

HOLLAND LINK + Von SCHWEIKERT



VR-2 Reference Grade Tower Loudspeaker

Albert Von Schweikert's design goal for the last 20 years has been to recreate a simulation of a live musical event. Not satisfied with conventional technology that he felt had been exhausted, AVS's recent research indicated that more realistic sound quality could be obtained by replicating an acoustic inversion of the microphone's signal. After all, it is the microphone's signal which is recorded, not music itself. Since microphones impart their characteristics upon the music, recording with microphones may be seen as an encoding process, while playing back the signal through speakers may be seen as a decoding process. If you think about this, you will realize that the goal of the speaker should be to behave as a microphone in reverse. Of course, there are several types of microphones, but they all have common but important characteristics which the speaker must emulate:



- **Point-source behavior:** mics receive the sound waves upon a very small diaphragm (12mm to 26mm in diameter). In order to project the sound back into the listening room in the same manner as the mic received the signal, a correctly designed speaker must operate as a point-source; this entails using a focused array of drivers in order to reproduce the full frequency bandwidth. We have designed the VR-2 to focus the image from the acoustic location of the 1" tweeter, which is placed at ear height.
- **Coherent driver integration:** as the recording mic is composed of a single diaphragm, it is by definition phase coherent. In order for a multiple-transducer speaker system to behave as a focused point-source array, the drivers all must be in phase, so that the acoustic pressure mimics a one-way system using a single diaphragm. Forcing multiple drivers to start and stop together is a formidable task, compounded by the fact that the woofers and tweeters have different masses, suspension compliances, and sensitivities. Our proprietary Global Axis Integration Network corrects the driver responses, ensuring coherent sound and a thrilling multi-dimensional sound stage.
- **Radiation pattern:** microphones pick up sound over a very wide arc, with omnidirectional pickup patterns being the most highly regarded. For this reason, the speaker system must reproduce a very wide dispersion pattern, including output to the rear. This ensures a very "open" sounding speaker system, eliminating the boxy effects of most speaker designs. Our Ambience Retrieval System "opens up" the sound stage, by means of a rear-firing mid/tweeter which is fed a specialized signal. The out-of-phase information that the mics pick up is reproduced by our proprietary depth simulation system, which generates a fantastic sound field image. Note that this effect is adjustable with an effects level control to compensate for various room conditions.
- **Low distortion:** microphones have far less distortion and coloration than average speaker systems, so the reduction of distortion and coloration is paramount. We have spent several thousand hours developing Low Distortion drive units utilizing space-age composite diaphragms and linear motors. The VR-2 has extremely clean sound!
- **Wide frequency bandwidth:** the best mics have a frequency response of 20-20kHz. This wide bandwidth is essential if the scale of the music is to be reproduced at full dynamics, especially in the lowest octave. For this reason, we developed the VR-2 to reproduce a 25 Hz to 25kHz range @ -3dB.

- High dynamic range: most speaker systems exhibit compression effects, especially planar transducers. Loss of dynamic range leads to "canned" sound. In order to reproduce a wide dynamic range that can be thrilling, we have utilized very light-weight composite diaphragms driven by very large magnetic structures.



The VR series of speaker systems, including the VR-2, has been designed with the above characteristics as design targets, and their optimization has led to a high degree of sonic fidelity, well beyond that of competing designs. In addition to the Acoustic Inverse Replication theory, Von Schweikert determined that several dimensional "planes" had to be optimized, hence the model name "VR", for *Virtual Reality*. These dimensional planes can be termed *amplitude*, *phase*, *time* and *space*.

AMPLITUDE

The total sound output, including fundamentals and harmonics, must be reproduced equally throughout the entire frequency bandwidth, commonly stated as 20 Hz to 20,000 Hz. Very few loudspeaker systems at any price have ruler-flat accuracy, but our quality control and engineering target specifies a very tight tolerance window. Bass response extends to 25 Hz, providing thrilling bass power. Most importantly, although the amplitude response directed towards the listener must be highly accurate, it is equally

important that the off-axis response must not suffer from dips or peaks. Conventional speaker design often "trades off" the sound heard off axis, due to diffraction caused by wide baffles, crossover phase shift, and driver/cone breakup modes. A typical room will reflect about 50 to 80% of the sound from floor/ceiling and wall boundaries, making the off-axis response very audible in the overall sound field. This coloration lets the listener know he or she is listening to speakers instead of live music. For this reason, the Virtual Reality series of speakers from Von Schweikert Audio feature novel techniques to eliminate and/or greatly reduce off-axis response anomalies; in fact, our wide-dispersion design creates a three-dimensional holographic sonic picture of the original sound field. Accurate frequency response enables the VR-2 to sound natural, ensuring long-term listening satisfaction.

Harmonic balance is also important in the search for natural sound quality. The harmonic structure of individual musical instruments is determined by the relative volume levels between the fundamental note and its overtones. Timbre is composed of harmonic structure, which must be reproduced with fidelity; most transducers add distortion to the upper harmonics due to diaphragm flex and/or motor non-linearities. Note that the tone quality differences between a priceless Stradivarius violin and a cheap assembly line instrument consists of differing ratios of harmonics! Since distorted harmonics do not affect the amplitude response of the speaker system, they are difficult to measure by conventional methods. Von Schweikert has developed several different methods of measuring and quantifying distortion caused by diaphragm flexure and motor non linearity. Most transducers generate emphasis to the upper harmonics, which sounds like an edge has been added to the upper midrange/lower treble notes. In some cases there is a fuzzy grain added, generating harshness at high volume levels.

Our engineering target was to eliminate this form of amplitude distortion and ensure correct harmonic balance of each note. We use proprietary spectral distribution measurements to improve our diaphragm design, and the woofers and tweeters of the VR-2 are composed of high tech composites to reduce the tendency of a single material to ring. We have determined that metal and ceramic diaphragms cannot be made to sound natural, since their high-Q ringing modes cannot be totally eliminated with crossover filters. On the other hand, simple paper and/or plastic diaphragms add coloration to the signal due to high mass and flexure of the soft materials. By contrast, our composite cone diaphragms do not add or subtract anything from the signal! Note that the VR-2 sounds incredibly smooth and rich, yet has highly detailed sound, ensuring thrilling realism.

PHASE and TIME

Since a wide bandwidth speaker system must employ more than one transducer to cover the entire frequency range, the blending of the drive units is critical to develop coherent sound waves that will result in a three dimensional sound image. Many speaker systems do not use phase consistent technology due to the difficulty of starting and stopping all of the drivers in unison. Due to the differing cone/dome weights, suspension stiffness, and efficiency, most multi-band speaker systems cannot be made pulse consistent, but worse, many designers utilize crossover designs that necessitate out-of-phase driver wiring! Note that a poor sound-stage image is developed with these incorrect techniques, along with poor timbral response. The VR series of designs, including the VR-2, utilize specialized transducers that were engineered to operate together in unison. To eliminate complex circuitry that degrades detail, the transducers were designed to eliminate peaks in their breakup region. To ensure that the four transducers in the VR-2 speaker start and stop in unison, the diaphragms and motors were developed as a complete package, and in combination with our proprietary Global Axis Integration Network, the consistency of the sound pressure is very uniform and faithfully accurate to the signal. In fact, there is less than 3 ms of total delay between the transient impulse of the woofer, bass/mid and tweeter of the VR-2 system, ensuring a highly dimensional sound stage and correct timbral balance between the transducers. This low level of transient delay is below the critical auditory threshold discovered by the leading psychoacoustic researchers, and is a major factor in the realism generated by the VR-2 speaker system.



SPACE

The illusion of a live orchestra playing in your listening room depends on a spatial image developed by an invisible speaker system. Our proprietary Ambience Retrieval System enables the VR-2 to successfully mimic the microphone in reverse, generating a sound field that is amazingly dimensional. The full depth and image size is correctly reproduced in full scale, and most importantly, this effect is adjustable to compensate for the reflectivity of the wall and the distance from the speaker. The Dimension Control is located on the rear of the cabinet and is calibrated for repeatable settings. If the added depth is not needed for a particular recording, the effect can be turned off.

Conventional technology has been likened to hearing music through an open window. Von Schweikert asks"..*why stand outside?*

VR-2 ENGINEERING DETAILS

GLOBAL AXIS INTEGRATION NETWORK

There are two schools of thought regarding the correct type of crossover circuits that should be used to blend the drivers. The followers of first order filters believe that a simple circuit will sound more transparent, and that the natural phase coherent behavior of these circuits will somehow impart a purer sound quality than higher order filters. On the other hand, the engineers employing steep filters believe that the high degree of overlap caused by first order filters between the woofer and tweeter can lead to distortion, coloration, and off-axis response errors. The truth is: both of these positions are correct! The choice of first order or 4th order filters are both compromises, each with a list of benefits and disadvantages. For this reason, Von Schweikert spent fifteen years developing a proprietary filter topology that would be a best possible compromise between the two filter designs. In effect, the Global Axis Integration Network employs ladders of first order filters, ensuring purity and coherence. However, the use of several stages of first order filters also enables our **GAIN** circuit to have the benefits of fourth order filters, with lowered distortion and greatly improved off-axis response behavior.

Although there is a delay of 3ms between the driver pulses, this is inaudible, according to our research and the studies conducted by several research labs around the world. The VR-2 employs only the finest quality polypropylene capacitors and air cored inductors to ensure that distortion and coloration are inaudible. If you are seeking the most natural sounding speaker in the world, you must audition the VR-2!

ENCLOSURE DESIGN

To greatly reduce the boxy effects of cabinet resonances, the VR-2 employs our Resonance Trap, an internal chamber that is filled with shot during setup. The shot greatly absorbs the cabinet wall vibration and ensures a very clean sound quality. In addition, only high quality MDF board is used, covered by a thin lamination of wood veneer. Naturally, internal bracing is used to further reduce resonances that are common to other designs.

WOOFER SYSTEM

To reproduce deep and powerful bass, twin 165mm woofers are employed in our triple chambered hybrid transmission line enclosure. Tuned to 25 Hz, the enclosure enables very tight bass due to the staggered resonances of the three internal chambers which are damped by Dacron polyester stuffing material. Sealed enclosures lack efficiency and dynamics, since $\frac{1}{2}$ of the cone's output is trapped inside the cabinet. However, bass reflex designs are very resonant, with a fat, one-note quality due to air sloshing in and out of the hollow air cavity. The best possible design is the transmission line, which combines the efficiency and speed of ported boxes, with the tight bass of highly damped (sealed) enclosures. Our proprietary triple-chambered design was developed over a period of fifteen years, and is noted for its extremely tight and accurate bass response due to the staggering of the resonances in three different chambers.

Twin Driver Design:

To further ensure clean bass, we have employed two different bass drivers: a subwoofer with low resonance tuning and a bass-mid woofer using a higher resonance and lighter cone. The 165mm subwoofer employs a very large voice coil and magnet to enable very high power handling at low frequencies and is crossed over at 200 Hz to ensure that the vital midrange area is not affected by the Doppler modulation effect. The upper bass-mid driver has a smaller voice coil and magnet and is optimized as a midrange driver, being crossed over to the tweeter at 2.2 kHz. As we use both of these woofers at low frequencies, their combined power and staggered tuning results in extremely powerful yet detailed bass. The VR-2's bass response far exceeds that of conventional speaker systems in both power and clarity: if you wish to feel the bass drum whacks in classical music or want to hear the deep growl of a Fender electric bass, you will love the VR-2's powerful bass response. If you wish to hear spine tingling sounds like finger prints brushing on cat gut acoustic bass strings in a jazz trio, the VR-2 is your top choice!

MAINDRIVER SYSTEM

As the midrange frequency band is a critical component of sound reproduction, great attention was spent on developing a transducer that could be as transparent as the best electrostatic panel, yet have the warmth of a human voice. Towards that end, we developed a 165mm bass-mid driver that has an extremely light but rigid cone, made from cellulose acetate pulp, plastic, and mica mineral-flake powder. This high-tech composite cone was designed to eliminate cone flex and/or ringing common to other stiff cones made from aluminum or ceramic materials. In addition, to reduce the distortion caused by conventional voice coil motion in a magnetic gap, we have employed a new Low Distortion motor design, which uses FEA (finite element analysis) methods to optimize the voice coil windings, top plate, pole piece, and magnet. To greatly improve the transient response, we also developed a linear suspension system that controls the cone motion, greatly increasing clarity. The end results of these engineering advancements is a midrange frequency band with impressive fidelity and clarity, but without the thin, dry sound passing as "transparency" in competing speaker designs.

TREBLE SYSTEM

As high frequency distortion is one of the worst problems in speaker design, we put great emphasis on our tweeter development program. Our secret was to develop a new type of dome material, a space age composite that will not ring with any type of signal, in addition to the utilization of a very powerful motor that can control the motion of the dome at extremely high volume levels. By lengthening the voice coil and doubling the depth of the magnet, we are able to greatly increase the power handling of the motor, greatly reducing distortion. Many instruments such as horns, violins, and the human voice can cause a tweeter dome to resonate and distort when the volume level is raised to intense levels. Think of a transient impulse with hundreds of times the average signal level, generated by a scream or snare rim shot. The mechanical distortion of diaphragm flexure and the voice coil chattering in the gap can cause very unpleasant sounds, but even low level signals such as a violin can also sound harsh if the dome and motor are not made to the highest quality levels. To eliminate the unpleasant distortion found in conventional tweeter designs, we have employed a composite diaphragm made with linen fabric and laminated with four coatings of synthetic rubber/plastic resin compound. Our proprietary dome material is a hybrid of both hard and soft dome designs, enjoying the frequency response accuracy of hard domes with the smoothness and liquidity of soft domes. To combat mechanical distortion at high volume levels, the dome's suspension is controlled by the addition of Ferrofluid cooling liquid in the magnetic gap, acting as a lubricant as well as drawing heat away from the voice coil to aid in power handling. If your mission is to find a speaker with very clean highs combined with a liquid smoothness, you may have found your perfect speaker system. Finally, listen to violins without gritting your teeth!

INPUTS and SHIELDING FOR VIDEO

Twin sets of exotic five-way binding posts are employed to facilitate bi-wiring or bi-amping. The pure copper posts are plated with rhodium to prevent oxidation and increase the signal clarity, and rhodium-plated jumper straps are provided if you do not wish to bi-wire. To comply with CE approval in Europe, the binding posts are covered with a clear plastic housing to prevent short circuits. These massive binding posts may be tightened with fingers or a wrench and are mounted on a black metal plate listing the serial numbers of the matched pair. To prevent stray magnetic fields from affecting a TV monitor screen, the magnets are shielded with permeable iron cups and a reverse-charged bucking magnet. The magnetic shielding also eliminates the Dangerous Cargo surcharge when shipping to foreign countries and is a CE mandated feature.

REAR AMBIENCE RETRIEVAL SYSTEM

In order to properly reproduce the depth that conventional "box" speaker systems don't get right, we have developed a rear-firing mid/tweeter that is fed an out-of-phase ambience signal. This signal is decoded by a special circuit, and consists of the signal that the recording mic would receive behind the microphone, i.e., the out-of-phase reflections coming from the back of the hall. A 1" dome tweeter, loaded with a wave-guide mounted at the top rear of the cabinet, reproduces the signal which is designed to be reflected off of the wall behind the speaker. The effects level is controlled by the Dimension Control knob mounted at the rear of the cabinet, and is calibrated to ensure consistent settings.


MOUNTING PLINTH AND SPIKES

To properly decouple the speaker from the floor, we have provided a mounting plinth that is to be attached to the VR-2 at the time of setup. The plinth is supplied with cone feet to decouple the speaker from the floor, and can be used on either carpets or hardwood flooring. This state-of-the-art decoupling system provides tight bass response and stable image focus, while masquerading as a cabinet design feature.

AVAILABLE FINISHES

The choice hardwood veneer is available in two types of wood and is protected by a clear coat of polyester resin, which adds a deep luster. The hardwoods available at no extra cost are: dark red cherry, black ash and African hazelwood. Standard grill cloth is a transparent black and the plinth base is painted in black polyester resin lacquer finish.

VON SCHWEIKERT VR-2 SPECIFICATIONS

System Type:	Three-way, four driver system, with Transmission-line woofer design	
Size:	40" (102cm) tall x 8" (20.3cm) wide x 16" (40.7cm) deep	
Weight:	66 lbs (30 kgs) raw, 85 lbs (38.6 kgs) with sand, 95 lbs (43 kgs) with lead shot.	
Woofer System:	Twin 165mm (6.5") composite cone Low-Distortion drivers.	
Treble System:	1" (25mm) fabric dome tweeter with soft resin damping layers, Low Distortion motor, Ferrofluid liquid cooling/damping, and long-throw voice coil and motor assembly.	
Damping System:	Resonance Trap cavity provided for insertion of lead shot.	
Crossover:	Global Axis Integration Network, 4th order slopes using cascaded 1st order filters at 200 Hz and 2.2 kHz. Polypropylene caps and air cored inductors are utilized. All drivers are connected in phase.	
Ambience Driver:	1" (25mm) soft dome tweeter with wave guide mounted at rear of the cabinet and Dimension Control for effects level adjustment, calibrated.	
Frequency Response:	25 Hz to 25 kHz, -3dB (+/- 1 dB in the midrange).	
Sensitivity & Impedance:	87.5 dB @ one watt/one meter, anechoic. 90 dB in room. 8 ohms nominal, 7 ohms low to 20 ohms high.	
Power Handling:	20 watts minimum power, 200 watts maximum r.m.s., 500 watts peak.	
Wire Connection:	Five-way binding posts, fitted for 6mm spade lugs, with CE approved sheathing. Twin pairs are fitted, for bi-wiring or bi-amping. Jumper straps are supplied.	

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