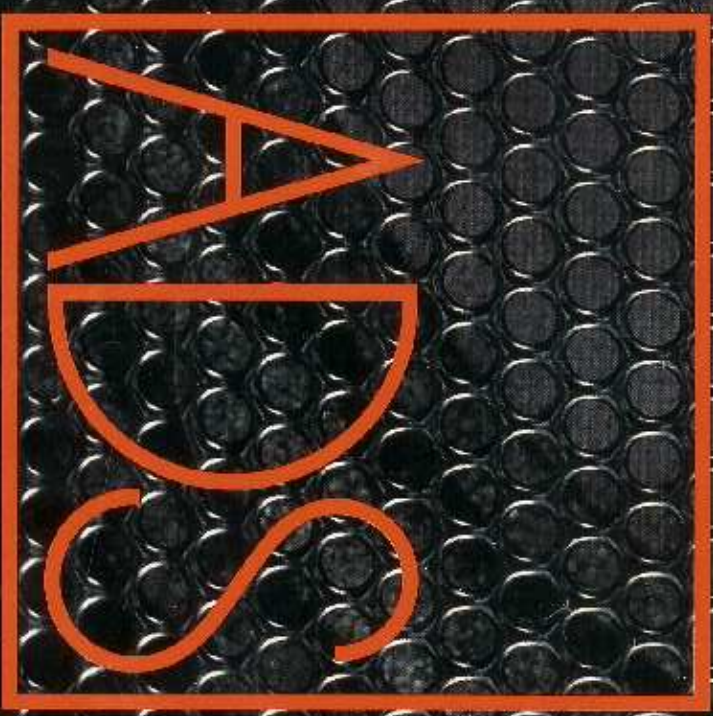


Audio Apart.

**ADS high-precision loudspeakers:
A technical perspective**



A matter of choice

The photograph shows the electrical impulse input and an ADS tweeter's resulting acoustic output on the screen of a high-resolution digital storage oscilloscope. Once captured by the digital scope, the information is transmitted to a computer for complex signal processing and analysis.

Any loudspeaker system is the product of hundreds of design decisions. The reasoning behind those choices may be based in physics, chemistry, statistics, even aesthetics or economics. Form, materials and manufacturing methods need to be evaluated and decided. But after all of these choices are made, we hear a loudspeaker as an integrated whole, not as a collection of disjoint parts. When each detail choice is made to improve performance, the result, in total, is substantially increased system performance—in short, excellence.

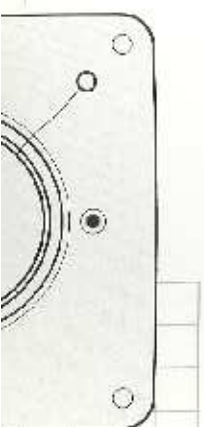
ADS loudspeakers are built with the conviction that a speaker should be first and foremost an accurate transducer—it must track the electrical input signal exactly. The ability to translate electricity into motion, or the converse, defines transducer. It is the ability to do so with precision that defines performance. Each of the many choices in the design of an ADS speaker system is first considered in terms of its impact upon the quality of the speaker as a precise or transducer.

ADS' approach to designing and manufacturing speakers is distinct from that of the majority. We expend the time and effort in engineering and manufacturing that we do for a simple, but far from trivial reason: the resulting products sound better. The high resolution of our speakers, both in tonality and in the depth and breadth of the acoustic image which they produce, makes all our efforts worthwhile. ADS speakers sound better today and they will continue to sound better.

The thoroughness of the engineering and the level of precision are worth knowing about. Of course, a speaker should be heard and evaluated, but the difference deep inside an ADS speaker that contribute to its high performance and the thinking behind the various choices make a fascinating technical story.

Dr. Godelhard Guenther
Founder and President

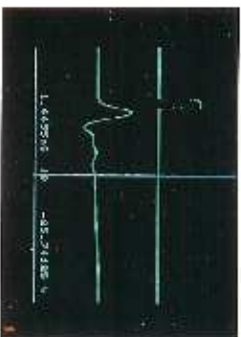
ADS



The driving principles

The performance of any speaker system is based primarily on the quality of its individual drivers. Shortcomings in drivers become, in turn, deficiencies in system performance; there should be no short-cuts here. Excellent drivers are the absolute prerequisites of precise, musical loudspeaker systems.

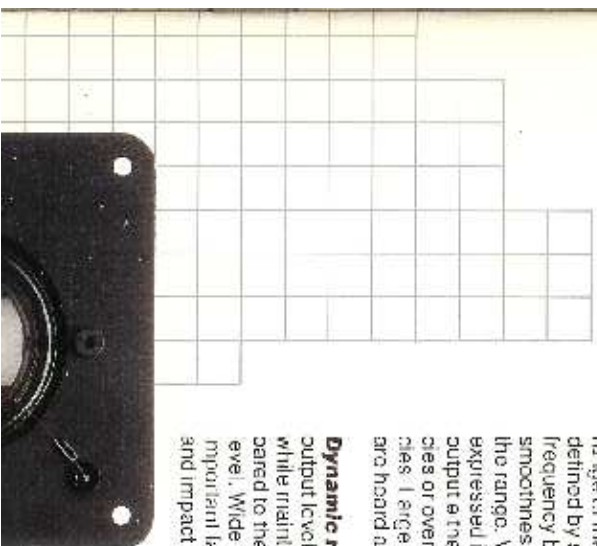
Regardless of the size of the driver or the part of the musical spectrum it is intended to reproduce, consistent measures can be applied to evaluate its performance. Important among them are:



Linearity — the degree to which the acoustic output replicates the electrical input. Deviations from the ideal produce distortion, compression or peak limiting.

Bandwidth and frequency response — the useful operating range of the driver or system defined by specific amplitude vs. frequency behavior, and the smoothness of the output within the range. Variations are expressed in decibels of acoustics output either at specific frequencies or over a range of frequencies. Large or abrupt variations are heard as coloration.

Dynamic range — the maximum output level that can be reached while maintaining linearity compared to the background noise level. Wide dynamic range is an important factor in the realism and impact of reproduction.



Advanced computer analysis provides a look into the performance of speakers under real-life transient conditions. These computer plots trace the impulse-time responses and the resulting frequency response of two tweeters. The upper plot shows the acoustic output versus time of the tweeter, when driven by a brief, high voltage impulse. The lower

plots show the frequency responses at several discrete moments in time, as computed from the impulse time response. This computer analysis of drivers under dynamic conditions lets ADS design from facts instead of guesses.

The plots on the left show the ADS 3c tweeter, soft-dome tweeter. Note the absence of ringing and oscillation during and after the initial impulse, and the mild undershoot below the baseline. This clear impulse response translates to smooth, peak-free frequency response characteristic of all ADS soft-dome drivers.

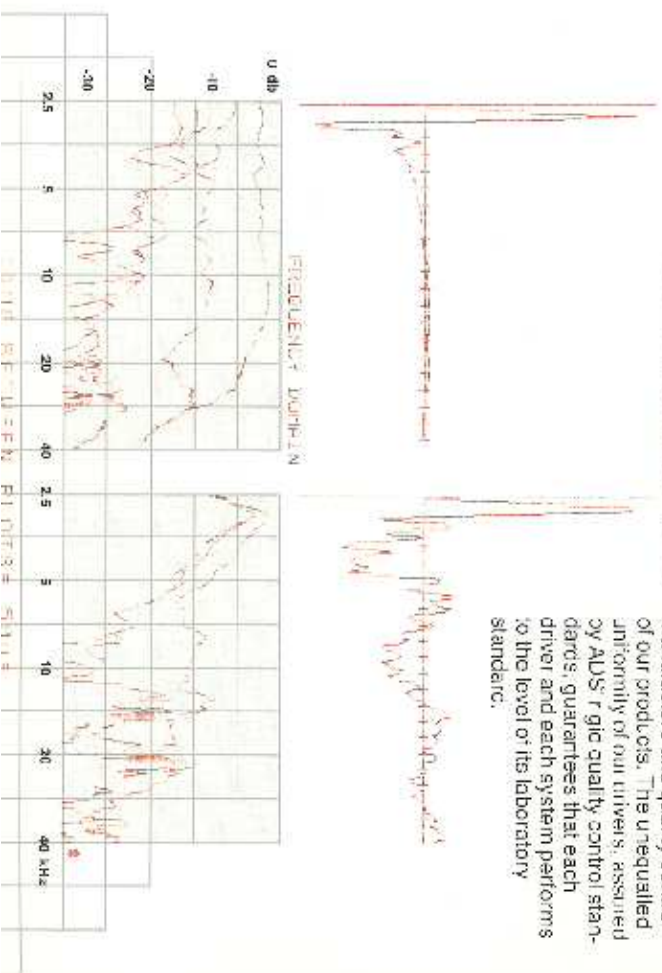
The plots on the right show the tweeter from another popular high-fidelity speaker. Note the ringing during and long after the initial impulse, the large undershoot below the baseline, and the resulting jagged, peaky frequency response. This kind of performance results in fatiguing, highly colored sound.

Efficiency — the ratio of acoustic power output to electrical power input. High efficiency contributes to wide dynamic range and reduces stress on both speaker and amplifier.

Transient response — the ability of the driver to accurately reproduce impulses and rapidly changing waveforms. Poor transient response results in distortion and coloration.

Dispersion — the angle within which the driver produces uniform output. Broad dispersion contributes to the size and quality of the sound stage, and increases flexibility of speaker placement.

Many popular speakers over-emphasize performance in one of these measures at the expense of the others. Truly accurate transducers are excellent in each of these measures and artfully balanced for best total system performance. Unlike most speaker manufacturers — who buy most of all of their drivers from outside suppliers — ADS builds all of its own drivers, optimizing them for balanced performance. We use modern measurement techniques, including advanced computer analysis, in the design, manufacture and quality control of our products. The unequalled uniformity of our drivers, assured by ADS' rigid quality control standards, guarantees that each driver and each system performs to the level of its laboratory standard.



The ADS soft-dome tweeter



High frequency drivers, called tweeters, must be small to reproduce short wavelength, high frequency sound with broad dispersion. The small dimensions and microscopic movements of tweeters make the cost of obtaining accurate performance high, but also make the benefits of precision manufacture most apparent in sound quality.

Absolute accuracy in high frequency music reproduction requires driver's engineering and build tolerances not unlike those of a fine Swiss chronometer. The laws of physics are unrelenting to attain extended frequency response, the driving force must be high and the moving system mass must be low. A high force-to-mass ratio also makes possible quick transient reproduction and high efficiency — qualities which together define ultimate performance.

At the same time, the diaphragm which couples the motion of the voice coil to the air must be rigid to move in perfect response with-

out changing its shape or producing unwanted motion. Being a spherical section, the dome's nature's strongest shape. Driven from its edge, the dome is the ideal shape for high frequency reproduction. However, the dome must be well-damped; the slightest bending or flexing motions must be absorbed and eliminated to keep all forms of coloration to a minimum.

All ADS midrange and tweeter drivers use a soft, woven fabric for the dome and its surround. Though supple and flexible to the touch, this fabric has been chosen because it is stronger than other plastics (and also many metals), is extremely low in mass and by its very nature possesses excellent internal damping characteristics. A proprietary compound that remains permanently "sticky" is precisely metered and applied to each dome to further damp it and to seal it acoustically.



The advantages of efficiency, accuracy and excellent transient response gained from the low mass, well-damped dome must not be degraded by the voice coil and the magnet structure—the "motor" of the driver. A heavy voice coil or inept magnet design can nullify the advantages of even the best dome. The differences in voice coil and magnet design are invisible in most speakers, yet they have a powerful effect on the sound quality.

Each ADS voice coil is wound on an ultra-thin aluminum band. Though more expensive and more difficult to produce than plastic or paper, aluminum was deliberately chosen for mechanical strength and quick heat dissipation. The low-mass, single layer coils are perfectly round and wound tightly, with out spaces between turns, to concentrate the maximum length of wire in the magnetic gap.

The ADS tweeter's woven soft dome and precisely constructed voice coil assembly make up the driver.



Each magnet is a precise on-ground ring of premium grade barium-ferrite with consistently small particle size, chosen for its unvarying field strength. The steel of the pole pieces surrounding the magnet is an alloy specifically developed to conduct the high magnetic flux without any decrease in strength.

The wire itself must be carefully and uniformly drawn to avoid failure-prone hot spots in the coil. The source of ADS' voice coil wire is the one factory in the world which produces eight purity wire absolutely uniform in cross-section.

The voice coil wire must be insulated to avoid short circuits. The type of thermoplastic insulation used on voice coil wire is thick and occupies substantial space in the finished coil. This constitutes wasted space which decreases efficiency. In contrast, ADS' wet-coats the bare wire, during winding, with a remarkably thin, tough insulation. This process achieves unequalled packing density of wire in the coil, further assuring the highest possible efficiency.

er's extremely low mass moving system. This low mass, and the strength and damping of the dome fabric mean high efficiency and accurate transient response. ADS makes all of its drivers from the ground up, because the only way to achieve the highest quality is by carefully controlling and checking every step of the manufacturing process.



Narrowing the magnetic gap in which the voice coil moves greatly improves magnetic field strength and efficiency, since the change in field strength is inversely proportional to the square of the change in gap width. ADS' precision magnet structures have gaps that are exceptionally narrow for the greatest possible field strength.

The ADS magnetic gap is also remarkably consistent in all its dimensions: height, width and symmetry do not vary. This level of consistency is difficult to achieve and costs more. But with this consistency, ADS obtains uniform field strength and, therefore, uniform motion of the voice coil and cone. This unvarying field strength significantly contributes to the driver's smooth frequency response and low distortion.

Heat is the inevitable byproduct of the conversion of energy from electrical to mechanical to acoustical forms. Most of the power from the amplifier will be turned into heat in the voice coil of the drivers. This heat can be a problem; it can worken metals

The ADS tweeter voice coil is a single-layer of high-purity copper wire precisely wet-wound on a light, strong aluminum former. The ADS mid-range driver voice coils, though larger, are made in exactly the same way.

and plastics, softer adhesives and, by raising the resistance of the voice coil wire, it can cause compression of the acoustic output and limit dynamic range. ADS has solved these problems: narrow magnetic gaps and aluminum voice coil bands quickly conduct heat out of the voice coil. Magnetic fluid further hastens heat removal.

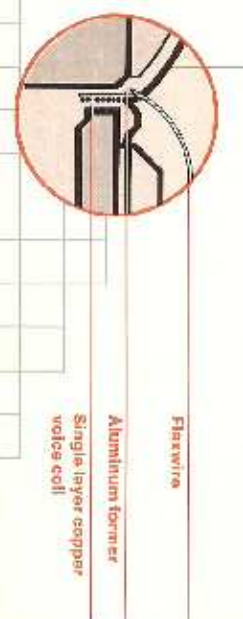
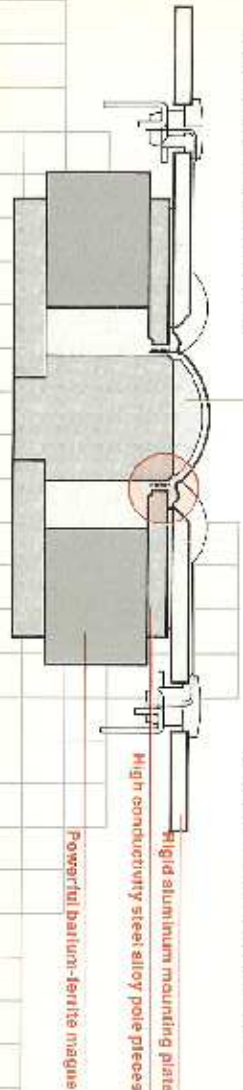
ADS uses magnetic fluid to improve the tweeter's dynamic range by dissipating heat quickly out of its small voice coil. ADS and the foremost supplier of magnetic fluid have developed a fluid that is specially processed for small, consistent magnetic particle size and that has a carefully controlled viscosity to optimize heat transfer and yet remain stable in the gap. The use of this unique fluid extends the already high power handling capability of the ADS tweeter for undiminished performance over time.

The gap of the ADS magnet structure is extremely narrow and unvaryingly consistent. The tight tolerances necessary for free voice coil movement in such a narrow gap are difficult to achieve and maintain, but the improvement in efficiency and linearity that result enable ADS speakers to resolve musical detail with less precise driver designs.



An exact amount of magnetic coating fluid helps conduct heat away from the voice coil. This quick heat transfer prevents transient distortion and maintains dynamic linearity at high playing levels. ADS speakers are noted for wide dynamic range and have been extensively used as monitors for digital recordings.

Together, the superb structural and damping characteristics of the dome, the low moving mass and uniformity of the voice coil, and the strong and unvarying magnetic field make a justifiably efficient and accurate driver with high maximum output capability. That endows ADS speakers with wide dynamic range. While our company has always stressed the importance of dynamic range, it becomes all the more crucial with today's emphasis on digital recording technology which is capable of reproducing the full range and intensity of a live performance.



The ADS soft-dome midrange

Middle frequency drivers are called midranges and cover the musical spectrum from roughly middle A (the piano) to about the upper end of the keyboard. It is in their operating range that human hearing's most sensitive and minor aberrations are most apparent. All of the advantages of the ADS soft-dome tweeter — high force-to-mass ratio, a rigid, well-damped diaphragm and precision motor system — apply equally to the ADS soft-dome midrange.

The soft-dome midrange has the further advantage, compared to cone type midrange drivers, of a complete absence of cavity resonances in the cone's surface of the cone, which cause pronounced variations in the output of the cone midrange driver.

With their ability to deliver all the power and to preserve all the nuances of live music, the high

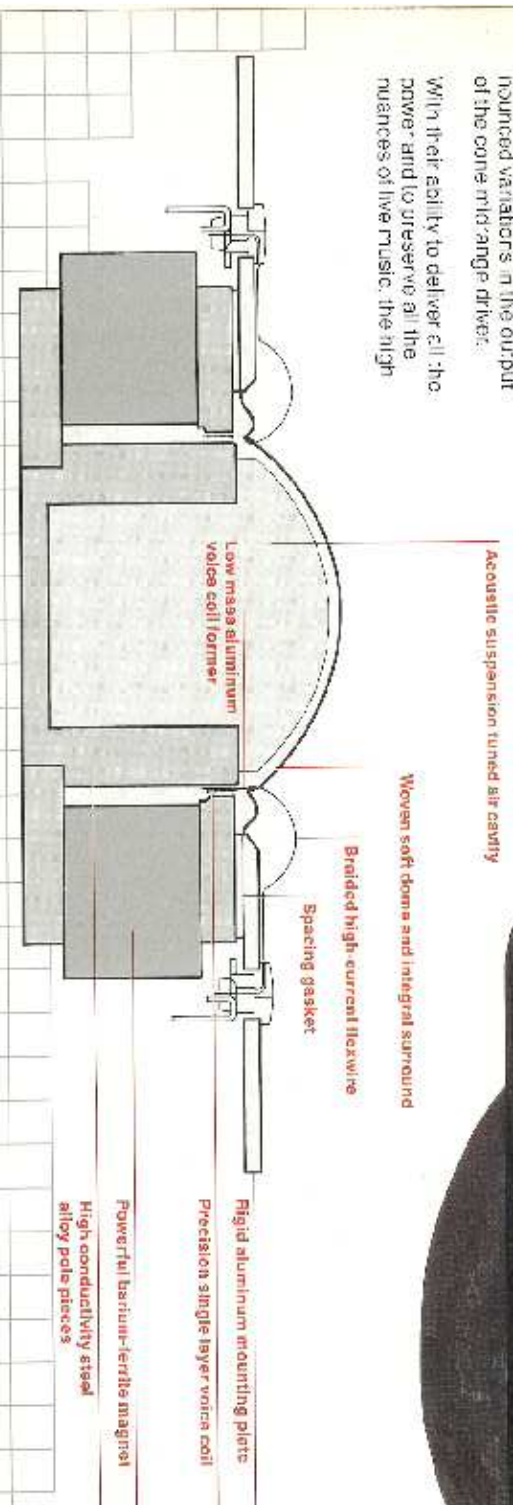


resolution ADS soft-dome midrange and tweeter set the performance standards for the world's finest mid and high frequency transducers. Drivers lacking ADS' precision and attention to detail do no performer as well.



The coating of ADS' midrange and tweeter domes is exactly metered and carefully applied. This proprietary compound seals the

dome and provides additional damping. Each driver is individually tested and every system is optimized and analyzed before it leaves ADS.



The ADS Stiffite® Linear Drive woofer

Drivers that reproduce the lower frequencies are called woofers. To reproduce high level bass sounds a woofer must move a great deal of air while controlling the movement completely. The laws of physics are no more forgiving here than in tweeters and midranges. The woofer must have extended linear excursion capability and a light, rigid, well-damped diaphragm. The necessity for long, controlled excursion and the requirement that the woofer be correctly enclosed for optimum performance impose stringent design demands and dictate that the driver be conceived as a coherent system composed of a great many parts — each vital to accurate reproduction.



Every ADS woofer features a proprietary cone material called Stiffite®, extremely light for good transient response, yet rigid to avoid distortion caused by flexing and boarding. Stiffite is a felled, air-filled cellulose composite whose low mass is a result of its high air content. The randomly oriented fibers that form the micro-structure of the cone account for its rigidity. The cross-linking of these fibers internally damps unwanted motion, assuring flat, smooth frequency response and low distortion. The cone is tapered in cross-section for optimum mass distribution and greatest possible strength.

The woofer's suspension system allows the cone and voice coil assembly to move as an exact analog of the electrical signal, while at the same time controlling the limits of excursion and eliminating extraneous motion. Durable rubber, though more expansive than conventional materials, has been chosen for the outer surround; it provides far superior



control, longer life and excellent damping of the cone edge, and greatly lowers distortion at the limits of excursion.

Because we design and manufacture our own drivers, we have control over the factors which optimize bass extension and efficiency. Even the smallest ADS minispeaker has bass output that is both musical and satisfying, equalling or exceeding the output from larger competitors.

The advantages of acoustic suspension design are well known; the bass response is free of any hangover or burriness and is deeper and tighter than that produced by other woofer systems. The slower rate of bass roll-off below the system resonance point provides superior deep bass output while producing the fastest, most accurate reproduction

This magnified cross-section diagram of an ADS Stiffite woofer cone shows the air-filled and cross-linked micro-structure of Stiffite that gives it low mass, high strength and excellent damping. These properties of Stiffite give ADS woofers smooth frequency response and low distortion. No other cone material combines the conflicting requirements of low mass, stiffness and intrinsic high damping as well as Stiffite.

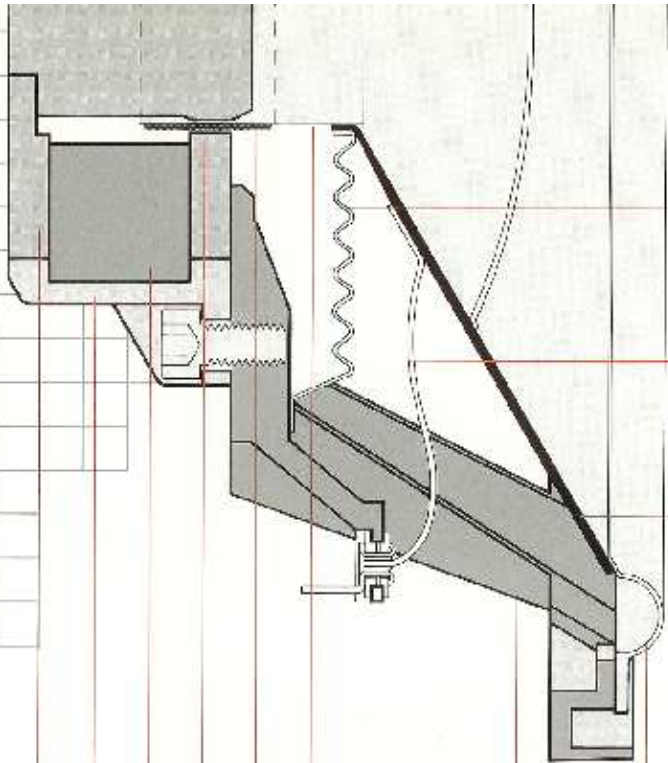
The Linear Drive woofer accurately moves large amounts of air because the premium butyl rubber surround allows long linear cone travel. ADS speakers can deliver astonishing bass performance without being uncomfortably large and awkward.



ADS' exclusive SSMHC cone

Braided high current flexwire

Centering spider



Premium butyl rubber surround

Rigid non-ferrous cast basket

Low mass aluminum voice coil former

Laser Drive long excursion voice coil

Narrow, precise geometry magnetic gap

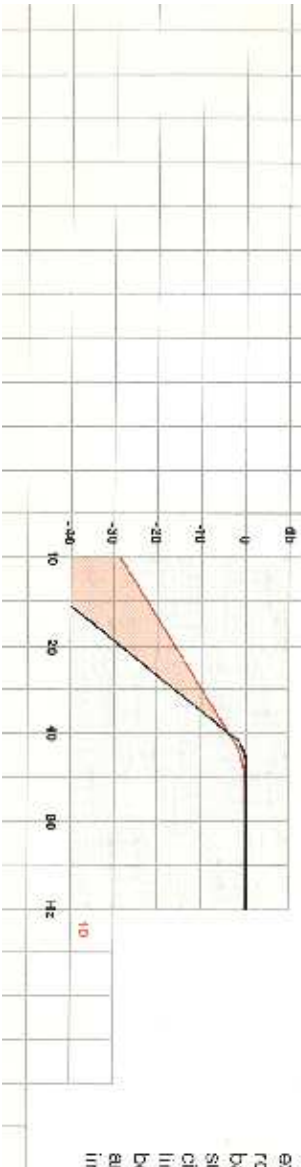
Powerful barium ferrite magnet

Ultramild magnet annealing

High conductivity steel alloy pole pieces

The straddled arbor in the graph shows the deeper bass reach provided by acoustic suspension woofer design compared to vented box, passive radiator designs. The red curve traces low frequency output of an ADS woofer; the black curve

shows the output of a similar woofer in a vented box. In addition to the extended bass response, acoustic suspension woofers exhibit less overshoot and ringing.



The ADS Linear Drive woofer voice coil on the left is not only longer than the typical woofer coil on the right but is also more smoothly and closely wound. The additional length and uniform winding mean that even at the limits of excursion the coil remains in the magnetic gap, under the control of the



efficiency and wide dynamic range are preserved by somewhat reducing deep bass extension.

amplifier for the low distortion, quick and accurate bass response that characterizes ADS speakers.

The ADS Linear Drive voice coil and magnet structure—the woofer's "rotor"—generate extended linear excursion. The suspension system guides this motion, but the rotor must provide the push and pull over the full length of cone travel.

Our voice coil is unusually long for full length cone drive and, like those of the tweeter and midrange drivers, is tightly and smoothly wound on an aluminum band for strength and quick heat dissipation. The woofer's two-layer coil is perfectly round, gap-free and, like the tweeter and midrange coils, tightly wound of wire that is wet-coat insulated as it is wound. The high and consistent packing density that results from this process produces high efficiency and linear motion in the woofer.

ADS prizes high efficiency for its benefits of wide dynamic range, driver reliability and reasonable amplifier power requirements. In woofer design, there are inescapable trade-offs among efficiency, enclosure volume and deep bass extension. ADS has an envied reputation for getting the best bass out of the smallest enclosures without sacrificing efficiency. Within the ADS speaker line-up, as ADS speaker systems become smaller, less complex and therefore less expensive, the important qualities of high effi-

ADS diffraction-free enclosure

The magnet structure has a narrow gap that produces a strong, uniform magnetic field to assure totally accurate voice coil motion. The narrow gap provides low distortion and high efficiency but also demands perfect roundness and centering of the coil and precise control of motion by the suspension. Only ADS' voice coil and suspension technologies and thorough quality control make possible the use of these desirable narrow gap magnets.

The magnet material and steel chosen for the woofer are the same expensive materials used in the high frequency drivers. Most ADS woofers use a cast basket, strong and non-ferrous so as not to distort or reduce the magnetic field within the gap, as steel baskets often do.

Every ADS loudspeaker system is an optimized closed box acoustic suspension design; box volume and woofer size are carefully matched for high efficiency, while affording the deepest possible bass reach and accurate transient response.

As important as driver excellence is, the enclosure has a profound effect on the performance of the system as a whole. A loudspeaker enclosure must be dense, rigid and free from unacceptable acoustic side effects and, at the same time, it must provide lasting visual appeal.

ADS enclosures obey most of the requirements. They are constructed of high density compressed wood chosen to provide maximum freedom from resonance and spurious sound transmissions which can color the sound. In this respect, ADS' thick enclosure wood is far superior to plywood or solid woods. The enclosures are braced internally and mortised at the corners for maximum strength.

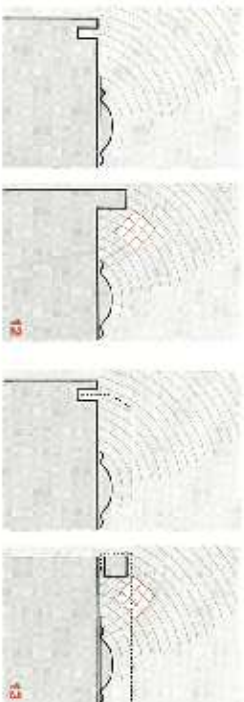
The enclosures are finished with natural wood veneers or thick plastic laminates of exceptionally high quality and durability. The veneers used are carefully selected to meet the finest furniture standards. Many of the enclosures are graced with solid wood corner collars for additional strength and distinctive appearance.

Inside the enclosure, acoustic energy is absorbed by high grade glass fiber blankets. The fiber size, the order of the fibers, the orientation of the fibers, in the blanket, all are critical to the performance of the woofer and enclosure. ADS' fiber glass is selected, cut and positioned for optimum absorption.

On their exterior, our enclosures are free of abrupt protruding edges that reflect and diffract the sound waves and so limit their dispersion at high frequencies.

ADS enclosures use flush front baffles because reflections from protruding edges interfere with higher frequency radiation. The ability of ADS speakers to create a solid, detailed stereo image stems, in part, from this smooth, unobtruded construction.

ADS' frameless, perforated metal grille preserves the integrity of the acoustic wavefronts in addition to protecting the drivers. The supporting frame for the cloth grille typical of many speakers also reflects and interferes with higher frequencies.



Though a fabric grille may be acoustically transparent, any frame used to support it can cause reflections and interference. ADS grille are frameless and acoustically transparent to further maintain the integrity of the acoustic wavefronts. They are formed of strong, perforated metal to protect the drivers, and their enduring good looks resist the stresses of a busy household.

While high quality enclosures do add to cost, they move the cost any extra cost with increased value. ADS has made quality choices based first on acoustic concerns, but balanced by an awareness that a speaker system is more often seen than heard, and that seeing the speaker should be a continuing pleasure.



ADS high accuracy crossover network



A crossover network is responsible for directing the correct frequencies, in accurate proportions, to the various drivers in a speaker system. The elements of this device determine the overall sonic balance of the system, and strongly affect efficiency, vertical and horizontal imaging and frequency response—both on and off axis.

Complexity is not a virtue in crossover network design, since adding elements increases losses and can degrade the smoothness of off-axis frequency response. While added network elements and increased complexity may help some manufacturers compensate for deficiencies in driver design and construction, ADS' superior drivers permit the use of a better, simpler crossover network.

The ADS crossover network is a two-pole, modified all pass design which offers power response (combined on and off axis response) superior to that of any other type. The ADS network is

The value ADS places on attention to detail is nowhere more obvious than in the crossover network. The components that together make up an ADS crossover network are of uniformly high quality, but that is only half the story.

Equally important is what is not included. Because of ADS' superior driver design and technology, the crossover need not be made more complex to make up for driver shortcomings.

characterized by high quality, low loss components which optimize efficiency and assure long, stable life.

The woofer inductor is made of heavy-gauge copper wire wound on a ferrite spool with large end caps; this provides the required inductance with extremely low resistance, and therefore low loss. While the usual woofer inductor has a resistance of 0.75 to 1.5 Ohm, the ADS inductor has a resistance of about 0.2 Ohm, reducing power loss from more than 20% to less than 5%. The low resistance also maintains ampifier damping of the woofer. The tweeter and mid-range inductors are air-core units wound on premium nylon bobbins.

All capacitors are (tight-tolerance, low-loss, AC rated type) chosen for stable performance. The especially critical mid-range and tweeter capacitors are constructed of computer-grade polyester film. Though much more costly than the electrolytic units used by many manufacturers, they have low dielectric absorption to provide best transient response. The woofer capacitor which must have large capacitance in a small volume, is a precision, low leakage, non-polar electrolytic type.

Crossover components are securely mounted on a high strength glass-epoxy circuit board, which is in turn fastened to a strong, glass-filled ABS housing. This housing holds the connection terminals and, where appropriate, provides access to the protection fuses and switches for tweeter level adjustment and bi-amplified operation.

The ADS network, in conjunction with our superb drivers, provides an acoustic image both precise and detailed in shape, size and realism. In stereo, the sonic stage and space take on remarkable depth, breadth and life, recreating the performance exactly as recorded.



The system as a whole

ADS offers a carefully thought out range of loudspeakers for the home — mini speakers, bookshelf systems, monitors and tweeters. And while there are naturally quantitative differences across the line, the qualities that characterize an ADS product — insightful

engineering, attention to every detail, innovative manufacturing — endure in all ADS loudspeakers.

ADS engineers and craftsmen have single-mindedly directed their efforts toward making the best possible transducers. Each choice has been made only after an exhaustive examination of all the options. Invariably, each choice has been made to obtain the highest level of performance.

And this overriding concern for quality and performance is tempered with an understanding of the requirement for value in every product. Each ADS product not only provides the best performance in its class, but also represents the most intelligent choice you can make in buying high fidelity equipment.

Every ADS speaker system closely approaches the goal of theoretical perfection. Through the artistic application of both engineering skill and manufacturing craft, the whole is indeed something more than the sum of its parts. An ADS loudspeaker system provides a level of satisfaction equal to that of an actual musical event — to enlarge our experience, to form our sensibilities and to elevate it to lasting pleasure that nothing short of art can provide.





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