

# PHANTOM

I M P L O S I V E S O U N D



*WHITE PAPER*

# PHANTOM

I M P L O S I V E   S O U N D

## What is PHANTOM?

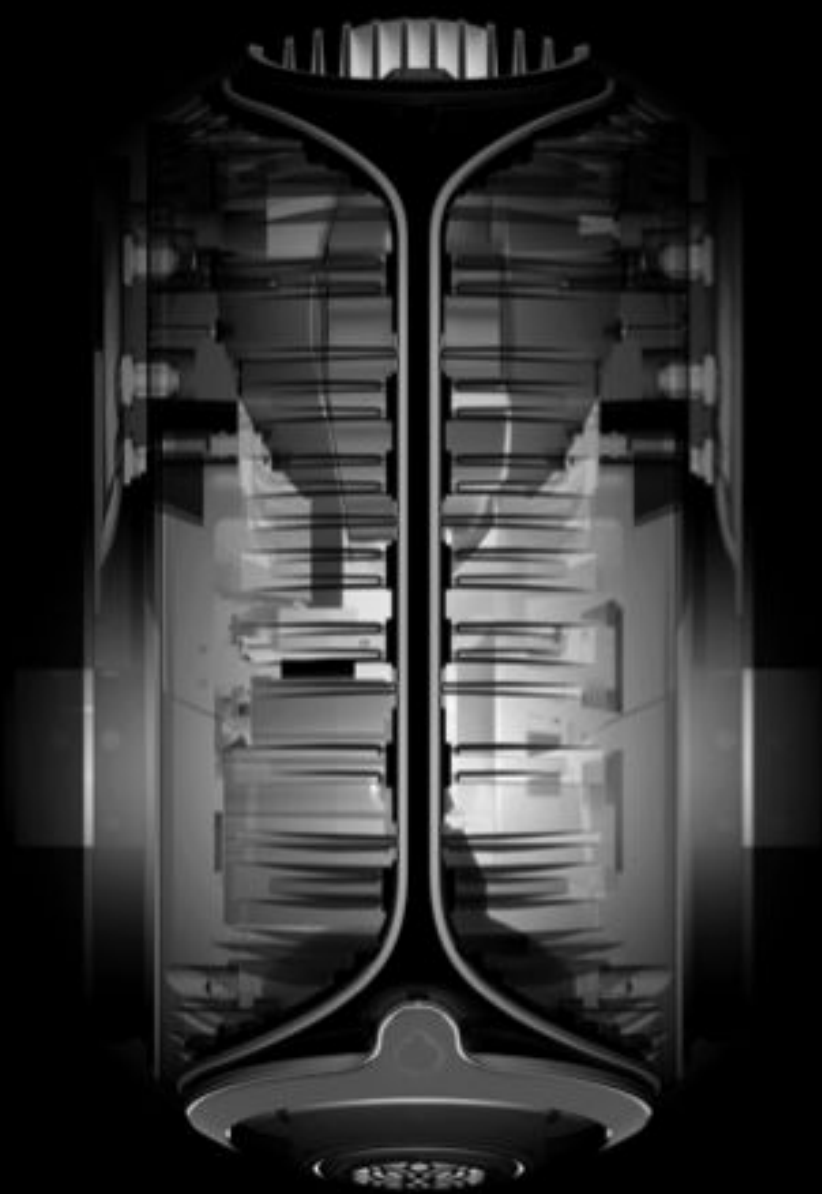
PHANTOM is much more than a connected speaker; PHANTOM is a revolutionary, plug & play, intense emotional experience. For the first time, experience ultra-dense sound with a physical impact. Feel music with unprecedented power, clarity and sharpness throughout your home.

At the heart of PHANTOM is the technology that has made Devialet the most awarded company in the history of Audio. PHANTOM'S ADH® technology combines the refinement of Analog (Class A) amplification with the power of Digital (Class D) amplification. SAM® Processing technology is then used to control the drivers to perfection, reproducing the exact sound pressure initially recorded by the artist. Together, ADH® Intelligence and SAM® Processing make the only engine in the world capable of driving the PHANTOM speaker.

In addition to this technology, Heart Bass Implosion® makes PHANTOM implosive. HBI® technology consists of two exclusive high excursion woofers that move in perfect symmetry to create ultra-dense sound with a physical impact that has revolutionized the audio world .

PHANTOM is the result of 15 years of research and development born inside of Devialet laboratories and carries more than 200 patents. Although extremely complex on the inside, PHANTOM is the very expression of simplicity and elegance on the outside. Moreover, it can be integrated into a multi-room architecture by combining several PHANTOMS or paired with a second PHANTOM of the same power to enjoy a true stereo experience.





# ADH<sup>®</sup>

---

The best of both worlds





## What is ADH® amplification?

ADH® (Analog Digital Hybrid) is the most important audio amplification invention of the last 40 years, and the very reason of Devialet's existence.

The idea behind ADH® is to combine the two existing amplification technologies - Analog and Digital, to achieve the best of both worlds: the linearity and musicality of the most popular analog amplifiers (Class A), and the power, efficiency and compactness of digital amplifiers (Class D).

Although simple to explain, this hybridization quickly turned out to be extremely complicated to achieve, since it requires the connection of two amplifiers in parallel. Three years of intensive research were necessary in order to obtain a high-power prototype exceeding the performance of the best electronics on the market by a factor ranging from x10 to x1000. ADH® finally surpassed its initial goal.

## How ADH® works?

ADH® operates according to the following engineering principle:

— A true Class A amplifier, directly connected to the speaker, controls the output voltage: as a master, it determines the sound of the entire ADH® core. That's why what we hear is pure analog sound.

— Multiple Class D amplifiers are added in parallel to provide the speaker with the current it needs to sustain the output voltage. They are companions to the master Class A amplifier, minimizing its workload.

An analogy of this principle is the power steering of a car: the driver imposes his trajectory on the car, assisted by a powerful motor helping him to turn the wheels, making his work effortless and indeed more precise.

A dedicated Class A amplifier is required to operate the ADH® core: although it is usually assisted by Class D amplifiers to provide the ideal voltage to the speaker, it must also be capable of delivering a high current over a short period of time, and absorb the high-frequency alternating current from the digital amplifiers.

This is made possible thanks to a highly innovative concept of the ultra-linear Class A of the ADH® amplifier, whose level of performance is comparable to the best Class A amplifiers on the market.



## What are the benefits of ADH®?

Thanks to the assistance of class D amplifiers, the class A amp is no longer required to supply a large current and becomes even more linear. The class A amplification performance is thus enhanced by the presence of class D amplifiers in the ADH® architecture.

Another advantage is that the output impedance of the ADH® core is equal to the Class A impedance divided by the current ratio of approximately 1:1000 between the Class A and Class D amplifiers. This is how an output impedance of approximately 1mΩ is achieved throughout the bandwidth, which is very important for maintaining high performance while controlling speakers with complex load.

ADH® technology truly delivers on Devialet's promise of 'Pure analog sound, smart digital power'. It offers the musical qualities of an exceptional Class A amplifier, without the usual constraints of weight, volume and heat generation. Class D amplifiers deliver powerful current to the load without compromising sound quality; on the contrary, the performance of the Class A amplifier is even better when it is assisted by Class D amplifiers.

## The Devialet "Magic Wire"

Located upstream of the ADH® amplification stage, another major technological innovation from Devialet is used: the "Magic Wire". The purpose of the patented "Magic Wire" typology is to implement the DAC (Digital to Analog Converter) in the heart of the class A amplifier, in order to reduce the parasitic phenomena hindering the music, such as noise and distortion, to a minimum.

In practice, the output current of the Devialet custom-made DAC developed for PHANTOM is directly converted into high voltage current without any processing in between: no operational amplifier, no current mirror. Instead, the highly elaborate leakage-free path constituted by the "Magic Wire" routes the original DAC current to a very high linearity resistor (accuracy 0.01%), which performs the current/high voltage conversion before entering Class A.

The "magic" comes from the fact that the guiding elements included in the "Magic Wire" do not process the music, while providing a high-voltage output. In addition, these guiding elements operate at constant current, resulting in a constant temperature, which reduces thermal distortion to an unmeasurable level. Simply put, the "Magic Wire" can be considered the dream of every audiophile: a straight wire with gain.

## Miniaturisation of the ADH® amplification?

The ADH® amplification core was originally developed for our EXPERT amplifiers. Therefore, an extensive research program was conducted in order to embed ADH® inside PHANTOM since the technology had to be considerably reduced in size.

The result is the ASIC (Application-specific integrated circuit) ADH® Intelligence, which combines the Class A "Magic Wire" circuits into a single component. In a second step, a new research program has pushed back the limits of what is possible by integrating the Devialet DAC as well as the SAM® technology calculation (see picture below) into this chip. This new SoC (system on a chip), called the Devialet Intelligent Processor, is now embedded in all new PHANTOMS.

This SoC has the incredible advantage of preserving the extreme performance level of ADH® amplification (Total Harmonic Distortion of 0.001%), while reducing its size by a factor of 200 and its power consumption by a factor of 10. Thickness is also now reduced to less than 1mm.

Each ASIC contains the equivalent of two channels in differential mode, i.e. more than 1000 electronic components grouped into one. As Phantom I is equipped with four speakers and two SoCs, each speaker benefits from its own ADH® Intelligence amplification system for optimal performance.

### Devialet Intelligent Processor

Devialet custom SoC

1cm<sup>2</sup>







**S A M**®



As the artist intended

DEVIALET



## What is SAM®?

After ADH® Intelligence, SAM® (Speaker Active Matching) is Devialet's second technological revolution. SAM® is the signal processing that allows ADH® Intelligence to adapt its behavior precisely to the specifications of speaker to which it is connected.

SAM® consists of a digital signal processing algorithm that occurs upstream of PHANTOM's DAC and power amplification section. By taking into account the characteristics of the loudspeaker and its acoustic load, it allows its membrane to be driven in an extremely precise and controlled manner. This allows an exact alignment between the recorded musical signal and the sound wave that reaches the listener's ears.

## How SAM® works?

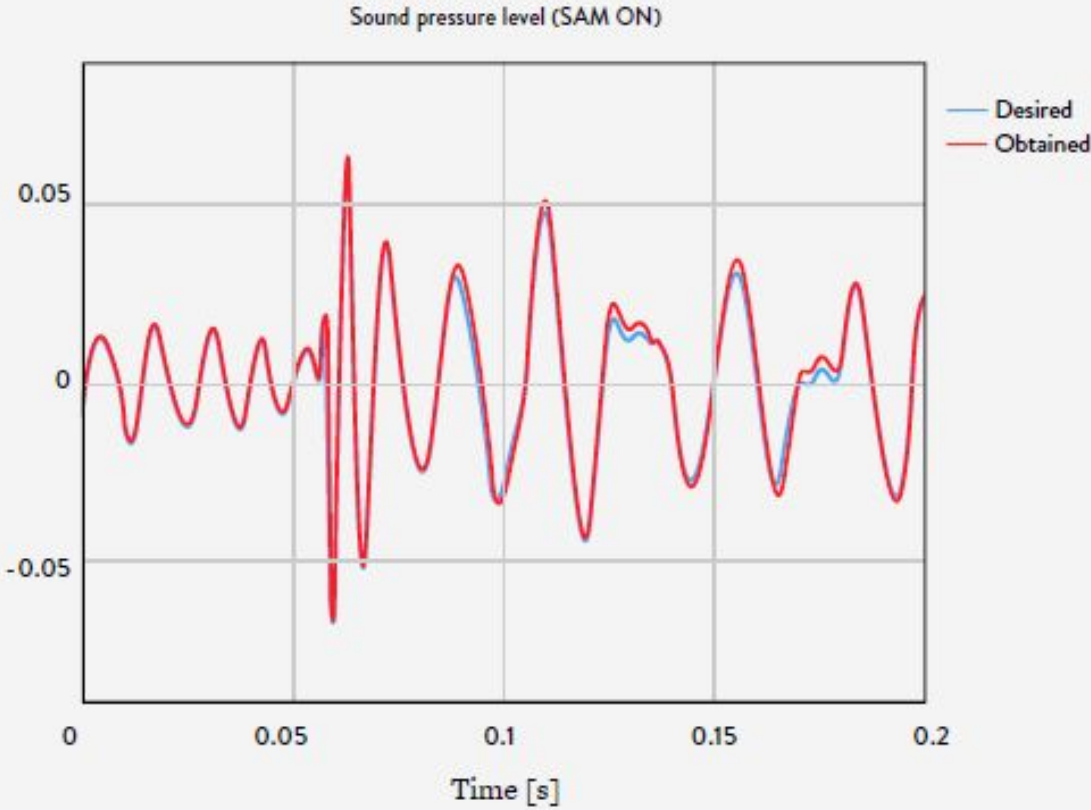
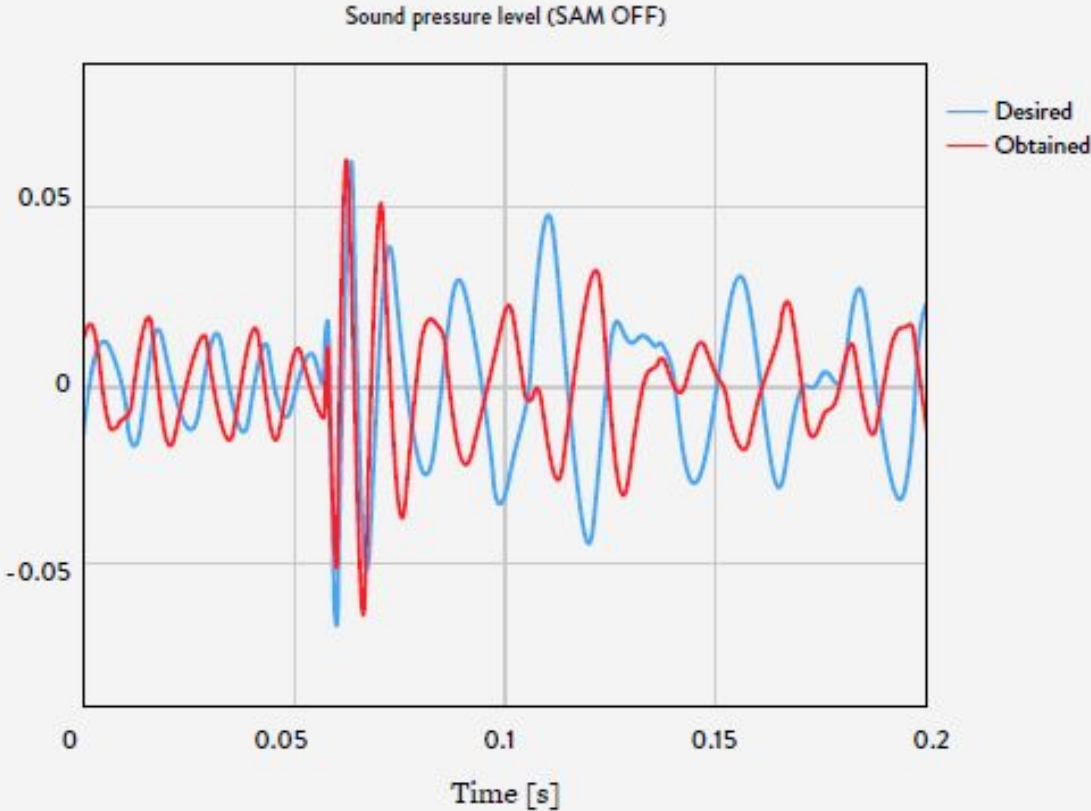
Where ADH® is the motor imposing the signal on the loudspeaker, SAM® is the signal processing allowing this motor to adapt this signal thanks to a deep understanding of the intrinsic electroacoustic behavior of the system.

SAM® acts on the movement of the loudspeaker by means of new time-domain audio signal processing, using a proprietary mathematical approach to achieve near-perfect acoustic performance. It optimizes the speaker's acoustic response in real time, at any moment, to any signal.

A mathematical model of the entire loudspeaker, taking into account its electronic, mechanical and acoustic behavior, is executed in real time within PHANTOM's internal processor. For each sample, it calculates the exact voltage that must be supplied to the loudspeaker by the power amplifier, so that the sound pressure is an exact image of the audio signal.

Other techniques for speaker optimization are commonly summed up as frequency domain equalization. They typically involve IIR or FIR filters and cannot achieve the same performance, being affected by phenomena such as additional phase rotation or time delay, and generally have sub-optimal performance on transients.

# Effect of SAM<sup>®</sup> on woofers' response



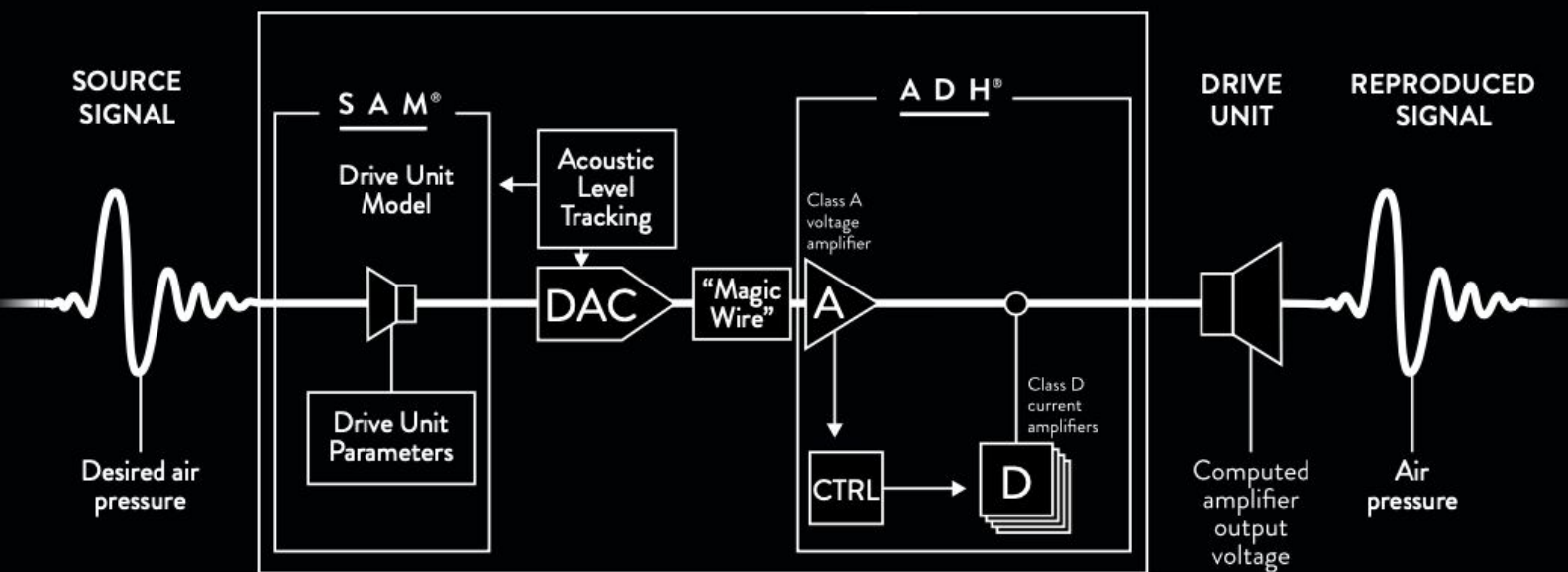
SAM® is implemented as time domain signal processing using patented mathematical techniques, featuring :

- zero latency
- no pre-echo
- no feedback

Here are the key subjective and audible benefits of SAM® reported by listeners:

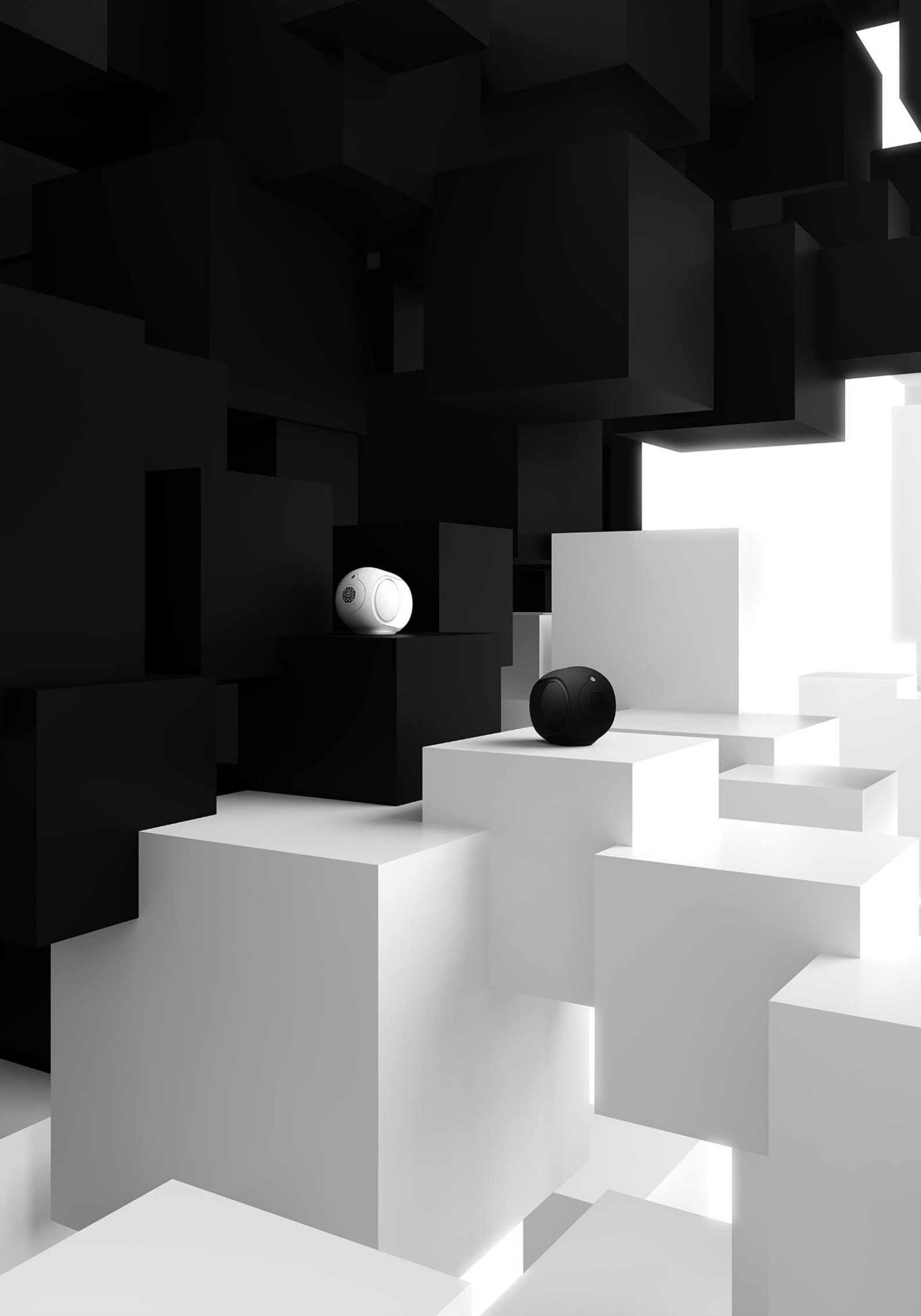
- higher impact, particularly on transients
- better sense of pace and music tempo
- better sound image & higher level of detail

## ADH® Intelligence and SAM® Processing complete diagram



ADH® Intelligence and SAM® Processing represent the most advanced amplification system on the audio market. Together, they allow the speaker to reproduce the exact sound pressure recorded.

The next challenge that Devialet faced was to create a revolutionary loudspeaker that is able to take full advantage of these two technologies. That's when the HBI® technology embedded in PHANTOM came to life.



**H B I**®  

---

Welcome to the deep end



## HBI® technical challenge

Since the company creation in 2007, Devialet's ambition is to bring high-end audio performance to as many people as possible. The goal remains to produce the best music and audio experience in the world, in as compact a form as possible.

The challenge was great, and familiar to hi-fi enthusiasts: to reproduce the entire musical spectrum in a way that would convey its physical and emotional impact. This required not only the best electronics, but also speakers of impressive size.

The process is simple: in order to reproduce low frequencies, it is necessary to move air. Instruments that are rich in low frequencies are big: such as a double bass, an organ and a grand piano. Similarly, speakers capable of reproducing the scale of these instruments traditionally use large speakers in very large enclosures.

## HBI® specifications?

Big sound requires big speakers. This has been true for a century, ever since the invention of electrodynamic loudspeakers.

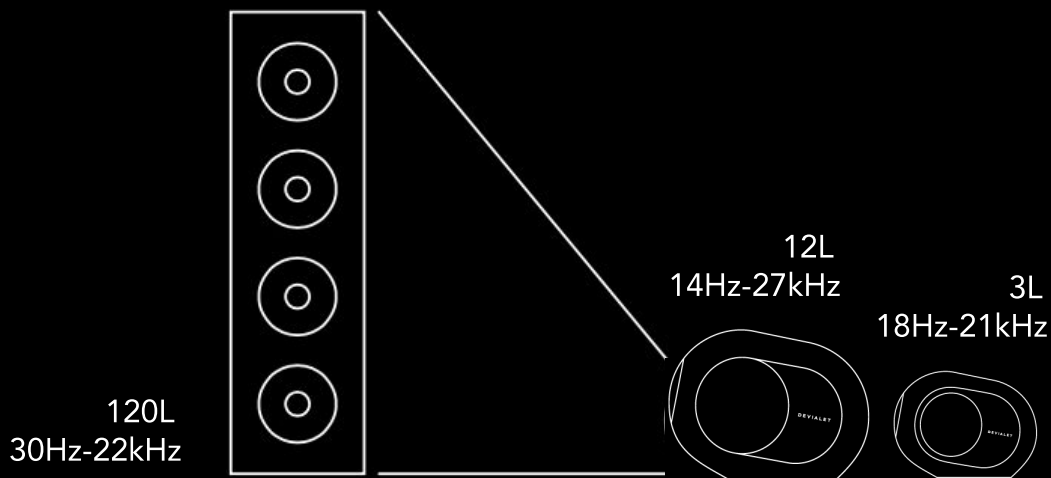
The most commonly used loudspeaker acoustic loading principles are bass-reflex designs (also called vented loudspeakers) and enclosed loudspeakers.

Vented speakers suffer from energy cancellation at the lowest frequencies below their resonant frequency; this is called acoustic short circuiting. With the exception of very large loudspeakers, the sound often lacks amplitude and impact since the fundamental frequencies, between 16Hz and 50Hz, are not reproduced by this technique.

Enclosed speakers are more desirable when it comes to being able to reproduce very deep bass without losing power due to acoustic short circuiting. But then again, very large speakers are needed in order to reproduce all the music with its full physical impact.

Typically, high-end speakers capable of reproducing most of the audible spectrum in a home have a large internal sound volume, between 100 and 200L! That's as much as a bathtub.





## How Heart Bass Implosion® works?

It is generally accepted, based on the laws of physics, that the best speakers should be large. The laws of physics cannot be changed, but sometimes there is much to be gained by pushing them to their limits. You can go very far if you don't rely on existing technologies and have the desire and ability to develop technologies that serve a specific purpose. It's all about going as far as is physically possible, looking at a given technical challenge from a new perspective.

Devialet set itself a performance to achieve in order to create the ultimate home audio experience from a compact design, transmitting all the dynamics of the music and its physical impact :

- 16Hz to 25kHz bandwidth,  $\pm 2$ dB
- 20Hz to 20kHz bandwidth,  $\pm 0.5$ dB
- 108dB maximum SPL (at 1 meter) on PHANTOM I
- 98dB maximum SPL (at 1 meter) on PHANTOM II

The idea behind the compact reproduction of ultra-bass was to maximize the efficiency of the electroacoustic system at all levels. The consequences of this logic are simple:

- Designing the most compact and efficient loudspeaker with a very high driver excursion
- Use low-frequency loudspeakers arranged in perfect symmetry to cancel mechanical vibrations



That's why we at Devialet call this technology Heart Bass Implosion: in order to create realistic bass in such a compact enclosure, PHANTOM's speakers must be able to withstand extremely high pressure and vacuum levels inside the cabinet. For the first prototypes, the strongest drivers on the market were used, and these gave the impression of 'imploding': the diaphragm fragmented into fractal shapes, sucked in by the excessive force resisting the movement dictated by the driver.

In order to meet this design challenge, key engineers were hired with very different but complementary expertise from a variety of industries:

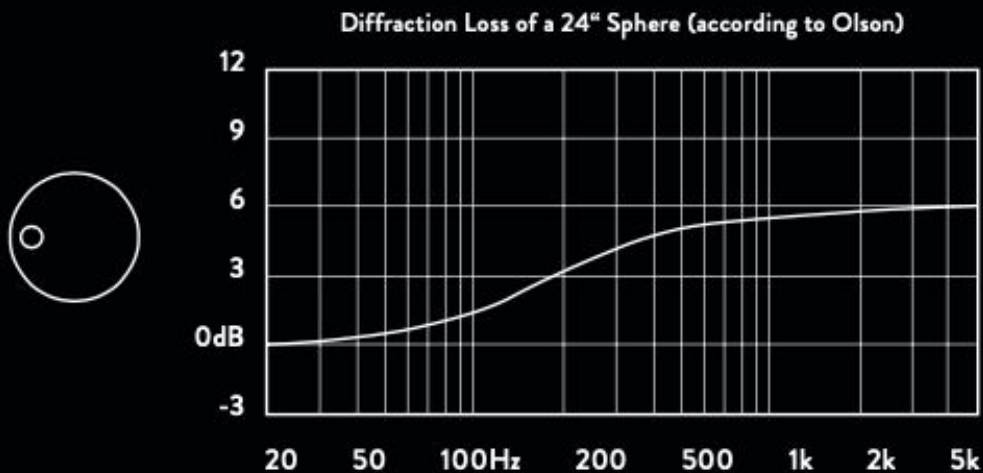
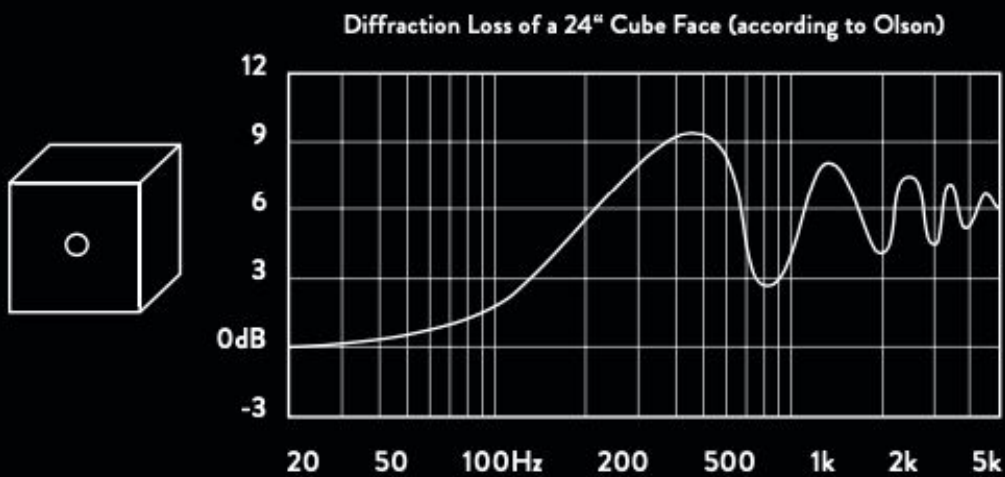
- Experts from the automotive industry, specializing in injection pumps, material deformation modeling and automated assembly of high pressure devices
- Experts in micromechanics, specializing in the design and manufacture of high-precision metal parts for the watchmaking industry
- High-performance professional loudspeaker experts specializing in repeatability and reliability for live stadium concerts

The result of this novel approach starting from a blank sheet of paper is the first HBI® Devialet woofer: a high-output, high-excursion (26mm peak-to-peak), yet very compact loudspeaker. Four times more powerful than the best woofers on the market with the same diaphragm size, but six times more compact and six times lighter. Each woofer can thus move a mass of more than 30kg.

The goal was to make the sound of PHANTOM as natural as possible, with a wide distribution of sound throughout the listening space in order to correspond to the modern use of listening to music, which is rarely for a single person sitting in a clearly defined listening position. The sound extends through space in spherical waves; a frequently used example is the 2-D visualization of a shock wave created on the surface of water after throwing a stone: the wave created on the surface of the water extends in concentric circles from the point of impact.

A perfect sphere is also the ideal shape when it comes to producing sound and diffusing its energy linearly in all directions. While a loudspeaker is traditionally a parallelepiped (mainly due to manufacturing costs), Olson's work showed, as early as the 1940s, that the sphere is by far the best shape to avoid diffraction on the surface of the loudspeaker.





In addition, just as different sized musical instruments are needed to produce sounds in several frequency ranges (a double bass for low frequencies, a violin for high frequencies), different sized transducers are needed to provide optimal performance in each frequency band: multi-channel speakers are the norm. In the case of PHANTOM, the idea was to use two symmetrical woofers for the bass frequencies, a midrange driver and a tweeter to reproduce the treble frequencies with a piston-like behavior throughout the frequencies.

However, the ideal sound source should theoretically emit all audible sounds from a single point in space to avoid direction-dependent interference between the different transducers. This idea of a 'point source' is difficult to realize in practice, since the dimensions of loudspeakers, especially bass drivers, are much larger than a single point.

However, we can get close to it through a novel design, using coaxial drivers for the midrange and tweeter, and diaphragms flush with the surface of a perfect sphere. The result is a unique design, inspired entirely by the laws of acoustics, that combines the best possible bass reproduction with a strikingly lifelike sound image, whatever the listening angle.



## HBI® Mechanical integration

Defining the key principles of acoustical architecture was only the first step. Designing a complete product that could be mass-produced repeatedly and reliably, within the constraints of size and cost, took a full two years.

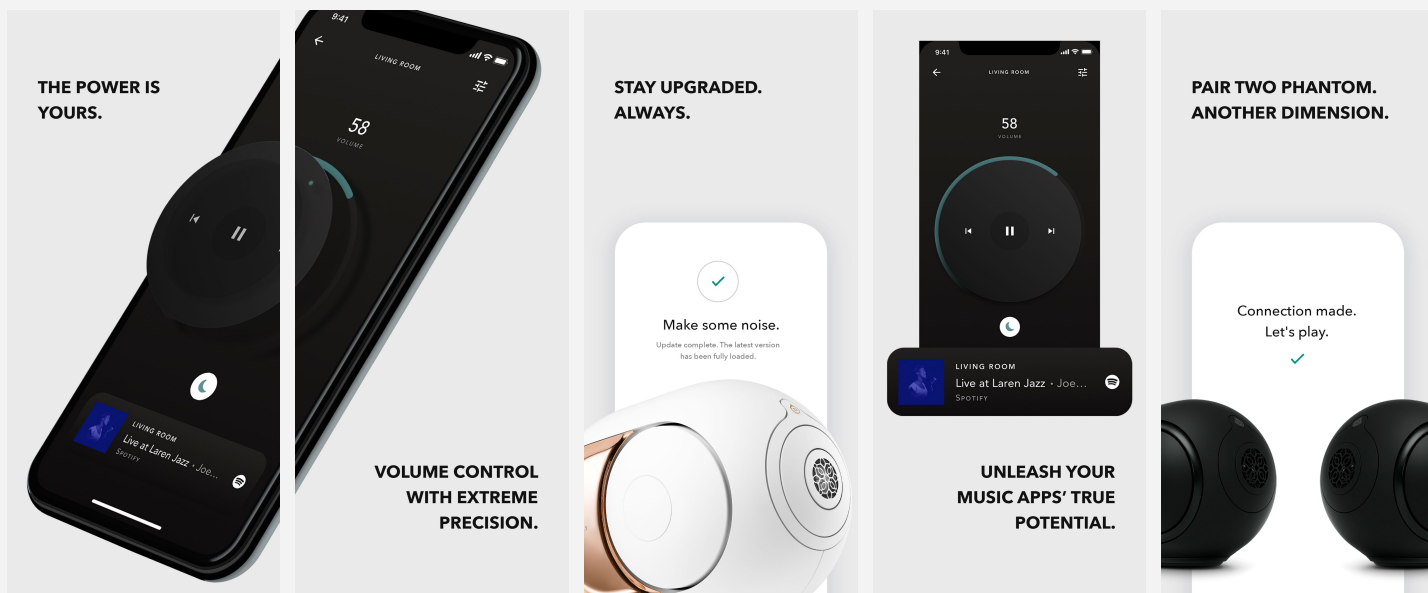
It would be possible to write a whole book to explain the many mechanical challenges we encountered during product development. Let's just mention a few key facts illustrating the level of detail and precision required to make such an integration a success :

- There is not a single wire in PHANTOM
- Precise frequency response between 20Hz to 20kHz,  $\pm 0.5\text{dB}$
- 108 dB maximum SPL on PHANTOM I or 98 dB maximum SPL on PHANTOM II









## The Devialet application

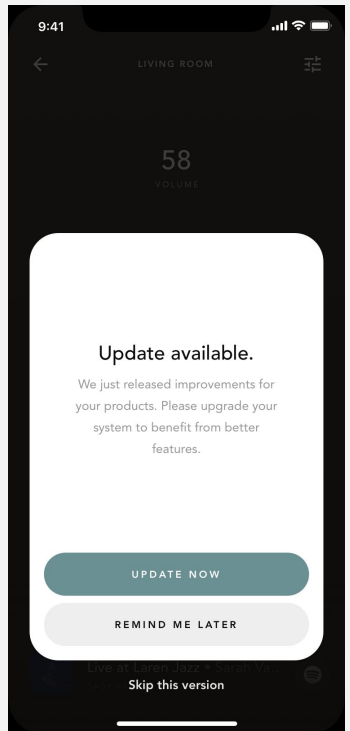
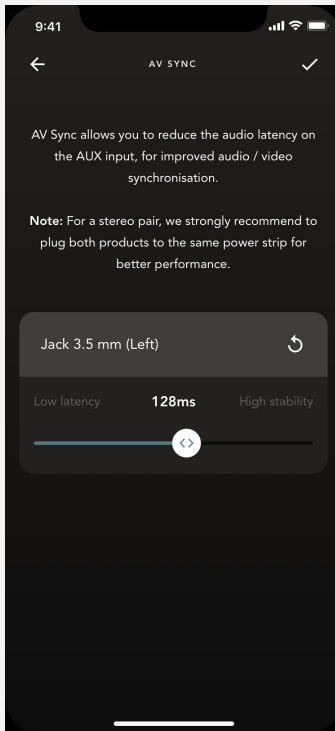
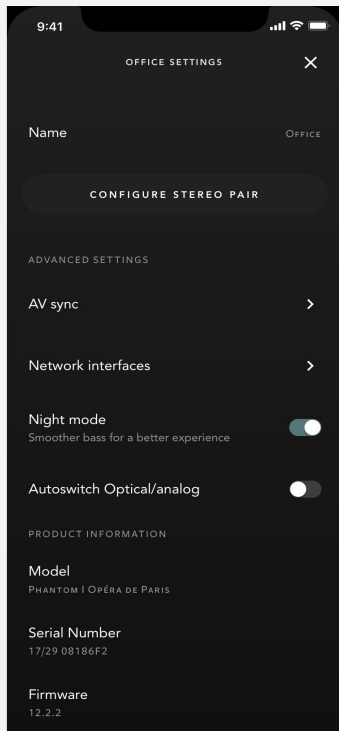
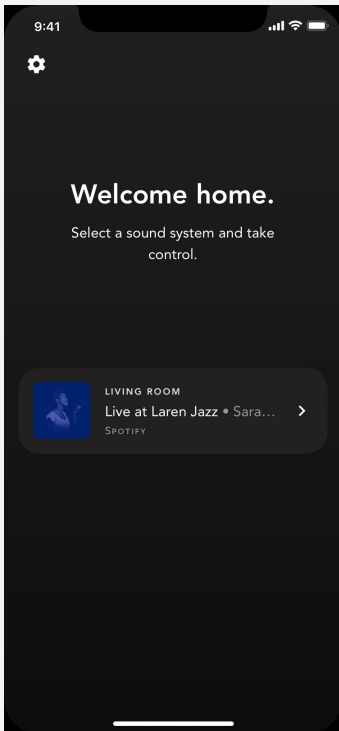
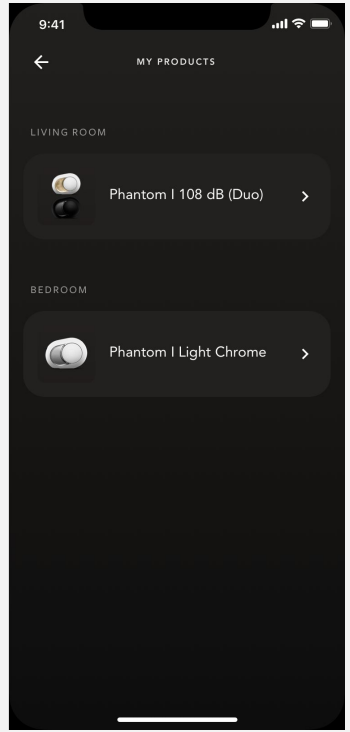
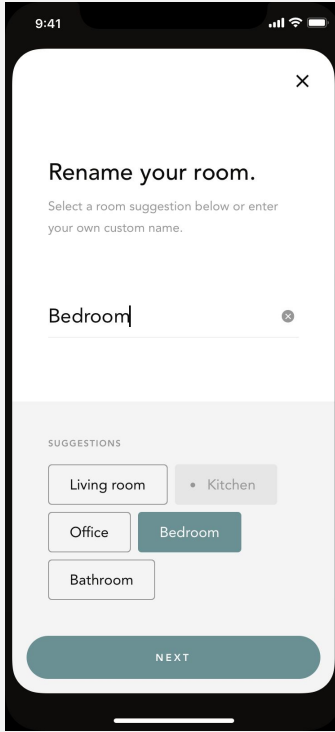
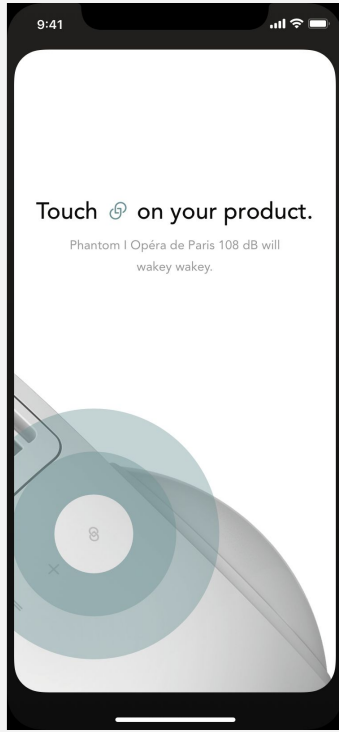
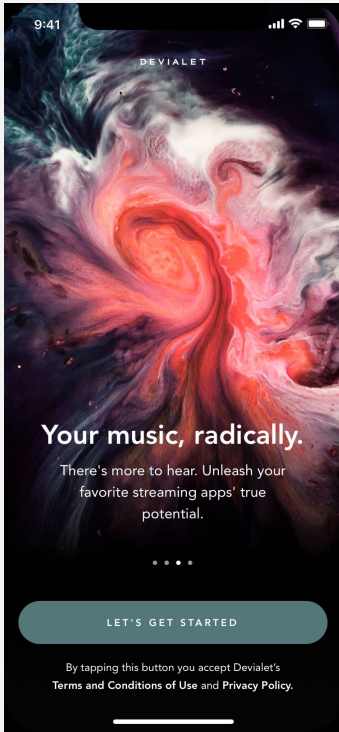
The Devialet application allows you to control and customize your experience with PHANTOM. It provides a wide range of features and connectivity that enriches the listening experience and offers constant access to the latest updates.

Once downloaded via the App Store or the Play Store, just follow the few steps necessary to install and configure PHANTOM in the room of your choice. It is also possible to configure a stereo pair between models of the same power as well as a multiroom system.

The application is a powerful and intelligent companion to control PHANTOM. It provides an open and versatile software ecosystem to take advantage of the many streaming services via compatible protocols: AirPlay 2®, Bluetooth, Spotify Connect, Roon Ready and UPnP, as well as tutorials to start directly within the application.

It also allows you to precisely control the volume no matter where you are in the room and adjust the volume while in different rooms, separately or simultaneously in a multiroom configuration. The application also provides control of the Arch accessory and gives access to many settings for PHANTOM such as night mode which reduces bass intensity as well as latency control on the auxiliary input in Audio/Video use cases.

Finally, thanks to the Devialet application, each user can access the latest updates of PHANTOM's internal firmware as well as the latest patches and enhancements.





## The Devialet Remote

A faithful companion to PHANTOM, the Devialet Remote allows you to adjust the volume, change the music, and turn off PHANTOM while remaining comfortably seated.

Remote pairs and communicates with PHANTOM using a Bluetooth 5.0 connection with a range of up to 20 m from the connected device. It is powered by a lithium-ion battery with an autonomy of up to 2.5 months and is quickly recharged by using the included USB-B cable.

It is also equipped with a proximity sensor as well as a module with an LED display matrix for better visibility. The Devialet Remote integrates perfectly into the Devialet ecosystem as a whole. Its sleek and minimalist design, adorned with refined details such as its stainless steel ring, remains in line with Devialet's simplicity and ergonomic excellence.

# PHANTOM

I M P L O S I V E S O U N D



Phantom I 103dB  
Light chrome



Phantom I 103dB  
Matte black



Phantom I 108dB  
Gold



Phantom I 108dB  
Dark chrome

# Phantom I: Spec sheet

## PHANTOM I 103dB

## PHANTOM I 108dB

	PERFORMANCE	
SOUND PRESSURE LEVEL	103 dB SPL at 1 meter	108 dB SPL at 1 meter
TOTAL AMPLIFICATION POWER	500 Watts RMS	1100 Watts RMS
AMPLIFICATION PERFORMANCE	THD+N* : 0.0005%   Saturation : 0   Background Noise 0 dB SPL at 50cm (-15,5 dB SPL at 3m) (*Total Harmonic Distortion + Noise)	
ACOUSTICAL PERFORMANCE	Bandwith: 16Hz to 25kHz (@-6dB)	Bandwith: 14Hz to 27kHz (@-6dB)
	Accuracy in frequency response : $\pm$ 2dB from 20Hz to 20kHz	
TECHNOLOGIES	ADH®; HBI 2®; SAM 2®; ACE 2; EVO®	

	SPECIFICATIONS	
DRIVERS	Aluminum Tweeter driver Aluminum Medium driver Aluminum Bass drivers	Titanium grade 1 Tweeter driver Aluminum Medium driver Aluminum Bass drivers
DIGITAL TO ANALOG CONVERTER	Devialet DAC embedded in Devialet Intelligence Processor 24bits/96kHz THD: -112dB	
INTELLIGENCE	ARM Cortex-A9 1.25GHz processor 512MB DDR3-1600 memory	
MATERIALS	Composite body Internal skin: glass fiber filled polycarbonate External skin: ABS Aluminum central core	
COLORS AND FINISH	Body: white RAL 9016 Polished stainless steel sides White RAL 9016 dome drivers  Body: black RAL 9017 Polished stainless steel sides Black RAL 9017 dome drivers	Body: white RAL 9016 22-carat pink-gold-plated sides White RAL 9016 dome drivers  Body: black RAL 9017 Polished stainless steel dark chrome sides Black RAL 9017 dome drivers
SIZE	Width: 253 mm   Height: 255 mm   Depth : 343 mm	
WEIGHT	11,4 kg	
POWER SUPPLY	IEC 100-240 V~50/60Hz	
POWER CONSUMPTION	0.5W (in standby)	



PHANTOM I 103dB

PHANTOM I 108dB

	FEATURES
OPERATING SYSTEM	Devialet Operating System 2 (DOS 2) up to 24bits/48kHz
CONFIGURATION AND SYNCHRONIZATION	Configuration and synchronization via Devialet App, connected to Wi-Fi, Ethernet or PLC
CONTROL	Devialet App (available on iOS & Android)
CONNECTIVITY	Airplay 2 Spotify Connect Bluetooth : A2D and AVRCP profiles, AAC, SBC audio codecs Room Ready (Hi-Res: Inputs up to 24bits/96kHz) UPnP Renderer (Hi-Res: Inputs up to 24bits/96kHz) Toslink optical input (Hi-Res: Inputs up to 24bits/96kHz)
NETWORK	Proprietary Network Wi-Fi Dual-band (a/b/g/n/ac 2.4 GHz & 5 GHz) Ethernet RJ-45 10/100/1000 Mbps (Gigabit) CPL Homeplug AV2
AUDIO FORMATS	HE-AAC (V1), AAC (16 to 320 kbit/s), WMA (16 bit), MP3 (16 to 320 kbit/s), MP3 VBR, Apple Lossless, AIFF and WAV, FLAC, OGG, VORBIS

CONTENT OF THE BOX
Phantom II speaker Power cable Documentation



# PHANTOM

IMPLOSIVE SOUND



Phantom II 95dB  
Iconic white



Phantom II 95dB  
Matte black



Phantom II 98dB  
Iconic white



Phantom II 98dB  
Matte black

# Phantom II: Spec sheet

## PHANTOM II 95dB

## PHANTOM II 98dB

	PERFORMANCE	
MAXIMUM SOUND PRESSURE LEVEL	95 dB SPL at 1 meter	98 dB SPL at 1 meter
TOTAL AMPLIFICATION POWER	350 Watts RMS	400 Watts RMS
AMPLIFICATION PERFORMANCE	THD+N* : 0.001% (*Total Harmonic Distortion + Noise)	
ACOUSTICAL PERFORMANCE	Bandwidth: 18Hz to 21kHz (@-6dB)	
	Accuracy in frequency response : $\pm 2$ dB* from 25Hz to 20kHz (*Average on $\pm 30^\circ$ )	
TECHNOLOGIES	ADH®; HBI 2®; SAM 2®; ACE 2; EVO®	

	SPECIFICATIONS
DRIVERS	1 x Aluminum Full-Range driver 2 x Aluminum Bass drivers
DIGITAL TO ANALOG CONVERTER	Devialet DAC embedded in Devialet Intelligence Processor 24bits/96kHz THD: -112dB"
INTELLIGENCE	ARM Cortex-A9 1.25GHz processor 512MB DDR3-1600 memory
POWER SUPPLY	IEC 100-240 V~50/60Hz
POWER CONSUMPTION	0.5W (in standby)
MATERIALS	Composite body Internal skin: glass fiber filled polycarbonate incorporating a metal insert providing additional rigidity. External skin: polished ABS Aluminum central core
COLORS AND FINISH	Body: white RAL 9016 White matte stainless steel sides / White RAL 9016 driver domes Body: black RAL 9017 Black matte stainless steel sides / Black RAL 9017 driver domes
SIZE	Width: 219 mm   Height: 157 mm   Depth : 168 mm
WEIGHT	4.3 kg

PHANTOM II 95dB

PHANTOM II 98dB

	FEATURES
OPERATING SYSTEM	Devialet Operating System 2 (DOS 2) up to 24bits/48kHz
CONNECTIVITY	Airplay 2 Spotify Connect Bluetooth : A2DP and AVRCP profiles, AAC, SBC audio codecs Room Ready (Hi-Res: Inputs up to 24bits/96kHz) UPnP Renderer (Hi-Res: Inputs up to 24bits/96kHz) Analog/Optical jack input (Hi-Res: Inputs up to 24bits/96kHz)
CONTROL	Touch controls: Play/pause, Bluetooth pairing, Volume +, Volume -, Link) Devialet app (available on iOS & Android)
NETWORK	Wi-Fi Dual-band (a/b/g/n/ac 2.4 GHz & 5 GHz) Ethernet RJ-45 10/100/1000 Mbps (Gigabit) PLC Homeplug AV2
CONFIGURATION & SYNCHRONIZATION	Configuration and stereo pairing via Devialet App
AUDIO FORMATS	HE-AAC (V1), AAC (16 to 320 kbit/s), WMA (16 bit), MP3 (16 to 320 kbit/s), MP3 VBR, Apple Lossless, AIFF and WAV, FLAC, OGG, VORBIS

CONTENT OF THE BOX
Phantom II speaker Power cable Documentation





ALIVE  
INSIDE