

DUO FACT SHEET





*Holger Fromme, CEO*

DESIGNED BY NATURE.  
DEVELOPED IN GERMANY BY PERFECTIONISTS.  
MADE FOR ETERNITY.

How do speakers look like, if nature supplies the technology and the design?

The hornspeaker systems from Avantgarde Acoustic™ are an homage to the real and pristine. As no other brand, we in our team from the picturesque Odenwald in Germany have dedicated ourselves solely to the most primordial sound transducer technology available: the horn speaker.

Our claim is simple: building some of the best speakers available today. Enthralling sounds which are unforgettable and which will never let you go. Timeless horn technology - timeless design. Sound in its most pure and natural shape. And at the same time incredibly powerful. A unique listening sensation in your home - this is Avantgarde Acoustic™.

To let music become a multisensual experience as described above, our real task is to drive this ingenious natural horn principle to its limits. To question every detail and continuously trying to improve each and every component of our audio systems. UNO, DUO and TRIO are now being build since 1991. Although the essential concept and structure of these systems has never been changed, we used the past 25 years all of our commitment, dedication and enthusiasm to bring these products to a special level of uncompromising perfection.

The new DUO XD Series is a combination of precisely manufactured horns, calibrated driver systems with high impedance voice coils, innovative membrane technologies reducing distortions, powerful 1.000 watt bass systems and a new versatile digital sound processing allowing for a seamless integration of the system in the customer room. This brochure will give you some valuable background of our design philosophy and the technical aspects of this speaker system.

Enjoy reading.



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ACOUSTIC

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DUO XD series with „Turmaline Vivid Black“ horns  
and „Tianshan Mystic Walnut“ veneer of front panels



DUO XD series with „Light Topas Blue“ horns and front panels

## THE SYSTEM



### DUO XD SERIES

*107 dB sensitivity*  
*18 ohm omega midrange driver with Alnico magnet*  
*27 inch spherical midrange horn*  
*CDC system with no passive crossover components*  
*100V CPC crossover (patent pend.)*  
*2 x 12 inch bass drivers*  
*1.000 watt subwoofer amplifier*  
*Digital sound processor with 10 band parametric EQ*



The DUO-series is the most significant product line within the Avantgarde Acoustic™ portfolio. The 27 inch spherical midrange horn is a stringent symbiosis of low 170 Hz cut-off frequency, size and performance.

All horn drivers are equipped with Omega voice coils. With this high impedance technology we improve the interaction of membrane movement and amplifier signal, to realise the full potential of the spherical horn technology. The result is 18 ohms impedance combined with 107 dB system sensitivity – likely the highest figures in any production speaker.

Using Avantgarde Acoustic's™ CDC-technology, we precisely align the frequency response, sensitivity of the driver, the geometry of the membrane and the air chamber at the horn throat to the response curve of the spherical midrange horn. This way the midrange driver has no passive filter components in the signal path – routing the music signal directly to the voice coil of the driver engine. Less components, less interactions, less friction ensuring more detail.

The tweeter of the DUO XD series is equipped with the patent pending Capacitor-Polarization-Circuit to bypass the structural limitations of capacitors. By applying a polarization current to the conductors of a custom designed capacitor, we managed to eliminate the physical phenomenon known as “dielectric memory effect”.

The active subwoofer SUB231 XD Series supplements the balance between spherical horn performance and low frequency reproduction. It is actuated by two 12 inch long-excursion drivers powered by a 1.000 Watt amplifier.

Frequency control in the low frequencies is managed by an advanced digital sound processor. The digitally controlled frequency crossover ensure a seamless integration of the bass response to the spherical horns. The DSP is equipped with 10 parametric equalizers to fine control the sound to the customers taste and to the acoustics of the room.



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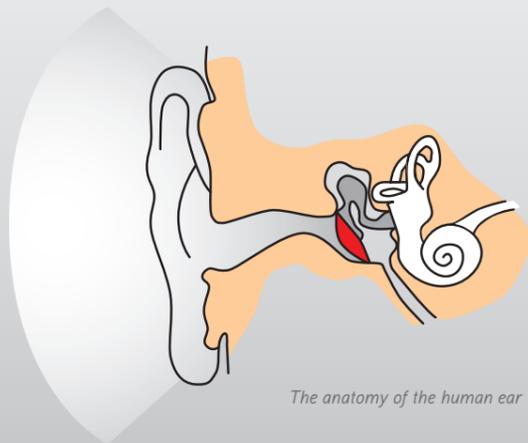
WHAT IS A HORN?

The horn principle is as old as the universe, maybe even older. Everybody knows the horn!

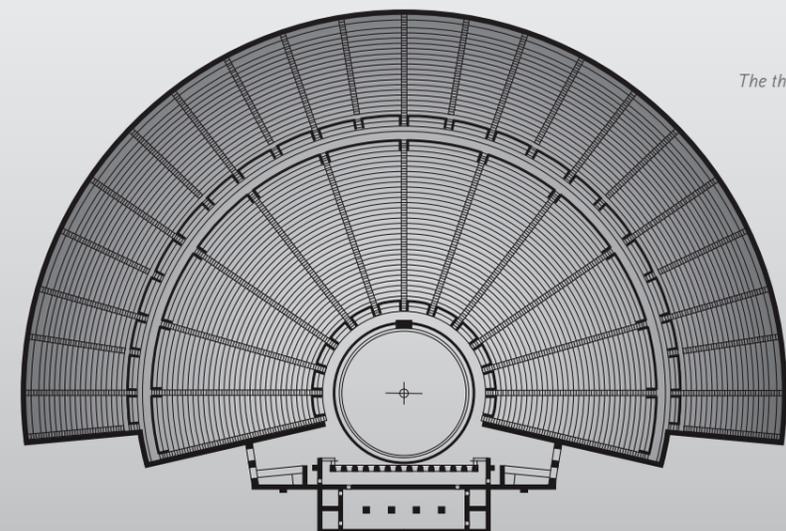
In nature the principle of the horn technology is ubiquitous. Our mouth is a funnel, as are our ears. And we form our hands in the shape of a copped funnel to amplify our voices and to improve the audibility when listening. Even the architectural design of the ancient amphitheatre in Epidaurus is based on the acoustical principles of the horn.

A horn funnel effectively guides the motion of sound waves and thus substantially increases the sensitivity and effectiveness of sound radiations.

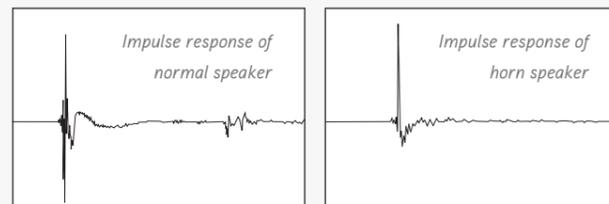
A horn is the most natural and powerful way to amplify sounds.



*The anatomy of the human ear*



*The theatre of Epidaurus, Greece*



## WHAT ARE THE ADVANTAGES OF A HORN?

A horn funnel connected to the front of a speaker driver is the most efficient way to amplify the sound and to increase the efficiency of a speaker. The actual moving parts of a transducer - voice coils and membranes - can be designed much smaller. Smaller moving parts means less weight. This reduction of the inertia of the moving masses will increase the responsiveness of the system. A horn speaker will accelerate much faster and at the same time will come to an immediate stop of motion if induced by the audio signal.

The reduction in the dimensions of the membrane area adds to the mechanical stability of the assembly. This higher sturdiness of the membranes and the reduced amplitude of the driver movement in a horn system will significantly reduce the distortions.

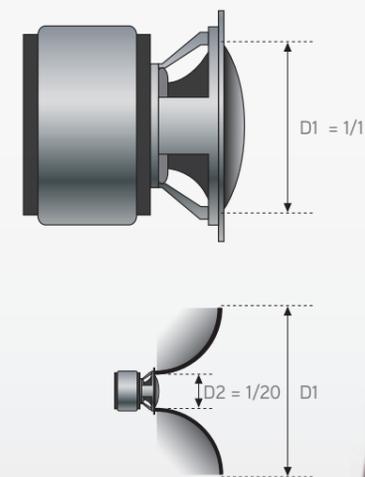
Distortions are alterations to the original shape of sound waves adding unwanted overtones to the original audio signal. This is negative in two ways. At first, these artificial dissonances will become audible by themselves, best described as an unnatural and harsh sound characteristic. Secondly, every detail of the original music signal which is smaller than these overtones will be masked and thus inevitably be lost.

Laboratory measurements of the DUO XD series drivers with and without the horns executed by Prof. Dr. Anselm Goertz at the University of Aachen impressively endorse the advantages of the Avantgarde Acoustic spherical horn technology:

- 8 x** 8 x times higher dynamic bandwidth
- 90%** 90% less distortions
- 10 x** 10 x times more details

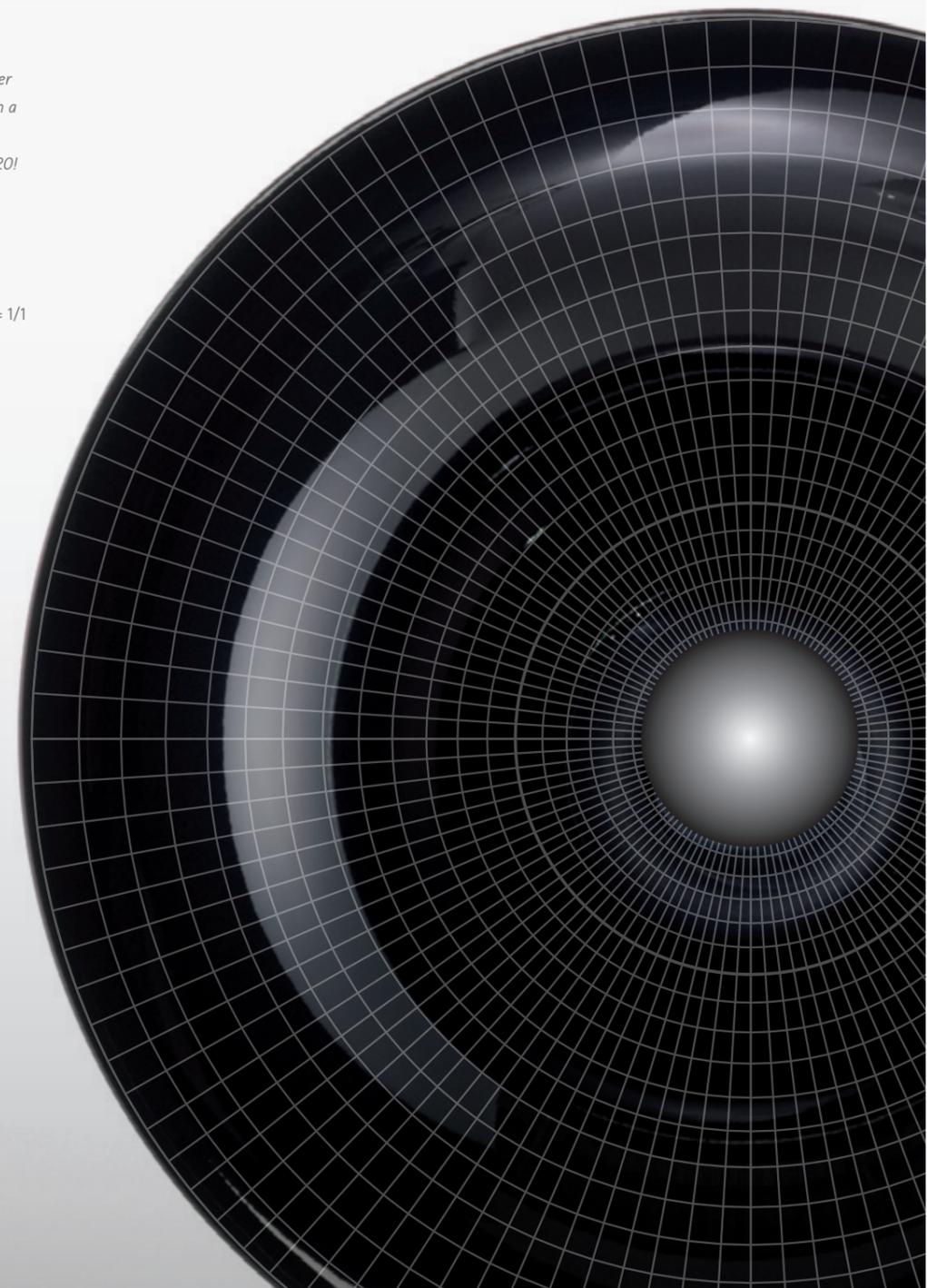
This means that with the Avantgarde Acoustic™ horn systems the usable range from the most silent to the most loud tones is increased by 8 x times. At the same time the systems have much less distortions and are thus capable of reproducing details which are 10 x times smaller than with conventional box speakers in the box design.

At a given SPL output a horn loaded driver can be designed significantly smaller than a driver without a horn. This results in a reduction of the moving mass of up to 1/20!

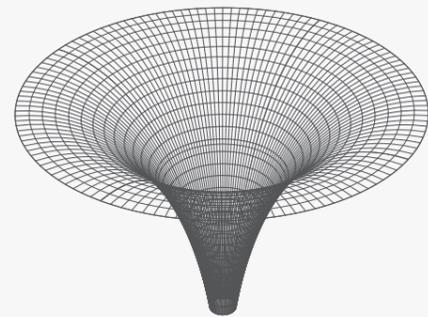


*"Compared to normal box speakers, these measurements are worlds apart."*

Prof. Dr. Anselm Goertz  
University of Acoustic, Aachen, Germany



# THE AVANTGARDE HORNS



## THE HORN FUNCTION

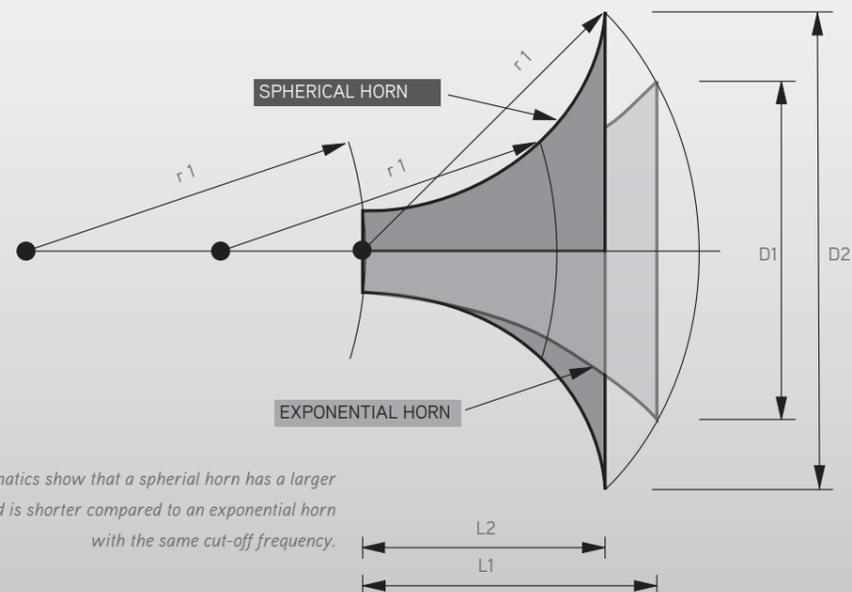
The shape of the Avantgarde Acoustic™ horn curvature is precisely determined by means of complex mathematical algorithms. The aim is to have a totally controlled motion of the soundwave from the beginning of the horn all along to the horn mouth. The precise spherical curvature of the horns ensures that no soundwaves are reflected back into the funnel. This results in a linear sound wave emission and well-controlled directivity along the entire frequency range of the spherical horn.

## THE HORN MANUFACTURING

Besides an accurate arithmetical calculation, it is very important to manufacture the horns as precise as possible. To ensure high quality in the production process Avantgarde Acoustic™ is using an elaborate injection moulding technology. Under a pressure of up to 2,500 tons a resin is injected into an accurate steel cast.

The massive steel molds for each of the spherical horns are manufactured to closest tolerance standards. This ensures a very precise execution of the exact horn curvature. On the other hand, it is possible to offer extremely high quality and product continuity in the Avantgarde Acoustic™ series production process. One horn resembles the other. Left and right channel are always 100% identical. This is indispensable for an exact stereo sound reproduction and imaging.

Avantgarde Acoustic™ uses ABS (Acrylnitril-Butadien-Styrol) material for the production of its spherical horns. The merits of this high-quality polymer are its neutral resonance behaviour and its durability and resistance to wear and tear.



The schematics show that a spherical horn has a larger hornmouth and is shorter compared to an exponential horn with the same cut-off frequency.



180 mm spherical horn assembly

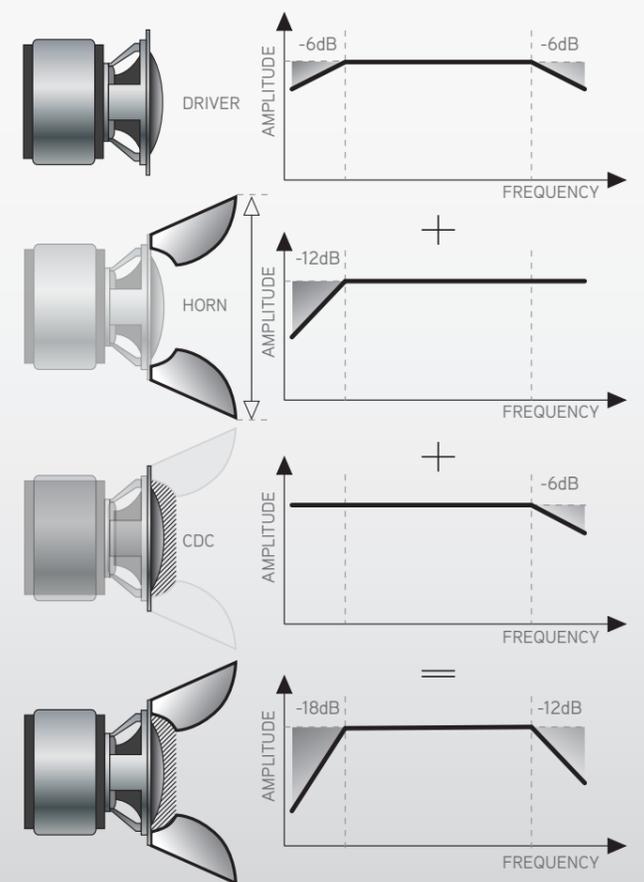
THE CDC SYSTEM

CDC stands for "Controlled Dispersion Characteristic". It is a technology developed by Avantgarde Acoustic™ to precisely align the frequency response, the sensitivity of the driver, the geometry of the membrane and the air chamber at the horn throat to the response curve of the spherical midrange horn. This way we manage to avoid any passive filter components in the signal path – routing the music signal directly to the voice coil of the driver engine. Less components, less interactions, less friction ensuring more detail.

This is how CDC works: the lower cut-off frequency of a horn loudspeaker is determined by the size of the horn. The larger the horn, the lower the response. Below the cut-off frequency of the horn, the response falls off steeply at 12 dB/octave. The midrange drivers 6 dB roll-off is set to exactly the same frequency thus achieving a total of 18 dB/octave bottom end attenuation. Avantgarde Acoustic™ speakers thus operate only down to their cut-off frequency limit and require no high pass filters.

The upper frequency response is determined by the driver itself. However, it can as well be influenced acoustically by the horn. For this purpose, Avantgarde Acoustic™ places a small chamber between the driver's membrane and the horn throat. The driver does not emit directly but via a small air chamber into the horn throat opening. This air volume operates as a low-pass filter and automatically filters frequencies above the resonance volume of the chamber (at 6 dB/oct.).

Avantgarde Acoustic™ now matches the -6dB roll-off point of the midrange driver to exactly the same frequency of the CDC air chamber. Thus we obtain an acoustic attenuation of the frequency response of 12 dB without any passive frequency crossover. No further low pass filters are necessary! The CDC system thus causes the midrange to only operate within its operational band and steeply fall off at the transition points.





THE OMEGA VOICE COIL TECHNOLOGY

By significantly increasing the impedance of the speaker, Avantgarde Acoustic's™ Omega technology effectively improves the control of an amplifier to better drive the speaker system.

The ability of a power amplifier to control the movement of the speaker's membrane is defined by the damping factor. The higher this damping factor, the stronger its authority to force the voice coil to follow exactly the music signal.

The damping factor is determined by the quotient of the speaker load impedance and the output impedance of the amplifier.

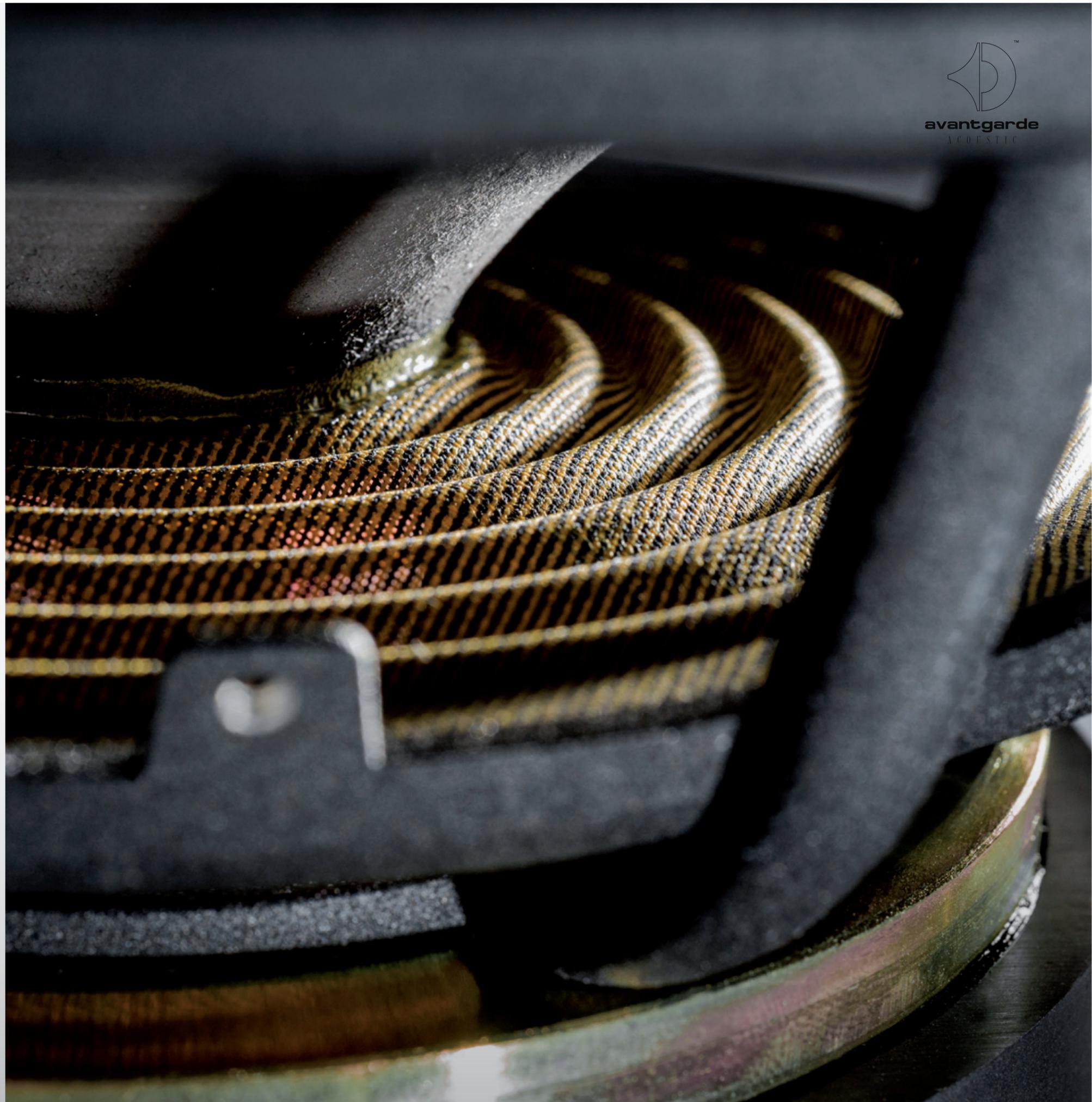
$$\frac{\text{impedance of speaker driver}}{\text{output impedance of amplifier}} = \text{CONTROL}$$

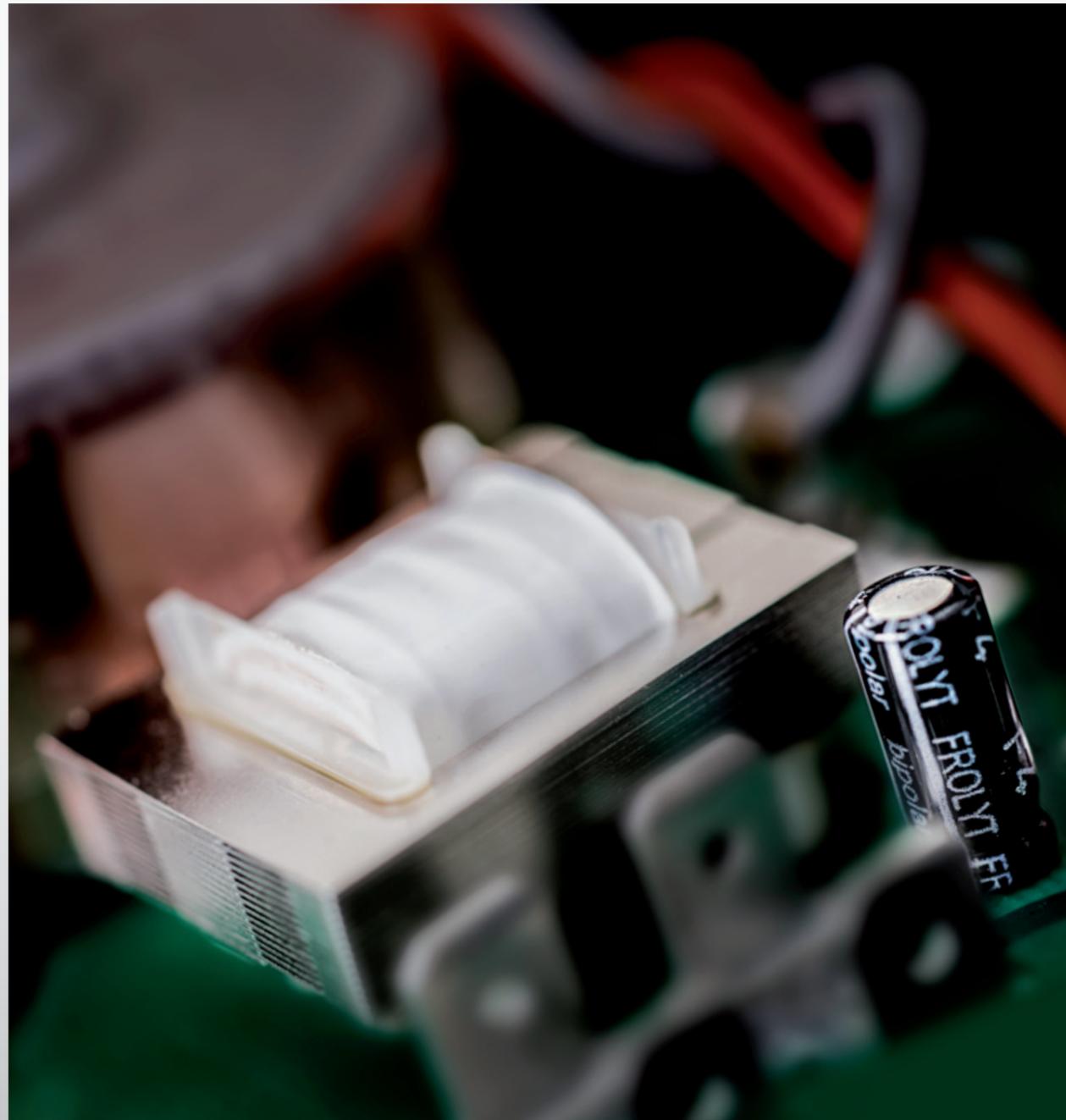
An amplifier with an output impedance of 0,04 Ω will thus have a theoretical damping factor of 100 when connected to an 4 Ω speaker. Adding a 5m speaker cable with 0,36 Ω and a resistance of the passive crossover components of 0,6 Ω, the effective actual damping factor will decrease to a value of only 4!

Connecting the same amplifier configuration to the DUO XD series will result in a real damping factor of 18. Thus the control of the amplifier has increased by 450% and at the same time the negative effects of long speaker cables has been reduced by 80%.

450 % 450% more control

80 % 80% improvement on speaker cables





decoupling transformer of UNO XD series CPC crossover

THE CPC CROSSOVER

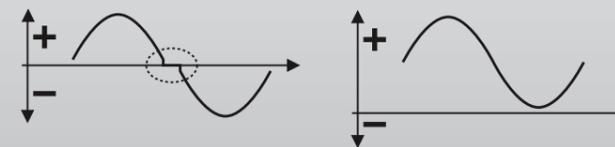
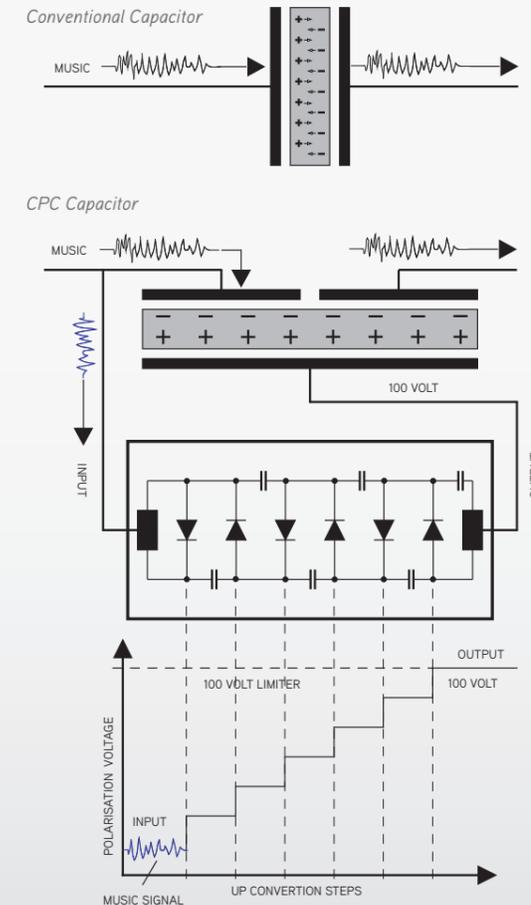
Although the Omega midrange driver is running full range without any crossover, the Omega tweeter requires a passive filter for thermal protection.

A potential limitation of any passive crossover is the capacitor required to filter low frequencies. A capacitor consists of two plates separated by an insulator. The conductor-plates have no physical contact but the signal has to pass through a dielectric isolator.

Every time the music signal is changing from the positive to the negative half-wave and vice versa the electric field gets inverted. The permanent change of direction of the field causes a phenomenon in the isolator called "dielectric memory effect". This leads to distortion which gets worse the closer the signal approximates the zero-voltage point and are at a max just when the electric field changes its direction.

Avantgarde Acoustic's™ "Capacitor Polarisation Circuit" eliminates these distortions. Different to conventional capacitors the CPC-capacitor has multiple conductor-foils. Using a voltage cascade circuit with diodes, the CPC module up-converts the income music signal to 100V. This high direct current is then fed into the inner conductor. A high impedance transformer prevents any backlash to the music signal.

The CPC biased capacitor has less distortions and can better control incremental signal variations.



Dielectric Memory Effect of Capacitor

CPC biased Capacitor

## THE SPEAKER DRIVERS



### THE MIDRANGE HORN DRIVER

Although most speaker designs focus on treble and bass response, we at Avantgarde Acoustic™ consider the midrange as the “heart” of our speaker system.

The DUO XD series midrange features the M2 Omega driver with high impedance voice coil technology loading a 670 mm spherical midrange covering a very wide frequency bandwidth down to 170 Hz.

The M2 Omega is a 170 mm (7 inch) midrange horn driver optimized for large, linear excursion. Our engineers managed to increase the effective magnetic flux in the air-gap of the driver by eliminating the usual copper inlay of the pole-piece. A strong Alnico magnet generates a powerful magnetic field which homogeneously controls the movement of the voice coil.

The geometry of the 108 mm (4 inch) membrane dome has been precisely aligned to the response curve of the spherical midrange horn to ensure a phase-neutral radiation of the sound waves.

The new “Soft-Mesh-Compound” membrane uses a stable grid carcass as its structural foundation. The microscopic apertures of the grid are sealed with a proprietary elastic durex coating. The combination of a stable grid structure with a flexible lining effectively reduces partial resonances of the dome itself and absorbs high frequency distortions.

The Avantgarde Acoustic™ CDC system features a controlled roll-off at 2,000 Hz, and eliminates all passive crossover components in the signal path. This way the M2 Omega gets the pure and undistorted full-range signal directly from the amplifier.

The nominal impedance of the M2 Omega is a benchmarking 18 ohm and the sensitivity with the spherical horn is 107 dB (Watt/m).



DUO XD series M2 Omega midrange driver with Alnico magnet and Soft-Mesh-Compound membrane



## THE TWEETER HORN DRIVER

The DUO XD series uses the same H3 Omega tweeter, as being used in our Trio flagship system.

The tweeter incorporates Avantgarde Acoustic's™ high impedance voice coils, to improve the damping factor of any connected amplifier and to reduce the negative effects of the speaker wires.

This driver combines the smoothness often associated with electrostatic driver and the authority of a strong 1 inch horn driver. The H3 Omega features a voice coil former made of Kapton with a minimised air gap, a 17 ohm voice coil and an ultra light diaphragm.

The force of the 3 kg (6.5 lb) magnet ensures a compression-free sound reproduction even at extreme sound pressure levels.

With its 180mm spherical horn the H3 omega offers an extended bandwidth down to 900 Hz. Due to the passive crossover point being at 2,000 Hz the H3 omega tweeter achieves a seamless smooth sound with incredible dynamic headroom.



*DUO XD series H3 Omega tweeter and spherical horn assembly*

## THE BASS DRIVER

The DUO XD series is supplied with the active SUB231-XD subwoofer, which is driven by two powerful 30 cm (12 inch) 600 watts (RMS) long-excursion drivers.

The bass driver features a 4 inch voice coil with laminated bi-material compound former to enhance the voice coil life and to ensure an optimum force transmission. A forced convection mechanism results in low power compression. This design has been optimized with the extensive use of miniature high temperature probes and real-time temperature acquisition systems, together with a thermographic camera to obtain real images of the heat distribution in the voice coil and forced convection effects.

The Double Conex Spider with its diaphragm surround and the double spider have been carefully designed with the assistance of Finite Element calculations in order to match coherently, enabling long and controlled cone displacements.

The long excursion bass driver is characterized by its high efficiency and power handling capabilities. The extended excursion is  $\pm 8$  mm. Ferrite magnets with a special under-pole magnet topology are used to improve the flux density in the air gap and to eliminate energy leakage of the magnetic field.





## THE SUBWOOFER AMPLIFIER

The active subwoofer of the DUO XD series is driven by the XD-1000 power module. This integrated amplifier consists of a 2 x 500 watt amplifier. Thus each of the two bass drivers is powered by a separate amplifier providing for ample headroom even in complex EQ settings.

The XD-1000 power module can be remotely switched on/off using a 12V trigger signal.

Direct connection to integrated amps, power amplifiers or receivers is done via speaker-level input terminals. Line level inputs via XLR terminals are available alternatively.

The signal take-off is not only at high impedance, but is also balanced and transformer coupled. This floats the circuit ground, avoiding hum loops and easing connection to balanced and bridged amplifier designs.

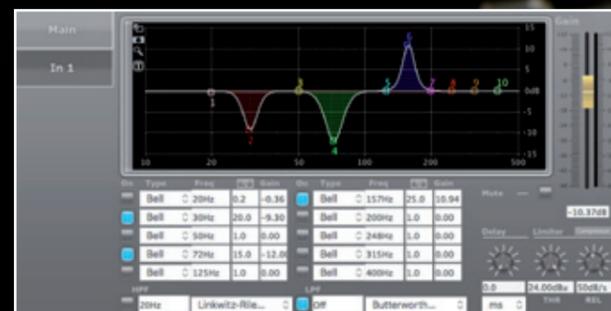
## THE DIGITAL SOUND PROCESSOR

The XD-1000 amplifier is equipped with an advanced digital sound processor.

With a precision and bit accuracy unattainable using analogue technology, the digital crossover network eliminates all the passive filter elements in the signal path of the subwoofer, thus circumventing a series of tonal problems caused by analogue filter technology (e.g. capacitors, resistors and coils in the signal path, phase shifts and associated negative effects on the impulse response).

Volume settings, delay time, high pass & low pass filters and up to 10 parametric equalizers are programmable. Thus a variety of parameters can be changed and fine tuned by directly using the control display at the rear of the XD-1000 module or by connecting a PC or Mac computer.

This way it is possible to adjust the sound to individual preferences and to allow for a seamless integration of the system in different rooms.



Screenshot of XD-1000 DSP control software

XD-1000 amplifier module of DUO XD series

## THE DESIGN



### THE MECHANICAL CONSTRUCTION

The midrange horn is installed into a circular housing cylinder with a solid cast aluminium back cover on its back end. The tweeter is located in a sealed compartment in the upper part of the subwoofer enclosure.

The entire loudspeaker system is placed on a solid cast aluminium base frame. The spike assembly – featuring solid 55 mm spikes and massive adjusting handles – is easily accessible from the top. Aluminium spacers with knurled head screws connect frame rails with midrange housing cylinder and subwoofer.

### THE AWARDS



Our desire has always been to design speakers which will move people visually in a similar way to how they are moved when they listen to music through them. Speakers that will unleash emotions and memories even when standing silently in the room. In short, speakers that are loved.

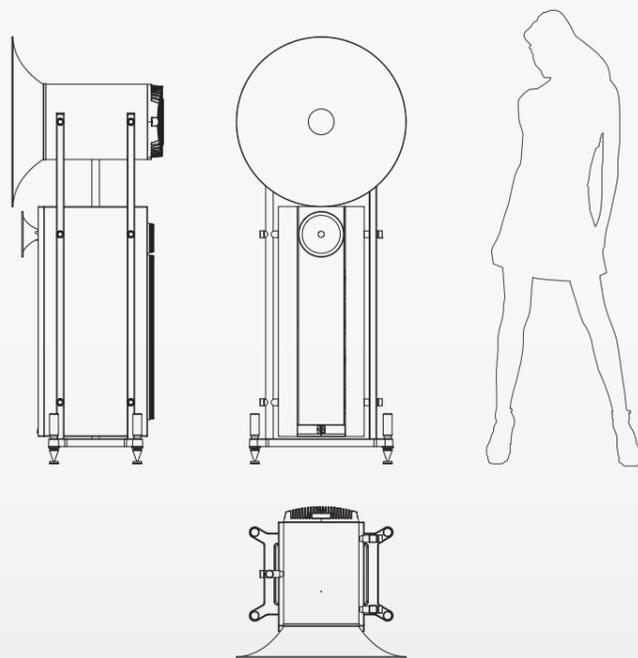
Giving very much attention to the finest detail and the composition of the complete system, we are very proud of being one of the highest awarded brands in our industry.

Besides winning some of the most reputed design awards like the Red Dot Award, iF Design Award Gold, German Design Award Special, Plus X Award and the Eisa Award, we have been elected in 2015 for an exclusive membership at the German Design Council.



DUO XD series spike assembly

# THE DESIGN



## COLOR OPTIONS FOR HORNS AND PANELS

Stealth Nocturne Black <small>(panel only)</small>	Turmaline Vivid Black
Stealth Nocturne Grey	Shiny Citrine Orange <sup>1)</sup>
Diamond Crystal Silver	Ruby Brilliant Red
Akoya Pearl White	Sapphire Burma Blue
Light Amber Bronze	Light Topas Blue
Saona Beach Cream	Smaragd Pearl Green

## WOODEN VENEER OPTIONS FOR PANELS

Zebrano veneer <sup>2)</sup>	Tiger Rosewood veneer <sup>2)</sup>
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A selection of ten standard colors is available for the horns. This includes eight metallic lacquer finishes, the uncolored „Saona Beach Cream“ finish and the modern „Stealth Nocturne Grey“ finish. The special „Shiny Citrine Orange“ multi-layer coating is available as an option.

The front panels can be ordered in any of the above horn colors, plus the elegant „Stealth Nocturne Black“ finish. Zebrano and Tiger Rosewood are available as optional standard wooden veneers.

Any customer specific color for the horns or wooden veneer for the panels is available as option.

On our website [www.avantgarde-acoustic.com](http://www.avantgarde-acoustic.com) you will find a comprehensive color selection tool. Select the color of the horn & the veneer of the front panel and download the high resolution picture of your favorite combination.

<sup>1)</sup> optional customized color

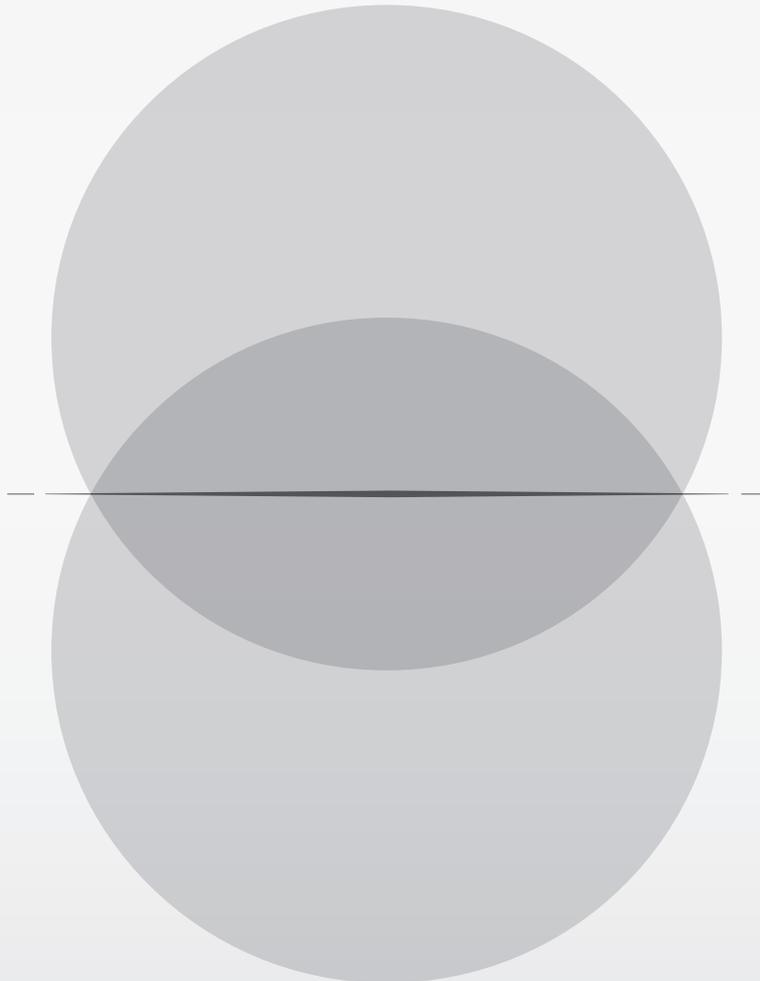
<sup>2)</sup> optionally available in high gloss piano lacquer finish

# SPECIFICATIONS



SYSTEM DATA		
Frequency response	satellite subwoofer	170 – 20.000 Hz 18 – 350 Hz
Power capacity		100 Watts
Sensitivity (1 Watt / 1 m)		> 107 dB
Crossover frequencies		170 / 2.000 Hz
Nomiale Impedance		18 Ohm
Recommended amplification		> 10 Watts
Recommended room size		> 20 m <sup>2</sup> / 200 ft <sup>2</sup>
CDC (Controlled Dispersion Characteristic)		Yes
CPC crossover (patent pend.)		Yes
HORN		
Horn type		Spherical horn
Horn material		ABS injection mold
Horn finish		polished
Dispersion type		180 degree
Horn mouth area	low mid range mid range high range	n/a 0,353 m <sup>2</sup> / 547 in <sup>2</sup> 0,025 m <sup>2</sup> / 39 in <sup>2</sup>
Horn mouth diameter	low mid range mid range high range	n/a 670 mm / 26 in 180 mm / 7 in
Horn length	low mid range mid range high range	n/a 370 mm / 15 in 85 mm / 3.3 in
HORN DRIVERS		
Diameter	low mid range mid range high range	n/a 170 mm / 7 in with Alnico magnet 25 mm / 1 in with Ferrite magnet
SUBWOOFER		
Amplifier Output power (RMS)		2 x 500 Watts
Total harmonic distortions		0,003%
Dynamic range		120 dB (A)
Driver diameter		2 x drivers 300 mm / 12 in with Ferrite magnet
DIGITAL SOUND PROCESSOR		
Delay		adjustable in 0,01 mSec steps
High pass and low pass filters		Bessel, Butterworth, Linkwitz-Riley filters
Parametric equalizer		10 x parametric equalizers programmable
Compressor		programmable
Limiter		programmable
DIMENSIONS/WEIGHT		
Dimensions	width depth height (+/- 15 mm)	670 mm / 26 in 600 mm / 24 in 1.695 mm / 67 in
Weight		88 kg / 194 lbs

purity



performance



**avantgarde**  
ACOUSTIC

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