

REPRINT

Vandersteen 5A Review

by Richard Hardesty

The Model 5A speaker system was developed over a period of nearly thirty years and evolved from previous Vandersteen systems that had been refined to their performance limits. This is not simply advertising hype—I sold Vandersteen speakers from the beginning and I was there to watch the innovations occur and the products progress.

This review is a first-person report with observations from someone (me) who is intimately familiar with Vandersteen speakers and virtually all the other top brands developed over the last several decades. I sold, installed, repaired and compared all the major



competitors. Many speakers were used in my home system over extended periods so that I could become thoroughly familiar with them.

My retail store was an authorized dealer (at one time or another) for Magneplanar, Audire and Eminent Technology planar magnetic speakers—Acoustat, Quad, Sound Lab, Dayton-Wright and Martin-Logan electrostatic speakers—Decca and Sequerra ribbon speakers—Thiel, KEF, B&W, Dahlquist, Gale, Braun, Mirage, Snell, Ohm, Spica, and many other dynamic speakers. Within this mix, Vandersteens were always leading contenders for top performance and were unrivaled for value.

Evolution not Revolution

They didn't have to reinvent the wheel to produce the Model 5As. Since the first commercial products were delivered, all Vandersteen *Aligned Dynamic Design* speakers have embodied certain principles. Good sound was important, of course, and Vandersteen speakers were required to accurately replicate the signal, just like other high fidelity audio components. This may seem like a joke but it's not.

Few people would accept an amplifier that delivered midrange frequencies out-of-phase with the bass and treble frequencies, but that's exactly what most speakers do. While some speakers are capable of providing fairly accurate amplitude response, phase relationships are often ignored.

All Vandersteen models have flat frequency response within narrow limits of error and exhibit excellent performance in the time domain. Flat frequency response assures that the speakers are free from euphonic colorations, and accurate time-domain performance allows the speakers to produce an acoustic replica of the electrical input signal—a task that remains unachievable by most speaker systems sold today.

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The original goals of Vandersteen Audio haven't changed. The products have been refined and improved again and again as better parts have become available and new facts have been observed.

Preserving Phase Integrity



3A Signature

The correct reproduction of musical timbre requires accurate frequency response and precise timing and that requires accurately replicating both the amplitude and phase of the input signal. Delivering a properly focused, three-dimensional

image is also dependent on correct time-domain performance, a fact that can be easily demonstrated.

“All drivers are wired in phase and the crossover networks are designed to keep them in phase.”

Producing an acoustic output that correctly follows the electrical input signal requires time- and phase-accurate speakers with a minimum of energy storage (time smear). Three major sources of energy storage which smear transients over time are resonances, ringing and reflections. Vandersteen speakers are engineered to produce fewer of these time smear aberrations while maintaining the phase integrity of the original signal. All drivers are wired in phase and the crossover networks are designed to keep them in phase.

In addition to first-order acoustic transitions between drive ele-

ments and temporal alignment of the drivers, Vandersteen speakers incorporate many innovative methods to eliminate resonances, reflections and stored energy, as well as other causes of time smear. Minimum-baffle enclosures and patented reflection-free midrange drivers, along with resistive acoustic transmission lines that absorb rather than reflect rear waves are among the unique attributes of Vandersteen speakers. Damped high-loss materials are used in the construction of driver diaphragms and enclosure panels to further reduce resonances and mechanical energy storage.

Many design breakthroughs originated at Vandersteen Audio. These innovations were quietly incorporated into a relatively inexpensive line of products, which became known primarily for value.

First Designs Based on FFT Analysis

Vandersteen pioneered the use of FFT (fast Fourier transform) computer analysis years before other speaker manufacturers started to use this technology. Before MLSSA and CLIO there was General Radio.

The General Radio #2512 instrument was among the first of this product type to reach the market. Vandersteen started examining speaker performance with this exceptional device in the 1970s and the GenRad's 100kHz bandwidth keeps it in the forefront of technology even today. Vandersteen also uses the industry standard MLSSA measuring system for both quality control and hand adjustment in the anechoic chamber.

“Vandersteen pioneered the use of FFT (fast Fourier transform) computer analysis...”

Richard Vandersteen trained with the late Richard Heyser at Cal Tech on the use of the (then) newly introduced Crown (now Gold Line) TEF (time, energy, frequency) analyzer.

Time- and phase-accurate speakers were developed as a direct result of this research and the time smearing effects of energy storage and reflection became clearly evident for the first time. The use of computers and the Fourier transform changed loudspeakers forever by providing designers with

insights that couldn't be obtained any other way.

Today, new Vandersteen designs are evaluated utilizing these techniques to assure accuracy, and newly manufactured products are measured to assure consistent performance.

Eliminating Reflections

Vandersteen's time- and phase-accurate designs have always provided a more detailed and transparent sound than planar speakers. The "boxless" minimum-baffle configuration produced a more open and spacious sound with better transient response than conventional speakers, which were hampered by baffle distortions. Control of diffraction and reflected energy was of paramount concern from the beginning.

"The 'boxless' minimum-baffle configuration produced a more open and spacious sound"

The introduction of the patented reflection-free midrange driver in the 1980s erased the last vestige of planar superiority by eliminating the early reflections common to dynamic midrange drivers.



Versions of this driver first appeared in the Vandersteen Model 4 and later in the Model 3. The standard version is available today in the 3A Signature speakers and the

Model 5. The latest version, with an entirely new woven diaphragm, comes only in the Model 5A.

Resonance-Free Subwoofers

In the early eighties, when Vandersteen developed the first aperiodic subwoofer that accomplished a first-order transition to

the main speakers, many dealers (including me) discovered the benefits of active subwoofers and passive high-pass filters.

The 2W subwoofer system utilized a first-order, passive high-pass filter that was inserted in front of the main amplifier to roll-off the bass response from the main amplifier and speakers. Low frequencies were handled by specialized amplifiers in the subwoofer, which were optimized for the job and the load. Bass amplifiers sampled the output from the main amplifier to provide a perfect blend between the main speakers and the subwoofer(s). This resulted in amazing performance gains and subwoofer integration previously unknown.

"First aperiodic, first-order subwoofers..."



The 2W was aperiodic (had no response resonance) within its pass band and used slot-loading to equalize the pressures on each side of the diaphragms and to provide a predictable interface with the room.

Slot-loading also made a first-order transition possible without coloring the midrange.

Feed-forward error correction and a unique "preview circuit," which analyzed the incoming signal and modified the output preventing electrical or mechanical misbehavior, were introduced in the 2W subwoofer. Vandersteen subwoofers simply can't be overdriven and won't make unseemly noises regardless of the signal they are fed.

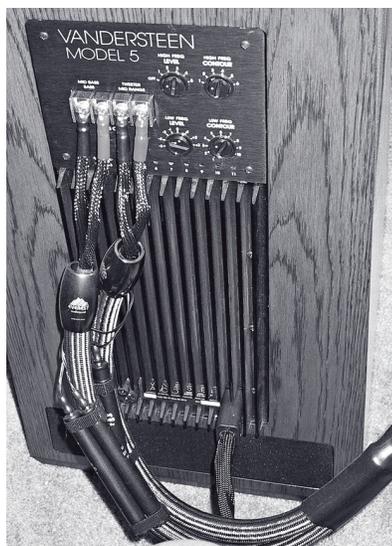
The 2Wq subwoofer introduced a control to vary the "Q" of the device in order to adjust the contour of response. The introduction of the 2Wq gave users greater latitude in subwoofer placement allowing the main speakers to be positioned for best image and the subwoofers to be positioned for best bass response.

Better Bass, Better Integration

Vandersteen proved that using a specialized amplifier for bass frequencies, thus relieving the main amplifier and speakers of this difficult chore, could greatly reduce intermodulation distortion and increase dynamic range providing vastly improved bass and midrange performance. These subwoofers were designed for music not sound effects.

Years before home theater was conceived, thousands of music listeners enjoyed enhanced satisfaction by combining Vandersteen 2 speakers with a 2W subwoofer or Vandersteen 3A speakers with one or two 2Wq subwoofers. These wise buyers got vastly improved performance and spent a lot less money than less thoughtful consumers. These high-value, ultra-high-performance speaker systems were hard acts to follow but improvement was still possible for those with bigger budgets.

Battery-Biased Crossovers



Vandersteen was the first to offer crossover networks in commercial speaker systems with battery-biased film capacitors. A constant charge on the capacitor dielectrics allows the speakers to sound as good when first turned on as they do after several hours (or days) of playing.

This technology has since been applied to cable dielectrics and it works very well. There are batteries all over my audio system and this advance stems from the first Vandersteen Model 5 speakers.

Adding it all Up

The Vandersteen Model 5 speakers were introduced in 1997 and provided an evolutionary improvement in performance and a new benchmark in value. They combined all the features of their high-value predecessors and added a fine-furniture appearance. Continuous refinement in virtually every area has resulted in the Model 5As.



The Model 5A system embodies every performance breakthrough that Vandersteen has produced over nearly three decades of research and development and represents the culmination of everything the company has learned about making truly accurate speakers. The Model 5A is a Model 5 with a new power supply for the bass amplifier, improved midrange and tweeter drivers and even more refined sound. The Model 5A speakers advance the performance standards set by the systems that preceded them and set new standards for cosmetic elegance.

Product Description

The Model 5A is a 5-driver, 4-way, time- and phase-accurate speaker system that incorporates a unique aperiodic, push-pull, powered sub-bass system using the most sophisticated driver made, a battery-biased passive high-pass filter and an 11-band equalizer—in a Vandersteen “boxless” minimum-baffle, non-resonant enclosure system.

The Model 5A utilizes a transmission-line loaded mid-bass driver with a proprietary Kevlar®/poly laminated cone—the patented Vandersteen “reflection-free” midrange driver with a linear surround and a tri-material, woven diaphragm—and a unique Vandersteen multichambered, ceramic coated alloy dome tweeter with an investment-cast chassis that is hand-adjusted to eliminate virtually all resonances to 30kHz and beyond. The midrange and tweeter drivers are also loaded with terminated, resistive transmission lines and feature ferrofluid-cooled voice coils.

All drivers operate in phase and are temporally aligned. The system is integrated with a completely balanced, battery-biased crossover network that provides first-order acoustic slopes to assure accurate waveform reproduction. There is a rearward-facing auxiliary tweeter that is only used in very large or very dead rooms to compensate for excessive absorbent material or the absence of reflective surfaces.

There is far more technology incorporated within this speaker than is available anywhere else at any price. I'll try to describe it piece by piece as space and knowledge permit.

Sub-Bass System

The Vandersteen subwoofer system takes advantage of the following facts. A low bass driver in a sealed enclosure has very predictable response characteristics. An internally amplified and equalized bass system can correct for any deviations (roll-off) or aberrations (response errors) and provide flat frequency

“There is far more technology incorporated within this speaker than is available anywhere else at any price.”

response and impedance to well below the range of human hearing. The additional roll-off created by a passive high-pass filter in front of the main amplifier and speaker can be easily compensated for as well.

Slot-loading the front wave from the bass driver equalizes the pressures that the diaphragm will encounter as it moves back and forth and allows predictable coupling to the room. (The slot is placed at floor level facing to the rear.) An indirect radiation path from the front of the driver also helps to absorb any out-of-band frequencies that might sneak past a first-order low-pass filter, preventing midrange coloration.

Some nonlinearities may occur in dynamic drive elements due to changes in inductance as the voice coil moves inward (encountering more iron) and outward (encountering less iron). Copper rings and shaped pole pieces can help but creating a complete push-pull bass system can eliminate virtually all sources of distortion.

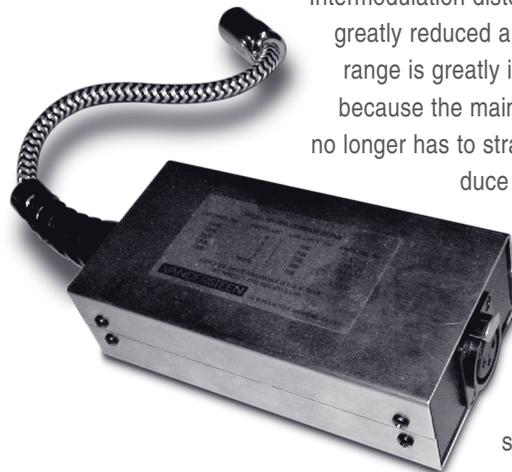
Amplifiers that operate only below 100Hz can be optimized for performance in the low bass region. Specialized bass amplification can be tailored to the exact characteristics of the drive elements for exceptionally refined yet powerful bass that extends to infrasonic frequencies. Feed-forward

error correction can assure that this bass is extraordinarily accurate to well below the range of human hearing.

So how is all this accomplished? By skillful engineering that takes everything into consideration and leaves nothing out. (See my review of the Vandersteen 2Wq subwoofer on the Vandersteen web site for even more information.)

Bass Crossover

A completely transparent, battery-biased, passive high-pass filter is inserted before the main amplifier. It creates a first-order (6dB/octave) bass roll-off starting at 100Hz (-3dB). The main amplifier is relieved of the task of delivering high current at low frequencies and deep bass frequencies are removed from the main speaker (not the subwoofer).



Intermodulation distortion is greatly reduced and dynamic range is greatly increased because the main amplifier no longer has to strain to produce high energy at low frequencies and the drivers in the main speaker can produce mid-

bass and midrange frequencies undistorted by the large excursions required for bass.

This results in better sound. The main amplifier seems to be more powerful and the midrange seems clearer and effortless. Bass frequencies are delivered with control and authority by a true subwoofer driven by amplifiers designed specifically for this purpose. Deep bass capability improves impact, transient response and the ability to follow the rhythm and pace of music, and helps to expand the sound of the performance space.

The bass amplifier(s) samples the output signal from the main amplifier and corrects for roll-off created by the high-pass filter

and the response characteristics of the bass driver in the enclosure. This compensation results in flat bass response that can be further tailored with the built-in 11-band equalizer to suit the speaker's position and the position of the listener, correcting for additions or subtractions contributed by the room.

Feed-forward error correction and a unique "preview circuit" are included in the subwoofer system. The preview circuit analyzes the incoming signal and modifies the output as necessary, preventing electrical or mechanical misbehavior.



Because the bass amplifier(s) samples the output of the main amplifier, it passes along the sound and propagation speed of the amplifier that drives the main speaker system providing an ideal integration of subwoofer and main speaker. No other crossover method can provide this kind of seamless blending and transparency.

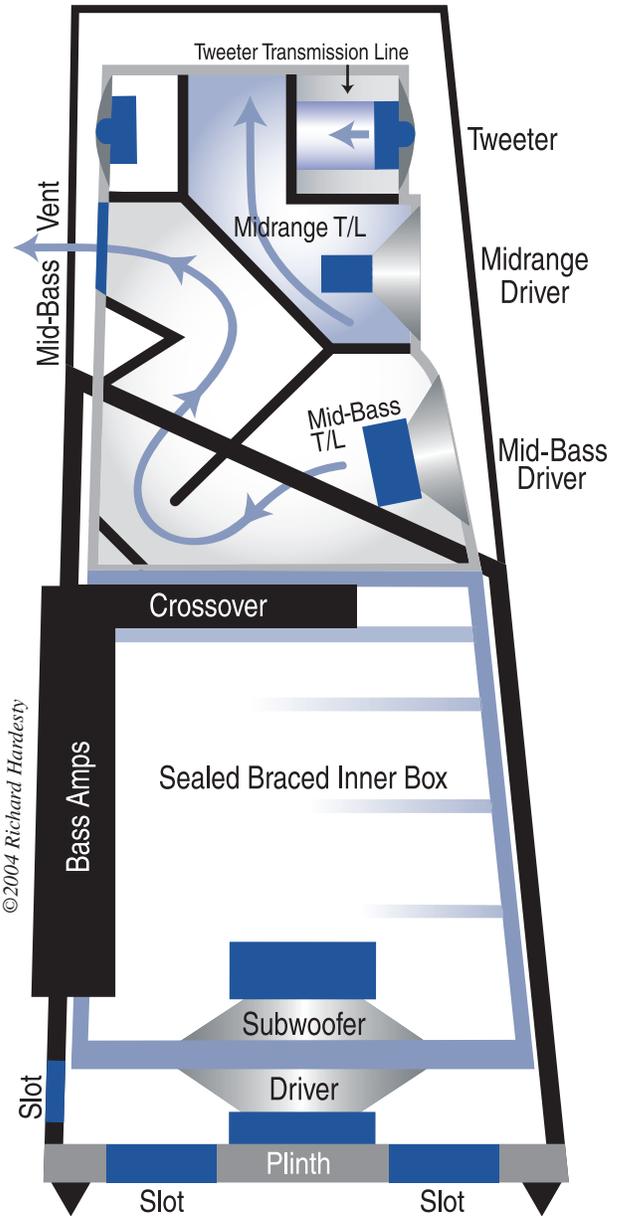
There are internal high- and low-pass filters that limit the subwoofer response to frequencies between about 7Hz and 100Hz. In addition to the eleven bass equalization controls, there are easily accessible controls to vary bass contour and overall bass level. These additional controls allow the speakers to be positioned where they image best and permit the bass to be tailored precisely to that location within the room and to the tastes of the listener.

Bass Enclosure



The unique Vandersteen push-pull subwoofer driver and balanced, bridged amplifier assembly are enclosed in a heavily

braced, constrained-layer enclosure shaped like a trapezoid and mounted on a plinth made from a high-pressure epoxy laminate. This bass section represents the bottom two-thirds of



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the speaker and is finished like fine furniture. (We'll consider the upper module, which is concealed behind the removable grille, separately.)

The main bass structure is an enclosure within an enclosure. The internal structure is heavily braced by a series of cross-members with varied shapes. Resonances are randomized and dispersed and all are isolated from the external structure with a layer of adhesive that remains semi-viscous—the constrained layer which separates the two structures. The visible outer enclosure is acoustically decoupled from the inner structure that houses the bass driver. The modular bass amplifiers and

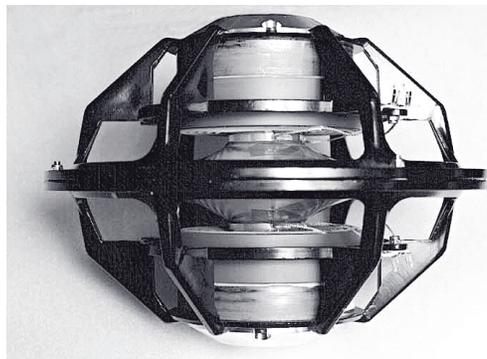


crossover network are also mounted in the lower portion of the speaker.

The plinth, beneath the enclosure within

an enclosure, is made from an exotic high-pressure epoxy-laminate material that other manufacturers advertise as proprietary and magical. It is neither. It is, however, extremely stable and nonresonant. It's also very expensive and difficult to machine. This material is shaped with diamond cutting tools and is also used for the replaceable driver baffles on the front of the upper module.

Bass Driver



The 12-inch Vandersteen subwoofer driver is unlike anything else available. It has two complete motor systems with

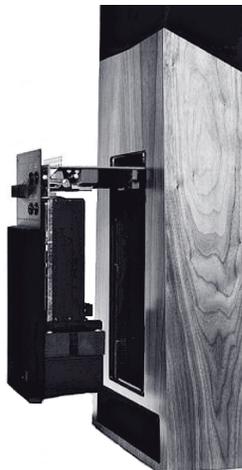
precision-formed magnet assemblies and copper faraday rings, which allow more than an inch of perfectly linear diaphragm excursion. These motors oppose each other and are supported by a rigid die-cast chassis, which resembles two driver baskets mounted face-to-face.

A single voice coil former, with a voice coil wound on each end, runs between the two motors and drives the diaphragm mechanism, which is comprised of two curvilinear aluminum cones sandwiched together with an exotic honeycomb material to form the most ridged diaphragm possible. This diaphragm is centered on the voice coil former and performs like a perfect piston within its pass band and well beyond.

Each voice coil is driven by its own amplifier and everything—mechanical and electrical—is mirror-imaged to cancel any non-linear distortion. One motor pushes while the other pulls. One

voice coil encounters more iron while the other encounters less. One amplifier pushes while the other pulls.

Bass Amplifiers



There are four Class B bass amplifiers in each Model 5A speaker. They share a power-factor-compensated switching power supply but the amplifiers themselves have high-current linear circuits operating in a bridged configuration.

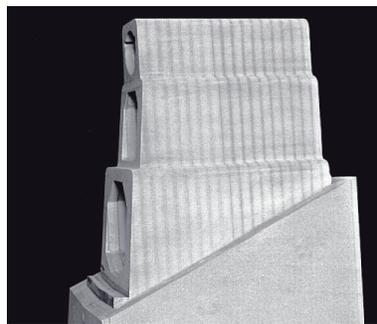
One bridged pair of amplifiers drives one of the opposing voice coils and another bridged pair drives the other voice coil. Amplifier nonlinearities are canceled along with driver nonlinearities in this completely balanced system.

ties in this completely balanced system.

Each amplifier uses a single pair of ultraheavy-duty bipolar output devices engineered to deliver very high current into the low impedance load of the subwoofer driver. The amplifiers, amplifier power supply, and subwoofer driver have been designed to work in complete harmony.

Because the driver has extremely long excursion capability and very high compliance and is mounted with the diaphragm in a horizontal position, the weight of the diaphragm and voice coil assembly would tend to allow the moving parts to be offset (sag) towards the floor. The amplifiers provide a levitating force to center the diaphragm and counteract this tendency so each bass note begins from dead center within the driver's range of excursion.

Upper Module Enclosure



The upper module houses the drivers that produce mid-bass and higher frequencies.

While the upper module is an integral part of the complete speaker, it is constructed separately to enable it to resist

resonances in the upper frequency ranges. This module is

made from 22 layers of machined MDF. Each layer is .750" thick and the layers are laminated together using several adhesives to vary and disperse resonances.

The completed module is a solid billet of material that has been machined into the required shape, only stiffer and far less resonant. It positions the drive elements and provides the resistive transmission lines that load each driver. But that's not all.

A hidden cavity that contains a "secret sauce" of semi-viscous damping material surrounds the entire module. This produces an enclosure that has virtually no measurable resonant modes.

The drivers are mounted on removable plates made from the exotic high-pressure epoxy-laminate material used for the sub-woofer plinth. This allows drivers to be replaced with new designs should they become available. These baffle plates provide an extremely rigid mounting surface for the drive elements and further isolate the drivers from the enclosure structure.



The front faces of these minimum-sized baffles are covered with a thick layer of felt. This eliminates any residual reflections that might emanate from the baffles, which are just big enough to support the drivers effectively. This is the Vandersteen "boxless" minimum-baffle design fully realized.

The upper module contains the drive elements that reproduce frequencies from 100Hz to 30kHz and beyond. This range is divided into three parts, which are handled by the mid-bass driver, the midrange driver, and the tweeter. We'll examine those next.

Mid-Bass System

The mid-bass driver is a 7-inch unit that has a rigid die-cast frame and a precision-formed magnet assembly with a copper faraday ring to reduce magnetic distortion and allow maximum



linear excursion. The surround is a unique co-injected fluoroelastomer rubber material molded into a distinctive shape that enhances performance. The diaphragm is a proprietary Vandersteen curvilinear poly/Kevlar® composite.

This driver is assembled by Scan-Speak using Vandersteen parts. Some manufacturers of more expensive speakers use the Scan-Speak catalog part with an off-the-shelf paper cone—as a midrange. You know the driver I'm talking about—it has razor cuts on the cone to break up resonances. This driver is actually a woofer and is too large to provide the speed and detail necessary for accurate reproduction of midrange frequencies. It's also too large to balance the polar pattern (dispersion) in the midrange.

Vandersteen uses this driver only as a mid-bass unit operating up to 600Hz and utilizes a special composite cone to ensure that it performs as a perfect piston within its pass band and well beyond. It is loaded by a resistive transmission line, which vents at the rear of the upper module. The purpose of this line is to eliminate in-band resonances and to flatten the impedance curve while preventing reflection of the rear wave back through the diaphragm, not to augment bass.

Diaphragm Materials

Vandersteen uses the best available materials for each driver diaphragm. The materials are not all the same because each one performs a different task. Each is optimized to perform over its range of frequencies while adding or subtracting nothing. The homogeneity of the sound of the complete speaker is a tribute to the success of this approach.

One further note: poly and polypropylene are not the same thing. Polypropylene is a milky-white plastic that was a popular diaphragm material twenty-five years ago. Poly is a new

moniker that describes a blend of plastic materials loaded with various minerals for damping. Let me inject a bit of history here.

The British speaker manufacturer, KEF, pioneered plastic diaphragms with the introduction of polystyrene cones. Polystyrene was light and stiff and easily produced but had little internal damping. KEF added layers of PVA (polyvinyl acetate) front and rear to damp resonances and called the diaphragm material Bextrene. Damped polystyrene sounded pretty good but was no longer light and fast, resulting in speakers with very low sensitivity. Polypropylene materials were tried next because they provided high internal damping with less weight. Internal damping was probably excessive because polypropylene drivers sounded dead and lifeless (to me).

“Contrary to what you might have heard, Vandersteen hasn’t used polypropylene in decades.”

Materials have come a long way. Today manufacturers can blend plastics and add damping materials as needed to produce diaphragms with nearly ideal characteristics. Diaphragms can be light to increase sensitivity and reduce rise-time, stiff to perform in a more linear, piston-like manner over a wider range of frequencies, and highly resistant to resonances due to high internal damping. Contrary to what you might have heard, Vandersteen hasn’t used polypropylene in decades.

The diaphragm in the Model 5A subwoofer is made from aluminum and honeycomb. The cone in the Model 5A mid-bass driver is made from Kevlar® with a laminated, mineral-filled poly skin. The self damping diaphragm in the Model 5A midrange driver is made from three different plastic fibers, which are woven together. The diaphragm in the Model 5A tweeter is made from an exclusive metal alloy that has been anodized to produce what is advertised as ceramic coated, and critically damped to eliminate resonance.

Midrange System

The unique 4.5-inch linear-surround midrange driver in the



Model 5A is protected by worldwide patents and features several unusual design features. It has a “reflection-free” aerodynamic frame and magnet assembly with a copper faraday ring and small diameter alnico

magnet, and features a diaphragm made from a proprietary woven material. It has a “linear surround” that can’t go out-of-phase with the diaphragm as many surround rolls do.

Planar speakers sound very “open” partly because there is no reflective surface directly behind the diaphragm. Most midrange dynamic drivers have a large ceramic magnet, and the chassis to support it, positioned directly behind the diaphragm. The magnet and chassis can reflect the signal back through the diaphragm with only a slight time delay, smearing transients over this period of time. The Vandersteen reflection-free chassis has a small diameter magnet made from powerful alnico (aluminum, nickel and cobalt alloy) material. There is little behind the diaphragm to reflect midrange frequencies back to the listener, delayed in time. Reflections are minimized in other significant ways as well.

The Vandersteen midrange driver doesn’t have a conventional surround roll that might reflect small vibrations back into the diaphragm material from the surround or produce distortion due to nonlinear behavior (flapping unrelated to cone movement or even out-of-phase with cone movement). Instead the diaphragm is terminated in a flat, nonreflective ring that acts as a suspension member allowing diaphragm movement while dissipating energy.

The diaphragm is made from a newly developed material that is comprised of three different plastic filaments, which are woven together to provide a highly damped and extremely rigid cone. This driver has flat frequency response to more than an octave above the crossover point to the tweeter.

The back of the midrange driver is loaded by a resistive transmission line designed to control driver resonance and impedance while absorbing rather than reflecting rear wave energy. This line

is closed and rear wave energy is completely dissipated.

Each midrange driver and its crossover components are hand-adjusted in an anechoic chamber to produce linear frequency response ($\pm 1.5\text{dB}$) and an exact acoustic match ($\pm 0.1\text{dB}$) for its mate in the other speaker.

Tweeter System



A dual-chamber tweeter is one with a hole through the pole piece that opens into a rear chamber that can be adjusted to counteract diaphragm resonances.

The first chamber is the volume of air between the diaphragm (dome) and the pole piece, and the second chamber is the volume of air in the hole and the cup at the back of the pole piece.

The Vandersteen tweeter has a proprietary resistive transmission line configuration that is inherently nonresonant and the diaphragm is meticulously hand-damped to eliminate the so-called "oil can" resonance that occurs at the first break-up frequency.

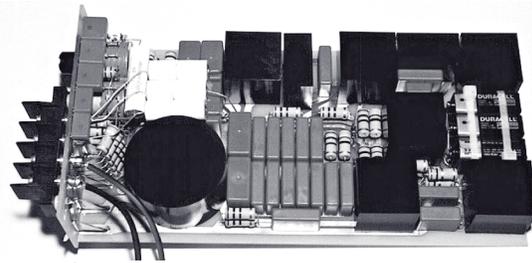
The diaphragms in all soft dome tweeters, including the fashionable ring radiators, start to break up (behave in a chaotic manner unrelated to voice coil movement) at about 10kHz. Stiffer metal alloys can be engineered to perform in a piston-like manner to a range beyond audibility. Eventually they too reach resonance and start to break up. Chaotic behavior ensues. At this frequency, usually 25-28kHz, they will exhibit a large rise in output (often 15dB or more) and a commensurate increase in impedance.

This ultrasonic resonance is ignored by many manufacturers because it's above the supposed range of human hearing. John Atkinson (*Stereophile*) has said that only bats can hear it. I disagree. Empirical evidence gathered through listening tests shows that we can hear the results of ultrasonic sounds even if we can't perceive pure tones at those frequencies.

Vandersteen eliminates rather than ignores the resonance by employing an exceptional anodized metal alloy diaphragm and critically damping this diaphragm with careful hand-adjustment in an anechoic chamber. This results in specified frequency response to 30kHz ($\pm 1.5\text{dB}$) and substantial output, albeit at reduced levels, to well above this frequency.

Each tweeter and its crossover components are hand-adjusted in an anechoic chamber to produce linear frequency response ($\pm 1.5\text{dB}$) and an exact acoustic match ($\pm 0.1\text{dB}$) for its mate in the other speaker.

Crossover System



First-order acoustic transitions and compensation for

driver frequency response anomalies and impedance variations are accomplished by a battery-biased, balanced crossover network employing the finest parts available.

The Model 5A crossover uses metal film resistors with copper leads, premium film capacitors from Wima and InfiniCaps® with batteries to keep the dielectrics charged for optimum performance, and solid-core pure silver wire. Caps and hand-wound inductors are encapsulated to minimize microphonic effects.

The first-order crossovers look complicated but all compensation components are in shunt, not in the signal path. The signal follows the shortest and simplest path possible.

The crossover is completely modular and can be easily replaced or repaired. Each crossover network is hand-tweaked in an anechoic chamber to perform as specified with the exact drivers used in that matched pair of speakers. Left and right speakers are adjusted to produce frequency response from 20Hz to 30kHz with a maximum deviation of $\pm 1.5\text{dB}$. Left and right speakers are adjusted for output that matches within $\pm 0.1\text{dB}$ across the entire spectrum.

You can spend a lot more but you can't buy another product with this level of engineering. So how does it sound?

Sound

I've spent a lot of time explaining the engineering features and the performance potential of the Vandersteen Model 5A speaker system. Let me assure readers that it all works just like it's supposed to. This is the most sophisticated design that I've ever examined and it provides the best sound I've ever heard—by a substantial margin.

The Model 5A's vertical array of drivers can provide a time- and phase-accurate simulation of a point-source over a limited vertical range (adjustable with spike shims) at a distance of 9 feet or more from the speakers. Listeners above or below a normal seated position, or closer than 9 feet from the speakers, will still hear good sound that won't be quite as phase coherent. A side benefit to this limited vertical dispersion is reduced floor and ceiling bounce, which means the room will typically have less negative impact on the sound of the speakers.

The model 5As have a balanced and uniform horizontal dispersion pattern, which means that they will be less sensitive to their position relative to the side walls. A three-dimensional image will require that they be positioned well forward of the front wall, a requisite that applies to virtually all speakers. Positioning the speakers a reasonable distance from the side walls—2 feet or more—will improve image focus.

“...instruments and vocals float in space with a holographic, three-dimensional reality that can only be described as palpable.”

And focus they can! The near-complete absence of resonances and reflections provides a clear window to the performance. There is absolutely no sense of the speakers' locations and instruments and vocals float in space with a holographic, three-dimensional reality that can only be described as palpable. It feels like you can reach out and touch the performers. Each one has a precise and specific position on the soundstage.

Speakers with steep filters can deliver a good “mono-in-the-mid-

dle” image but instruments and voices towards the sides of the soundstage tend to pull forward towards the speakers. Time- and phase-accurate speakers can deliver images with depth and dimension across the entire stage. The Model 5As do this in spades producing the most convincing images I've heard.

The sound is remarkably smooth and free of distortion, yet incredibly detailed and resolved. Bandwidth is outstanding. No passive speaker system can rival the range of the Model 5As and none sounds as homogeneous.

In my room the system measures flat to below the range of my test instruments and I can hear low frequency information that is simply thrilling. Low bass and mid-bass are delivered with detail and authority that is unrivaled. I have reviewed more than 60 subwoofers and have never heard bass that can equal what the Model 5As can deliver. No full-range speaker even comes close.

“...this is the best speaker system available regardless of price.”

Bass is not simply low and loud—it is finely detailed and textured. This speaker system allows the listener to hear more of what's going on in the music—all the way down to the deepest audible frequencies. There is an absolutely seamless transition from the lowest frequencies, which are produced by the subwoofer, through the mid-bass region where most musical fundamentals and vocals are delivered by the direct radiating mid-bass driver. If you have never heard a properly set-up pair of Vandersteen Model 5As, you have only heard a vague semblance of what's on the recording.

The midrange is mercilessly revealing. Does that mean that Model 5As can only be used with bleeding-edge associated components? Not necessarily. This speaker system is a relatively easy load to drive but it will reveal everything about the system components that drive it and the recording that stores the music.

Components with sins of omission are preferable because flaws that include additive colorations will be clearly exposed.

Poor recordings are well tolerated by the Model 5A speakers but production flaws can be easily identified. When the best recordings are played through the finest components the results can be magical.

It's difficult to criticize any aspect of the high frequency response. It's clean, clear, extended and completely free from zing and exaggeration. There is virtually no sound from the enclosure providing an openness and image focus that is unrivaled in my experience. The tweeter doesn't stand out like a ribbon or provide an artificial sense of detail like some inverted domes. It blends perfectly with the rest of the speaker providing a completely integrated sound.

There is a clarity and freedom from strain that allows dynamic contrasts I didn't know were possible from an audio system. This is mostly the result of reduced distortion, but freedom from resonances and reflections probably contributes to this relaxed sense of ease. I have a preamp that can deliver more than 30 volts and mono amplifiers rated at 400 watts each, which can't hurt. The system is dead quiet and can play loud enough to make your ears bleed. Dynamic range is startling.

Proponents of speakers with steep filters claim that first-order speakers won't play loud and suffer from driver strain. Vandersteen has overcome these supposed deficiencies with a powered bass system and a 4-way design that uses exceptional drivers. Think your horns have greater dynamic range and less distortion? Come visit my house.

I could continue with additional superlatives but an audition would be better than another thousand words. I think this is the best speaker system available regardless of price. I put my money where my mouth is and bought a pair for myself. Although I've probably owned more speakers than most people, I suspect that this is my last pair. 

Vandersteen Audio
116 West Fourth Street, Hanford, CA 93230
(559) 582-0324 www.vandersteen.com