



DEVIALET
GEMINI

WHITE PAPER



What is Devialet Gemini ?

The music you love, the voices you want to hear, the noise you want to keep away from. That's the promise of our True Wireless Devialet Gemini earphones. A balance between sound permeability and sound impermeability, allowing you to bring the "Devialet sound" to an ever-widening range of audiences and contexts.

Devialet Gemini is the result of fifteen years of R&D and acoustic engineering, concentrated in a resolutely nomadic design. The headphones embody a set of proprietary technologies, with three registered patents, which we are pleased to show you in this document .

DEVIALET GEMINI

Devialet Active Noise Cancellation™

With Devialet Active Noise Cancellation™, the outside environment becomes totally impermeable to the user. Three levels of reduction are accessible via the dedicated application, Devialet Gemini. Our proprietary noise reduction is based on a hybrid dual microphone structure combined with dedicated digital filters. It is based on a brand new acoustic architecture, called Pressure Balance Architecture (PBA®), which offers particularly immersive passive isolation and optimal listening comfort. It is also based on another proprietary technology, called Internal Delay Compensation (IDC®), which reinforces the level of active reduction and its impact on the entire bandwidth.

Intelligent Transparency Mode

Thanks to the transparency mode, the listener can enjoy the best of the music while staying in tune with the surrounding world. The external environment and dialogues become permeable for better interaction with the user's surroundings.

In this mode, the two microphones dedicated to the ANC synchronize to faithfully transmit the outside sound. Two levels of transparency are accessible via the dedicated application Devialet Gemini.

Ear Active Matching (EAM®)

The third embedded patent pending, the proprietary Ear Active Matching algorithm (EAM®) instantly detects the shape of the user's ear canal and automatically adapts the signal several thousand times per second for an immersive and personalized listening experience.

Custom Devialet Driver

At the heart of Devialet Gemini is a full range speaker designed exclusively for the earbud architecture. This transducer measures 10 mm in diameter and consists of a moving coil electrodynamic motor that delivers a dense, deep and enveloping sound.

Devialet Gemini brings Devialet's engineering and acoustic expertise to the True Wireless headphone market. This white paper describes in more detail the unique technologies that Devialet Gemini is composed of and what they bring to the Audio industry.





Devialet Active Noise Cancellation™

Devialet Active Noise Cancellation™ is the noise reduction solution designed exclusively for Devialet Gemini wireless headphones.

It combines an acoustic architecture that maximizes passive isolation with a hybrid system of two microphones and dedicated digital filters that generate the noise reduction.

How does Devialet Active Noise Cancellation™ work ?

In order to achieve the best possible noise reduction, all elements of the noise control system must work in parallel with each other.

1. Active noise cancellation by feedback and by anticipation:

In an active anti-noise system called "ANC", one or more pressure sensors, usually microphones placed on the surface and inside the earphone, pick up vibrations from the air coming from the outside (ambient noise). The unwanted noise is converted by the transducers of the sensors into an electrical signal that is transmitted to the DSP (Digital Signal Processor). Through specific digital filters, DSP generates a wave that is perfectly in phase opposition to that of the noise recorded by the microphones.

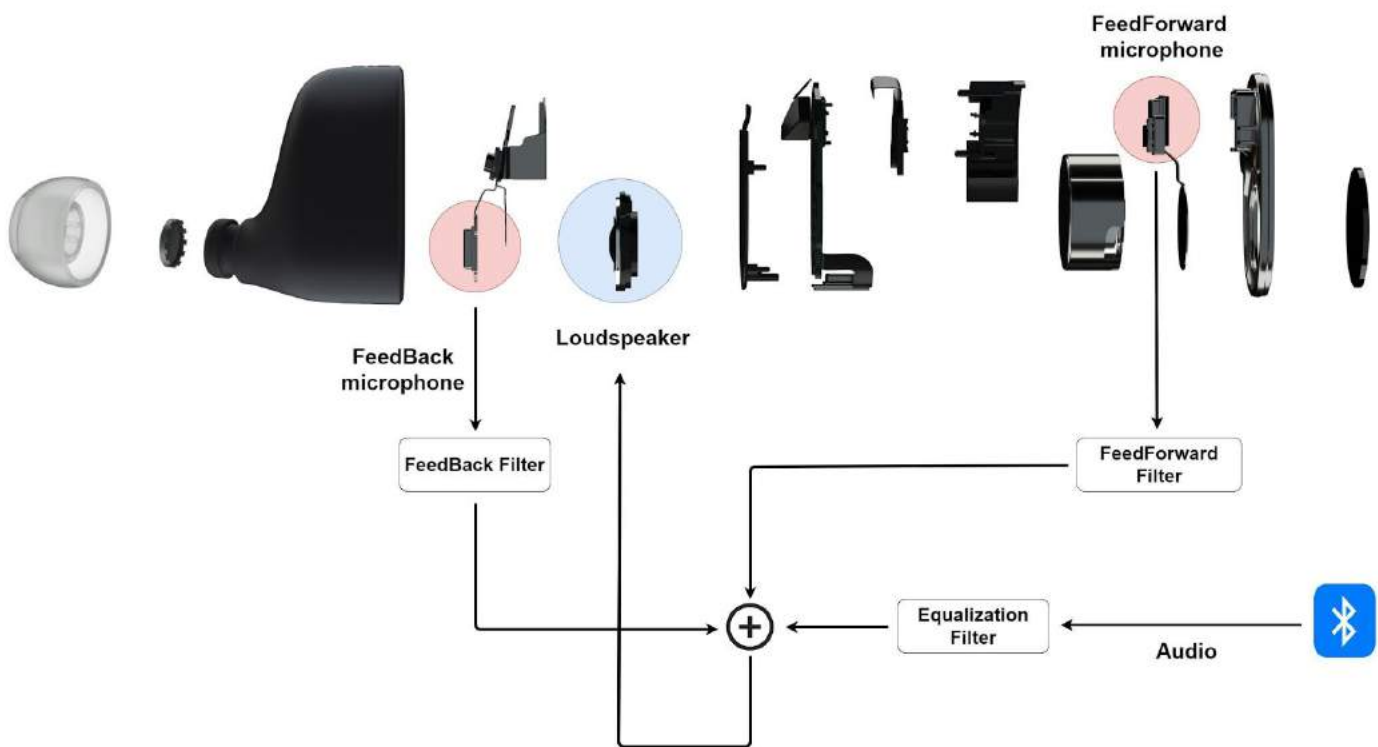
This new signal is then played by the loudspeaker. The initial wave (the unwanted noise) is thus directly added on the DSP's anti-noise in the listener's ear. Their stacking leads to the appearance of a physical phenomenon called "destructive interference" and the intensity of the stacked signal is thus reduced or even completely cancelled.

In so-called anticipatory systems, the microphone is placed on the outside of the earphone. The microphone therefore picks up the noise before it reaches the listener's ear. Then the ANC system processes the noise and generates the corresponding noise canceller before sending the resulting signal to the loudspeaker. This type of reduction is very effective in reducing high-frequency noise up to about 3-4 kHz. The microphone has more time to respond and generate the anti-noise because it picks up the sound upstream. Performance may vary slightly depending on the position of the earphone in the ear, with the microphone positioned on the outside.

In feedback configurations, the microphone is placed directly inside the earpiece and in front of the speaker (feedback), so it is able to hear the resulting signal in exactly the same way as the listener's ear. This system is more accurate because the microphone picks up the exact noise that should reach the listener's ear.

For Devialet Gemini we chose a hybrid system that incorporates both feedback noise reduction and anticipation noise reduction to achieve the best possible result.

The resulting hybrid system combines the advantages of each of these architectures to extend the noise reduction and make it more accurate and effective over the widest possible frequency band.



Devialet Active Noise Cancellation™
(Up to 40 dB in reduction over a wide frequency band)

2. Internal Delay Compensation (IDC®)

The performance of Devialet Active Noise Cancellation™ in high frequencies is largely based on the IDC® algorithm.

In practice, conventional ANC systems are less efficient on medium and high frequencies (generally from 1.5 kHz upwards). The higher the frequency, the greater the delay in reduction in the higher frequencies. Therefore, a phase shift in the system can be observed. Additionally, the strong directivity of the higher frequencies are more difficult to cancel than the less directive low frequencies.

IDC® is a proprietary signal processing system that allows for the precise adaptation of noise processing filters by anticipating the natural limitations of an ANC system. Sound signal processing is performed digitally in the frequency domain.

The IDC® algorithm acts directly on the transfer function of the anti-noise filter, it ensures that its response is optimized to extend the range of action of the filter to extend its action band from the infra bass to the midrange.



3. Pressure Balance Architecture (PBA®)

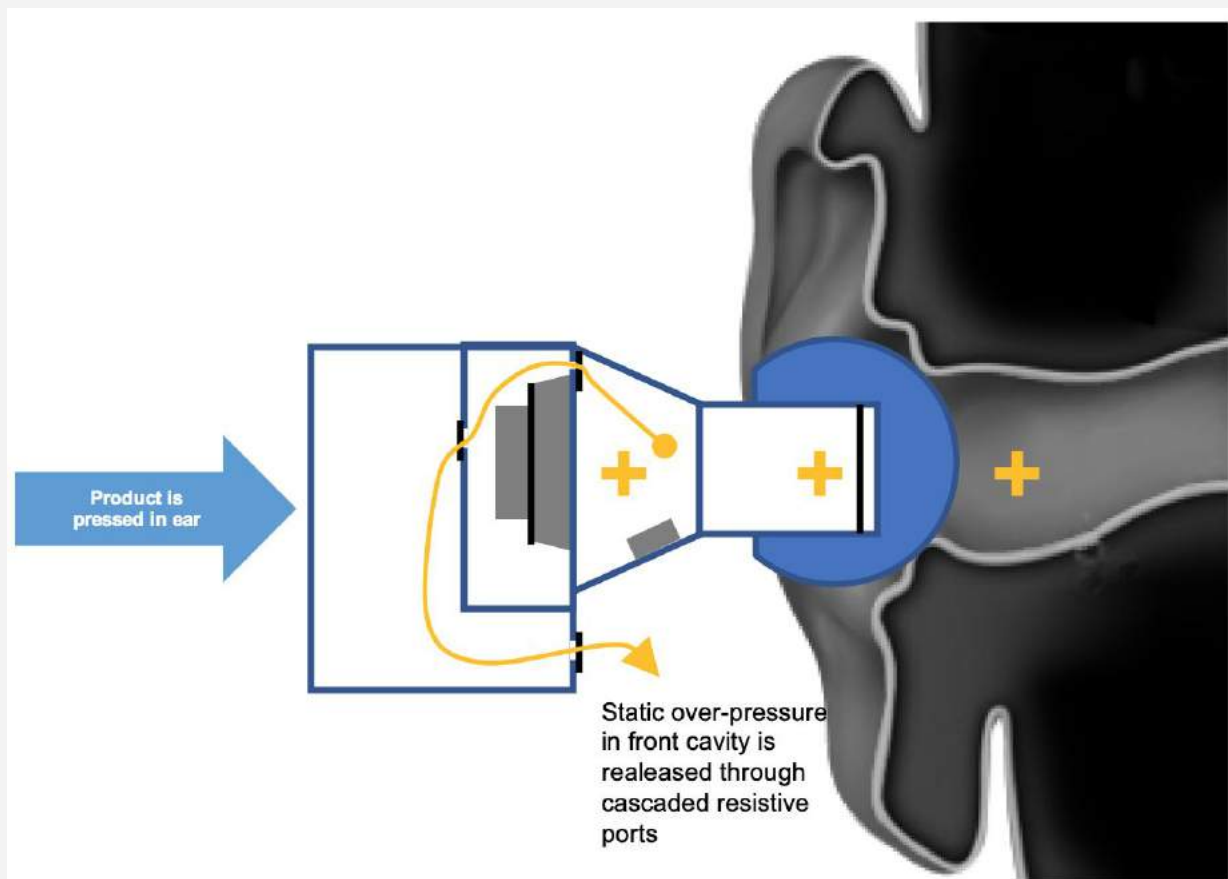
PBA® is the second patent for Devialet Active Noise Cancellation. It is a unique acoustic architecture with a 3-vent decompression system.

Born from the resolution of a problem aimed at limiting the static air compression encountered with in-ear earphones when inserted in the ear, the PBA® architecture optimizes the sensitivity of the loudspeaker in low frequencies while adjusting the insulation to external noise.

Cascaded vents provide decompression (i.e., equalization of static pressure) by allowing air from the ear canal to flow outward. The vents incorporate specific meshes that dampen sound propagation. The impedances chosen for these meshes, as well as the size of the cavities of the double back load, make it possible to obtain a high passive isolation from ambient noise combined with a high sensitivity in low frequencies.

PBA® Acoustic Layout

(enhanced passive insulation and suppression of unwanted noise)

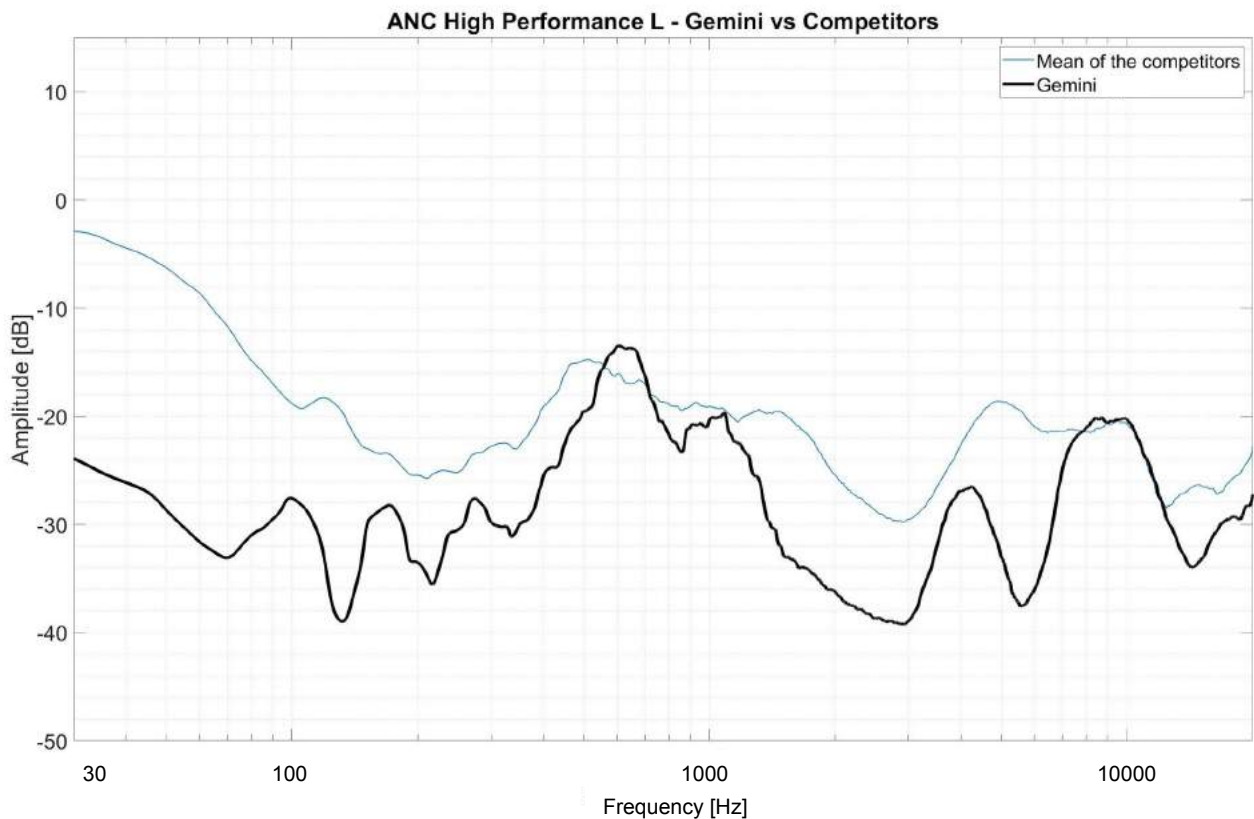


What are the performances of Devalet Active Noise Cancellation™ ?

Devalet Active Noise Cancellation™ provides a set of audible benefits:

- Essential noise reduction on a set of frequencies, with up to 40 dB of attenuation on low frequencies (averaging twice as much as the competition in December 2020).
- Better passive insulation in the medium and high frequencies, thanks to the PBA® acoustic architecture.

The following graph* shows the amplitude of the reduction over all frequencies of the audible spectrum compared to the average of competing products positioned in the same price range (the lower the curve the better).



**Insertion loss measured in an equalized diffuse field.*

Background noise playback system composed of 8 wall-mounted speakers with 3 subwoofers using a pink noise signal.





Transparency Mode

Based on the same hybrid structure as Devialet Active Noise Reduction™: the transparency mode uses the two microphones of the ANC system to allow users to actively hear external sound as naturally as possible.

The transparency of Devialet Gemini has been worked to faithfully retransmit external sound without amplifying or attenuating the original signal.

It is available in two modes: "low" and "high".





What is EAM®?

In addition to Active Noise Reduction Devialet™, EAM® (Ear Active Matching) is Devialet Gemini's second major technology. EAM® is a signal processing algorithm that automatically adapts music based on the placement of the earphone in the user's ear.

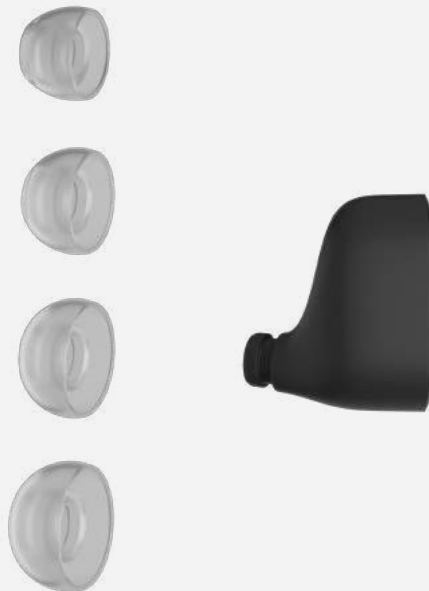
How does EAM® work?

The algorithm is directly calculated in the Devialet Gemini microcontroller upstream of the digital-to-analog conversion and amplification circuit. It corrects the musical signal played by the loudspeaker by measuring acoustic leakage several thousand times per second.

EAM® technology acts directly on the musical signal transmitted to the loudspeaker. While being transmitted to the loudspeaker, the initial signal is simultaneously buffered by the microcontroller as soon as it is received in Bluetooth. The signal played by the loudspeaker is then captured by the internal microphone (known as feedback) and then compared with the initially stored signal to determine the optimal equalization to be adopted.

The operation of the EAM® algorithm can be summarized as follows:

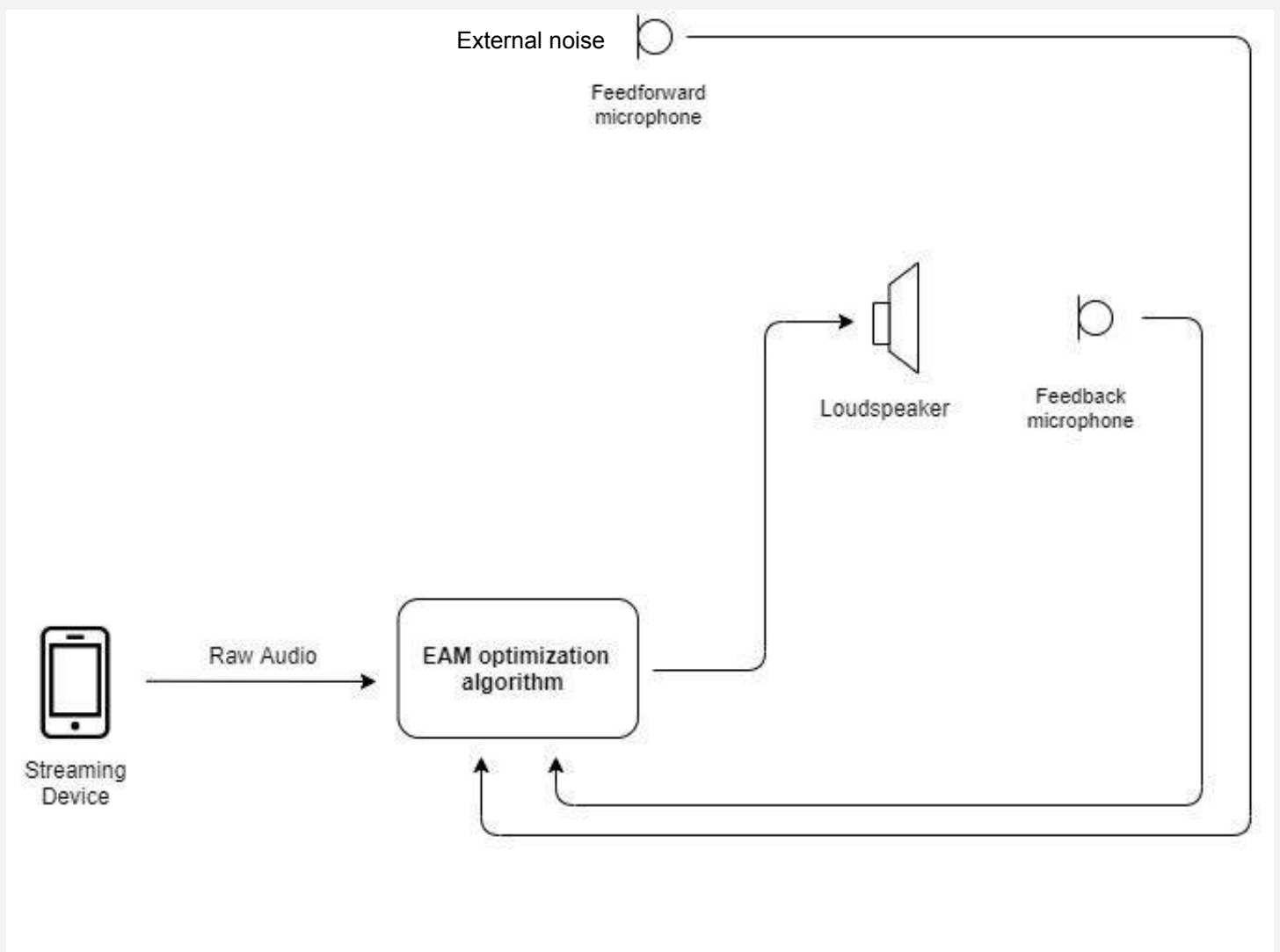
- The response of the earphone is measured using the music signal and the signal picked up by the internal microphone.
- The measured response is monitored and used to modify a compensation filter and adapt the equalization accordingly.



What are the advantages of EAM® ?

The EAM® algorithm allows Devialet Gemini to have an acoustic response that is faithful to the recorded musical signal and allow for the production of deeper bass.

Diagram of EAM® algorithm (adaptive equalization)



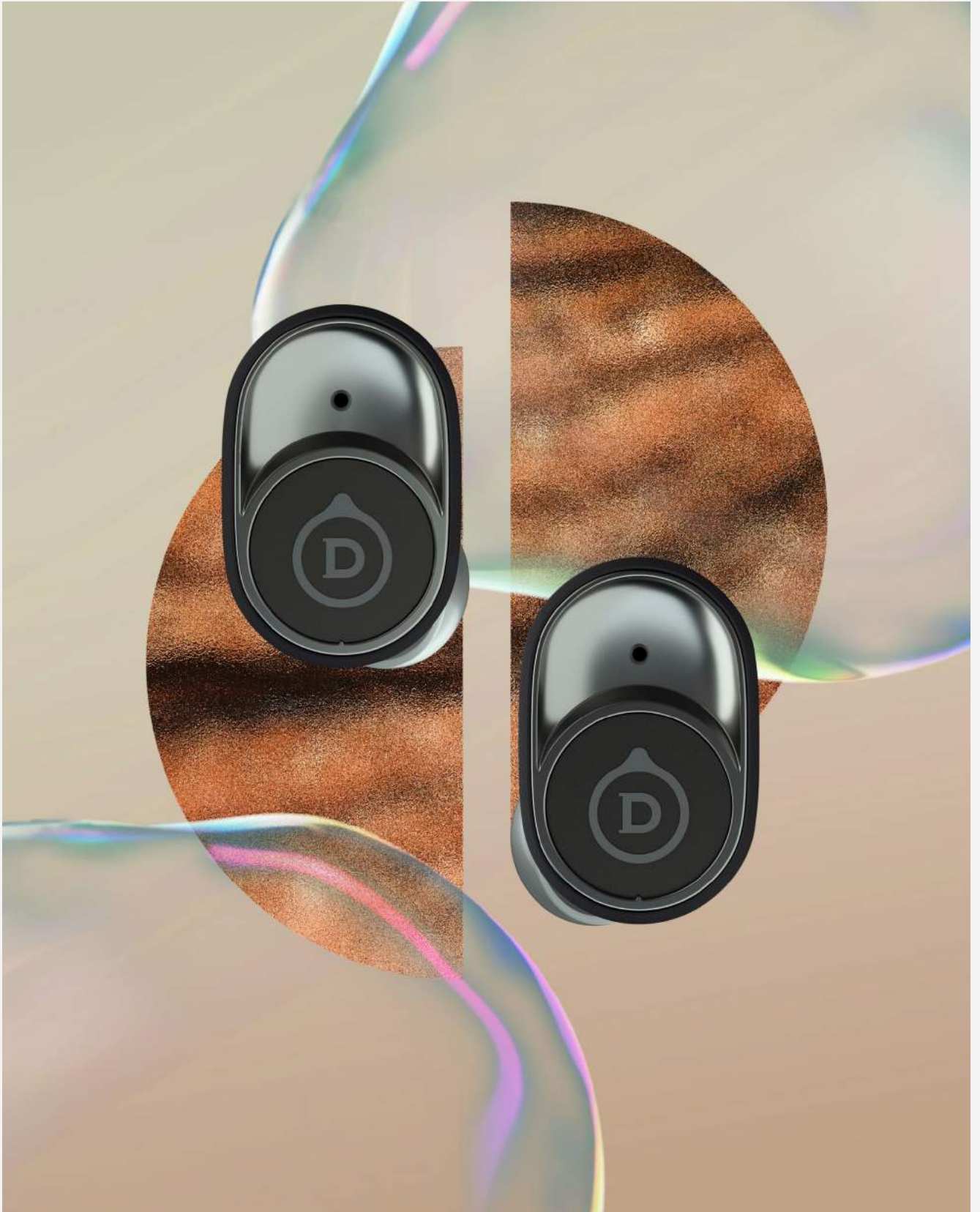
Custom Devialet Driver

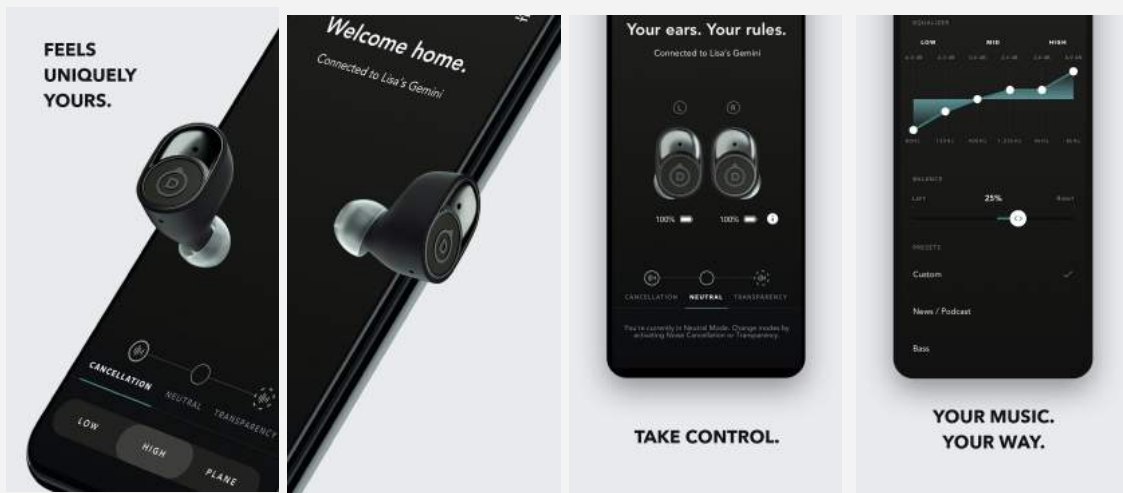
Devialet Gemini is driven by a loudspeaker called transducer (broadband with high excursion), specifically chosen according to the electroacoustic and mechanical characteristics of the earphone.

The 10 mm diameter transducer, wider than the average of the competitors, allows Devialet Gemini to provide rich and powerful bass down to 5 Hz, and precise treble up to 20 kHz. All of this while maintaining excellent linearity and power sensitivity. The transducer has also been designed to optimize audio quality and active noise reduction.

To operate the transducer, the amplification circuit of each earphone consists of a DAC, as well as an analog amplifier that sends the sound to the custom-made transducer.







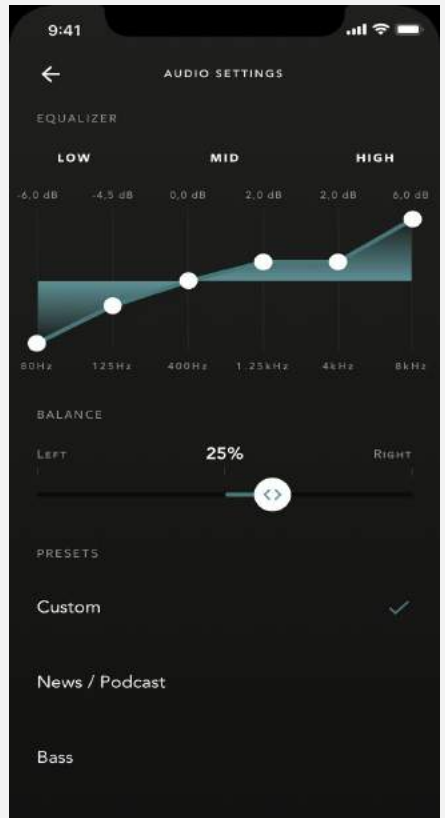
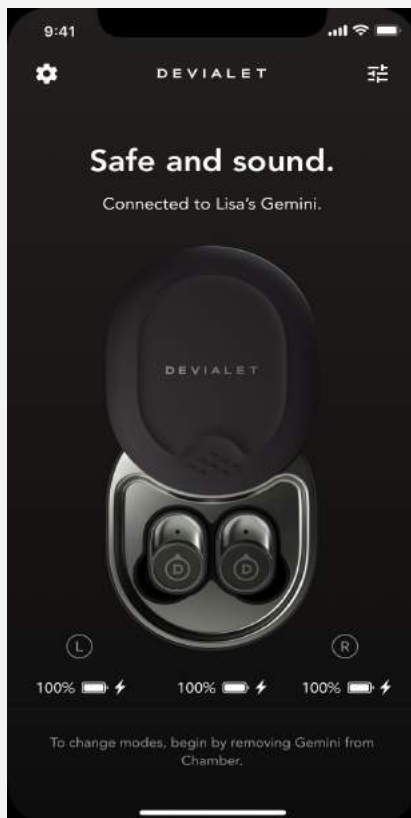
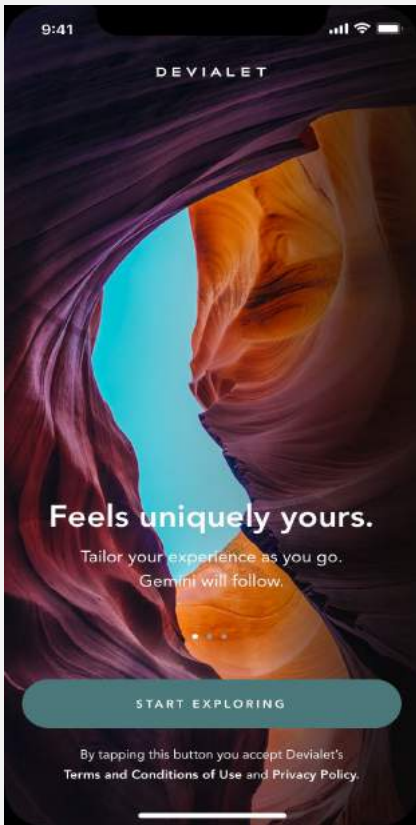
Devialet Gemini mobile app

Devialet Gemini has a dedicated application to control and customize the user experience. It is not essential to use the app but it introduces a panel of functionalities as well as access to software updates.

The application offers access to the different listening modes such as Neutral Mode (passive isolation only), "Active Noise Cancellation" and "Transparency" mode. Users are able to navigate between the modes and choose their intensities ("low", "high" and "airplane" for the ANC, and "low", "high" for the Transparency).

The application also provides access to a customizable 6-band equalizer, with the choice of amplifying or attenuating sounds between 6 dB and -6 dB, in 0.5 dB steps. The EQ also comes with 6 pre-selected settings including a Bass, Mid, Treble or Podcast mode.

Finally, thanks to the Devialet Gemini application, it is possible to configure dual support so that it activates the phone's voice assistant (Siri/Google Assistant depending on whether the phone is under iOS/Android) or the possibility to change the music track.



Devialet Gemini spec sheet

AUDIO TECHNOLOGIES

DEVIALET ACTIVE NOISE CANCELLATION	<p>Devialet proprietary technology Hybrid noise reduction system with two microphones Up to 40 dB of Noise Cancellation 3 levels available : "low", "high", "plane"</p>
TRANSPARENCY	<p>External sound active retransmission Optimized for human voice frequencies 2 levels available: "low", "high"</p>
EAM® (ADAPTIVE EQ)	<p>Devialet proprietary signal processing Real-time music tuning based on ear canal measurement</p>
HIGH EXCURSION DEVIALET DRIVER	1 x Full range speaker per earbud
	Custom-made 10 mm drivers
	Bandwidth: 5 Hz to 20 kHz
AMPLIFICATION POWER	69 mWatts peak per Earbud
AMPLIFICATION PERFORMANCE	Total Harmonic Distortion < 0.1% (measured for 94dB @1kHz)

FEATURES

CONNECTIVITY	Bluetooth 5.0
AUDIO CODECS	Qualcomm aptX, AAC, SBC
BLUETOOTH PROFILES	A2DP, AVRCP, HFP, HSP
TOUCH CONTROLS (customizable via the app)	<p>Press to Play or Pause. Double-press on the left earbud for previous track or right earbud for next track. Press and hold to switch between Active Noise Cancellation and Transparency modes. When receiving a phone call, double-press to answer or press and hold to reject. When on a phone call, double-press to hang-up</p>
DEVIALET GEMINI APP (iOS & Android) Search for "Devialet Gemini" on the App store or Play store	<p>ALL FEATURES AVAILABLE:</p> <p>Bluetooth discovery and pairing. Swap between Active noise cancellation and Transparency modes. Touch controls reconfiguration. Smart pause control. 6-band fully customizable equalizer. Access to the latest firmware updates</p>

SPECIFICATIONS

SENSORS	<ul style="list-style-type: none"> External and internal microphones Voice call microphone Infrared optical sensor Capacitive force sensor
CHARGING CASE	Works with Wireless Qi-certified chargers or the USB-C connector
BATTERY	Earphones battery: Up to 6 hours of autonomy
	Charging case battery: Up to 24 hours of autonomy
MATERIALS	<ul style="list-style-type: none"> Earbuds: <ul style="list-style-type: none"> PC/ABS Body Inox steel Protective Grid Silicone Ear tips
	<ul style="list-style-type: none"> Charging case: <ul style="list-style-type: none"> TPU External skin Anodized Aluminium Chamber
SWEAT AND WATER RESISTANT	Sweat and water resistant (IPX4 rated)
EARBUDS SIZE & WEIGHT	Length: 33 mm (1,3 inches) Width: 18 mm (0,70 inch) Height: 15 mm (0,59 inch)
	Weight: 6 g (0.21 ounce)
CHARGING CASE SIZE & WEIGHT	Length: 73,8 mm (2,87 inches) Width: 58 mm (2,28 inches) Height: 31,2 mm (1,22 inches)
	Weight: 74 g (2,6 ounces)

WHAT'S IN THE BOX

	<ul style="list-style-type: none"> Devialet Gemini earbuds Wireless charging case USB-C charging cable Set of eartips with 4 sizes (XS/S/M/L) with M size mounted on the earbuds Documentation
--	---



