sound pans,” in which the sound appears to move from left to center to right. If the program material also appears to travel up and down, it can destroy the illusion of panning effects and so should be avoided.

**AMBIENT SURROUND SPEAKERS:** Although it has been common for many years to use a number of surround speakers in commercial movie houses, until recently, the traditional home theater configuration called for 5.1 channels, i.e., front left, center, front right, surround left and surround right, plus a low-frequency-effects channel. The newer surround formats that are appearing in consumer audio equipment are calling for more complicated 6.1- and 7.1-channel systems. The advantages of using additional speakers are many. Additional channels enable a more versatile use of directionality for a more accurate surround presentation. Also, a higher overall sound-pressure level can be achieved with less energy expenditure from any individual speaker. Placement of the surround speakers remains critical.

## 5.1-CHANNEL SYSTEMS

The S4Ai multipole ambient surround speakers work optimally if they are placed as far back from the screen as the viewing chairs are. If there are two rows of chairs, these speakers should be placed between them.

The ambient surround speakers should be placed higher than the seating area, at least two feet above (seated) ear level (see Figure 4).

The preferred method to mount the ambient surrounds is to put them directly in the side walls. This lets each speaker radiate to the front and back of the room and to reflect off the side walls.

There are a few instances in which the ambient surrounds would perform better if mounted in the ceiling rather than the walls. If one or both of the walls are “acoustically dead,” due to the presence of windows, fabric, furniture or other absorption, it may be necessary to turn the ambient speakers sideways and, instead of mounting them in a vertical orientation, mount them in the ceiling in a horizontal orientation.

## 6.1-CHANNEL SYSTEMS

A 6.1-channel system can be thought of as a 5.1-channel system with the addition of a rear center speaker placed midway between the two surround speakers, and further to the rear than the surrounds. It should be placed at the same height as the side surround speakers (see Figure 5).

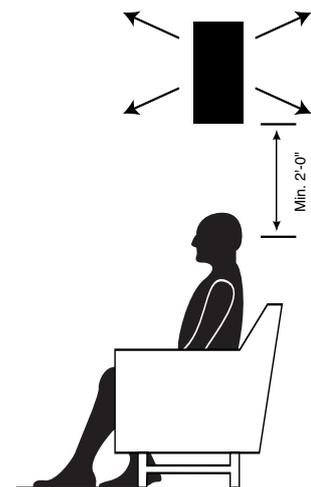


Figure 4.

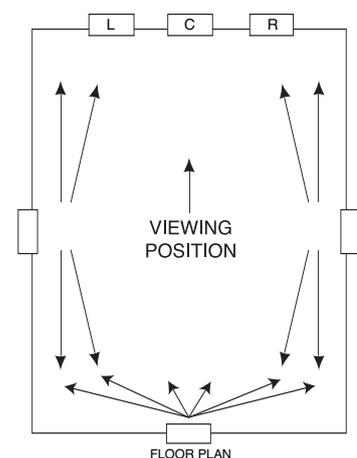


Figure 5. 6.1-Channel system

# SPEAKER PLACEMENT

## 7.1-CHANNEL SYSTEMS

In a 7.1-channel system, two speakers are added for rear fill, in addition to the surround speakers in a 5.1-channel system. The two additional speakers are placed on the rear wall or near the rear wall in the ceiling (see Figure 6).

## S4Ai MODES OF OPERATION

The S4Ai multipole ambient surround speakers feature the unique capability of being configured in any of three operational modes. Choose between Dipolar or Bipolar operation for cinema reproduction, and Direct Radiating for music. Both Dipole and Bipole modes are diffusive, meaning there is less energy on-axis than off-axis relative to the front of the speaker baffle. As Figure 7 indicates, the S4Ai's omnidirectional woofer faces toward the listening area, while dual sets of tweeter/midrange (diffuse) arrays face toward the front and rear or from side to side in the room. In Dipole mode the arrays play out of phase in relation to each other, and in Bipole mode they play in phase with each other.

To activate the Direct Radiating mode for music playback, use the JBL Synthesis electronics package, including the SDP-40 surround processor, to trigger the autoswitching relay in the loudspeakers. The input to the trigger connection is located at the bottom of the speaker, next to the speaker terminals (see Figure 8) and accepts two-conductor, #24 to #16 AWG wire. The relay is activated by a constant 12V DC signal.

## S4Ai WIRING GUIDE

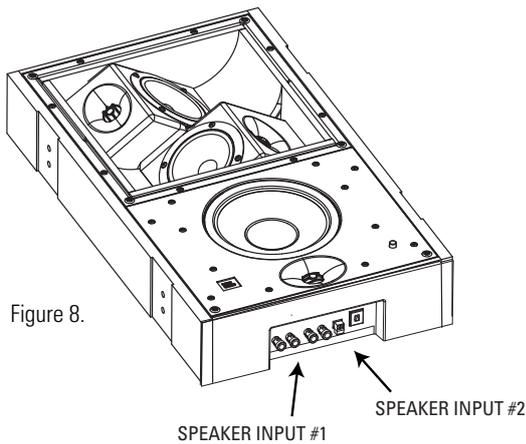
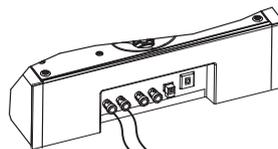
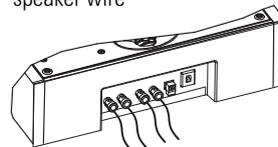


Figure 8.



Single-drive – Dipole or Bipole operation only – two-cond. speaker wire



Dual-drive – Bipole operation only – four-cond. speaker wire

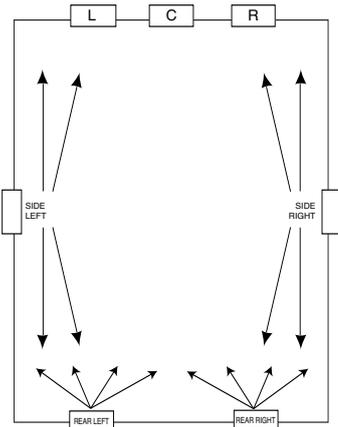


Figure 6. 7.1-Channel system

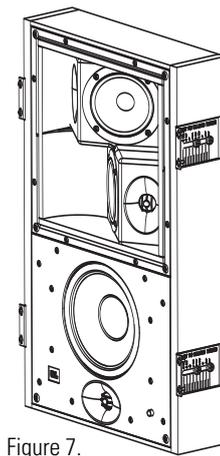
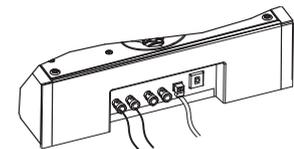
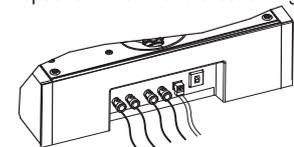


Figure 7.



Single-drive w/Direct – Dipole or Bipole and Direct Radiating operation – two-cond. speaker wire and two-cond. trigger wire



Dual-drive w/Direct – Bipole and Direct Radiating operation – four-cond. speaker wire and two-cond. trigger wire

Each S4Ai speaker can be wired in single- or dual-drive mode. The best performance can be obtained by installing four S4Ai speakers in a 7-channel system and wiring them in single-drive mode; that is one amplifier channel per S4Ai speaker. If only two S4Ai speakers can be used in a particular application, then they should be wired in dual-drive mode so as to gain the advantages of a 7-channel system. Each S4Ai speaker receives amplification from two channels – side and rear – which can only be accomplished in the Bipole mode.

# SPEAKER PLACEMENT

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## WHICH DIFFUSE MODE IS THE RIGHT ONE FOR THE JOB?

### DIPOLE MODE IS TYPICALLY USED WHEN:

- The speaker is located relatively close to the listening position.
- Multiple side or rear speakers are being used in a small listening room.
- The speaker is mounted near, but not in, a corner and will be subject to negative reflections from nearby walls.
- The room is highly reflective.

### BIPOLE MODE IS TYPICALLY USED WHEN:

- One speaker location is used to drive both side and rear channels in a dual-drive configuration.
- The speaker is located relatively far away from the listening position.
- Multiple side or rear speakers are being used in a large listening room.
- The speaker is mounted in a corner, at a 45-degree angle.

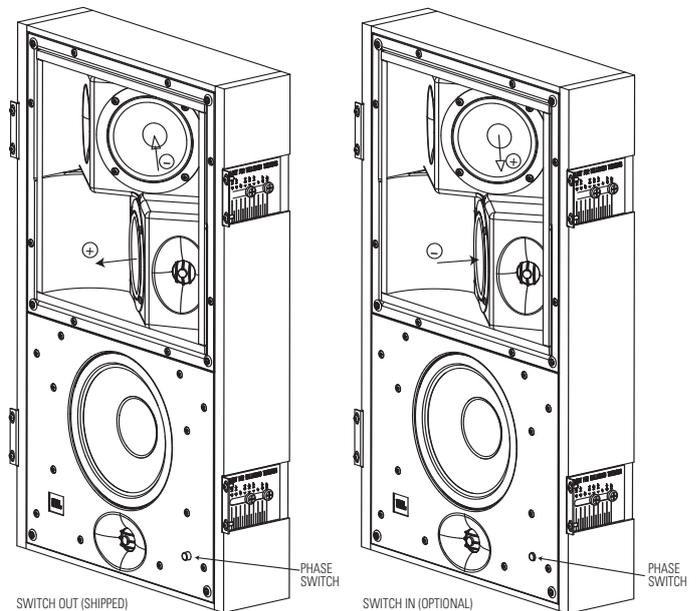


Figure 9. Dipole phase relationship

## PREPARING THE S4Ai FOR THE CORRECT OPERATIONAL MODE

It will be necessary to choose which of the two diffuse modes to use at the time of installation. The S4Ai is shipped from the factory in the Bipole mode. If this is your choice and the speaker will be placed in the vertical orientation, no changes are required and the S4Ai can be directly installed into its permanent location.

Setting the phase in relation to the other speakers in the room only applies when the S4Ai speakers are set in Dipole mode. If you choose to use the S4Ai in Dipole mode, the following information for proper phase relations between speakers will apply:

The S4Ai speakers are shipped from the factory with the phase switch in the OUT position. In this position, the positive phase array is pointing toward the left as you face the speaker. That is, when positive voltage is applied to the cone, the cone will move outward. Usually, when the Dipole mode is used in a 5.1 system, the positive phase array should fire toward the front of the room. The array facing the rear of the room will have a negative orientation. That is, when positive voltage is applied to the cone, it will move inward, in the opposite direction of the other array on the speaker. As shipped from the factory, the S4Ai is set up for placement in the right-side wall in a 5.1-channel system. The speaker that will be placed in the left-side wall should have its phase switch pushed in so that the positive phase array will be firing toward the front of the room when installed (see Figure 10).

# SPEAKER PLACEMENT

In a 7.1-channel system, where two additional S4Ai speakers may be mounted in the rear wall, the positive phase arrays for all speakers should fire toward the rear corners, as shown in Figure 11. Thus, the side left speaker should be configured with its phase switch in the IN position, and the speaker on the right should be configured with its phase switch placed in the OUT position (see Figure 11). See the table on the right side.

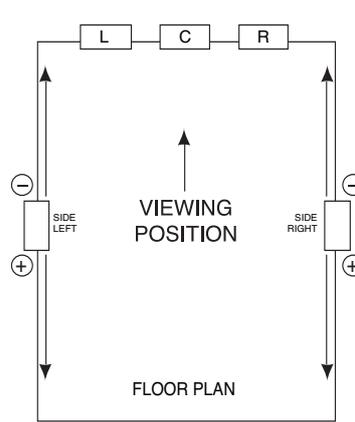


Figure 10. 5.1 System

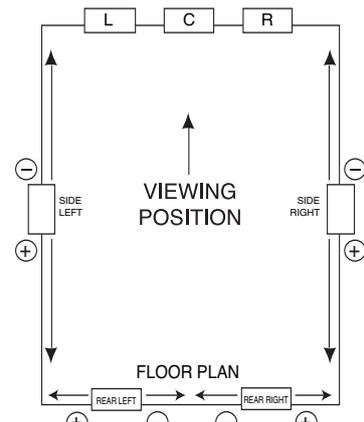


Figure 11. 7.1 System

To change the operational mode between Bipole and Dipole, move the switch to the Dipole-mode position (see Figure 12). The switch can be accessed from the back of the speaker, or from the front by removing the upper half of the baffle.

### Phase Switch Setting in Dipole Mode

	5.1 System	7.1 System
Side Left	IN	OUT
Side Right	OUT	IN
Rear Left	N/A	IN
Rear Right	N/A	OUT

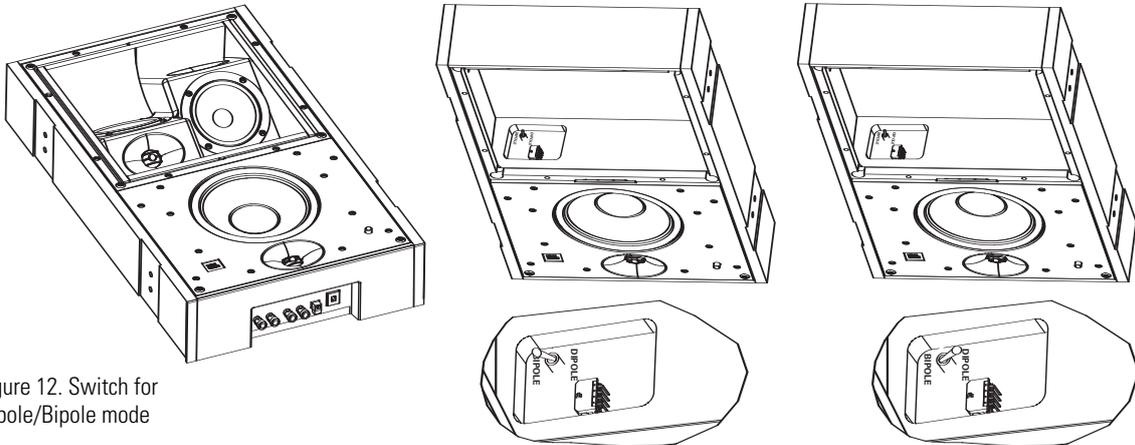


Figure 12. Switch for Dipole/Bipole mode

## S4Ai ORIENTATION – VERTICAL OR HORIZONTAL

The S4Ai's top baffle or "diffuse array" may be rotated 90 degrees clockwise so that the speakers can be placed in either vertical or horizontal orientation and still be able to produce the correct dispersion pattern. This may be necessary, for example, if the S4Ai is being installed in a ceiling and the joists are running from front to back in the room. In that situation, conventional in-wall side channels would be firing side to side rather than front to back. To correct this and produce the correct pattern, remove the eight retaining screws from the "diffuse array" and rotate 90 degrees so the dispersion pattern is correct in relation to the room and the other surround speakers in the system. If changing from the vertical to horizontal configuration, rotate the array clockwise. If changing from the horizontal to vertical configuration, rotate the array counterclockwise (see Figure 13). In both cases, take care not to damage the wiring, which will remain connected to either the Dipole or Bipole connector, as discussed above (see Figure 12).

# SPEAKER PLACEMENT

## S4Ai DUAL-DRIVE MODE

As the S4Ai has the capability of producing both side and rear fields from a single location in Bipole mode while dual-driven for cinema playback (see S4Ai Wiring Guide on page 7), some care must be taken when using the Direct-Radiating mode with the autoswitching trigger for music playback.

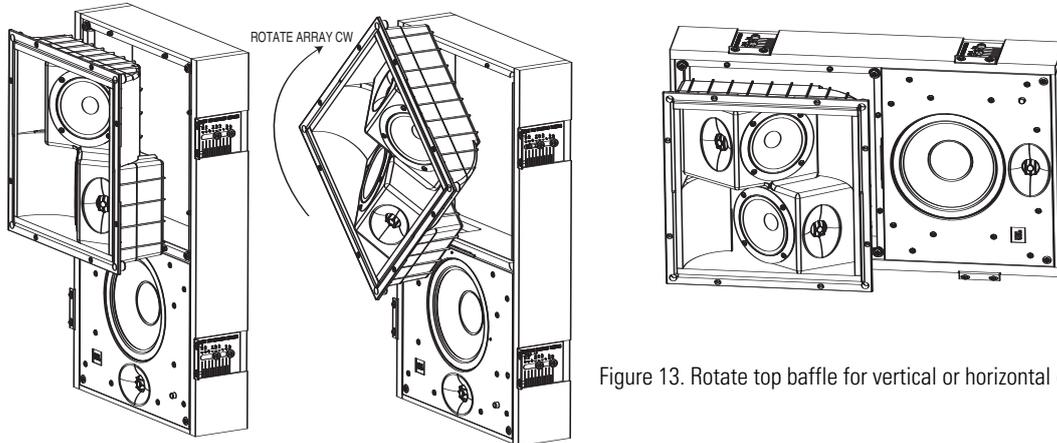


Figure 13. Rotate top baffle for vertical or horizontal orientation

Use Speaker Input #1 (see Figure 8) for the side field so that the direct-radiating tweeter for both speakers plays the correct information generated by the decoder. This can be accomplished by rotating the “diffuse array” 180 degrees from default so that the speakers mirror each other in the installation.

See Figure 13, which shows how to rotate the array, but note that for Dual-Drive mode you will need to rotate the array an additional 90 degrees from the position shown for a final position, in which the tweeter-midrange array that started out on top ends up on the bottom (and thus with the tweeter facing to the right rather than the left).

## MOUNTING THE SPEAKERS

### SPEAKER-MOUNTING OPTIONS

The S4VC, S4HC and S4Ai models all use the same mounting bracket. There are two models to choose from, based on the type of installation. In the case of new construction, choose the S4PCB preconstruction bracket. For retrofit installation, use the S4RFB. Both are sold separately. The speakers will fit into standard-construction 2" x 6" walls with 16" on-center studs. For horizontal mounting, cross-bracing is required; also at 16" on center. See separate instructions on mounting either S4PCB or S4RFB, included with the brackets.

The speakers are directly attached to the mounting L-brackets with hardware supplied in the speaker packing box, and can be adjusted for proper mounting depth with a variation of up to 2-1/2 inches. The actual depth will vary depending on wall construction and acoustic materials applied to the wall surface (see Figure 14). To flush-mount the grille to the wall

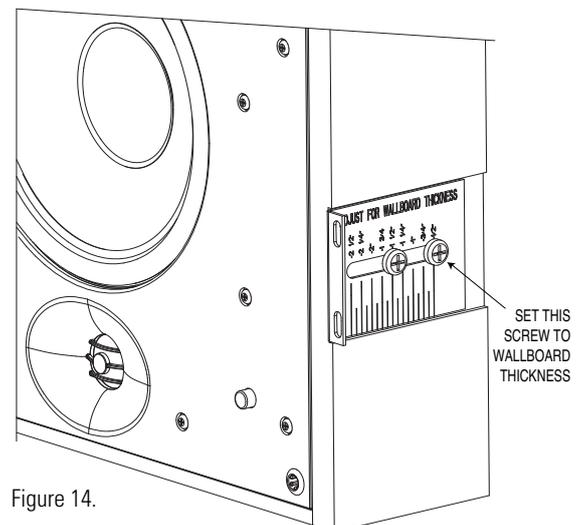


Figure 14.

# MOUNTING THE SPEAKERS

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surface, the speaker must be recessed in the wall no more than 1/4 inch. The grille pins fit directly into the speaker cabinet via receiver bushings with 15 ft/lb of tension per pin. Use the marked speaker-depth-indicator flanges (attached to the sides of the speaker baffle) to appropriately adjust the depth from the wall surface so that the baffle is recessed 1/4 inch. This will ensure that the grille will sit flush to the wall surface.

## REQUIREMENTS FOR MOUNTING

**OPTION 1 – NEW CONSTRUCTION:** The S4PCB mounting-flange bracket must be installed before the drywall is installed in the room. Attach the included L-brackets to the speakers (see Figure 14), and attach them to the mounting flanges at the appropriate recessed distance. The S4VC and S4HC require a minimum 6" wall depth. The S4Ai requires a minimum 4" wall depth (see Figures 15, 16 and 17).

Figure 15. Mounting the S4VC speaker using the S4PCB kit

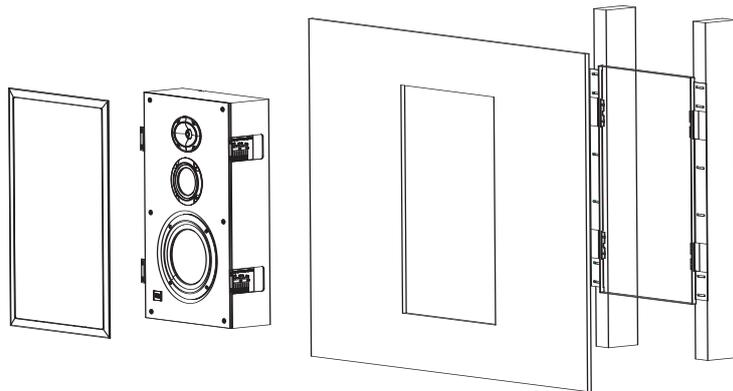


Figure 16. Mounting the S4HC speaker using the S4PCB kit

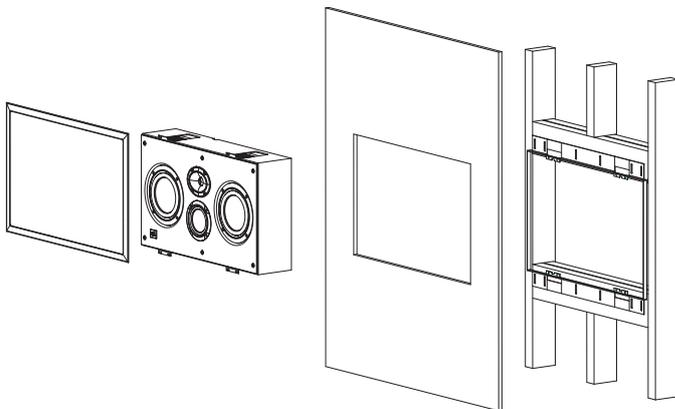
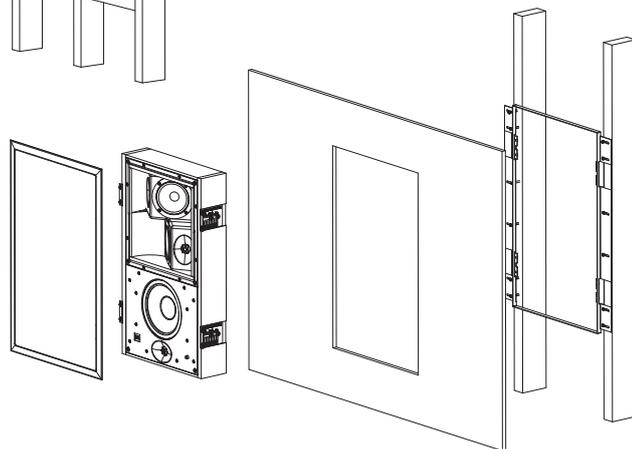


Figure 17. Mounting the S4Ai speaker using the S4PCB kit



# MOUNTING THE SPEAKERS

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## REQUIREMENTS FOR MOUNTING

### OPTION 2 – RETROFIT/PREEXISTING

**CONSTRUCTION:** Use the S4RFB bracket.

Mount the S4RFB to the wall surface and secure it to studs behind the wall. Attach the speaker via mounting flanges to the appropriate recessed distance. The S4VC and S4HC require a minimum 6" wall depth. The S4Ai requires a minimum 4" wall depth (see Figures 18, 19 and 20).

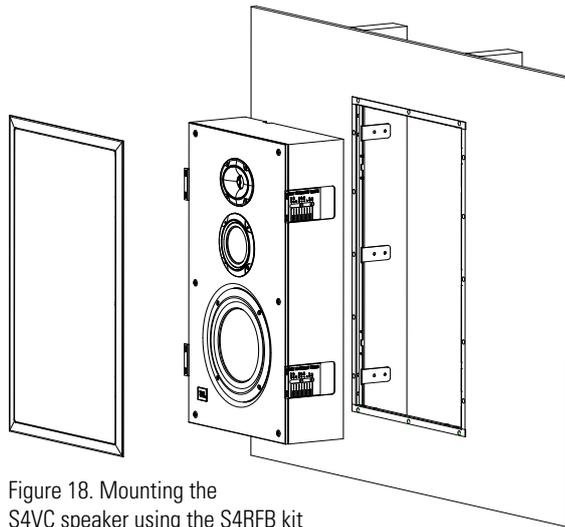


Figure 18. Mounting the S4VC speaker using the S4RFB kit

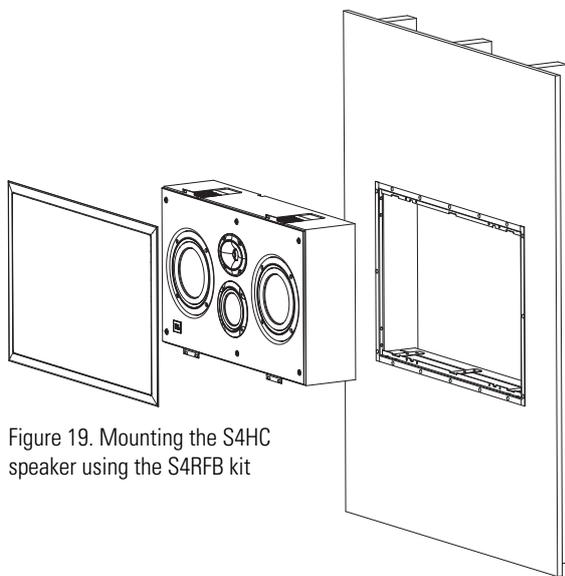


Figure 19. Mounting the S4HC speaker using the S4RFB kit

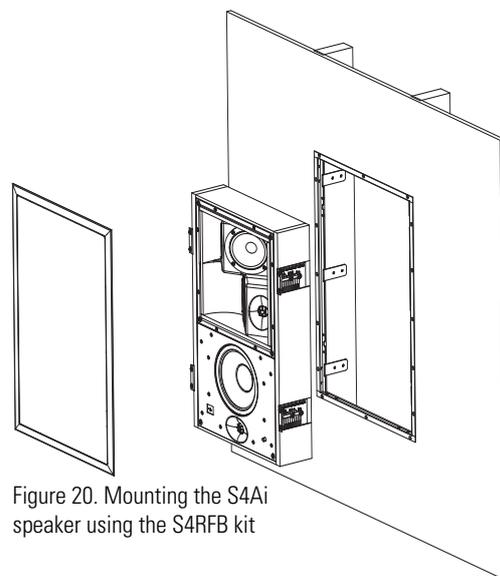


Figure 20. Mounting the S4Ai speaker using the S4RFB kit

**NOTE:** Do not attempt to install any type of mounting bracket other than the S4PCB, the S4RFB, or any other bracket that JBL may supply for these speakers in the future. Drilling holes in the product or improperly installing mounting brackets may void your JBL warranty and cause a safety hazard.

A JBL factory-authorized custom installer can install appropriate brackets. Contact JBL and your installer/dealer for additional information.

## CONNECTING THE SPEAKERS TO THE REST OF YOUR SYSTEM

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To connect the Synthesis Four loudspeakers to the power amplifiers or receiver, use two-conductor insulated speaker wire. We recommend #14 AWG wire as a minimum size. Your JBL dealer can recommend suitable cables.

Both the S4VC and S4HC utilize push-style friction binding posts that can accommodate up to #10 AWG stranded wire.

Since the S4Ai can be configured in three different ways, be sure to run the correct number and type of wires. Refer to the S4Ai Wiring Guide on page 7.

### PREPARING THE HOOKUP WIRE

1. First determine the distance between your amplifier and the most distant speaker in each group (fronts, surrounds, back surrounds, subwoofers).
2. Now make the hookup wires for all speakers in each group this length, even if one speaker is much closer to your amplifier than the other. This will help maintain proper signal balance.
3. Strip off 3/8" of insulation from both ends of each conductor.
4. Twist each set of standard wires into a tightly bunched spiral.
5. Speakers and electronics terminals have corresponding (+) and (–) terminals. Most manufacturers of speakers and electronics, including JBL, use red to denote the (+) terminal and black for the (–) terminal, although some electronics manufacturers have adopted the new color-coding standard promulgated by the Consumer Electronics Association. In that case, the positive terminal will be colored to correspond to the channel position, while the negative terminal will be black.

It is important to connect all speakers identically: (+) on the speaker to (+) on the amplifier and (–) on the speaker to (–) on the amplifier. Wiring "out of phase" results in thin sound, weak bass and poor imaging.

With the advent of multichannel surround sound systems, connecting all of the speakers in your system with the correct polarity remains equally important to preserve the proper ambience and directionality of the program material.

Now find a visual difference between the two conductors of each molded pair of speaker wires. Differentiating marks can be a different color wire (copper or silver); a strand of yarn in one conductor; thin, raised ribs on one part of the outer insulation; or a printed marking on one part of the outer insulation. It doesn't matter which of the two strands go to the (+) and (–) on the speakers and amplifiers, as long as all speakers are connected identically. Push down on the binding post, insert the wire into the hole, and release.

# FINE-TUNING YOUR AUDIO SYSTEM

## ACOUSTICAL PROBLEMS IN LISTENING ROOMS

A home THX audio system, such as the Synthesis Four system, addresses many of the problems common to high-quality reproduction of music or soundtracks in a home environment. For example, the dispersion pattern of the front LCR speakers minimizes the effects of floor and ceiling reflections. Still, the single most important variable in any sound system is the listening environment. Room reflections create spurious false images and “comb filter” interference effects which alter the tonality of the system while degrading the localization of specific sounds. Larger rooms sustain echoes that degrade dialogue intelligibility and detail. All rooms have standing waves that emphasize certain frequencies at the expense of others, based on the dimensions of the room.

Other concerns include environmental noise, which is often greater than people realize. Although they might become accustomed to its presence and “tune it out,” it still reduces the perceived low-level resolution of the system. In addition, the profound bass capabilities of a home THX audio system can create distracting rattles that lesser systems might never evoke.

This section of the manual contains a variety of suggestions for addressing some of the peculiarities of the listening environment to improve the accuracy of your Synthesis Four system’s sound reproduction.

## ROOM REFLECTIONS

The most troublesome room reflections are usually the early reflections of the front LCR speakers off the floor, ceiling and side walls. These reflections reach the listener’s ears after a delay, with respect to direct sounds, and blur the perceived image. They can also degrade dialogue intelligibility through the same mechanisms (see Figures 21 and 22).

The design of the Synthesis Four speakers minimizes the floor and ceiling reflections. As an extra enhancement, it is often a good idea to place a thick, absorptive carpet between the front speakers and the listening position, just to further reduce this primary reflection from floors with hard surfaces. A rug made of wool will generally have more uniform absorption characteristics than one made from synthetic fibers.

JBL Synthesis Four speakers have broad dispersion in the horizontal plane in order to ensure a wide usable listening area. This design choice can induce reflections off the side walls, especially in installations where they are relatively close to the front speakers. With conventional speakers, these reflections can be reduced simply by angling the left and right speakers inward somewhat.

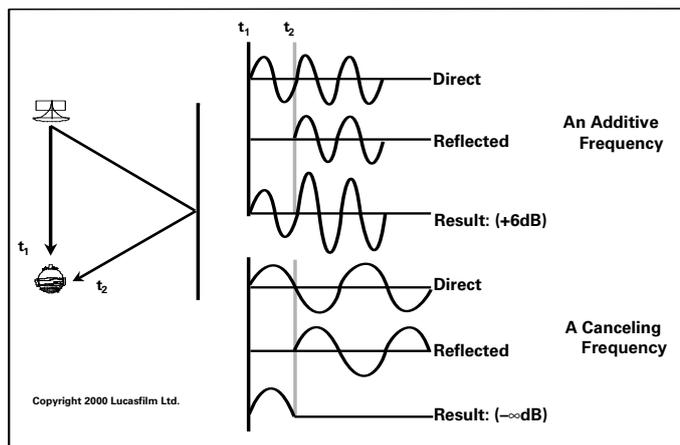


Figure 21.

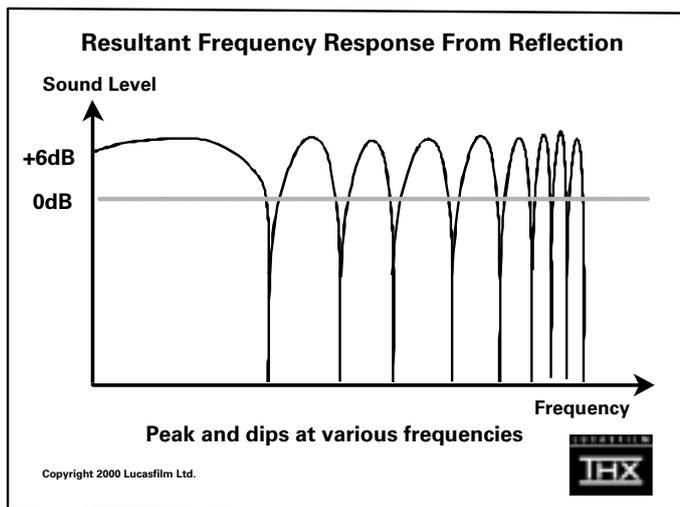


Figure 22.

## FINE-TUNING YOUR AUDIO SYSTEM

However, since it is not possible to “toe-in” flush-mounted speakers, the next step is the strategic placement of absorptive materials on the side walls. These range from commercially available fiberglass and dense foam to heavy draperies and even large, overstuffed furniture. The optimal position for these materials can be found with a small hand mirror and the help of an assistant. Sit at the primary listening position and have the assistant slowly slide the mirror along the wall. When you can see any of the front speakers reflected in the mirror, mark the wall at the mirror for later placement of absorptive material (see Figure 23).

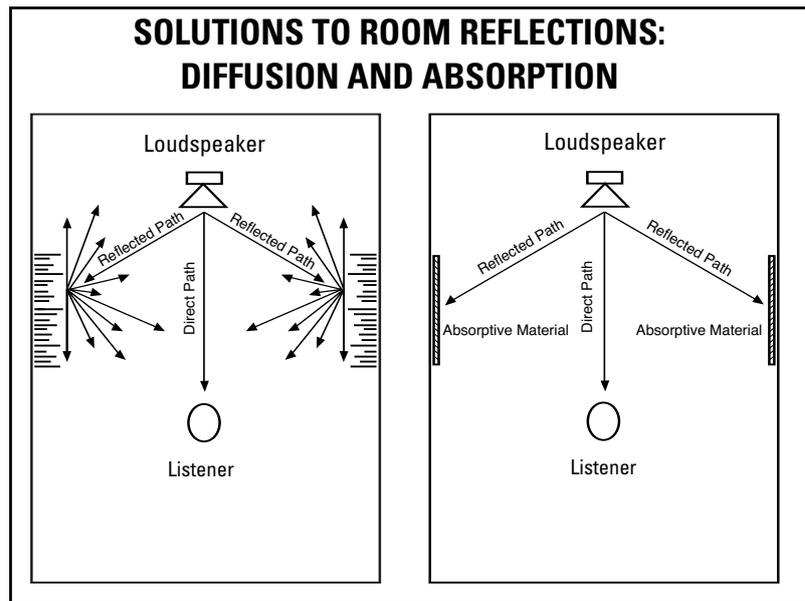


Figure 23.

A variation of this method is especially helpful in rooms that are already fairly “dead” acoustically. Rather than using absorptive material in rooms like these, try using diffusion instead. Commercially built diffusers are available, but large bookcases and irregularly shaped furniture will also serve the same purpose. They reflect sounds in a highly random way that effectively “scatters” the sound in all directions. Place the diffuser where you would otherwise place the absorptive material (using the “mirror trick”), to break up the first early reflections and scatter them randomly throughout the room.

Commercially available fiberglass, foam and diffusion panels may not be aesthetically acceptable in many installations, particularly when the home theater room serves multiple purposes. All of these materials can be covered with acoustically transparent cloth for design considerations. It is important that the cloth be acoustically transparent, however, or the effectiveness of the absorptive material will be greatly reduced. The simplest test for this is to hold a large sample of the cloth in front of a speaker playing pink noise. If you can move the cloth in front of the speaker without hearing a difference, the cloth is good for use in this application.

Large expanses of glass can be challenging. Glass reflects mids and highs, but often lets bass pass through, almost as if the glass were not there. The result is a characteristically bright, rough sound that can be difficult to correct electronically. The best treatment is generally the heaviest insulated drapes that can be found. (Incidentally, these serve double duty, controlling light that might otherwise fall on the screen.)

The materials just discussed are ineffective at lower frequencies. See the discussion on standing waves for more information about treating environments with low-frequency response problems.

### EXCESSIVE USE OF ABSORPTIVE MATERIALS

Absorptive materials should be used judiciously, as overuse can acoustically deaden the room and create additional difficulties. While the ideal home theater should be considerably “deader” acoustically than a typical living room, it still needs some reflectivity and diffusion. In particular, the surround speakers depend on nonabsorptive surfaces for their operation, since they radiate virtually no sound directly at the listeners.

## FINE-TUNING YOUR AUDIO SYSTEM

The best arrangement of the absorptive and nonabsorptive surfaces in the room can be seen in Figure 24. Most of the room surfaces are relatively absorptive, with the notable exception of the rear wall and the highest portions of the other walls, which should be diffusive.

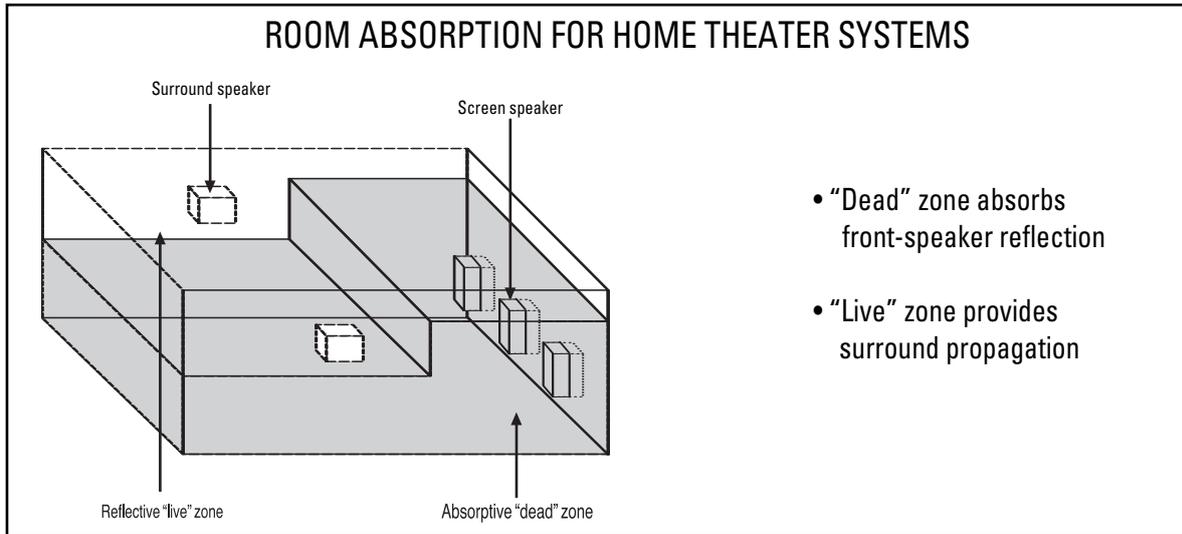


Figure 24.

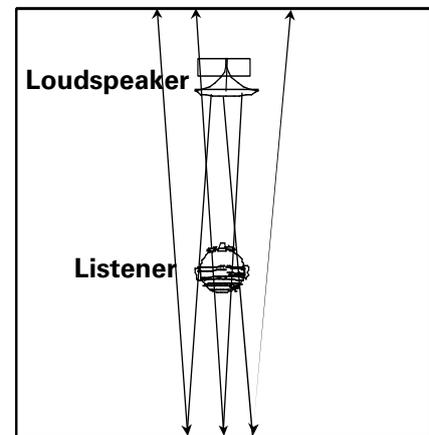
### "SLAP" ECHOES

"Slap" echoes are common in rooms that have parallel walls with little or no absorption or diffusion. Sounds tend to bounce back and forth between the parallel walls many times before they die out, causing a characteristic bright, "zingy" sound and interfering with the intended tonal balance and acoustic nature of the soundtrack (see Figure 25).

Walk slowly through the room, clapping your hands. No clear reflections should be heard at any point in the room – especially not near the primary seating area. Listen for a "flutter echo" of the hand clap (a rapidly repeating percussive sound, indicative of the sound bouncing between two parallel walls). Again, the best home theaters are fairly "dead" acoustically. This allows the program material and the playback system to create the environment, rather than having the room's native acoustic signature color everything.

The solution for slap echoes is usually a combination of absorption and diffusion. Specifically, place absorptive material behind the front speakers (heavy drapes, fiberglass, dense foam) and elements that will facilitate diffusion in the rear of the room (bookcases, irregularly shaped furniture, etc.). This will effectively suppress the slap echoes while at the same time providing a diffusive surface in the rear for the surround speakers. This enhances the enveloping characteristic of the surrounds even further.

In those relatively rare cases in which you have the luxury of building the home theater room as new construction, consider using nonparallel surfaces in the construction of the room. A difference of as little as 6 degrees will break up the slap echoes very effectively. For example, "flaring" the side walls out from the front by approximately



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Figure 25.



## FINE-TUNING YOUR AUDIO SYSTEM

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6 degrees and having the ceiling rise toward the rear of the room at a comparable rate will do wonders for the room's acoustics, if the wall design is solid and the angles are clearly intentional from the outset.

### RATTLES

Rattles in the room are structural resonances (as opposed to standing waves, which are airborne resonances) that the system may stimulate due to its broad frequency response and wide dynamic range. They are particularly prominent for sounds in the lower frequencies, and can sound like distortion. Sources of rattles include: furniture, loose window frames, walls, lighting fixtures, ventilation systems and even knickknacks on various shelves around the room. The simplest way of identifying these rattles is by using a rattle test. This is an *extremely* slow low-frequency sweep from 20Hz to 500Hz, recorded at the reference level. Ten decibels of output level increase over the standard level may be necessary in order to hear all the room rattles. Be careful with this test, as it is also a severe test of associated amplifiers and speakers.

As the sweep makes its way up the frequency range, you will probably find a surprising number of rattles in your room. All of these rattles will occur at one time or another during music or movies, but are usually perceived as background noise or distortion in the system.

Once identified, eliminating the rattles is usually straightforward. As an example, small pieces of felt can be affixed to the back of a painting (in the frame's bottom corners) to prevent audible rattles against the wall. Likewise, strips of felt can be wedged into a loose window rattling in its frame. Recessed lighting fixtures can be tightened up. A piece of cloth can be placed under offending knickknacks.

Every home THX audio system should be subjected to the rattle test at least once – the difference in low-level resolution and in freedom from pseudodistortion is sometimes large, while the effort involved is quite small.

### BACKGROUND NOISE

The effect of background noise on system performance is dramatic, yet often overlooked. Most people might think of it merely as a minor inconvenience, yet it has a profound effect on the way we perceive sound.

The presence of virtually constant background noise alters the way we perceive volume, since subjective loudness is a relative measure. In a quiet room, even a 70dB SPL sound can seem fairly loud. In a noisy convention center, the same volume would be barely audible. Since there is a practical upper limit to both the volume to which we should subject ourselves and the volume a given system can reproduce, having a relatively noisy environment effectively limits the perceived dynamic range of the program material. This, in turn, limits the dramatic effect that might have been intended by the director or music artist.

Constant background noise also obscures, or masks, low-level signals that are frequently important in films. Many scenes use subtle ambient noises to set the mood prior to an important event – without the full perception of the whispered secret or the barely heard creaking of a door, the impact of the scene is diminished.

It has been demonstrated that even a relatively narrow-bandwidth noise can effectively reduce our hearing acuity over a broad range of frequencies, far greater than the noise itself. When you add up all the various sources of noise from electric motors, noisy heating/cooling systems and outdoor noises, plus noises that even audio and video components can introduce such as noisy transformers, motors in laser players or projector fan noise, our ability to discern the low-level information in the soundtrack is greatly compromised – and the director's intention along with it.

# FINE-TUNING YOUR AUDIO SYSTEM

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## BACKGROUND-NOISE SOLUTIONS

Many sources of noise in a home environment can be addressed simply. Locating the home theater in the basement often removes it from many household noises as well as isolating it from other family members. Taking care to completely seal windows and doors can also make a significant difference in reducing outside noise.

Heating and cooling systems are more challenging. Sometimes, the answer may be as simple as using a “whistle-free” diffusion grille rather than one that creates undue noise from turbulence. For new construction, using larger-diameter air ducts for lower air velocity is very beneficial. You can go further by using ductwork that is lined with acoustically absorptive material. Where possible, longer ducts that have several turns further reduce the sound of the airflow by eliminating the straight path from the heating/cooling system to the room.

Some of the construction techniques used to minimize the transmission of external sounds into the listening environment include:

- Double or triple layers of drywall (gypsum board)
- Double wall construction, meaning two complete sets of studs (preferably stuffed with fiberglass insulation)
- Double wall construction with staggered studs (to minimize transmission of vibrations from one set of studs to the next)
- Floating floor construction (again, preferably stuffed with fiberglass; this also can enhance the perceived bass, since the subwoofers may cause structural vibrations through the false floor that can then be transmitted up through furniture)
- Seal all windows, doors and vents
- Seal and caulk all apertures in the wall (electrical outlets, through-wall plumbing, etc.)

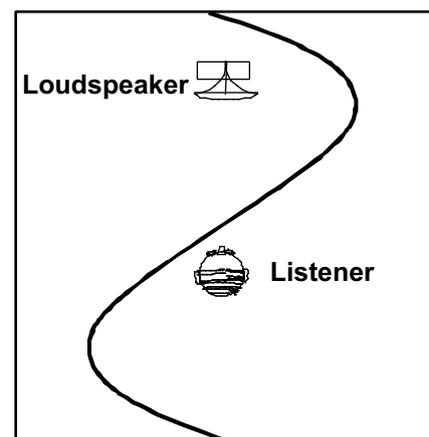
Finally, transient noises (traffic on the street, dripping faucets, etc.) distract your attention away from the program material and remind you that you are in your home theater/living room, and not in the midst of the action of a movie.

## STANDING WAVES

A “standing wave” is what causes a pipe of a particular length in a large pipe organ to have its characteristic pitch. The pipe literally amplifies certain frequencies, based on its length and the wavelength of the frequency.

A typical rectangular room has three characteristic “lengths” and, thus, three fundamental standing-wave frequencies. In addition, multiples of these frequencies are also amplified. These frequencies are often referred to as “room resonances” or “room modes,” i.e., the frequencies at which the room tends to vibrate of its own accord. These resonances lead to uneven frequency response, the greatest problems being in the 60Hz – 150Hz range for a typical living room (at lower frequencies in larger rooms). See Figures 26 and 27.

Unfortunately, there is no way to eliminate the effects of standing waves completely. The best that can be done is to minimize their effect through a variety of strategies.



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Figure 26.



# FINE-TUNING YOUR AUDIO SYSTEM

## STANDING-WAVE SOLUTIONS: ROOM RATIOS

In new construction, the best way to minimize the audibility of standing waves is to plan for an even distribution of them, so that their effects do not “pile up” on top of each other. In this regard, the ratios of room dimensions are the critical factor. Rooms having equal dimensions are the worst, since the standing waves in all directions reinforce one another. Room dimensions that are even multiples of one another should also be avoided where possible.

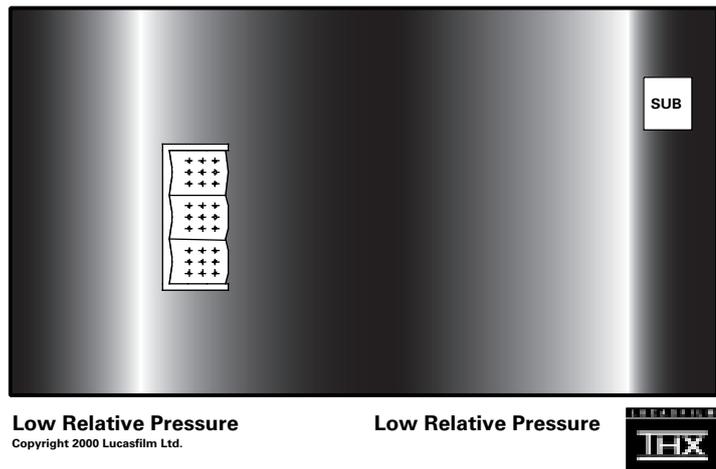


Figure 27.

## STANDING-WAVE SOLUTIONS: SPEAKER PLACEMENT

Speaker placement also has an effect on standing waves and their audibility. In particular, placement of any speaker (including subwoofers) where two walls and the floor meet will tend to stimulate all of the available standing waves, causing the most irregular response. The displacement required to minimize a particular standing wave depends on its frequency, with lower frequencies requiring more movement owing to their longer wavelengths. As a result, minimizing colorations due to standing waves often requires significant adjustment of subwoofer placement. Leave yourself some latitude with regard to subwoofer placement when planning your system – the final adjustment will probably have to be done on something of a trial-and-error basis. See Figures 28 and 29 for some suggestions.

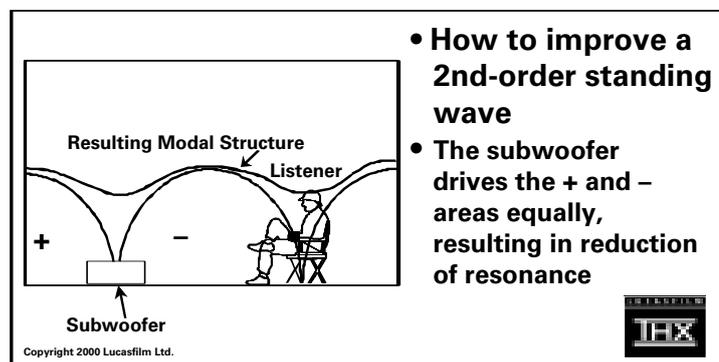


Figure 28.

## STANDING-WAVE SOLUTIONS: ABSORPTION

In theory, it is possible to dampen standing waves with absorptive material. The difficulty is that the thickness of the absorptive material would have to be approximately one-half the wavelength of the lowest frequency requiring damping. This means a five-foot thickness of fiberglass would be required in order to damp everything down to 100Hz – not very practical.

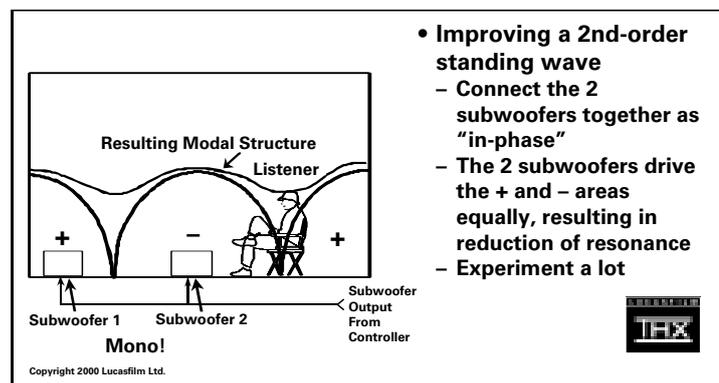


Figure 29.

## FINE-TUNING YOUR AUDIO SYSTEM

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Standing-wave energy tends to be concentrated in the corners of rooms, which is why placing a subwoofer in the corner tends to increase its bass output. Because of this, it is possible to break standing waves up somewhat by “breaking up” the corner. This can be accomplished by placing a column of thick, absorptive materials in the corners (covered by acoustically transparent cloth, of course). The column ought to be at least a foot on a side, and run from floor to ceiling. A variation of this is to run an absorptive panel diagonally across the corner, leaving open air space behind it. Both of these techniques are easily tried and sometimes quite effective.

### **STANDING-WAVE SOLUTIONS: ROOM EQUALIZATION**

If a room exhibits severe standing-wave problems, the best solution is to know your own limitations; hire a trained acoustician. These professionals have the necessary background to analyze the various room modes and recommend appropriate action. This will sometimes take the form of a custom-designed bass trap, which may be easily constructed. But it takes specific skills to determine its optimal design.

In other cases, careful analysis and parametric equalization may be appropriate. Optimize everything else that you can, then use EQ, if necessary, to “touch up” the room. This is its best use. Parametric equalization must be applied with care and a light touch to obtain optimal results. Professionals use it all the time, with excellent results – because they know its limitations and how to apply it.

Never equalize a room by ear. Room analysis is not as straightforward as it may seem. The analysis should be done using equipment with at least one-third-octave resolution, using both spatial and temporal averaging.

In any event, rooms requiring this level of treatment are relatively rare, and the skills necessary to handle them properly are highly specialized. Do not hesitate to use the professional services of an acoustician when you need them.

# TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	SOLUTION
<p>No sound coming from speaker</p>	<ul style="list-style-type: none"> <li>• Amplifier not turned on</li> <li>• Amplifier gain is low</li> <li>• Correct source not selected or turned on</li> <li>• Defective patch cords to amplifier</li> <li>• Speaker wires not connected to amplifier</li> <li>• Balance control set improperly</li> <li>• Speaker wires damaged or shorted</li> <li>• Speaker not configured correctly</li> <li>• Center speaker is configured incorrectly</li> <li>• Problem not diagnosed</li> </ul>	<ul style="list-style-type: none"> <li>• Turn on amplifier.</li> <li>• Make sure that there is amplifier gain for that channel.</li> <li>• Select proper source.</li> <li>• Check/replace patch cords.</li> <li>• Check speaker wire connection to amplifier.</li> <li>• Make sure Balance control is set at center, or 12 o'clock, position.</li> <li>• Make sure none of the speaker wires are frayed, cut or punctured. Make sure no wires are touching other wires or terminals and creating a short circuit.</li> <li>• In Dolby® Digital or DTS® mode, make sure that the receiver/processor is configured so that the speaker in question is enabled.</li> <li>• In Dolby Pro Logic® mode, make sure the center speaker is not in phantom mode.</li> <li>• To diagnose the likely source of the problem, it is often helpful to switch the nonfunctioning speaker with one that is functioning correctly. Turn off all electronics before exchanging the speakers. Turn everything back on, and determine whether the problem is in the same place, or has moved with the speaker. If the problem is in the same place, the source is most likely with your receiver or amplifier. If the problem has followed the speaker, then contact your authorized JBL Synthesis custom installer or dealer for further assistance. If that is not possible, visit our Web site at <a href="http://www.jblsynthesis.com">www.jblsynthesis.com</a> for further information.</li> </ul>

# TROUBLESHOOTING

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SYMPTOM	PROBABLE CAUSE	SOLUTION
Bass is very weak	<ul style="list-style-type: none"> <li>• Subwoofers are wired out of phase</li> <li>• Subwoofers have not been placed optimally</li> </ul>	<ul style="list-style-type: none"> <li>• Make sure that positive terminals on the subwoofers go to the positive terminals on the amplifiers (red) and do the same for the negatives.</li> <li>• Experiment with different locations.</li> </ul>
Poor or smeared imaging	<ul style="list-style-type: none"> <li>• Poor room acoustics</li> <li>• Poor program source</li> <li>• Improper polarity</li> </ul>	<ul style="list-style-type: none"> <li>• Use absorptive materials to minimize early reflections.</li> <li>• Aim speakers at listening area.</li> <li>• Check another program source.</li> <li>• Check polarity of wire connections.</li> </ul>
Indistinct dialogue	<ul style="list-style-type: none"> <li>• Slap echoes</li> <li>• Miscalibration of center channel output level</li> </ul>	<ul style="list-style-type: none"> <li>• Add absorption or diffusion materials.</li> <li>• Check output levels of surround processor.</li> </ul>
Uneven surround coverage	<ul style="list-style-type: none"> <li>• Poor speaker placement, strong reflections</li> <li>• Excessive absorption near surrounds</li> </ul>	<ul style="list-style-type: none"> <li>• Place surrounds according to THX specifications.</li> <li>• Add absorption and/or diffusion materials.</li> <li>• Remove absorptive material to provide surround reflections.</li> </ul>

# SPECIFICATIONS

MODEL #	S4VC	S4HC	S4Ai
Description	3-Way 8" (200mm) vertical flush-mount speaker	3-Way dual 6-1/2" (165mm) horizontal flush-mount speaker	Configurable-array flush-mount surround speaker
Power Handling	250W	250W	200W Single-driven or 175W-per-array dual-driven
Nominal Impedance	6 Ohms	6 Ohms	6 Ohms
Sensitivity (2.83V@1M)	91dB	91dB	91dB
Frequency Response	65Hz – 20kHz	65Hz – 20kHz	80Hz – 20kHz
Crossover Frequencies	600Hz, 3.5kHz	600Hz, 3.5kHz	Dipole Mode: 400Hz; Bipole Mode: 800Hz, 3.6kHz, Direct Mode: 2.5kHz
Bass Transducer(s)	8" (200mm) Titanium-alloy inverted dome with rubber surround and cast basket, shielded	Dual 6-1/2" (165mm) titanium-alloy inverted dome with rubber surround and cast basket, shielded	8" (200mm) Dual-voice-coil inverted dome with rubber surround and cast basket
Midrange Transducer(s)	4" (100mm) Titanium inverted dome with rubber surround and cast-aluminum basket, shielded	4" (100mm) Titanium inverted dome with rubber surround and cast-aluminum basket, shielded	Dual 4" (100mm) neodymium full-range with rubber surrounds and cast-aluminum baskets
High-Frequency Transducer(s)	1" (25mm) Pure-titanium dome with rubber surround, shielded, with EOS waveguide	1" (25mm) Pure-titanium dome with rubber surround, shielded, with EOS waveguide	Triple 1" (25mm) pure-titanium dome with rubber surrounds, shielded, with EOS waveguide
Dimensions (H x W x D)	23-7/8" x 14" x 5-1/2" (606mm x 356mm x 140mm)	14" x 23-7/8" x 5-1/2" (356mm x 606mm x 140mm)	23-7/8" x 14" x 3-3/4" (606mm x 356mm x 95mm)
Weight	26 lb (12kg)	32 lb (15kg)	23 lb (10kg)
Connectors	Two-conductor push-type, 10 –16-gauge	Two-conductor push-type, 10 –16-gauge	Speaker: four-conductor push-type, 10 –16-gauge; Control: two-conductor screw terminal, 16 – 24-gauge

All features and specifications are subject to change without notice.

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