

# VANDERSTEEN

## LOUDSPEAKER DESIGN AND APPLICATIONS



### DESIGN

Every Vandersteen loudspeaker is designed to be as accurate and as true to the original music, voice or sound as possible. To do this, we had to abandon conventional loudspeaker engineering concepts with their inherent limitations and develop new designs with greater performance potential. As you can see in the cut-away picture, Vandersteen speakers have a very unique internal design. We discovered that the baffle holding and surrounding the drivers in a conventional speaker affects the sound of the drivers just like holding CD cases on either side of your mouth affects your voice. Mounting the drivers in individual, minimum-sized, curved-edge enclosures rather than a baffle or front panel dramatically reduces early reflections and diffraction and significantly improves our loudspeakers' performance. This boxless mounting of the drivers provides an open sound and allows the texture and dynamics of each instrument, sound and voice to be reproduced with astonishing detail and transparency.

To insure that the outputs from the different drivers all reach the listener at exactly the same instant, the individual driver enclosures are staggered to perfectly align the drivers. The aligned drivers are all connected in positive phase so that they push and pull in unison.

Each frequency range is reproduced by a single driver to escape the detrimental effects of multi-driver interference. Above the omni-directional deepest bass, the drivers all fire forward to insure easy placement and avoid the distortions and response variations of multi-directional (bi-polar) designs. Round dowels support the open-center wood top and acoustically transparent grille cloth. The surface areas of the dowels and wood top are minimized to insure that their vibrations are not audible. Although it has often been shown that anything round—like a broom handle—leaned up against a speaker is inaudible, we have set the dowels at carefully calculated distances and angles from the drivers to insure that they do not cause any audible interference. So while the Vandersteen design does not lend itself to the currently popular narrow look, the narrow speakers that simply round their baffles, cover their baffles with an absorbent material or use fitted grille frames to reduce diffraction do not offer the uncompromised performance of our aligned, baffleless, phase-correct design. Beyond the sonic advantages, our design also allows a distinctive look that is cost effective and visually pleasing. In a conventional speaker, the wood veneered cabinet is often the most expensive component. (Over 65% of the total manufacturing cost.) The veneer takes considerable time and skill to finish and the entire cabinet is useless if it is even slightly scratched or dented during assembly. With their unique construction and grille cloth wrapped finish, our cabinets account for less than 16% of the total manufacturing cost. We are able to invest these huge savings in the drivers and crossover parts directly responsible for sound quality. With better critical components than many speakers costing three times as much, each Vandersteen model is an exemplary value offering superior performance, reliability and consistency.

The design and physical appearance of our speakers have proven to be very flexible as the small amount of exposed wood allows them to blend into and complement a wide variety of decors. (See your dealer for information on custom finishes.) Due our popularity and wide acceptance, other companies have tried to make their speakers look like Vandersteens. But don't be fooled, behind the grille there is a box speaker with all the box speaker problems.

## **AUDIO APPLICATIONS**

Vandersteen full-range speakers are suited to all types of music, systems and environments. They reveal small differences between state-of-the-art associated components, yet they can be driven by moderate electronics with excellent results. They play at realistic levels without strain while their satisfying reproduction of the deep bass convincingly conveys the music's rhythm and timing. They recreate the music's subtleties and nuances as well as its power and crescendos throughout an expansive listening area. They are easy to place and accommodate within your domestic situation and they maintain their significant performance advantages in any listening environment. There is no distorted and time-delayed reflected sound from rear facing drivers to interfere with the direct sound so they combine maximum dynamic contrast with superior transparency and detail on everything from simple vocals to complex orchestral pieces. Whether you're sitting back in your easy chair with something soothing or air guitaring with something wild, Vandersteen speakers realistically recreate all the music and all its emotion.

To further enhance the performance of the entire system, Vandersteen 2Wq powered subwoofers can be added to any of our full-range models. While it may seem unconventional to use subwoofers with speakers that already have such excellent bass response, filter theory dictates that the main speakers must have predictable response at least an octave below the crossover point to insure proper blending with the subwoofers. For an 80Hz subwoofer crossover point, the main speakers must have predictable response to 40Hz or lower. This is why it is impossible to successfully mate subwoofers with mini-speakers--the limited range small speakers simply cannot reach the required full octave below any reasonable subwoofer crossover point. But when they are mated with full-range Vandersteen speakers, the 2Wq powered subwoofers reduce the demands on the main amplifier as well as the speakers so that the system's treble and midrange are improved in addition to the bass enhancements. Your favorite music sounds better and your system has taken the first step toward being video compatible.

## **VIDEO APPLICATIONS**

Just twenty years ago, the only way to fully experience a film at home was to purchase a projector, find a good print of the film you wanted to see and add a big room onto your house to hold everything. Not surprisingly, most people just waited until the films they missed at the theater ended-up on TV and then endured them on a small screen with anemic, mono sound. Now, videodisc players, hi-fi VCRs, large-screen TVs and thousands of movies on disc and tape allow you to view films with an involving picture and multi-channel surround sound in the convenience and security of your own home.

As a loudspeaker manufacturer, we closely followed this evolution, paying particular attention to the unique demands and requirements that film sound placed upon the speakers in the system. We examined the basic concepts behind the different approaches to film sound reproduction and evaluated the actual results. We ultimately discovered that a few systems had superior clarity, intelligibility and realism that other systems could not begin to match. Based upon these better systems, we developed an innovative center speaker and recommendations on building a phase-correct, high-fidelity home theater system where you, your family and your friends can experience music, films and even broadcast television with maximum sonic realism.

Because they are called home theater systems, many people mistakenly assume that movie theater sound is the reference. While a home theater system does try to create the same emotional experience as viewing a film in a movie theater, the sound in a home must convey

more of the feelings and sensations than the sound in a movie theater. The sheer size of the movie theater picture commands your attention and manipulates your emotions more effectively than even a large TV screen. Without the overwhelming picture, the sound in a home theater system is much more crucial to the success of the experience.

In a movie theater, it is ultimately more important that every paying customer be able to understand the dialog and hear the music and sound effects than it is for everything to sound its best. Since movie theaters don't charge more for the better seats, their systems are engineered so that the kid in the front row and the guy way back in the rear corner hear adequate sound even if it is detrimental to the sound in the central part of the theater. In a movie theater, the sonic performance for the best seats is compromised to improve the performance for the worst seats. Engineering for this extreme level of consistency guarantees only consistent mediocrity. Luckily, it is not a mediocrity you have to live with in your home system.

In your home, you control where people sit and since you probably will have less than ten viewers, instead of more than a hundred, you don't need the sonic compromises of a movie theater. You can arrange the seating where everyone is in the optimum viewing and listening area and design the audio portion of your system for extreme realism and clarity rather than for the movie theater's extreme consistency. You can apply the lofty standards of high-end audio to your high-fidelity home theater system.

An accurate, detailed two-speaker music system is the perfect basis for a high-fidelity home theater system. Speakers and electronics that sound real on music will also sound real on voices and other film sounds. Films contain many sounds of real life that we hear everyday so we instinctively use those familiar sounds to evaluate the sonic realism of the experience just as we use flesh tones and other intimately familiar clues to evaluate the visual realism. If your system cannot realistically reproduce familiar sounds as well as familiar sights, you will never be fully drawn into the emotional experience of a film.

Whether you build your home theater system from scratch or as an extension of an existing music system, the performance of the core components--the front left and right speakers, the preamplifier and the main front amplifier--will define the ultimate capabilities of the entire system. The core components are where an investment in better speakers or a superior preamplifier or power amplifier will significantly improve the performance of your system on both film and music.

Vandersteen full-range speakers excel as the core speakers in a high-fidelity home theater system. Their accuracy enhances realism while their detail and transparency convey the background sounds that contribute to a film's mood and ambiance. As noted in the Audio Applications section, they have the low-frequency extension to seamlessly blend with subwoofers. Their phase-correct design allows you to build a coherent and cohesive totally phase-correct system that performs much better than a conventional home theater system on both films and music.

Once you have your core components, the next step in building a home theater system is the addition of subwoofers. While subwoofers are optional in a music system, they are an integral and required part of a home theater system. Modern filmmakers take considerable artistic license with the low frequency content of sound effects to create incredibly dynamic sounds that would never occur in the real world. Even with full-range main front speakers and a powerful main amplifier, these high intensity low-frequency sound effects can only be properly reproduced by subwoofers and can damage a system without subwoofers. While we recommend using a stereo pair of subwoofers, at least one is required in every home theater system.

There are significant advantages to using two subwoofers. Summing the channels into a single subwoofer reduces or cancels all the low frequency information containing phase differences

between the channels. Stereo subwoofers reproduce all of the bass information complete with the phase differences that help provide the imaging and location clues we use to place people and things at distinct points in the sound field. Stereo sub-woofers are more linear since they introduce the bass into the room at two different places and also lend themselves to natural placement near the corners where the low frequency room gain is often desirable on spectacular film sound effects.

Whether you use one or two, the Vandersteen 2Wq powered subwoofer is an extraordinary performer in a high-fidelity home theater system where it has the power, cone area and frequency extension for you to fully experience the most intense low-frequency film sound effects. The high motor-to-cone area ratio of the 2Wq's three 8-inch drivers reduces distortion and provides a more seamless transition to the main speakers than is possible with a larger driver. The 2Wq features adjustable Q so the bass can be optimized for a music or home theater system and tailored to match your room and personal taste.

With the core components and subwoofers in place, your home theater system is ready to become a multi-channel surround system. In a system built around a preamplifier and power amplifier, this functional metamorphosis will require an external surround sound processor that is compatible with the core electronics, a pair of speakers for the surround channels and an amplifier to drive the surround speakers. An A/V receiver based system will only require the addition of the surround speakers as the processor and surround amplifier are built into the receiver.

In a system with separates, a surround sound processor that is inserted into the tape loop of the preamplifier allows you to engage the surround sound modes for film viewing while still being able to switch the processor and other surround related equipment completely out of the system for listening to CDs or records. This gives you maximum flexibility since the system does not favor one listening mode at the expense of another.

There are several performance attributes to consider when selecting surround speakers for a high-fidelity home theater system. You are not forced into the compromises of a theater so you don't have to settle for bi-polar surround speakers which, in addition to their unavoidable interference problems, produce a vague, diffuse sound that severely compromises the detail and spatial characteristics of the system. In the early surround sound days, this lack of definition from these fuzz box speakers actually helped cover up the noise and distortion of the primitive digital delay lines. Now that the fidelity is equal in all channels however, you can use uncompromising front-firing speakers with precise imaging that enhance the spaciousness of your system and insure satisfying and stable surround effects. While small bookshelf surround speakers often have these desirable imaging characteristics, they do not have the bass extension or power handling capability of larger speakers. This may not be a problem with conventional matrixed surround modes that attenuate the low frequencies to the surround speakers and keep the levels relatively low, but many processors now feature proprietary modes that send full-frequency information to the surround speakers. When you consider that the new discrete multi-channel modes also send full-frequency information to the surround speakers and the excessive dynamic demands that this puts on small speakers, the advantages of using surround speakers designed to handle the high-power, full-range information become apparent.

An important consideration when putting together a high fidelity home theater system is the phase characteristics of the various speakers. Most conventional stereo and A/V speakers have one or more of their drivers intentionally connected out-of-phase to help achieve flat frequency response. When a pulse is sent to these speakers, the out-of-phase drivers move one direction while the in-phase drivers move the other direction. If you combine front, center and surround speakers with different driver configurations and crossover frequencies in a home theater system, an out-of-phase driver in one speaker will invariably be reproducing the same frequency range as an in-phase driver in another speaker. Instead of working together, the drivers in the different speakers

will be moving in opposite directions and conflicting with each other. Even when all the speakers are from one manufacturer and have complementary frequency responses, this lack of consistent phase integrity prevents the creation of a satisfying soundfield.

All Vandersteen speakers are aligned, phase-correct designs with their drivers connected in positive phase through first-order crossovers. When they are combined in a home theater system, all the drivers in the system are in-phase and moving together. By matching phase as well as frequency response, the speakers move together in unison and blend together seamlessly into an expansive panorama of sound with superior clarity and vocal intelligibility. A Vandersteen home theater system demonstrates the significant sonic and spatial benefits of a totally phase coherent system.

The aligned, phase-correct VSM-1 surface mount speaker complements our front speakers while providing the benefits of convenient, inconspicuous on-wall mounting. Designed for the particular requirements of the surround positions, the VSM-1 offers better surround channel performance than any other Vandersteen speaker. (Including the Model Five.) The bass response of a wall-mounted speaker is very predictable so VSM-1s can be easily matched with appropriate subwoofers to provide true full-range performance.

Should budget considerations dictate the use of inexpensive, limited-range surround speakers, we recommend that you select a phase-correct two-way with a five or six inch woofer in a narrow baffle. Speakers with small woofers and narrow baffles usually sound decent through the critical middle frequencies and have good imaging characteristics. To prevent the small speakers' woofers from distorting or being damaged by intense low frequency sound effects, you can program your processor to limit the bass to the surround channels or be careful to only use modes where the bass to the surround channels is automatically limited. If you cannot program your processor to limit the bass and you want to use a surround mode that sends full-range information to the surround speakers, you can install capacitors on the inputs to the surround amplifier or surround speakers to limit the low bass.

The amplifier you use to drive the surround speakers in a separates based system should be matched to the power requirements of the speakers and the sonic characteristics of the amplifier driving the main speakers. This can be a stereo amplifier or two channels of a multi-channel A/V amplifier.

A center speaker and amplifier are the final components you need to complete the audio portion of your home theater system. The center speaker helps localize dialog and other film sounds at the screen for viewers seated outside of the central listening area. During a film, much of the sound will be coming from the center speaker so it must have the proper phase and frequency characteristics to integrate seamlessly with the front left and right speakers. The Vandersteen VCC-1 is an aligned, phase-correct center speaker designed to complement our main and surround speakers. It's magnetically shielded; coaxial configuration avoids multidriver interference and provides perfect blending with the main speakers regardless of placement. It has user selectable response compensation to insure that your system will always realistically reproduce the voices, music and effects of your favorite films. The subwoofers and main speakers are responsible for reproducing the bass so it is not necessary to drive the VCC-1 with a high current amplifier. You only need one channel of amplification for the center channel so you can bridge a moderate power stereo amplifier or two channels of a multi-channel A/V amplifier into mono.

Perhaps the most significant advantage to building your home theater system with components and speakers offering superior musical performance is that it will be multi-channel music ready. As processors offer improved music modes that enhance the listening experience with standard two channel recordings, multi-channel music will eclipse stereo reproduction. Your system's

qualities that serve two-channel music so well will also provide superior performance on multi-channel music.

A home theater system based on a music system is also a great value. Most of your stereo components will integrate directly into your audio/video system. Your system can be built piece by piece and then upgraded the same way. Just the first step of adding 2Wq subwoofers to your main speakers and running the video sound through your stereo system will give you more than 80% of the total home theater experience. From that point on, every improvement you make to the core components will increase your enjoyment of both music and film. Eventually, you'll add surround capabilities and a center speaker to complete your home theater. Then, you can upgrade the power amplifier or preamplifier for better sound in a separates based system or switch processors to acquire new surround modes. With an A/V receiver, you can add a separate power amplifier to better drive the main speakers and at the same time, take the first big step toward the superior performance of separates. You can change from small bookshelf surround speakers to VSM-1 on-wall speakers and move the small speakers into a bedroom, den or office system. Since the system is modular, it will be easy to make any alterations that future surround modes or technology may require without having to redo the entire system.

## **DISCRETE MULTI-CHANNEL APPLICATIONS**

### **(DTS, AC-3, etc.)**

Vandersteen video speakers may have more capabilities and advanced features than needed for conventional matrix surround systems, but these features and capabilities insure that the speakers are perfectly suited to the additional demands of the discrete multi-channel audio formats. The goal of all the discrete formats is to provide the same time, phase and amplitude characteristics from each channel to the listener. (I.e. timbre and voicing) In conventional sized rooms, the phase-correct design and position specific engineering of the Vandersteen speakers provides unsurpassed multi-channel integration and consistency for all the listeners.

In a normal living room, it is often not possible to place conventional multi-driver or bi-polar surround speakers far enough away from the listeners for the drivers to fully converge. The drivers in the VSM-1 surround speaker fully converge within inches. The surface-mount VSM-1 can easily be mounted higher than ear level to provide the most consistent and expansive soundfield.

The VCC-1 center speaker's small size minimizes box effects and contributes to the open, natural sound that makes dialog easier to understand. Designed for the specific requirements of the center position, the VCC-1 focuses the dialog and other center information while contributing to a seamless sonic panorama across the front of the room.

The 2Wq subwoofer's innovative crossover maintains the system's time, phase and amplitude to insure complete multi-channel integration. All discrete multi-channel formats have a Low Frequency Effects channel, however extensive research has revealed that most processors sound significantly better when they are programmed to redistribute the LFE information to the other five channels. The 2Wq is optimized for this system configuration and allows you to use up to five subwoofers in the system for the ultimate bass experience.

All the speakers in a discrete multi-channel audio system contribute to the overall sonic performance, but there are advantages to a quality bias in favor of the front speakers. Until we have a 360-degree video screen, the picture and the source for most of a film's sound will be up front. While it may seem excessive to match Vandersteen Model 3 or Five series loudspeakers with a VCC-1 center speaker and VSM-1 surround speakers, putting the best speakers up front insures that the most critical channels are reproduced with the highest fidelity. Since a proper center channel does not take over for the main speakers, but just focuses the center information,

using the best possible main speakers is a sensible quality bias that greatly enhances the system's performance.

It is inevitable that discrete multi-channel audio will some day come to many of the 100,000 plus stereo systems that are already making beautiful music with Vandersteen speakers. If you own any model or vintage of Vandersteen full-range loud speakers, you can be confident that the new formats do not obsolete your speakers in any way. Multi-channel audio formats add additional channels and capabilities to the system, but still require the highest-fidelity loudspeakers to achieve the best results. Upgrading a Vandersteen stereo system into a discrete multi-channel system means adding-on rather than replacing. The 2Wq subwoofer, VSM-1 surround speakers and VCC-1 center speaker are compatible with any Vandersteen full-range speakers ever built. You can add the additional speakers, a processor and more channels of amplification and keep the superior realism and musicality of your existing loudspeakers.