

# SHAPE YOUR SOUND. HD BEAMFORMING TECHNOLOGIE

Engineered  
and  
Made  
in  
Germany

**ADVANCED DIRECTIVITY OPTIMIZATION.**

**SCALABLE & ADAPTABLE.**

**GENUINE 1-WAY DESIGN.**

**COMPACT DESIGN.**

**MULTIPLE BEAMS.**

**COST EFFICIENT.**

 Dante®



*...simply harmonic sound*

Harmonic Design® Beamforming Technology  
hd ML-/PL-Series  
03/2018



# About Us

... simply harmonic sound

## Over 38 Years Of Experience

Since its foundation in 1980, Harmonic Design® stands for research, development and manufacturing of cutting-edge loudspeaker systems and acoustic services. We thought early in systems and established the use of system controllers (analog at that time) as early as 1988. At the beginning of the 90s, the MLSSA measuring system took computer-aided speaker development to a new level. The first digital signal processor followed in 1994 with pioneering filter capabilities. In recent years, we have pioneered technologies like GroupDelayCorrection, PowerSound-Algorithm, the revolutionary HybridLineSource-Technology and hd Beamforming.

## Made & Engineered In Germany

Harmonic Design® products are designed, developed and manufactured entirely by hand in South Germany, Steinheim. Regional specialist suppliers from Germany deliver premium and durable components and devices to fulfill our strict quality requirements. Thus we achieve an extraordinarily high quality and reliability of our products. With our constantly growing worldwide distributor network we can offer direct support to the end-users around the world.

## Audiophile Top Performance

Harmonic Design® loudspeaker systems are well known for their neutral and linear sound. Using state-of-the-art methods and measuring techniques, the loudspeaker components are examined and improved down to the smallest detail. The linearity is characterized not only by the flat frequency response, but also by the impulse response accuracy, precisely graduated tonal depth and minimal distortions.

## The Harmonic Design® Philosophy

The holistic system consisting of loudspeaker box, digital system controller and amplifier represents our understanding of a future-oriented system. The individual components are individually optimized and unfold their full potential in combination as a system: The sound pattern is faithful, the power is exceptional and the handling is simple.

## Our Cooperate Goals

As a long-standing and reliable partner of many distributors, rental companies, system integrators, planners, musicians and producers, we want to continue to work alongside you and offer practical top-of-the-range products. The development of new, innovative technologies for the improvement of products plays a key role.

## The Promise

We are constantly facing new, demanding challenges, going on unprecedented paths and thus shifting the boundaries of the possible. Our passion comes from our love for art and music. In search of uncompromising sound accuracy, minimal dimensions, superior quality and smart accessories, our goal is a harmonious design. All Harmonic Design® products are made by hand exclusively in Germany. Our top modern facilities ensure the best quality of every product.

## What We Provide

Harmonic Design® (hd) offers innovative products with practical orientation that operate due to their specifications, sound quality and diversity in the highest level available in the audio industry. Our products serve professional sound engineers, musicians, DJs, rental companies and system integrators as perfectly matched tools to best support their daily work and performance. The handling and appearance are extremely minimal and unobtrusive, making the sound system almost invisible, connecting the audience to the performance and focusing on the performance itself. We want to support you in your applications and offer you not only sophisticated products, but also a personal contact point for questions, advice and support. Feel free to contact us!

Yours faithfully,

Robin Maier  
- CEO -

# Harmonic Design® Beamforming Technology

## Overview

Harmonic Design® Beamforming loudspeakers offer great potential for improving sound distribution in complex architectures and highly reverberant rooms. The goal is to focus the sound only on the auditory surfaces, while shading surfaces that cause unwanted reflections and produce disturbing diffuse sound should be shaded. This leads to a much better speech intelligibility and a first-class listening experience in speech and music performances for each listener, allows an unobtrusive positioning of the speakers in previously unsuitable positions, as well as a flexible adaptation of the speaker radiation characteristics to different applications.

### Compact Design.

The ultra-compact width of just 86 mm makes the hd ML-Series the narrowest beamforming speaker available, which is almost invisible in permanent installations. The elegantly designed aluminum enclosure and the finely woven steel grille with premium powder coating seamlessly integrate the sleek, unobtrusive look of the column speakers into the room architecture, inspiring planners, architects, system integrators, event organizers and the audience.

### Genuine 1-Way Design.

For excellent and linear reproduction of a sound event from the lowest to the highest audible frequency, conventional loudspeakers must use different types of drivers to reproduce the entire frequency range. The result is incoherence and phase shifts in the middle frequency range due to different membrane mass, varying transient response and decay time speakers of different sizes have. The hd column loudspeakers of the hd ML- and PL-Series are exclusively equipped with full-range loudspeakers and thus trouble-free in the important mid-frequency range, as each loudspeaker has the same response and characteristics. The result is excellent sound quality for speech and music, improved dynamics and consistent horizontal coverage of the listening areas.

### Cost Efficient.

With our Beamforming technology, we offer a completely new price-performance ratio. This allows the use of the technology for projects that would require influencing the sound beams, but have so far exceeded the budget. Our own in-house developed and manufactured components, algorithms and the planning software guarantee cost efficiency.



### Scalable and Customizable.

The modular concept of the hd ML-/PL-Series continues in the Beam-Series. Up to 32 DSP/amplifier channels, scalable in segments of 8, individual length and RAL colors, seamlessly integrate the speaker into the architecture - not the other way around. The standard colors are black (RAL 9005) and white (RAL 9010) without surcharge. The continuous U-slot on the back of the aluminum profile allows the use of M6 square nuts to attach a wall mount adapter or the use of the hd mounting adapter for quick and easy mounting of the tilt and swivel stand adapter for mobile applications. Top and bottom M6 threads allow wall mounting with minimal space requirements using the accessories L-brackets. The electronic unit is integrated into the housing of the loudspeaker and is optimally protected by the continuous fine-structured design grid with backed acoustic foam and ensures an inconspicuous integration into any room architecture.

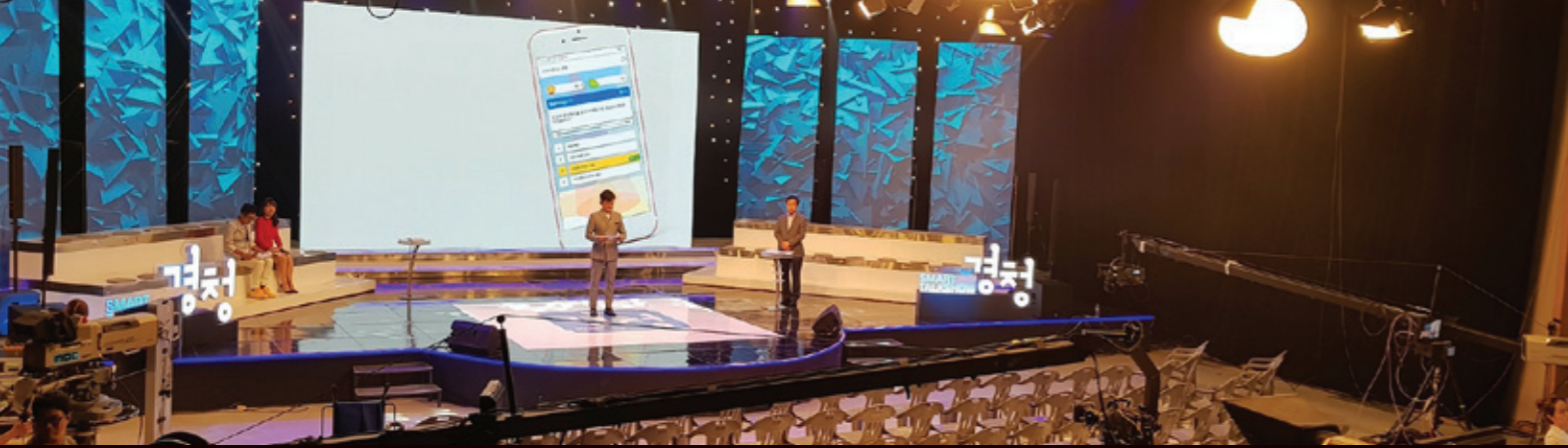
### Dante® Spoken here.

The Harmonic Design® Beamforming loudspeaker are prepared for digital audio transmission with Dante audio streams from e.g. mixers or Matrix systems. This allows digital streaming of audio packets over a Dante network directly and without additional DA/AD conversion to the integrated DSP core and amplifiers. A software-controlled redundant input selector switch for the analogue secondary input ensures fail-safety if required. If no digital transmission is required, both analog inputs (primary and secondary) can be used to create an analog fallback strategy.

### Way-Beyond Spatial Aliasing.

The selection of 2" and 3" full-range chassis enables the shifting of the inevitable spatial aliasing from linear loudspeaker arrays to the highest frequencies. Due to the increasing directivity of the speakers, this phenomenon is also suppressed. The motivation to keep the speaker diameter to a minimum has increased the challenges for our research and development department in terms of the size of multi-channel amplifiers and DSP platforms, but it was a necessary step to ensure the musicality of the beam-formed speaker array.





## Multi-Channel DSP Architecture.

Based on the enormous computing power of our hd MultiDSP, a new multi-channel DSP architecture has been developed that meets the high demands of beamforming algorithms. Each of the up to 32 output channels as well as user channel features a 384 Taps FIR filter and 16x IIR filters in double precision. The all-new hd BeamDSP performs over 300 million instructions per second to meet real-time criteria and provide enough freedom to shape the sound as needed.

## Powerful Amplifiers.

Each loudspeaker chassis is equipped with a DSP channel and a digitally interfaced and microprocessor controlled state-of-the-art Class-D amplifier. This guarantees best SNR for all gain settings and the possibility to surveil the impedance of each chassis and report its status in case of any fault. Each amplifier channel can deliver up to 75 watts into 4 Ω loads, delivering uncompromised audio with premium dynamics and headroom.



## Harmonic Design® Beamforming Key Features

- 2In/32Out High-End hd BeamDSP
- redundant input selection fallback algorithm
- analog + digital inputs with Dante®\*
- AdvancedDirectivityOptimization algorithm
- 384 Taps FIR-Filter each Input/Output
- 16x IIR-Filter (double precision) each Input/Output
- modular equipping in segments of 8
- 75W Class-D amplifiers with digital input for best SNR
- ImpedanceControl with fault detection
- multistage Limiter-Architecture (Peak/RMS/Thermal)
- hd LevelZ Remote Software via USB
- standard colors: black RAL 9005 & white RAL 9010

## Applications

- airports
- stations
- churches
- lecture halls
- houses of worship
- museums
- conference rooms
- hotels
- sport arenas
- AV installations
- live events
- mobile use

\*Dante® optional



Daimler AG, TECFABRIK, Sindelfingen

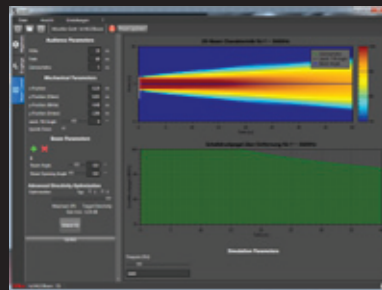


# Shape your Sound

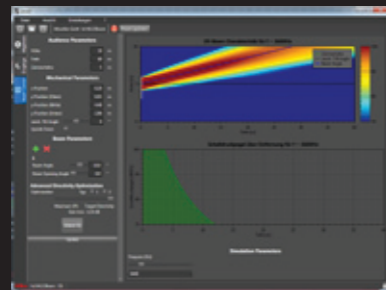
## BeamControlParameters

### Beam Steering.

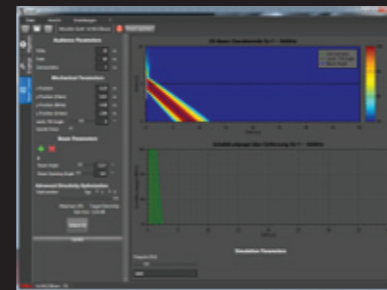
Beam steering is the basic discipline of beam forming where the main lobe is digitally steered up- or downwards. Harmonic Design® Beamforming loudspeakers are capable to adjust the vertically main lobe beam angle up to  $\pm 45^\circ$  with an accuracy of  $0.1^\circ/\text{step}$ .



main beam @  $0^\circ$



main beam @  $+10^\circ$



main beam @  $-32^\circ$

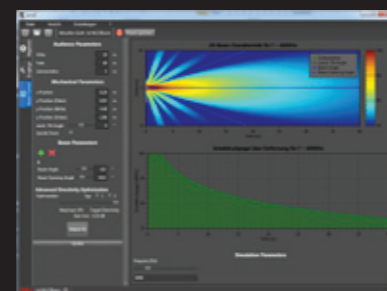
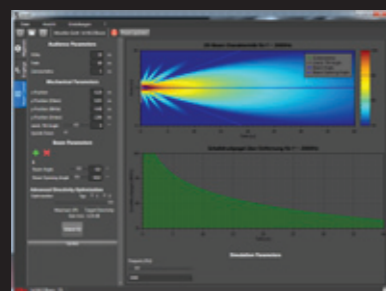
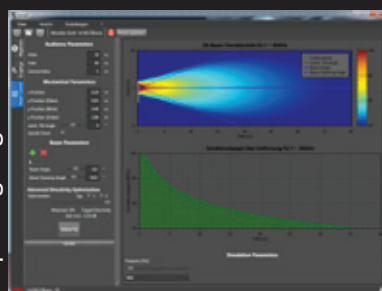
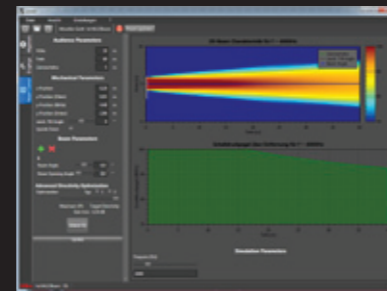
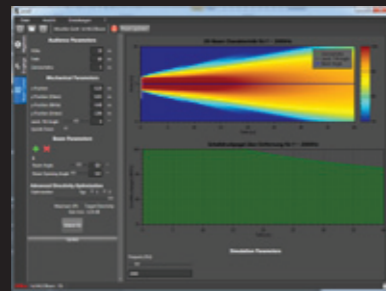
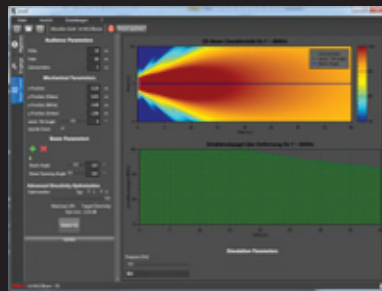
### Frequency Independent Opening Angle.

Conventional loudspeaker arrays increase their directivity with increasing frequency resulting in a wide main lobe at low frequencies and a narrow main lobe at high frequencies. A frequency independent opening angle preserves the same opening angle over a great bandwidth within physical limitations and is adjustable from minimum to  $90^\circ$  in  $0.1^\circ$  steps. This guarantees perfect concentration of sound where it belongs and where not.

f = 800 Hz

f = 2 kHz

f = 4 kHz

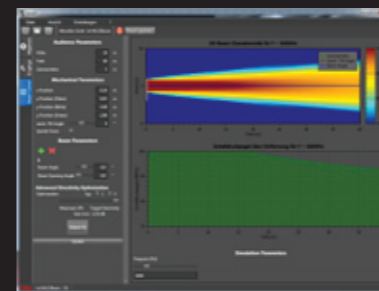


conventional main beam

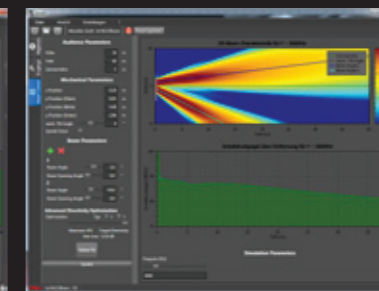
frequency independent opening angle  $\theta = 30^\circ$

### Multiple Beams.

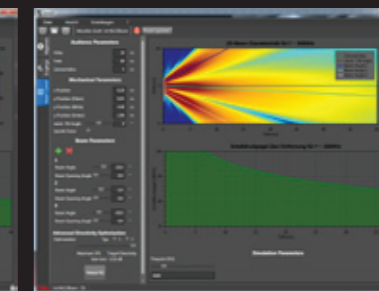
The unique Harmonic Design® Algorithm enables up to 4 separate main beams that can be steered individually and still create a specific frequency independent opening angle.



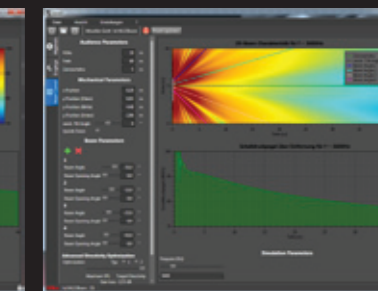
main beam @  $0^\circ$



2 beams @  $+5^\circ | -20^\circ$



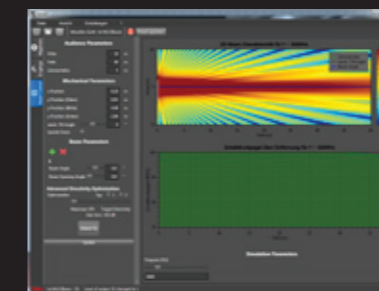
3 beams @  $+20^\circ | -2^\circ | -20^\circ$



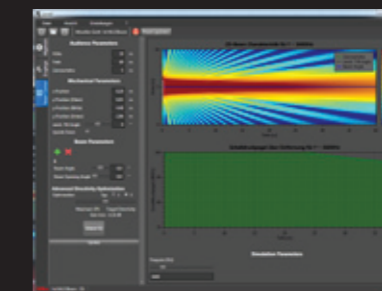
4 beams @  $35^\circ | +12^\circ | -12^\circ | -35^\circ$

### Advanced Directivity Optimization.

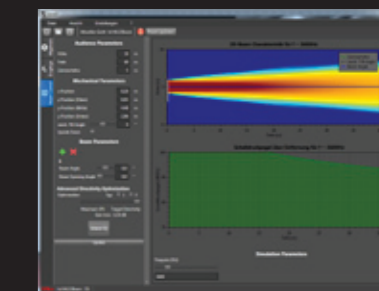
The conventional beam radiation pattern also contains unwanted side lobes that excite the auditorium with disturbing noise while declining the speech intelligibility. By applying special algorithms to the individual DSP channels, an almost optimum, light-beam-like main lobe beam is achievable with an accurate side lobe suppression. The enhancements to improve speech intelligibility in reverberant rooms by applying ADO algorithm are extreme. The strength of the optimization tool may be adjusted by the end-user either towards maximum SPL or optimum target directivity.



conventional beam pattern, ADO off



intermediate ADO



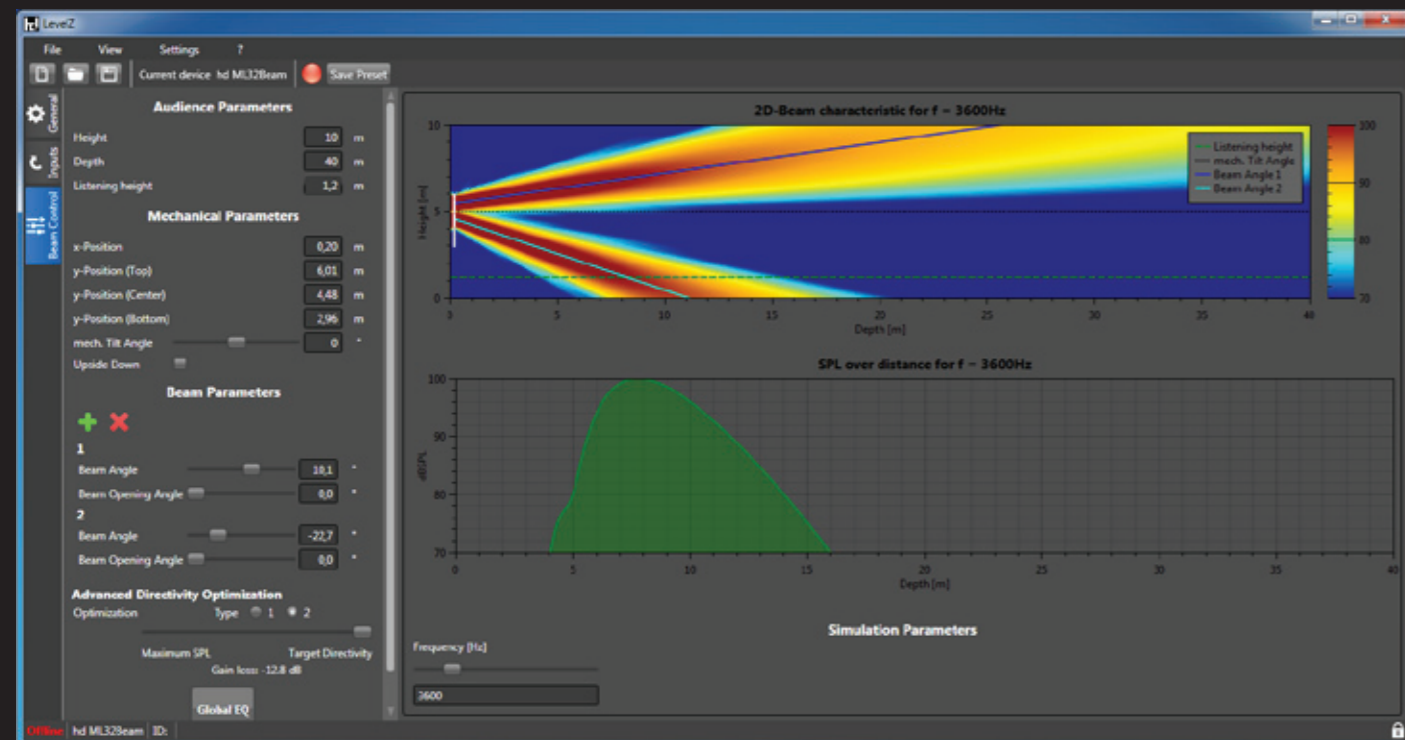
maximum ADO

### Focus.

By default the focus point of the wave fronts of the individual loudspeakers is infinity and creates parallel running pressure waves. At the distance infinity all wave fronts are perfectly correlated and coherent meaning they arrive at the same time with the same relative phase. Whenever this large throw is not necessary it may be useful to focus the wave fronts to the front rows in steps of 0.1m to tighten the „sweet spot“.

## Reliable Prediction.

To adapt the beamforming loudspeaker to the specific venue it's necessary to perform a simulation and tweak the beam parameters. Therefore a complete simulation tool has been integrated into the remote software hd LevelZ. Set the audience parameters like height, depth and listening height of the venue and place the speaker at the desired position with optional mechanical tilt angle. Lastly, give a rough estimate of the beam parameters and start to evaluate the 2D Beam-Plot and SPL over distance plot at various frequencies until the final settings have been derived.

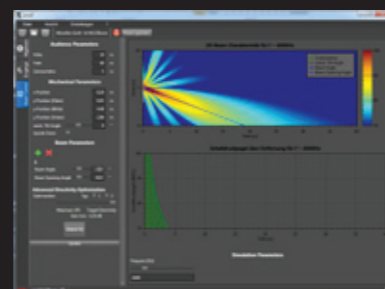
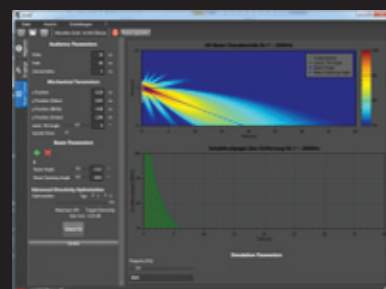
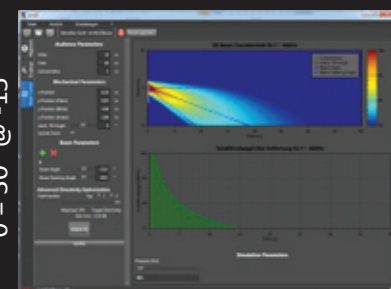
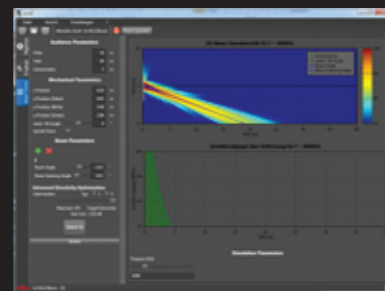
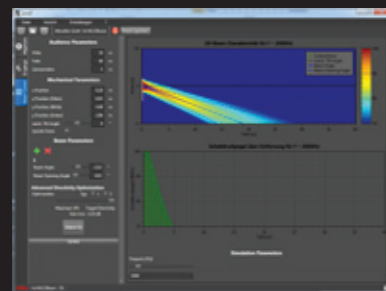
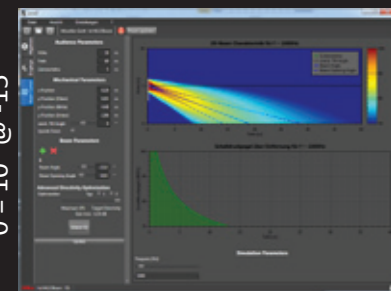


## All Disciplines Simultaneous.

f = 800 Hz

f = 2 kHz

f = 4 kHz



all simulations show hd ML32Beam

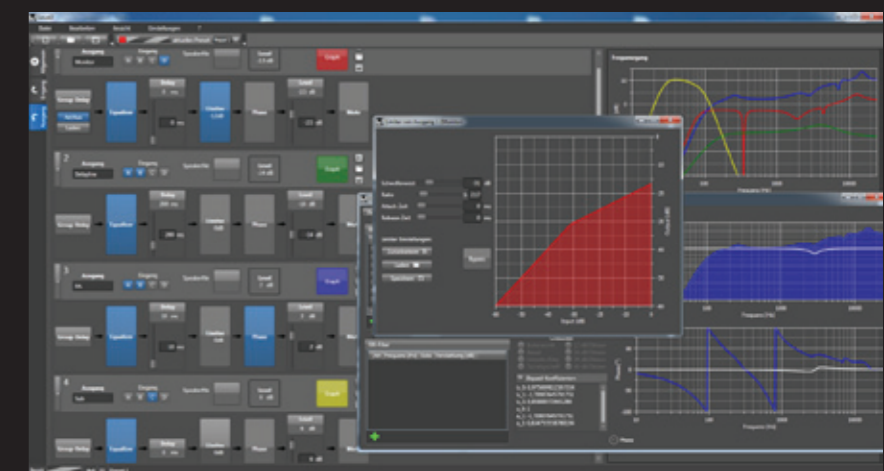


# hd LevelZ

## Remote & Simulation Software

The hd BeamDSP platform with open architecture guarantees a perfect control of all relevant system components thanks to the all new and easy to use, windows-based remote and simulation software **hd LevelZ**. This new DSP platform enable all processing and remote features of large scale sound systems in a smart beam-formed device. The input section comprises a redundant input fallback selection logic, a function generator (sine and noise) a fully configurable user EQ section with 16 IIR-Filter in double precision with adjustable type, slope, width, gain and a 384-Taps FIR-Filter, up to 100 ms delay, phase reversal, gain and mute for full control of the end-user.

Control via the software enables most detailed changes and manage unlimited User-Preset configurations. All settings will be loaded even from totally unknown devices and may be adjusted after few seconds of synchronization.



### Key Features

- windows-based remote control software
- integrated beam prediction/simulation tool
- intuitive handling
- connection of multiple devices
- fully syncable to unknown devices





# hd PL-Series Beamforming

## 3" fullrange speakers

# hd ML-Series Beamforming

## 2" fullrange speakers

The **hd ML-Series** is a product family of very compact LineArray Sticks designed specifically for high-quality music and speech reproduction. The lightweight and elegant speakers can be set up and installed in only a few seconds. A perfect integration into the existing room architecture or stage design is achieved by the slim and stylish design of the column speakers and therefore makes the hd ML-Series the first choice of system integrators, event organizers, agencies, musicians and audiences. In the hd ML-Series special designed 2" neodymium drivers produce sound with accurate cylindrical dispersion characteristics in the whole operating frequency range and up to the highest audible frequencies. The long throw of up to 35 m and smooth horizontal coverage of 100° makes the hd ML-Series a decent and powerful loudspeaker for superior audio environments. The 2" chassis, with their small diaphragm weight and almost the same size as the human vocal cords, are the best choice for reproducing the human voice in the most difficult applications such as houses of worship, conference rooms, airports, train stations and live music.

### Key Features

- shielded 2" fullrange chassis
- standard colors: black RAL 9005 & white RAL 9010
- smallest footprint available with only 86mm width
- perfect sound & excellent dynamics
- wide horizontal coverage of 100°
- superb speech intelligibility
- best integration into room architecture
- HiFi-Sound

### Options

RAL color, custom length, various mounting solutions: tilt & swivel adaptor, L-brackets

### suggested Subwoofer

hd Slim265, hd Sub12i, hd P12i, hd Sub15i, hd P15i

Model	Transducers	max. Beam Count	Amplifier	SPLmax	Freq. Range (-6dB)	Connections	Weight	Dimensions W x H x D (mm)
ML8Beam	8x 2"	1	8x 75W	119 dB	160 Hz - 20 kHz	Phoenix 3-pole Mains	5 kg	86 x 1095 x 86
ML16Beam	16x 2"	2	16x 75W	123 dB	140 Hz - 20 kHz	Phoenix 6-pole Input	8 kg	86 x 1772 x 86
ML24Beam	24x 2"	3	24x 75W	125 dB	110 Hz - 20 kHz	Dante® Ethernet*	12 kg	86 x 2404 x 86
ML32Beam	32x 2"	4	32x 75W	127 dB	90 Hz - 20 kHz	USB	16 kg	86 x 2990 x 86

*\*optional*

The **hd PL-Series** extends the Harmonic Design® LineArray Stick portfolio with a more powerful PowerLine Stick loudspeaker series. The elegant design introduced with the hd ML-Series has been transferred to a slightly larger column speaker series. Lightweight and highly stiff aluminum enclosures paired with groundbreaking newly developed 3" drivers provide high reliability and performance. The true 1-way design delivers superb natural sound reproduction of music and speech in reference studio monitor quality. For mobile applications, the elegant PowerLine sticks can be combined with active system subwoofers of the hd P-Series with their open system architecture to create an elegant and high-performance PA system. With the modular design of each Harmonic Design® column loudspeaker series, custom lengths and color schemes are available to meet the needs of any permanent installation project. A perfect integration into existing space architecture and stage scenery due to the remarkable size-to-performance-ratio makes the hd PL-Series the first choice of architects, system integrators and rental companies around the world.

Equipped with new designed Harmonic Design® 3" drivers the hd PL-Series reproduces a coherent sound within a cylindrical wave propagation to the highest audible frequencies. The 1-Way design improvements provide longer, coherent throw range with less loss of level and frequency over distance at the same time. Cylindrical wave propagation provides better speech intelligibility compared to other column loudspeakers and predestines the PowerLine Stick hd PL-Series for the usage in difficult acoustical environments such as churches, stations, airports or concert halls where excellent performance and long throw up to 45m is needed.

### Key Features

- shielded 3" fullrange chassis
- standard colors: black RAL 9005 & white RAL 9010
- perfect sound & excellent dynamics
- high SPL
- smooth horizontal coverage of 80°
- superb speech intelligibility
- best integration into room architecture

### Options

RAL color, custom length, various mounting solutions: tilt & swivel adaptor, L-brackets

### suggested Subwoofer

hd Slim265, hd Sub15i, hd P15i, hd Sub18i, hd P18i

Model	Transducers	max. Beam Count	Amplifier	SPLmax	Freq. Range (-6dB)	Connections	Weight	Dimensions W x H x D (mm)
PL8Beam	8x 3"	1	8x 75W	123 dB	130 Hz - 20 kHz	Phoenix 3-pole Mains	10 kg	108 x 1110 x 108
PL16Beam	16x 3"	2	16x 75W	126 dB	110 Hz - 20 kHz	Phoenix 6-pole Input	18 kg	108 x 1755 x 108
PL24Beam	24x 3"	3	24x 75W	127 dB	90 Hz - 20 kHz	Dante® Ethernet*	23 kg	108 x 2533 x 108
PL32Beam	32x 3"	4	32x 75W	129 dB	70 Hz - 20 kHz	USB	29 kg	108 x 3181 x 108

*\*optional*



# References

Fascinating Versatile



## Architecture and Technology are no contrasts

All speakers and accessories may be colored like the surroundings to ensure a decent optics and best integration into room architecture or may be protected with the outdoor option from damage due to varying climate. Simulation data of the loudspeaker help during the planning of installations and generates beforehand planning certainty.

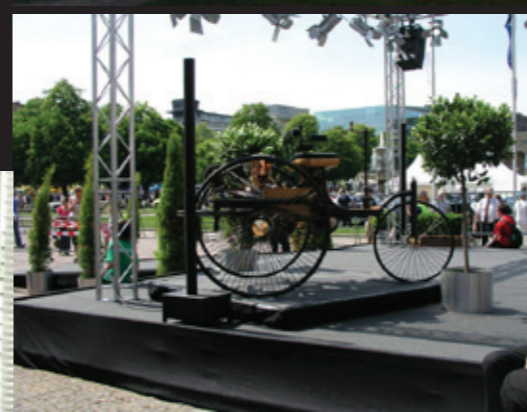
## No compromises at mobile usages

The active plug&play systems are built for daily operation even under worst circumstances. They are a reliable tool for live sound engineers and musicians all over the world that not only go in for quality but also for decent optics, ease of use, seamless flexibility and efficiency.



## At home on the main stages of the world

Harmonic Design® Systems are a symbol for audiophile reproduction of spoken word and sound since 1980. They accomplish what they are designed for on multiple stages, events and venues: Open your artistry to a wide audience.





**Engineered**  
*and*  
**Made**  
*in*  
**Germany**



*...simply harmonic sound*

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