XA Reference
Owner's Manual

XA
REFERENCE

Snell

SPECIFICATIONS

Frequency Response (±3dB)	27-24,000Hz
Nominal Impedance	4 ohms
Minimum Impedance	3 ohms
Recommended Amplifier Power	200-1000 watts
Sensitivity [2.83v at 1m]	88dB SPL
Driver Complement	
Front Tweeter	1-inch (25mm) titanium dome with neodymium magnet and aluminum heat sink
Rear Tweeter	1-inch (25mm) with titanium dome and coated surround
Midranges	Two 4-1/2-inch (110 mm) mounted in separate enclosure
Woofers	Four 8 inch (210mm) with black anodized aluminum cones
Controls	Five switches to fine-tune loudspeaker balance. Each switch has three discrete settings to allow maximum flexibility for adjustment.
Bass Tuning Options	Long port pair, short port pair, blanking plate (sealed enclosure) are included with each tower.
Cabinet Construction	Heavily braced, double-wall cabinet with high-loss adhesive
Baffle Construction	Constrained layer damping; low diffraction edge radius
Maximum Dimensions (HxWxD)	$72\frac{3}{4}$ x $17\frac{3}{4}$ x $21\frac{1}{2}$ in (185 x 45 x 55 cm)
Net Weight	210 lbs (95kg) each
Shipping Weight	300 lbs (136kg) each
Finishes	Black Oak; any desired veneer is available for an additional charge.
Grille	Cloth covered aluminum structure
Included Accessories	
Port tuning options:	(2) short port assemblies
	(2) blanking plate assemblies
	(1) allen wrench
Floor spikes:	(8) pieces
Carpet glides:	(8) pieces

THE DESIGN OF THE XA REFERENCE TOWERS

The Snell XA Reference Towers were designed as a cost-no-object speaker system to be the best system we know how to build. They are the culmination of our 25-year history and bring into play our broad engineering experience and our wide range of manufacturing skills. Because of the special nature of this system, we'd like to explain the design process and thinking that went into their development.

The process of designing a system goes through a number of phases. The first phase is to define the system and create it on paper. Secondly, the hardware is chosen and assembled, and a prototype cabinet is made. A preliminary crossover is built and adjusted until the measured performance of the system is to a high level. Finally, a great deal of listening and fine-tuning of all variables is done until we feel that the system has reached perfection. Even then, the design still evolves as manufacturing prototypes are made and the manufacturability of the system is developed.

The process of designing the XA Reference Tower was no different except that the expectations were higher at every step of the way. The development team was given the directive that any change that could improve the performance of the system, even slightly, should be incorporated regardless of cost.

Design of the XA Reference began with many simulations of the driver array. It is a common problem with many multi-driver arrays that the frequency response varies greatly from different listening positions, especially positions of different elevation. An array has directional properties stemming from the various units (woofers, mids and tweeter) and their physical spacings, combined with the crossover network that divides the musical signal between them. At some positions the drivers may sum nicely, at others they may interfere disastrously. The listener must then sit in the "sweet spot" to hear the balance the designer intended. More subtly, the varying response at different angles causes the room's reflected energy to color and thus degrade the sound.

Several years ago Snell developed an array technique for the XA90 system, termed the eXpanding Array. We have found that, through computer optimization, the drivers (woofers, midranges and tweeter) can be configured such that the effective length of the array grows longer in proportion to radiated wavelength. This gives a constant vertical directivity so the system has a very wide sweet spot with virtually no change in frequency response or perceived balance, regardless of listening position. Where as many large systems have driver arrays with a central tweeter surrounded by a pair of midrange units surrounded by a number of woofers, only Snell uses this design process and achieves this ideal eXpanding Array performance.

The design of the XA Reference Tower caused us to revisit these simulations and come up with an even better array, with smoother directivity over a much wider frequency range. Armed with a theoretical array design on paper giving us the performance that we wanted, we needed to find the drivers that would fit the requirements of this array. We needed drivers with the ultimate in smooth response and low distortion. They had to be clean sounding within and beyond their frequency range and free from any delayed resonances. They also need to handle the power that such a large system might be called upon to handle. The XA design simulations required the central three drivers to have very tight physical spacing and a low crossover from tweeter to mids. This called for a tweeter with wider than average response range and a compact physical size.

The three central drivers are mounted on a 1/2" thick numerical control (NC) machined plate. This achieves several objectives. First the tweeter is rear mounted behind a specially contoured flare. This flare gives the tweeter a horizontal and vertical directivity that matches the rest of the array's directivity and enhances its power handling. The mounting also time delays the tweeter energy to better mate up with the midrange energy, simplifying crossover design, and allows some physical overlapping of the front mounted midranges with the rear mounted tweeter. Being computer machined, it is repeatable to a high dimensional tolerance and very inert. The three driver/mounting plate module is used in our XA2900 for home theater use and in a mating center channel to a pair of XA Reference Towers.

For woofers we also had specific parameters in mind. Cabinet volume, low frequency cutoff and the number of woofers defined the "Thiel/Small" parameters needed. These parameters differed from the norm in that unusually high mass and above average motor strength was required. We were able to achieve these parameters with a special custom-built aluminum cone woofer. We optimized suspension and motor parameters to assure that the woofers have low distortion and are well behaved to very high output levels.

With system configuration and driver choices done the cabinet design was next. Experience with our .5 systems and then with our QBx line had demonstrated the importance of highly damped enclosure walls to control resonance and preserve midrange purity. These prior designs used two different techniques to dampen the baffles. Our QBx line uses a baffle constructed of layers of wood material and a high loss central layer. With the XA Reference extended this technique and its benefits to the entire cabinet. The final cabinet is a multilayer affair with 2 layers for all sidewalls and the back and 3 layers for the baffle. Each layer is adhered to the next with a high loss polymer that absorbs resonant energy. Whereas other manufacturers deal with mass and rigidity and ignore resonance control, we feel that this high loss cabinet design is central to the clean bass and midrange of the XA Reference.

Cabinet styling was important too. At this stage we worked closely with an industrial designer to give the XA Reference its sophisticated look without compromising in any way its performance.

With all of the "raw parts" in place we designed the first listenable prototype. Computer simulation and optimization provided a crossover network that would meet the XA objectives and get the drivers to meld seamlessly into a high performance *system*. The computer is a great tool in this, but takes us only so far. Once objective measurements show that the system is operating well, response is smooth and flat on axis and off, our measuring system outlives its usefulness. At that point we put away the test equipment and start *listening.*

Only the human ear can truly evaluate the musical balance of a loudspeaker system. A great deal of listening and fine tuning of the system is needed until it has a musical balance that gives it the purity and invisibility that we demand.

A secondary requirement of the crossover network for the XA Reference was that we wanted to give the system a large degree of subtle tunability. Many years ago there was a system designed by Henry Kloss, the KLH 12. Its unique feature was that the crossover parameters that defined its frequency balance were adjustable via a box with 4 multiposition switches. In every crossover network certain crossover components will have a dominant effect in certain frequency ranges. Adjust the values of these dominant components and you will adjust the response in one or two octaves, just as you might with a graphic equalizer. The KLH 12 had three switched values for a number of these key components to give plus, minus, and zero positions for 4 frequency ranges. No system since had offered this feature, but we wanted to incorporate it into the XA Reference. The goal was to cover most of the frequency range with subtle adjustability. Why would we want to offer this if a loudspeaker should ideally be flat? In short, because the loudspeaker cannot be separated from the effects of the room and the system it is a part of. A "flat" speaker in a non-flat room, or which is part of a less than neutral system, will not sound as good as it could unless some subtle adjustability is incorporated into the system. In addition to the network adjustments, the XA Reference Towers offer bass adjustments through three port options. Later in the manual we will cover all of these adjustments, and how to set them, in detail.

Nearly a year after we began the design of the XA Reference, we are in production and very proud of the end result. We hope it will give you many years of musical enjoyment and satisfaction.

David Smith
October 2001

XA REFERENCE TOWER FEATURES

1 Multi-Element eXpanding Array

Snell first pioneered the XA technique with the XA90 system. Months of study and computer simulation resulted in a scientifically designed five-element array with idealized dispersion characteristics. We found that with a carefully optimized crossover frequencies and slopes in conjunction with precisely defined driver spacings, that a near constant directivity and lobe free system was achievable. The net result was a spectral balance with remarkably little variation over the difficult vertical listening window and a useful reduction in floor and ceiling bounce energy that give the system a more revealing character. The XA Reference Tower has the best XA performance yet with even smoother response over a wider listening window and a wider frequency range. You will note that the central three drivers are mounted on a very expensive solid machined MTM plate. This both allows their spacing to be minimized and also lends the tweeter the same vertical directivity as the rest of the array's components. Crossover and spacing of the outer bass units continue the XA effect down to a very low frequency.

2 Inert Cabinet Construction

Previous models of Snell systems use a 3-part sandwich baffle to deaden the mounting surfaces of the drivers. This is a practical compromise with most of the benefit with reasonable cost.

The XA Reference Tower, however, has its entire enclosure built from a multi-layer inert box technique. Cabinet walls are constructed from 2 wooden layers bonded together with a high loss polymer adhesive. The baffle is constructed from 3 wooden layers all bonded together with this special adhesive.

The end result is a massive and inert cabinet design that produces cleaner bass and purer midrange than traditional cabinets built with heavy single wall or even double wall construction.

3 Radiused Edge Baffle

The elliptical radius on our baffle edge near the tweeter reduces re-radiation for a cleaner and smoother response. Snell pioneered this technique in the original Type A speaker system in 1976.

4 Rear-Firing Tweeter

The rear-firing tweeter on the XA Reference Tower adds necessary high-end fill to the soundstage, creating a broader, deeper stereo image. A three-position switch allows you to select from two different tweeter levels or defeat the rear tweeter when the back of the speaker is close to a wall.

5 Grille Design

Acoustically transparent grill cloth is applied over a complex network of hand-welded aluminum extrusions. The result is a stylish form that does not detract from the XA Tower's sonic performance.

6 Handmade Cabinets

The entire construction and finishing process is done by hand. Each cabinet is assembled by our craftsmen, and then sanded several times. Multiple coats of hand-applied finishing oils reveal the great depth of the wood grain. The result is a cabinet of exceptional workmanship, with sharp corners, smooth sides, and natural beauty.

7 Veneers

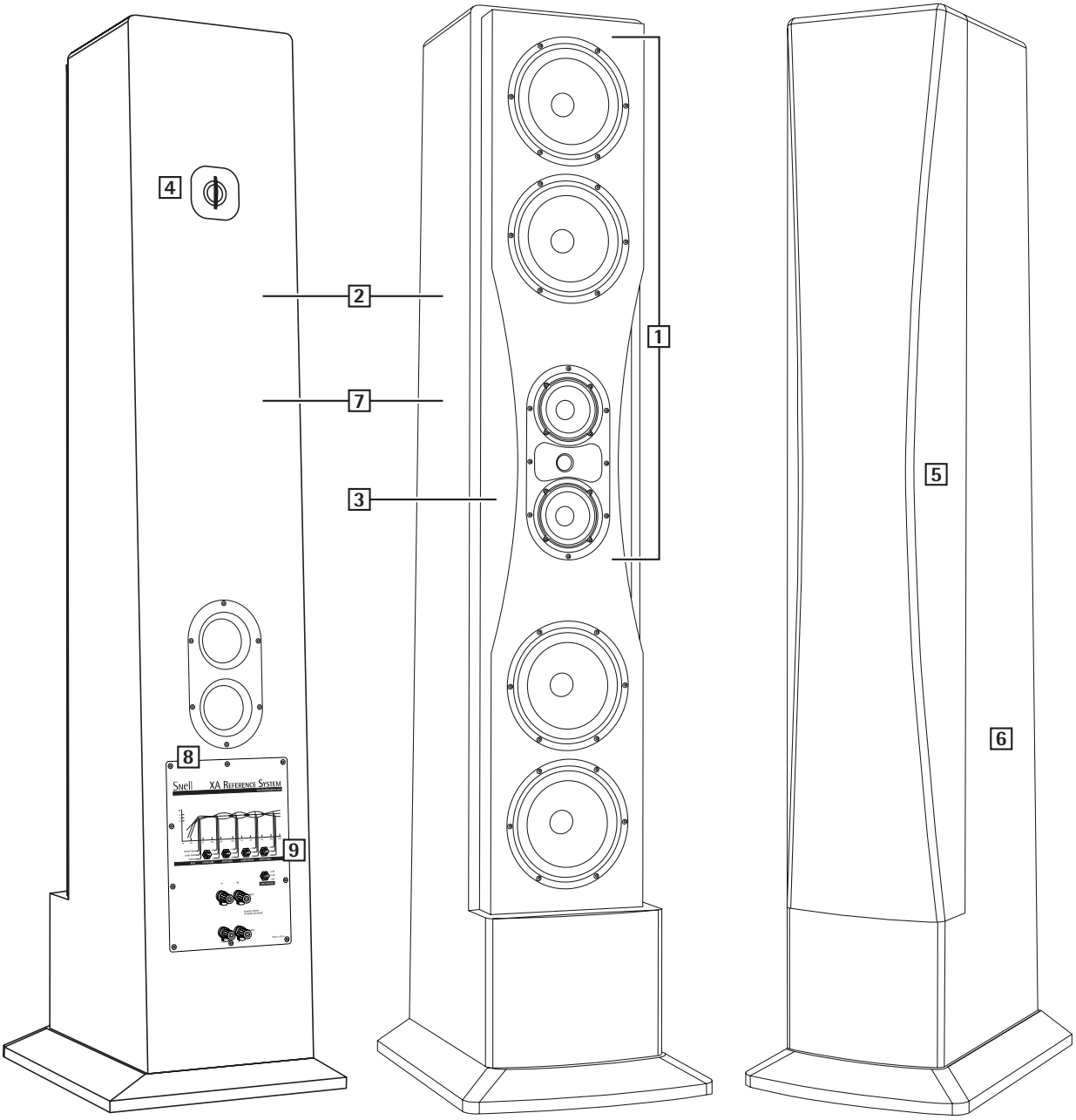
We use premium book-matched veneers, chosen for grain consistency and aesthetics, in our cabinets. Each pair of speakers has wood veneer from the same tree, so grain patterns are consistent. Our cabinet shop sequences the veneer, maintaining a match for the top, right/left, and left/right sides of each pair of speakers. We even go so far as to veneer the inside of the cabinet to ensure that it won't warp or come apart at the edges when exposed to changes in humidity.

8 Hand-Tuned Crossover

These networks adhere to an in-phase or Linkwitz-Reilly design. (Time alignment and coherency are maintained through the transition region from driver to driver.) Each crossover is individually tuned by our production technicians to within ±0.5dB of the master reference, ensuring a consistent sound balance and predictable performance.

9 Toggle Switches

Toggle switches are the finest made in the US, and designed to meet the stringent specifications of the aerospace industry. These rugged switches and extremely reliable, quiet and even feature a waterproof seal. All of these switches are carefully tested and their circuits adjusted to provide unprecedented options in adjusting spectral balance as well as outstanding performance.



Setting the Carpet Spikes and Glides

Four steel spikes are included with the XA Reference Tower. They enable you to level the speakers and provide a solid coupling with the floor when the speaker is placed on a carpeted surface. (Figure 1) Alternatively, if you need to level the speakers, but do not feel comfortable using steel spikes on your floor coverings, four heavy duty nylon carpet glides have been provided. If you choose to use the carpet glides, please be sure to use the jam nut (from the steel spike assembly) with them. The following instructions refer to the spike installation, however the procedure for installing the carpet glides is the same.

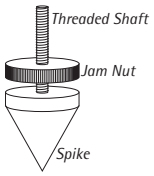


Figure 1

Caution: *When moving the speakers or installing the spikes, do not touch the drivers. Be particularly careful of the tweeter on the back of the cabinet.*

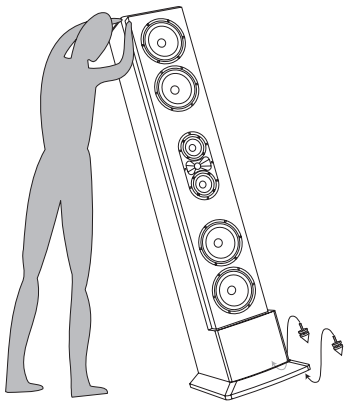


Figure 2

Installing the spikes requires the assistance of reasonably strong person. Start by positioning the jam nuts on the threaded shafts of the spike. Thread the jams nut all the way to the base of the shafts. Then turn them back 6 full turns. This will provide about 1/4" (6mm) of adjustability.

Have your assistant carefully tilt the speaker to one side so you can reach under the base and thread the spikes into the base. (Figure 2) Set the speaker down so the spikes contact the carpet. Then tilt the speaker up on the spikes and install the remaining spikes. (Figure 3) Set the speaker down so it rests on all four spikes. Check to be sure the speaker is level and adjust the spikes if necessary to compensate for uneven flooring. If it is necessary to adjust the spikes, be sure to turn the jam nuts so they are against the base of the speaker.

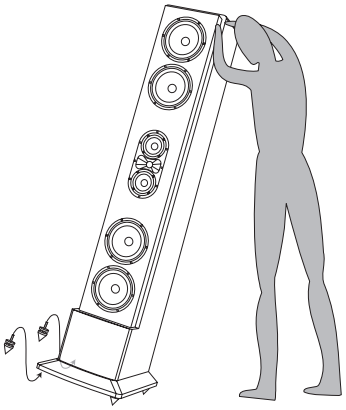
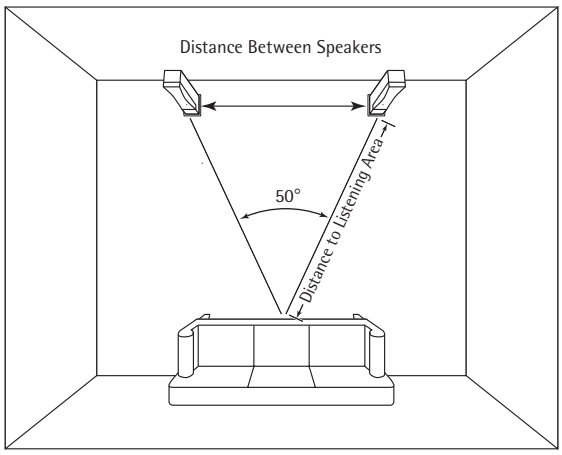


Figure 3

Stereo Image

The distance between the speakers determines the width of the stereo image. If the speakers are placed too close together, the image will be too narrow; too far apart and the blend will suffer, creating a hole in the middle. When properly placed, your speakers will create a continuum of virtual images from left to right, with an illusion of sound outside, in front of, and behind the speaker systems. We recommend an angular separation of approximately 50 degrees (when viewed from above). This is equivalent to a separation between the speaker systems that is about 85% of the distance to either of the speakers from the listener location.



– continued

Stereo Imaging, cont. –

The distance from the listener location to the left speaker and the right speaker should be as equal as possible. We advise using a tape measure to ensure the distance from each of the speakers to the primary listening position is the same. The result will be well worth the time and effort.

Room-Related Bass Effects

Your room dimensions will determine the frequencies of a phenomenon call "standing waves". Where the speakers are placed relative to the strong points and weak points (anti-nodes and nodes) of these standing waves significantly affects the bass characteristics of the system. Experiment until you find the speaker locations that produce the best overall sound for your room. Choose a musical selection with a heavy and continuous bass line. Repeat a short section until you have a firm impression of it in your mind. Then try another speaker location. Repeat this process until you are content with the bass response. Your goal should be even reproduction of each bass note without undue prominence of any of them. Moving your listening position may affect the sound as much as moving the speakers. If practical, try different listening locations as well as speaker locations.

See Optimizing the Sound section of this manual for more information.

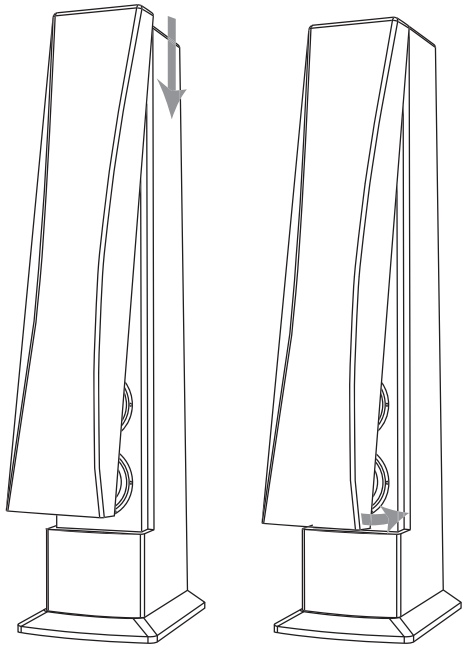
Toe-In

Toe-in refers to the angling of the speaker systems toward the listener location. Toe-in is a matter of taste. As the degree of toe-in increases, the stereo effect becomes more sharply defined, that is, more like listening to headphones. Toe-in also improves the stereo effect for listeners seated in off-center positions. Having your speakers aligned with their backs parallel to the wall gives a more diffuse sound with a less defined central image. Toeing-in should be the last step in the placement of your speaker system. After finalizing speaker position and listener location, place the speakers with their backs parallel to the back wall or cabinet. Experiment from there, turning the speakers toward the listening area in 10-degree increments, until you achieve the desired effect.

Grille Installation

1. Position the grille over the front of the speaker so the top edge of the grille is above the top of the cabinet. Lower the grille into place. There is a metal flange on the top inside surface of the grille that snaps into a receptacle in the cabinet.

2. Swing the lower edge of the grille toward the cabinet. When the bottom of the grille is properly seated, spring-loaded hardware will snap it firmly in place.

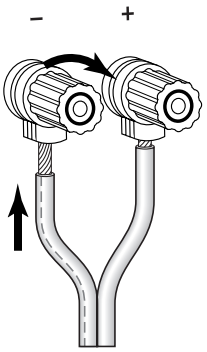


Choosing Cable

We recommend high-quality, minimum 16 gauge speaker cable for runs up to 25 feet (8m) and 12-gauge wire or thicker for longer runs. (We use a custom-configured 14-gauge oxygen-free cable in our crossover networks.)

Connecting with Bare Wire
Twist the strand of the wire into a neat bundle. Insert the bare wire into the holes in the terminals and tighten.

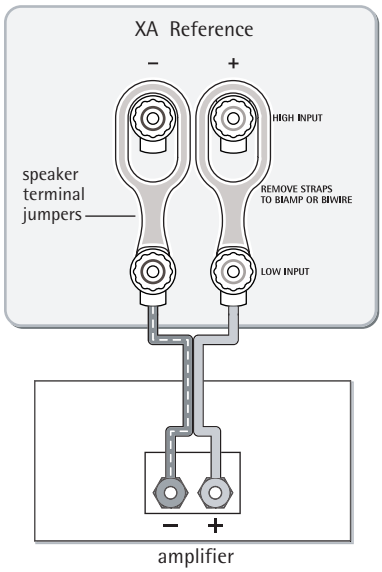
Connecting with Banana Plugs, Pins or Spade Lugs
The binding posts accept single banana plugs and pins, and can accommodate 5/16" or larger spade lugs.



Warning! To prevent electrical shock, always switch off the amplifier or receiver when making connections to the speaker system.

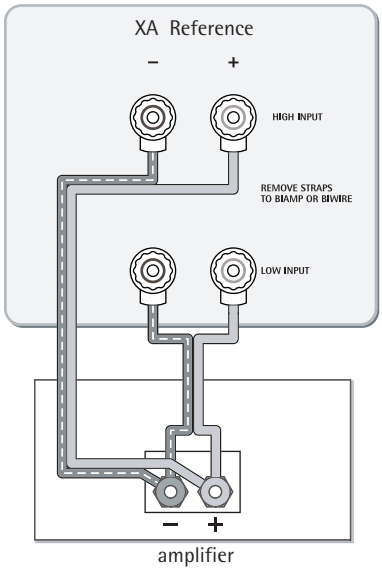
Basic Connections

Keep the speaker terminal jumper straps in place. When making connections between the amplifier and speaker be sure to connect + to + (red) and – to – (black).



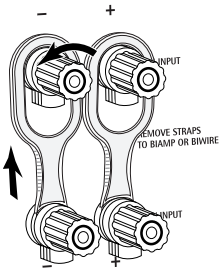
Bi-Wiring

1. Use equal lengths of the appropriate wire when bi-wiring each speaker. Consult your dealer for cable options.
2. Unscrew both sets of terminals and remove the jumper straps.

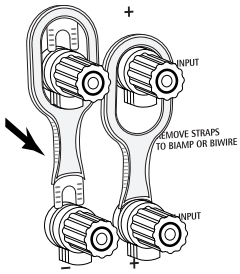


Jumper Removal

1 - Loosen both sets of terminals and lift the jumpers upward.



2 - Pull the jumpers straight off the terminals.

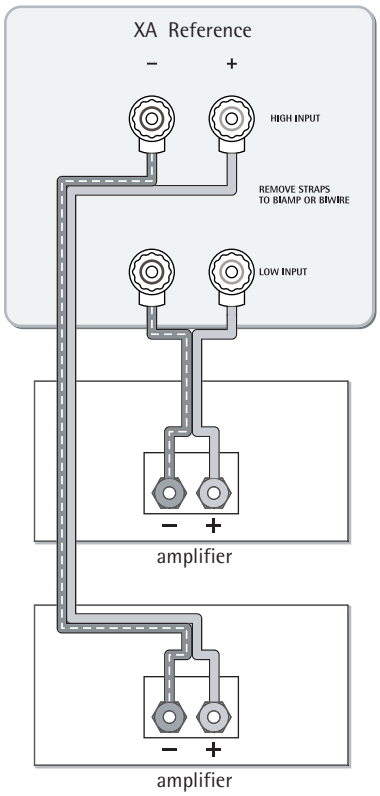


Bi-Amplifying

Using one amplifier for the bass and one for the high end

1. Unscrew both sets of terminals and remove the jumper straps.
2. Connect the cables from the bottom set of terminals to the low frequency amplifier driving the bass units.
3. Connect the cables from the top set of terminals to the high frequency amplifier driving the tweeters.

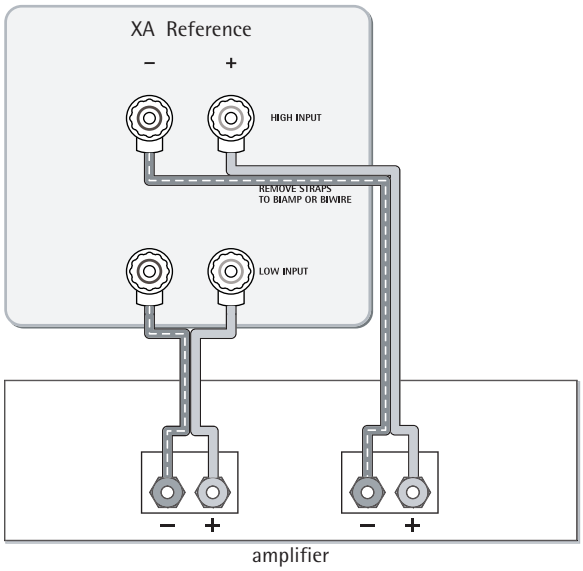
Do not use an external crossover. It will interfere with the phase and frequency response.



Using one amplifier for each speaker

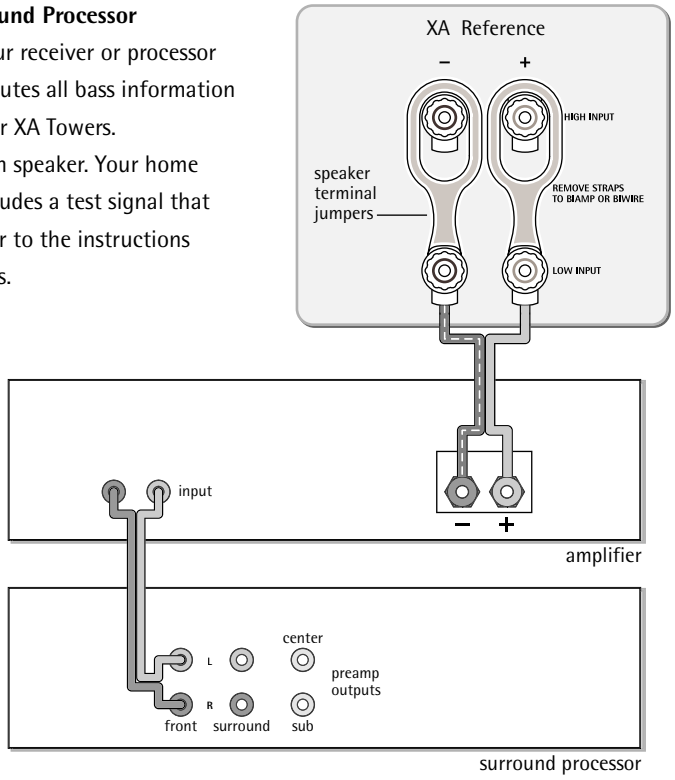
Make sure that the amplifiers are identical.

1. Unscrew both sets of terminals and remove the jumper straps.
2. Connect the cables from the bottom set of terminals to the first amplifiers right channel.
3. Connect the cables from the top set of terminals to the first amplifiers left channel.
4. Repeat steps 2 and 3 above for the second amplifier.



Using with a multichannel Surround Processor

1. Select the Large setting on your receiver or processor for your main speakers. This routes all bass information (typically below 100Hz) to your XA Towers.
2. Match the sound levels of each speaker. Your home theater system most likely includes a test signal that simplifies level matching. Refer to the instructions provided with these electronics.



OPTIMIZING THE SOUND, SYSTEM ADJUSTMENTS

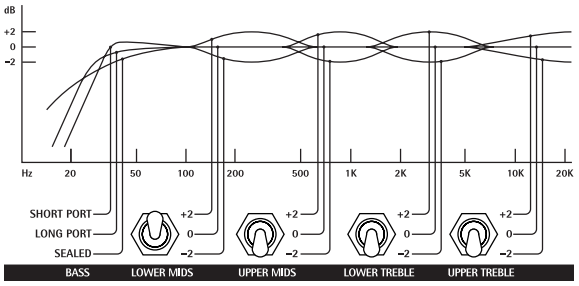
Probably the most unique feature of the XA Reference Tower is its total adjustability via a number of band trim switches and through 3 bass port options. At Snell, our experience with installing and optimizing our systems into a variety of homes has taught us the value of fine adjustments to a speaker's balance to suit both the acoustics of the room and the characteristics of allied equipment.

To do this we have split the sonic spectrum up into 4 sections. Each section has an electrical switch with 3 subtly different setting. The bass then has three port tuning options and there are three settings for the ambience-increasing rear tweeter. In the following section we will describe what to listen for in each band and how to adjust them for optimum performance.

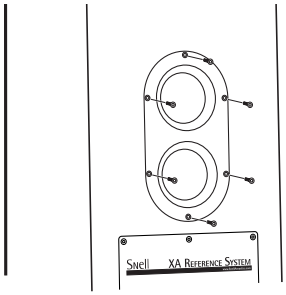
First please note that all adjustments are subtle with approximately 1.5dB difference per position. No combination of settings of the rear panel switches can make the XA Reference sound bad. Also note that it is acceptable to leave them all in their middle position as this will give the flattest balance in a very good room with very neutral electronics. We just feel that, with a little patience and experimentation, that an even better performance is achievable in most case with judicious adjustment of the various controls.

Low frequencies are adjusted via 3 optional port assemblies that are bolted into the rear of the cabinet. These assemblies give two tuning frequencies (24 and 36 Hz) and a sealed plate will convert the system to a non-vented enclosure. The system is shipped with the long port assembly (24 Hz). This will give the flattest and most extended bass response and is often the best choice for a full range system with no subwoofer. The blanking plate (no ports) will give a tighter bass character with less weight but more speed. The sealed option is probably best when using a subwoofer. Crossover blending between the towers and subs will probably be made easier with the lower order roll off and softer corner that the blanking plate will provide.

– continued

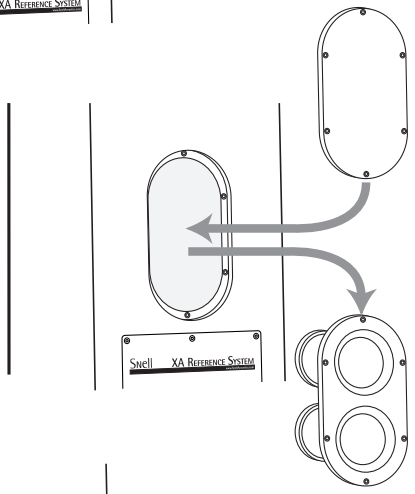


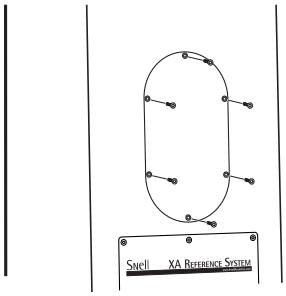
This is the system response graphic that appears on the input/control panel of the XA Reference. NOTE: The switch settings are for example only. They are not necessarily a recommended setting.



1. Remove the six screws that hold the ports in place

2. Replace the ports with the solid plate or the other port set.





3. Replace the six screws. Tighten them gradually in a star pattern until each is firmly set. Do not over tighten.

Low Frequency Adjustments, cont. –

The short port assembly will raise the tuning to 36 Hz and increase the level of mid-bass (from 40 to 80 Hz). The bass character will become more robust with some loss of the sense of extension.

Our advice for deciding which ports to use is to listen to a variety of music while concentrating on the bass character. Room placement will be a complicating variable and you may want to experiment with placement relative to adjacent boundaries first until you get the smoothest response and then fine tune with the ports. The 3 options will strongly impact low bass and to a lesser degree the upper bass. Switch to the short port if more upper bass seems called for. Switch to the blanking plate if a tighter bass character is called for and then repeat the listening on the same material.

The lower midrange switch will impact the region from 100 to 300 Hz. This will fine-tune the effects of near by boundaries and also floor to ceiling standing wave that a number of rooms have. Listen to naturally recorded voices and pay special attention to the balance between the lowest parts of male voice especially vowel sounds, versus upper edge and harmonics. If voices sound thin and lacking in body then try the increase position. If fat, try the decrease position. Lower brass instrument such as French horns and trombones also would be revealing of this section of the spectrum.

The upper midrange switch covers upper harmonics of human voice, especially vowel sounds like "i" and "eh". Again, listen and choose which of the 3 positions seems most neutral.

Next switch up the spectrum would be for **lower treble**. Excesses here give hardness to the character, whereas absences lend "sweetness". Some electronics and source components can add harness to the chain and could be compensated with the lower position. The upper position might be used if the room's acoustics are particularly dull.

The topmost spectrum adjustment is for the **upper treble**. This range gives sparkle to the sound and contains the highest harmonics of instruments, especially percussion instrument as well as the bite of some brass instruments.

All of the adjustments can be usefully employed to compensate for room acoustic issues. Also your listening distance might have some bearing. Close listening distances might warrant some reductions of the top two controls to prevent the system from sounding overbearing. At greater listening distances the same controls can offset the distant perspective that naturally occurs.

The **rear-firing tweeter** warrants special comment. The rear-firing tweeter adds spaciousness and ambiance to the soundstage, and is particularly effective when the XA Reference Tower is placed at least 12 inches (30cm) from a back wall. Snell has long included rear-firing tweeters in their tower speakers to compensate for the combination of increasing room absorption and increasing driver directivity at high frequencies. The rear-firing tweeter augments the energy of the front firing tweeter and evens out the power response within the room. Doing this will increase the sense of depth from the system and give a more distant perspective. These are highly subjective factors and you will want to experiment with the two different levels and off position of the rear-firing tweeter. The off position is important in instances where hard and flat reflective surfaces behind the system (such as glass walls) make the rear tweeter's output obvious. Our feeling is that multichannel systems will sometimes not need the full output of the rear-firing tweeter since multiple channels add to the system's spaciousness. Don't be afraid to make final settings by ear to suit your taste.

POWER-HANDLING

The power recommendation for the system assumes you will operate the amplifier in a way that will not produce distortion. All speakers can be damaged by a modest amplifier if it is producing distortion. If you hear a gritty noise or other signs of strain, immediately turn down the volume. Prolonged or repeated operation of your speakers with a distorted signal can cause damage that is not covered by the warranty.

CARING FOR YOUR SPEAKERS

For Painted Finishes (Including baffles, backs, and bases.) Use a soft terry cloth towel slightly dampened with water, glass cleaner or a diluted mild detergent. The towel should be just damp enough to wipe the surface clean without leaving a trail of moisture. Be very careful to not apply pressure to the fronts of the drive units. Do not use abrasive cleaners or any cleaner containing chemicals harsher than those found in glass cleaner.

For Oiled Natural Wood Finishes
To remove dust and fingerprints, use the same technique as above. If your veneer begins to dry, apply a light coat of rose or lemon wood oil. This should return the wood to its original richness. Do not use spray waxes. These will create a buildup and eventually cause the veneer to appear dull. Note: Your veneers appearance and color will naturally mature and perhaps darken over time. Avoid placing speakers in extreme conditions. If direct sunlight is unavoidable, be sure that there is nothing partially covering the veneer in order to prevent "tan lines". Avoid placing speakers where they could be subjected to standing water. It will cause the wood to swell, breaking apart glue joints and ruining the air seal. Grilles You can remove the grilles from the speaker system and wipe them with a damp cloth to remove any dust.

LIMITED WARRANTY

For five years from the date of purchase, Snell Acoustics will repair for the original owner any defect in materials or workmanship that occurs in normal use of the speaker system, without charge for parts and labor. Your responsibilities are to use the product according to the instructions supplied, to provide safe and secure transportation to an authorized Snell Acoustics service representative, and to present proof of purchase from an authorized Snell dealer in the form of your sales slip when requesting service. Excluded from this warranty is damage that results from abuse, misuse, accidents, shipping, repairs, or modifications by anyone other than an authorized Snell Acoustics service representative. This warranty is void if the serial number has been removed or defaced. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

If Service Seems Necessary

Contact the dealer from whom you purchased the speaker system. If that is not possible, call us at 978- 373-6114, or write to:

Snell Acoustics
143 Essex Street
Haverhill, MA 01832

We will promptly advise you of what action to take. If it is necessary to return your speaker system to the factory, please ship it prepaid in the original factory packaging. Please note that Snell Acoustics will not be held liable for shipping damage due to improper packaging. After it has been repaired, we will return it freight-prepaid in the U.S. or Canada.

Snell

143 Essex Street
Haverhill, MA 01832
phone: 978-373-6114
fax: 978-373-6172
email: info@snellacoustics.com
www.snellacoustics.com

Part #542-1023