Sigma

OWNER'S MANUAL

AND TECHNICAL WHITE PAPER

Infinity®

Sigma

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AND TECHNICAL WHITE PAPER

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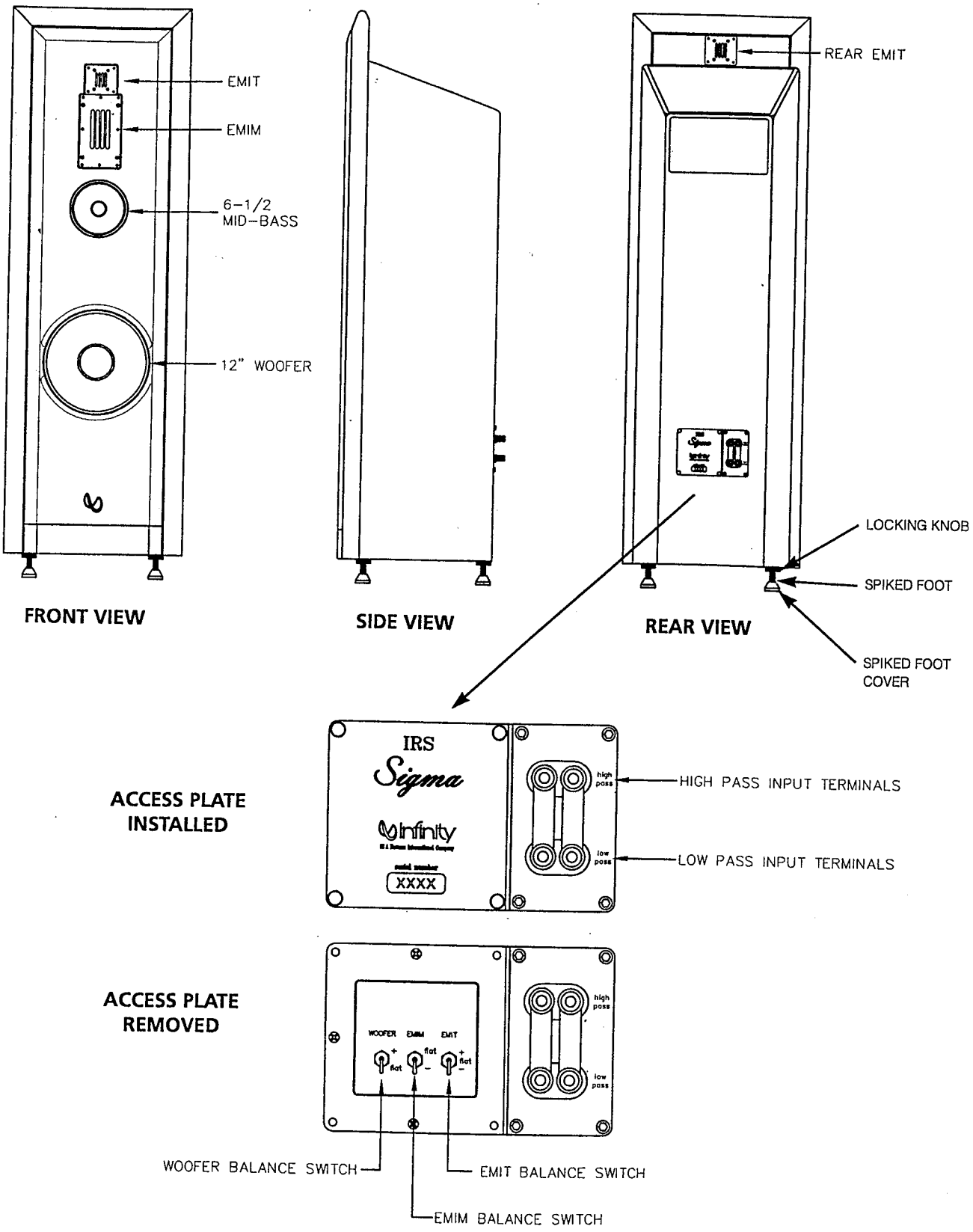
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INTRODUCTION

Your Sigma loudspeakers are the result of Infinity's more than 25 years of research into the acoustics, operation and design of high performance loudspeakers. The design goal for Sigma was nothing less than to achieve the highest overall level of performance, ever, from a single pair of loudspeaker enclosures. A corollary of that goal was to give them a reasonable size and an attractive appearance, important factors in making them welcome in any listening room.

Each Sigma loudspeaker employs unique Infinity technologies to deliver all of the hallmarks of high fidelity sound: Wide bandwidth, high acoustic power output, uniform coverage, smooth frequency response and extremely low distortion.

These characteristics enable a Sigma system to reproduce accurately the entire frequency spectrum, dynamic range and sonic levels of the original performance. In short, Sigma faithfully recreates the recorded performance in your listening room.

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THE INFINITY REFERENCE STANDARD SIGMA OWNERS MANUAL:

Manual Overview

This manual provides information about unpacking, locating, connecting, and using your Sigma System. The sections about Amplifiers and Other System Components, Wiring and Loudspeaker Placement come before the Unpacking instructions. This is because we want you to have a clear view of the system as a whole before you begin to think about the details of connecting and using your Sigma System.

Most people prefer to minimize the handling and moving of large, heavy loudspeakers and amplifiers. When you have a clear picture of the factors affecting the placement of these components, you may be able to make some essential decisions about equipment placement and the effects on other furnishings before you unpack. This in turn may result in less overall disruption and heavy lifting.

Please read this manual all the way through. Even if your dealer has done the heavy work and looked after the set-up details, we believe the manual will provide you with a better understanding of your Sigma System and the opportunities it gives you for truly superior sound reproduction.

Amplifiers and Other System Components

Overall Component Quality

Your Sigma System is one of the finest loudspeaker systems ever made. You and your Sigmas deserve supporting audio components of the highest quality. Audio systems are highly synergistic — excellent sound quality in any one component can raise the overall performance of the other components connected to it, while poorer quality can seem to diminish the overall result more than you would expect. Choose your other system components with the same care you have devoted to selecting the Sigma System.

Wiring

System cables, wiring, and connectors have come to occupy a central position in audiophile discussions about sound quality. We make no recommendations about specifics of cables and interconnects, except to note that the power transfer between the amplifiers and speakers should be as efficient as possible. This means using heavy gauge, low impedance speaker cables. There is no substitute for personal experience in the selection of audio components, and nowhere is this more true than in choosing cables and interconnects.

Maximum Power

As a practical matter, there is no upper limit on the power of the amplifiers you can use with the Sigma System. If you always listen at moderate levels, you can easily end up with amplifier power you never use. If you often listen at concert levels or beyond, then high power amplifiers (250W/ch and more) yield immediate dividends in dynamic range and clarity.

Your Sigma loudspeakers are capable of stunning sound pressure levels. If your music begins to sound bad at elevated listening levels, and these are the levels you require your system to reproduce, more than likely you have exceeded the capabilities of your amplifiers and not those of your Sigma speakers.

Placing the Amplifiers

Audiophiles often prefer to place the power amplifiers close to each loudspeaker, to eliminate power losses and distortions that can result from long speaker cable runs. Many prefer to locate the amplifiers midway between the speaker pair as a means of optimizing both proximity and aesthetics.

Cable Lengths

Please do not cut or order any cables to a finished length until you have determined the exact locations for all of your components. Cables that are too long rarely create problems (except for vastly too-long speaker cables), but cables that are too short are one of life's sharper irritations.

LOUDSPEAKER PLACEMENT

Few of us have the luxury of creating a listening room from the ground up. Even for rooms whose primary use is listening, other uses also must be accommodated. As a result, the types and locations of furniture, passageways, windows, and room dimensions, as well as floor, ceiling, wall materials and treatments, may not be the optimum choices from a purely acoustical point of view.

That is why your Sigma loudspeakers are designed to deliver inherently wide coverage, producing superior "staging" and imaging over a large listening area. Although the Sigma's planar drivers are dipole radiators (meaning that they radiate equally, but in opposite polarity, toward the front and rear), the rear housing of the Sigma has been designed to absorb some of the rear radiation, smoothing and widening the coverage, while still providing the "spaciousness" for which dipole radiators are noted. Its acoustic design makes Sigma unusually versatile at fitting into your particular listening room and delivering great sound.

The huge variety of listening room geometries, room acoustics, and user preferences make it impossible for us to recommend a particular set-up for your equipment. Serious listening and uninhibited experimentation with placements and aiming angles are your best path to sonic excellence.

The goal is a wide, realistic stage from left to right, with instruments and vocalists properly balanced in loudness, and correctly located in the sonic stage's width and depth.

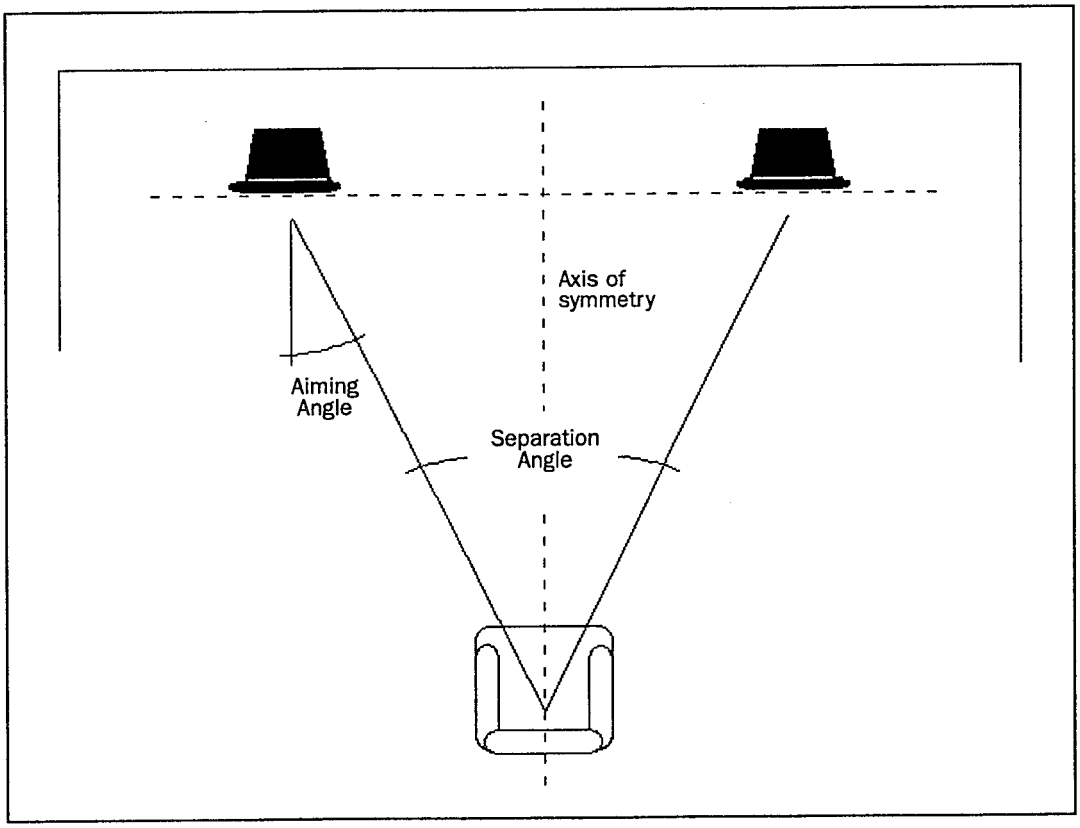
Recordings which have detailed program notes on the location of various instruments and/or vocalists at the time of the recording can be a great help in determining the optimum separation and aiming angles.

Separation Angle

A starting point for placement is to put the primary listening position(s) on the axis of symmetry between the two Sigmas, with the sight lines toward the speakers (the separation angle) forming an included angle of 60°. See Figure 2 for the basic geometry.

Because the Sigmas have wide dispersion and very smooth off-axis response, they can be placed so that they create the widest possible sonic stage. Widening the separation angle will widen the stage and the best placement will be one in which the Sigmas are as far apart as possible, yet create a complete sonic stage with no sense of a "hole in the middle." Smaller angles will be called for in some rooms, particularly when the speakers are necessarily close to the side walls; see *Aiming Angle*, following.

FIGURE 2: BASIC LOUDSPEAKER GEOMETRY



Aiming Angle

Unlike many conventional speakers, the Sigmas usually perform best when their front panels are in line, as shown in Figure 2, rather than "toed-in" to face the listening position.

When the room's geometry or its furnishings (such as the presence of a large home theater viewing screen) require a wide separation for the Sigmas that results in a "hole in the middle effect," adjusting the aiming angle, or "toe-in," can help to create the proper sense of the sonic stage. Toe-in the Sigmas only to the point that the hole in the middle is filled.

Placing the Sigmas very close to the room's side walls can create a variety of unwanted sonic effects These effects include an outward movement of the apparent locations of sounds which originate at the left and right of the sonic stage. The effects also include making sound sources more diffuse, rather than pinpoint; this tends to make soloists, for example, seem physically larger than they should be. All such effects are caused by too much sound reflecting off the side walls. If necessary, toe-in the Sigmas only to the point where the proportions of the sonic image are correct.

Distances to Room Boundaries

Like most large loudspeakers, Sigmas tend to produce their smoothest overall frequency response when relatively far from the walls of the listening room. In larger listening rooms, we recommend that you take advantage of this characteristic and locate your Sigma speakers away from the side and rear walls. There is no "magic" distance — as noted, the room's size, plus the composition, draping, and decoration of walls and windows, all have major effects on the overall sonic balance.

The distances of the two Sigmas to the rear wall should ideally be the same. If possible, the two Sigmas should also be the same distance from their adjacent side walls. Where the room's geometry or furnishings make this symmetrical placement of the speakers in relation to the walls impossible, you will have to experiment with the separation and aiming angles to achieve the best overall sound quality. The distance from the central listening position to each speaker must be exactly the same – within one inch (25mm).

Regardless of which wall, placement closer to a wall will increase the deep bass output, and corner placement will make an even larger apparent increase. There is no substitute for trying many positions. Even crazy-looking arrangements can be instructive, especially when the room's geometry is unusual.

UNPACKING

Your Sigma System has most likely been delivered, unpacked, and connected by the dealer from whom it was purchased. However, if you are unpacking your Sigmas, note that the unpacking instructions for the two loudspeakers are found on their cartons.

The size, weight and special connections of this system mean that extra care is required in unpacking and connecting it, and at any later time that you move it.

Spiked Feet

Please note that the speakers stand on spiked feet, which come with plastic caps installed to prevent injury to you and your belongings. The loudspeakers will perform best when the spikes make direct contact with the floor. If you wish to protect hardwood or other solid floors, leave the plastic caps in place.

To level the speaker and to provide firm support at each corner on uneven floors, you can adjust the height of each foot by screwing it in or out of the bottom of the speaker. The feet have knurled locking rings that you can run up against the base of the speaker to secure the height setting.

We recommend that you leave the plastic caps in place until all of the connections and adjustments are complete, and you are satisfied with the location and sound of the loudspeakers. Then, you can remove the plastic caps and adjust the height of the spiked feet to level the speakers. It is easiest to remove the caps and adjust the feet if you have a helper. Have your helper tilt the speaker to one side while you work on the feet which are free of the floor; then repeat by tilting the speaker to the other side. The Sigma is very heavy and care must be exercised during this procedure.

Please Keep the Packing and Cartons

We strongly recommend that you keep all the shipping cartons and packing materials. If you move or ship the system for any reason, carefully repack it with the original packing materials. Follow the packing order shown on the loudspeaker cartons.

LOUDSPEAKER SET-UP

Once you've unpacked the speakers and they are upright, you must perform several steps prior to connecting them for use. These steps require access to the rear of each loudspeaker. If the initial positions you have selected for the speakers do not permit easy access to their rear panels, set them in a position which gives you access for the following set-up and for cable connections.

Initial Balance Switch Settings

Remove the access plates located on the rear of the speakers next to the speaker input terminals. Keep the plate and screws handy because you will want to replace the plate after adjusting the switches.

Place each of the three balance switches in its FLAT position. You will most likely want to experiment with these switches once your system is fully connected and operating, so do not replace the access door at this time.

Woofer Switch — "FLAT" is down.
Midrange Switch — "FLAT" is up.
Tweeter Switch — "FLAT" is center.

Place the speakers near the initial positions you have chosen, leaving sufficient room behind them to make the cable connections.

Amplifier-Loudspeaker Connections

Speaker Wire Polarity

All speaker wires are marked with symbols, color stripes, different color insulation, or different color conductors (for example, copper and silver) to identify which conductor is which, at each end. This simple convention prevents inadvertent reversals of polarity that can cause poor sound quality.

Unless otherwise indicated, this manual assumes that the "+", copper, red, or striped conductor in a wire-pair is the "+" conductor and connects to the red, "+" or "4 Ohm" terminals of the amplifiers and speakers.

Sigma Input Terminals

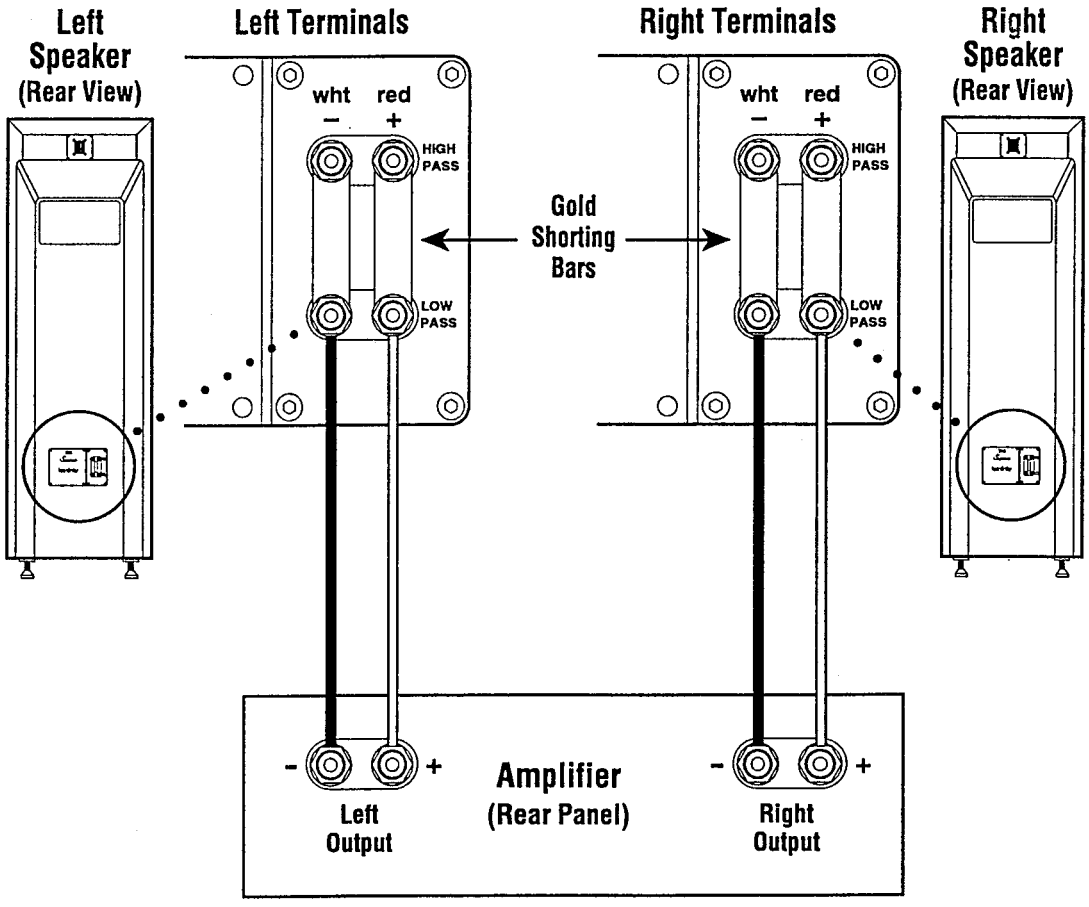
The Sigma's HIGH PASS and LOW PASS input terminals accept most of the speaker wire terminations currently in use. If you have wires with unusual connectors or terminals that don't fit Sigma's inputs, please seek assistance from your dealer. The input terminals' knurled posts provide plenty of grip for finger-tightening the connections. Do not use pliers to tighten the posts; you could damage them or strip their threads, making it impossible to undo the connections.

Amplifier Output Terminal Identification

Amplifiers have a variety of identifications for output terminals. Most solid-state amps have just two output terminals per channel; often these are red and black terminals, or screw-type terminal strips. Amps with output transformers have several output terminals, usually identified by the speaker load impedance they are intended to drive, such as 4Ω or 8Ω, and also a common terminal.

In this manual, we call the amplifier output terminals "+" and "–", meaning that the "+" terminal is the red, "4Ω", or "+" terminal, and the "–" terminal is the black, "common", "ground", or "–" terminal. When the amplifier has output terminals for more than one speaker impedance, always use the "4Ω" terminal for the "+" connection.

DIAGRAM A — CONNECTING SIGMA SPEAKERS TO A SINGLE POWER AMPLIFIER



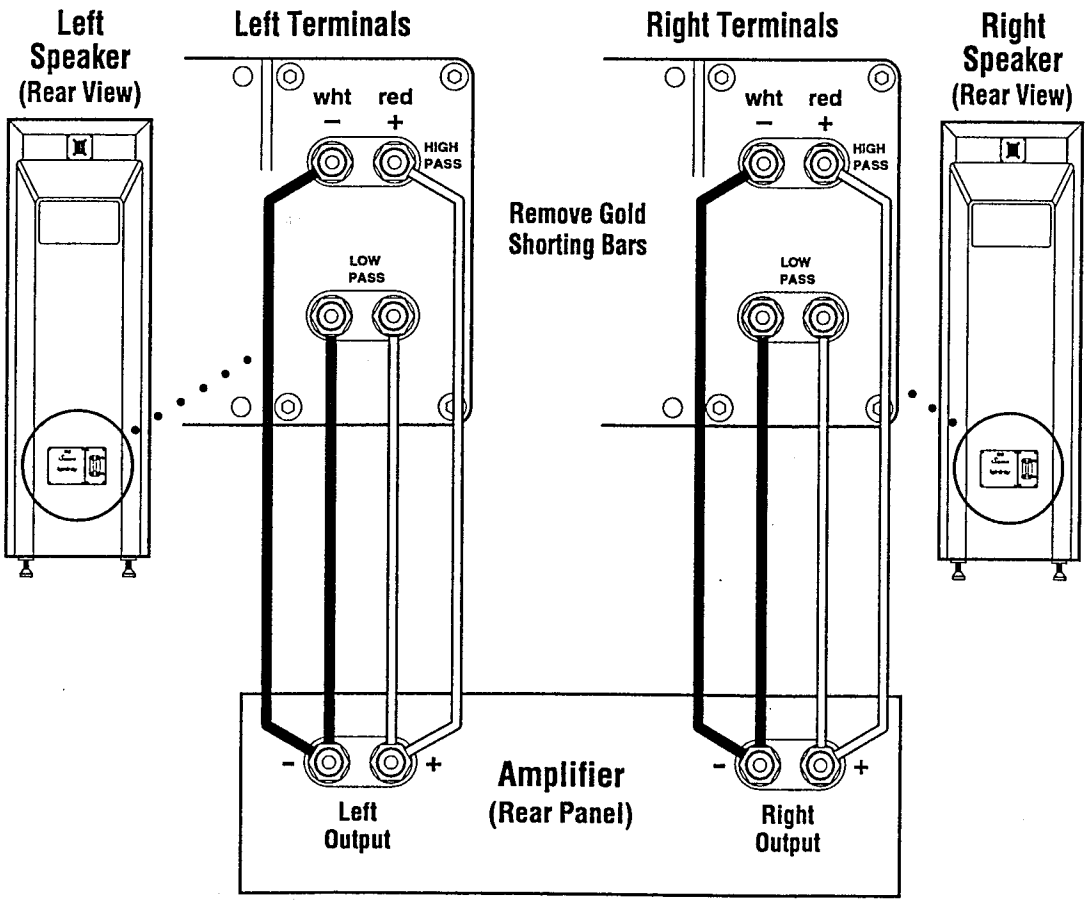
Power Amplifier to Sigma's Input Terminals

In order to achieve the best sonic clarity, always connect your speaker wires (when using a single power amplifier and a single pair of wire for left and right channels) to the upper set of binding posts. Make sure that the gold plated shorting bars which tie the upper and lower inputs together are tightly fastened.

Connect the plus ("+") terminal of the amplifier's left channel to the RED HIGH PASS terminal of the left Sigma speaker (the speaker on your left as you face them from your listening position). Connect the minus ("–") terminal of the amplifier's left channel to the WHITE HIGH PASS terminal of the left Sigma speaker. Repeat these connections for the right amplifier section and right Sigma speaker. Refer to ***DIAGRAM A*** (on page 6) showing this connection.

Your Sigma speakers may also be connected to a single power amplifier but with two sets of speaker wire (in parallel). Many listeners feel that this method of connecting the speakers (referred to as bi-wiring) delivers greater sonic clarity than when using only a single pair of speaker wires. The basic connection is the same as above, only with two separate sets of speaker wire and with the shorting bars removed completely. Observe proper polarity with each set of wires. Refer to ***DIAGRAM B*** (below) showing this connection.

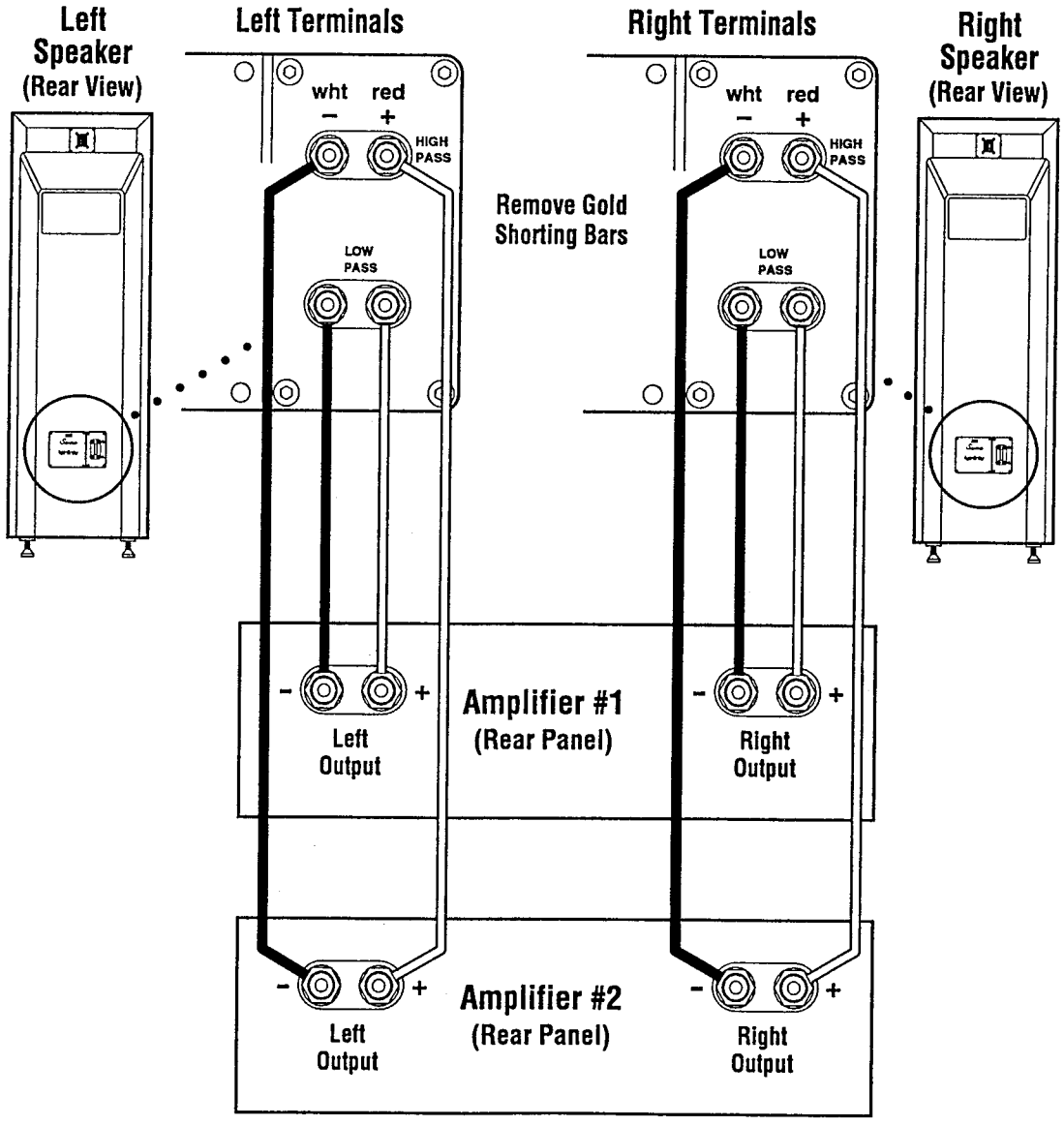
DIAGRAM B — CONNECTING SIGMA SPEAKERS TO A SINGLE POWER AMPLIFIER WITH TWO SETS OF SPEAKER WIRES (BI-WIRED)



Passive bi-amplification is another way to install your Sigma speakers. It involves use of two power amplifiers (usually the same type with the same power and gain), with each power amplifier connected independently to the HIGH PASS and LOW PASS terminals. One of the amplifiers provides power for the low frequencies and the other for the higher frequencies. The amplifiers may be connected in either the horizontal or vertical mode. This means that in the horizontal mode, one of the amplifiers supplies power to both the left and right Sigmas and it is connected to the HIGH PASS inputs, while the other amplifier supplies power to the left and right Sigmas and connects to the LOW PASS inputs. Refer to ***DIAGRAM C*** (below) showing this type of connection.

Vertical bi-amplification still requires two separate power amplifiers; however, in this case one of the amplifiers delivers power to the left HIGH PASS and LOW PASS terminals while the other amplifier delivers power to the right HIGH PASS and LOW PASS terminals.

DIAGRAM C — PASSIVE BI-AMPLIFICATION USING POWER AMPLIFIERS IN A HORIZONTAL ARRANGEMENT



Audiophiles feel that this type of configuration often yields the best results because neither amplifier has to deliver full current capacity into the speakers. Only one half of each amplifier feeds bass which means that the amplifier is not as taxed when it has to drive bass frequencies from both channels simultaneously. If you wish to install your system using the vertical bi-amplification method, please consult your dealer who will explain how this is done.

Active bi-amplification employs an external crossover and it is extremely complicated. It is best to discuss this type of speaker connection with your dealer. We generally do not recommend this type of arrangement with Sigma speakers.

First Time Power-Up and Use

Check Everything!

Before turning on the power to your system, confirm that all cable connections are fully and securely made, and that all switches and controls are in their recommended initial positions. Be sure that the pre-amp volume control is all the way down.

Power-up Sequence

Turn on the system in sequence from signal sources to pre-amp to amplifiers, keeping the amplifiers for last. Turn the amplifiers on one channel or stereo amplifier at a time, and wait for each to stabilize before turning on the next. This procedure gives you time to immediately turn off the amplifier in question, if there is any unusual or loud noise resulting from incorrect connections or control settings, before damage can occur. At the end of the initial power-up, you should be greeted by silence from your system.

Play Some Music

Put on a CD or LP or tape, and advance the pre-amp volume control. Play the system at a moderate level for a while and check that the left and right speakers are actually reproducing left and right channel sounds — a test CD with voices or sounds in each channel separately is very helpful for this. Verify that the system sounds well balanced from left to right with stereo music, and that each of the drivers is actually operating.

Sigma Woofer, EMIM and EMIT Level Switches

These switches do not change the levels of their respective drivers by very much, however, because the switches vary a wide range of frequencies (several octaves), even 1/2 dB of boost becomes quite audible.

The bass switch boosts the lower portion of the frequency spectrum by approximately 1 dB. It should be used if it appears that bass response is not adequately full. Speaker wire that is not totally compatible with the speaker and its electronics, room acoustics and speaker placement can cause diminished bass. A word of caution. At times, when bass is very tight and dry, it may appear that it is deficient. This is not necessarily the case; however, the ultimate decision as to how much (or little) bass the Sigmas should deliver is, clearly, up to you.

The midrange switch (controlling the EMIM) does not have a boost function; however, it will diminish midrange response by approximately 1dB. The switch operates in the critical middle frequencies and if the sound is overly bright in this portion of the spectrum covered by the EMIM, throw the switch to minus "–".

The high frequency switch controls the EMIT tweeter on the front and rear of the speaker. This switch offers 1dB boost and cut in an extremely critical area of the frequency response. If your system's sound is overly bright, use the minus "–" position. If there is a lack of airiness, place the switch in the plus "+" position.

These switches with their subtle control will help you obtain the best overall sonic balance from your Sigma speakers. Experiment freely with the settings to determine which combination produces sound that offers the best balance and realism with all types of music.

Maintenance, Trouble-Shooting and Things to Avoid

To remove the grille

Locate the two plastic plugs located on the rear left and right upper part of the speaker. Remove the tabs and place a screwdriver or similar device into the holes and push forward. This will separate the grille from the frame. Pull the grille forward from the front to remove. Replace the plastic plugs.

Cleaning

The Sigma enclosures should be keep dust free — simply wipe the finished surfaces with a soft, clean, lint-free cloth on a regular basis. The cloth grilles covering the rear of the speakers may be lightly vacuumed with a dust brush attachment. Do not vacuum over the location of the rear-facing EMIT tweeter at the top rear of the enclosure. The front grille cloth may be lightly brushed to remove dust. Do not vacuum over the openings of the EMIM and EMIT drivers.

Avoid connecting and disconnecting equipment without first turning off the power to all of the components

Long familiarity with audio equipment tends to make even experts casual about connecting and disconnecting equipment. Not turning off the power to each component can lead to low frequency pulses or bursts of high power noise that can damage amplifiers and/or loudspeakers. It is best to be cautious.

Avoid trying to find out how loudly the system will really play

This is like trying to find out how far you can stretch a rubber band — the answer is only known when the rubber band breaks. With a high performance system like the Sigma, it is easy to play music at levels well beyond those of actual performances. Of course, it also is tempting to play some sonic spectacular as loudly as the equipment will let you. Please remember that you can damage your equipment with sustained power levels beyond those required for realistic reproduction.

This is especially true when an amplifier is driven into overload (clipping) and it generates huge amounts of high frequency energy not found in any ordinary acoustic signals. This problem is most frequently encountered when amplifiers of insufficient power are used. It is hard to tell the difference between amplifier overload and loudspeaker overload, and to compound the matter, some recordings contain sounds that can absolutely convince experts that something is wrong with the playback system.

Any electronic or mechanical system can be driven to the point of failure and your Sigma loudspeakers are no exception. After you have become familiar with your new system and have sustained listening experience with it, a doubt or a hunch that all is not well is often correct. If you have any doubts about the system's performance, call in an expert immediately.

Sigma

THE INFINITY REFERENCE STANDARD SIGMA TECHNICAL WHITE PAPER:

For the Listener Who is Technically Inclined... A View Into Sigma's Advance Design and Technology

One of Sigma's major design goals was to make further improvements in Infinity's planar driver technology and in overall system design that would deliver higher levels of acoustic performance from a single pair of loudspeakers; performance that would approach that of Infinity's four-enclosure Beta system, but at significantly lower cost and in a more space-efficient and decor friendly form.

Each Sigma loudspeaker contains a pair of high efficiency, high energy Electro Magnetic Induction Tweeters (EMIT), one facing forward and the other firing toward the rear; a newly designed high energy Electro Magnetic Induction Midrange (EMIM); an IMG (injection molded graphite) midbass coupler, and an IMG heavy magnet woofer. The drivers are mounted in a vertical array in a large, gently curved front panel whose side "wings" form an acoustic baffle and launching pad for the drivers. The forward-firing woofer is mounted in a sealed enclosure that is integrated with the vertical panel and forms the panel's supporting bass.

The Attraction of Planar Drivers

Planar drivers are attractive to loudspeaker designers because they potentially offer the closest approach to Lord Rayleigh's theoretical ideal of a perfect acoustical piston. The practical difficulty in any driver is getting the diaphragm surface to move absolutely uniformly, so that all parts move linearly, in the same direction, by the same amount, at the same time. Although not perfect, Infinity's planar drivers came very close to this theoretical ideal.

Infinity's breakthrough solution is to use two arrays of magnets, one on each side of the diaphragm, which have "like" poles facing each other. Because like poles repel, the opposing fringe fields are strongly compressed into a powerful, uniform and linear field. To wring maximum performance from this unique design, we optimized the magnetic circuit and its field geometry using advanced computer modeling techniques.

The advantages are plain: The magnetic field in which the voice coil and diaphragm move is both strong and uniform, yielding higher efficiency and much lower distortion. The high field strength and the resulting high motor strength mean that the diaphragm-to-magnet spacing can be large enough for the excursions needed to generate very high acoustic outputs. Finally, the drivers can be physically small enough to yield wide dispersion and outstanding overall acoustic power response.

While the solutions to the problems of the magnetic circuitry resulted in considerable performance gains, additional attention was paid to the construction of the laminated diaphragm/voice coil assembly. A planar diaphragm (and its voice coil) has to be under

tension in order for it to have a zero-signal resting point at the exact center of the magnetic field — this assures full excursion capability in both directions of movement and fast restoration to center when driving signals cease. However, even relatively inert substances become resonant when under tension. This means that the diaphragm/voice coil assembly must include damping material to suppress resonant action.

Midrange (and high-frequency) diaphragms also must have extremely low mass in order to have high efficiency and quick acceleration under the drive of fast transient signals. For years, Infinity has employed a polyimide film for the diaphragm base material of our planar driver designs. The polyimide film offers excellent strength, very low mass, and extremely high dimensional and thermal stability when laminated to the voice coil (which becomes hot under high power drive conditions). Its strength makes it easy to work with in assembly operations and it also offers superb production consistency.

We have developed exclusive laminating techniques and procedures to work with extremely thin films of polyimide, aluminum and adhesives. The intricate voice coil shape is etched from a full-surface aluminum film after its lamination to the other components. The adhesive layer which bonds the voice coil also is etchable. After etching, the adhesive remains only under the actual aluminum voice coil trace, which helps to reduce total mass. The voice coil trace and the adhesive together are only one-thousandth of an inch thick — and most of this thickness is in the aluminum trace to give the voice coil high current handling capability.

However, the issue that most concerned us was that of damping the laminate diaphragm structure to eliminate the standing waves that develop when the wavelength of reproduced sound is smaller than the dimensions of the diaphragm surface. This phenomenon, known as modal break-up, is found in diaphragms of any shape. It is most audible in the diaphragms of large drivers such as midranges and woofers, because the frequencies of break-up in these drivers are in the most sensitive range of human hearing. The challenge was to find an adhesive damping material which would suppress the break-up without adding excessively to the mass of the diaphragm. It would make no sense to develop ultra-thin, light diaphragms only to give up the low-mass benefits by using a heavy damping material that would result in a diaphragm with the mass of a conventional material.

After much searching, an isothermic damping material was found which meets the design objectives of low mass and high damping. In the final design, the damping layer, which is a pressure-sensitive adhesive, is layered between the 0.002" thick polyimide base film and a second, much thinner layer of polyimide which provides both a smooth outer working surface and additional strength to the final diaphragm. The complete laminate assembly, including the voice coil, is only 0.0043" thick, approximately one and a half times the thickness of a typical human hair.

Together with the improvements in the magnetic circuit, this advanced diaphragm construction gives the new EMIM driver more than 12dB greater dynamic range than the previous Infinity EMIM design, as well as smoother response and wider bandwidth. These performance gains extend to the EMIT driver as well.

The construction of the new EMIT tweeter diaphragm is like that of the new EMIM driver and shares all of its sonic benefits. The EMIT's primary difference is in thickness—the complete EMIT diaphragm is a mere 0.0018" thick, less than half the thickness of the EMIM construction. This means that it also has less than half the mass, an element critical to the upper bandwidth of a tweeter's response.

The low mass diaphragm and powerful motor combine to give the EMIT on-axis frequency response to 45kHz and outstanding power response to well beyond 20kHz, which is remarkable performance by any standard. As can be seen, all of the magnetic circuit refinements and diaphragm quality found in the EMIM are present in the EMIT, making it one of the world's finest high-frequency reproducers.

The Infinity IMG™ Woofer

Reproducing low frequencies at high sound levels requires moving an enormous amount of air, more even than the best planar drivers can achieve. This means that a high output woofer must employ another design. A standard shape for low frequency driver diaphragms is the cone. It is a mechanically strong shape, one that can be made adequately large and that is easily formed from a wide variety of materials. It is also well-suited to being driven from its apex, making it ideal for attaching a compact, powerful motor. In short, the cone is a good shape to use for woofer diaphragms.

Sigma's closed box design, woofer cone mass, woofer throw, voice coil length and cone size have been carefully calculated to deliver deep, clean bass response without the need for additional expensive bass-enhancing devices. Bass response of Sigma extends to below 30 hertz, down by 3dB at 26 Hz, and it is extremely linear to its point of rolloff.

Sigma's Woofer Enclosure

In general, woofers present the fewest surprises and problems to a loudspeaker designer. A closed box woofer design primarily requires an enclosure that is acoustically rigid and inert, and that is mechanically suited to supporting a large, heavy woofer driver (and often, other system components).

The Sigma's woofer enclosure is made from Medium Density Fiberboard (MDF) with walls one inch thick. This pressed-wood material is substantially more dense than the fiberboard material commonly used in speaker enclosures. The enclosure is heavily braced and tapered toward the rear, so that it does not have parallel walls, a design that helps suppress resonances. The front baffle, to which the woofer driver is mounted, is more than three inches thick. The stiffness and mass of this front baffle, which is partially made up from the vertical baffle that supports the planar drivers, helps to give the woofer a stable platform for generating high-acceleration (>90G) bass cone motion.

The woofer enclosure is filled with sound-absorbing material that converts the acoustic energy of the woofer's rear wave from adiabatic compression to isothermal — in other words, from sound pressure into heat. This transformation of energy makes the volume of the enclosure look "bigger" to the woofer, extending bass response. The filler also prevents the acoustic energy, particularly at frequencies above 150Hz from reflecting off the interior of the enclosure, passing back through the woofer cone and into the room as unwanted distortion. The resulting high-mass, high-stiffness, high-absorbency enclosure has no audible "box sound" from the operation of the powerful woofer driver.

The Disadvantages of Uncontrolled Dipole Radiation

Sigma's planar drivers, the EMIM and EMIT, place difficult constraints on enclosure design. Planar drivers usually are operated as dipole panels that are free to radiate equally from both sides. In order to prevent the out-of-phase interference and cancellations described previously, these panels often are large, acting as their own baffles at upper midrange and tweeter frequencies.

Since dipole speakers freely radiate equal energy from both side of their diaphragms, they generate a great deal of acoustic energy that is not directed to the listener, but which instead indirectly reflects off of room surfaces, and then interferes with the direct sound.

Even more significant are the cancellation effects that occur in the near field of the loudspeaker. These near-field cancellations, which are the result of baffle-cutoff effects and of reflections and diffractions, have a powerful negative affect on the quality of the direct sound reaching the listener.

The acoustic result of these direct and indirect phase cancellations is the creation of acoustic "comb" filters that cause manifold and serious deep notches in the frequency response of the speaker. The sound quality of uncontrolled dipole speakers is often promoted as having unusual "depth." In our experience, however, this depth is artificial; it is actually the result of amplitude variations caused by the comb filter action of the dipole radiation. Instruments and voices typically seem to move back and forth on the acoustic "stage" as they go up and down the scale, moving in and out of the amplitude notches of the comb filters. They literally fade in and out, creating a false sense of stage depth.

Ideally, we would like to completely absorb the rear wave of the planar drivers. Unfortunately, the low mass diaphragms of our planar designs, which are a huge benefit in generating accurate sound, also create difficulties. These ultra-thin, light diaphragms are essentially transparent to acoustic energy, which passes right through them. Even materials that are ordinarily considered absorptive can reflect considerable energy, especially at longer wavelengths. This means that any sound waves reflected from a rear enclosure or its filling, however weak, will enter the room as a source of phase distortion. Furthermore, a sealed enclosure can load or stress the diaphragm, adding "stiffness" to the system which impairs its designed operation.

Rather than suffer the ill effects of uncontrolled dipole radiation, or trying unsuccessfully to absorb completely the rear wave, Infinity experimented with reducing and controlling the rear wave energy.

The first thing that was done was to adopt a slightly rounded baffle front surface, into which the planar drivers fit flush, in cutouts. This baffle design makes the grille material and its frame an integral part of the driver's mounting frame, which then smoothly joins with the baffle opening. Furthermore, the frames and solid face surfaces of the drivers are covered with acoustic felt to prevent reflections that cause response anomalies in the upper midrange and high end. The smooth transition from driver to gently rounded baffle ensures the projection of uniform wavefronts at all radiated frequencies, free from "fold-back" cancellation effects caused by the diffraction that occurs at abrupt edges of any kind. The baffle's width gives the lower frequency drivers sufficient area to ensure smooth waveform launch.

Even with this advanced baffle design we discovered that cancellation effects were occurring in the lower midrange that adversely affected the uniformity of the total power response. One problem is the deep cancellation wells, or notches, at 0° and at 180. The second problem is amplitude notching that occurs at approximately 800Hz, at 90° (the on-axis response), and is a side-effect of the baffle cutoff frequency.

As mentioned, Infinity decided to experiment with partial absorption of the rear wave. We found that by carefully sculpting special long-fingered foam into a shape that narrows in width and depth behind the progressively smaller drivers, the dipole cancellations could be nearly eliminated. At the same time, the front hemisphere response significantly improved in smoothness and breadth, indicating improved acoustic power response. This wide, smooth power response of Sigma is a key to its open, smooth sound quality at nearly any listening position.

Sigma's Radiation Pattern Control: EMIT Acoustic Filter

The new EMIT tweeter design of the Sigma system offers improved vertical dispersion compared to the previous design. We achieved this by making the diaphragm shorter. However, in order to maintain enough diaphragm surface area for smooth response at the lower end of the new EMIT's range, the diaphragm had to be widened. So, while the vertical dispersion widened, the horizontal dispersion narrowed above 8kHz.

This "beamy" effect actually appears in every tweeter, regardless of the diaphragm shape. As the wavelength approaches the dimensions of the diaphragm, the waveshape begins to become planar rather than spherical. In a typical 1" dome tweeter, for example, this narrowing, or "beaming" becomes serious at about 10kHz. If the dome had flat power response, the on-axis response would actually rise, and some do, however most show a roll-off in power response due to the reactive mass of the dome. The on-axis frequency response of such a tweeter may show a "flat" characteristic out to beyond 20kHz, but this is only because the energy is concentrated in an increasingly narrower angle. The actual power response of the dome is falling off rapidly, beginning its drop-off as low as 6kHz.

As discussed previously, the EMIT diaphragm provides extremely wideband response — on-axis, to 45kHz — and it also has exceptionally good power response to well beyond 20kHz. This means that the narrowing of the horizontal dispersion actually causes a strong rise in on-axis response above 10kHz. For the new EMIT tweeter, we needed a way to narrow the horizontal opening at high frequencies, so that wide dispersion is maintained and the on-axis response flattened. At the same time, we needed to keep the opening wide at lower frequencies to assure flat response and high output.

This difficult problem in dispersion control caused a lot of thought and experimentation. In the end, we designed a multi-layer fabric acoustic filter that is relatively transparent at lower frequencies and relatively absorbent at higher frequencies. This filter gives exactly the control needed to have broad dispersion above 8kHz, both vertically and horizontally.

To further broaden the top two octaves of Sigma's power response, a second EMIT was placed in the rear of the baffle, outside of the foam rear housing, so that the resulting wide overall power response gives a pair of Sigmas an exceptional quality of spaciousness and "air."

Passive Crossovers

Sigma's planar drivers all employ passive crossover networks that are driven from a set of input terminals separate from those for the woofer section. The benefits of bi-amplification are so important that even inexpensive loudspeakers now often have bi-amp capability. The two pairs of gold-plated input binding posts for the woofer section and for the upper end of the loudspeaker are located on a connector panel, on the rear of the speakers.

The passive crossovers are located within the woofer enclosure. The individual boards are as widely separated in the enclosure as possible in order to reduce interaction among the various components, particularly the inductors. The component parts are of very high quality, each selected to perform its task in the way that works and, most importantly, sounds best. Glass-epoxy circuit boards with heavy copper traces, low-loss polypropylene capacitors, precision resistors, high-grade inductors, high-quality cabling, gold-plated connectors — all of these premium quality components affect and improve the sound of the loudspeaker.

Three switches on the back of the enclosure, behind an access door, provide for small but highly significant adjustments of the relative level of each section.

We sincerely believe that the Infinity Sigma establishes a new standard of excellence in high fidelity loudspeakers for use in the home. While not compact, or even moderately small, Sigma nevertheless offers a level of performance that substantially exceeds its physical size. It has the wide bandwidth, high output, low distortion, broad power response and dynamic range to reproduce faithfully any kind of music in the home at realistic, live concert levels. Sigma's reproduction is so clean that listeners often do not realize that the system is playing at ear-bending levels until they attempt to talk over it, and suddenly realize that not only can they not hear each other, they cannot even hear themselves.

We've done our best to give Sigma qualities not found in many other speakers, from its precision and care in manufacturing, to its appearance and sonic stature. We hope that this look at the technology and art of Sigma helps you to appreciate the achievement we believe it represents.

About Infinity:
Over a Quarter Century of Sonic Excellence

Infinity Systems, Inc. was founded in 1968 from a passion for music, with a commitment to excellence and a drive to perfection. Its founders brought advanced aerospace technology and materials science to the task of building the finest possible loudspeakers.

The company's first product, the Servo Statik 1, was the world's first hybrid three-piece system, employing a servo-controlled subwoofer and a pair of electrostatic satellites. The Servo Statik immediately captured the attention of audiophiles and Infinity was on its way to creating an American tradition of breakthrough audio technologies.

Today, Infinity builds advanced audio products covering a wide range of audio applications, with advanced technology loudspeakers as a primary focus. Whether for audiophile-grade stereophonic reproduction, high performance home theater, or high-quality, yet high-value smaller systems, Infinity's goals remain the same as they were at the company's founding — to extend the boundaries of the art and science of loudspeaker design and manufacturing.

The term "High End" and the name Infinity have become synonymous over the past 27 years in the audio world. Infinity Systems, founded with the breakthrough speaker, the Servo Statik One, has time and time again hit home runs with products that pushed the state of the art even farther than ever thought possible at the time of the company's founding.

The firm's secret has been its commitment and total dedication of resources to innovation at the very highest levels of audio reproduction. Striving to achieve a theoretical ideal, innovation upon innovation has driven Infinity to the forefront of the audio community as an internationally leading manufacturer of the "world's finest loudspeakers."

After the development and release of Epsilon, Infinity's first controlled dipole loudspeaker, Sigma was conceived and developed as a lower cost version of Epsilon, without the servo system and the L-EMIM midbass driver. The same design theory which drove the development of Epsilon was employed in the design of Sigma. The newest generation of EMIM™ and EMIT™ planar drivers, the same as which constitute the mid- and upper-frequency ranges of the Epsilon, were used as the heart of Sigma. The lessons learned involving cabinet and driver interaction were further explored, refined, and perfected, making Sigma one of the finest loudspeakers ever produced, regardless of cost.

When driven by comparable electronics, Sigma's speed, transparency, imaging, and sheer musicality is awesome, far more lifelike than conventional designs, including uncontrolled bipoles and dipoles. Sigma represents a genuine breakthrough in audio reproduction which moves us another step closer to what it is all about . . . the recreation of the live musical experience.

DECLARATION OF CONFORMITY

CE

We, Infinity Systems A/S
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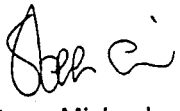
DDK-3460 Birkerød
DENMARK

declare in own responsibility, that the product described in this owner's manual is in compliance with technical standards:
EN 50 081-1/1992
EN 50 082-1/3.1995



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