

# DALI PHANTOM S

WHITEPAPER



**DALI**

IN ADMIRATION OF MUSIC



## INTRODUCTION

The enjoyment of music is the cornerstone of everything that DALI does. From manufacturing speakers to our engagement in the music scene, our mission is to bring a high quality audio experience to you no matter what the circumstances.

We know that finding space for traditional boxed speakers in a living room, in certain cases, is almost impossible. We also understand the need for enjoying music even if the speakers have to be discreetly hidden away. Our aim is to offer the possibility of having the traditional DALI boxed speaker sound without having to give up valuable living room real estate.

DALI's Custom Install speaker range, the DALI PHANTOM, now offers more ways than ever to place speakers discreetly in ceilings or walls. The PHANTOM E series is the perfect choice for in-ceiling use, the PHANTOM H series offers the best in compact in-wall speakers, and the brand new DALI PHANTOM S series is the choice for no compromise in-wall audio.

The woofer used in the PHANTOM S series is a specially developed 8" woofer optimized for both bass and mid-range performance. To ensure the best possible bass performance, we paired a 10" passive radiator with the primary woofer(s) in the two larger models in the series. This ensures the full frequency response of a traditional box floor standing speaker from the comparable compact in-wall speakers.

Combining the latest advances in loudspeaker technologies with the well founded knowledge of traditional speaker design, DALI has produced an amazing range of high performance in-wall speakers.

Each model in the range features a slim cabinet that fits into almost any standard wall, proven speaker technologies like solid MDF front baffles, wood fibre cones, low-loss surround and magnet design.

Combining these elements with our latest advances, such as the SMC pole piece and best in class hybrid tweeter module, the PHANTOM S series stands out from the crowd in more ways than one.

It is with great pleasure and immense pride that we introduce you to the DALI PHANTOM S series.

# PRODUCTS

The DALI PHANTOM S series consists of three models for maximum flexibility. The compact PHANTOM S-80, the full-size PHANTOM S-180 and the power-house of the family, the PHANTOM S-280. All models are built around a rotatable hybrid tweeter module, enabling both vertical

and horizontal mounting. This makes them easy to install for any audio use: stereo, centre channel, surround speakers and even high positions if placed close to or in the ceiling.

PHANTOM S-180 and PHANTOM S-80.





# PHANTOM S-80

The most compact model in the range, offering the optimal balance between audio performance and flexibility in placement. With its 8" bass/mid-range woofer working in combination with the rotatable hybrid tweeter module, it delivers a clear and very well defined audio reproduction including a surprising bass performance. The relative compactness of the PHANTOM S-80 makes it perfect for any placement in your audio system. Front, centre, rear or high positions.



## PHANTOM S-180

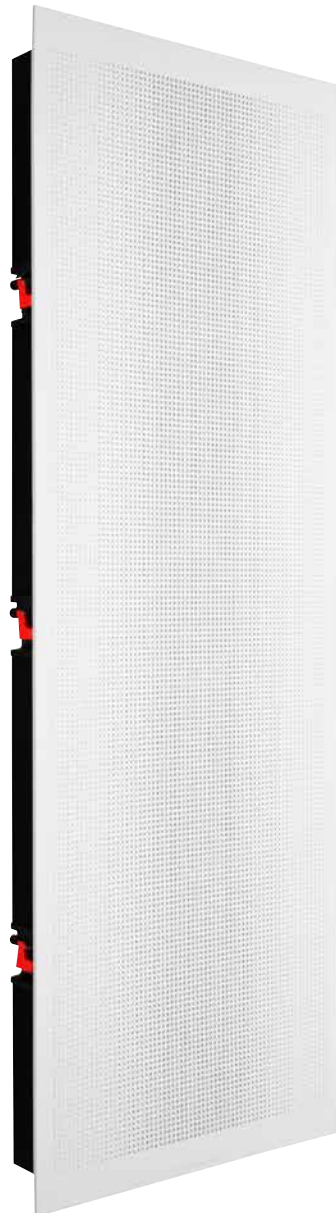
The S-180 takes all qualities of the S-80 one step further by adding a massive 10" passive radiator to work in combination with the 8" bass/mid-range driver. This combination enables the PHANTOM S-180 to reach even deeper down in the lower frequencies and reproduce the audio signal on par with a traditional floor standing speaker. Despite this, it is still a compact speaker that is perfect as front left or right, or centre speaker in your audio system.





## PHANTOM S-280

Taking everything to a new level, the S-280 is true flagship in-wall speaker. Combining an improved rotatable hybrid tweeter module, two 8" bass/mid-range drivers and no less than two 10" passive radiators, this 152 cm powerhouse of an in-wall speaker needs to be heard to be believed. Clean, coherent, detailed, powerful and room filling sound is what this speaker is all about. If you are looking for a no compromise performance in an in-wall speaker, the PHANTOM S-280 delivers, and then some.







The woofer magnet penetrates the back of the cabinet allowing for long-throw 8" woofer.



The drivers are mounted in a black painted solid MDF front baffle.

## DESIGN GOALS

Before the first lines were drawn on the PHANTOM S series, we set out a handful of fixed goals we wanted to meet.

- Sealed cabinet for optimum control of the audio reproduction
- Very shallow cabinet for maximum flexibility when installing
- Full range frequency response minimising the need for a subwoofer
- High quality, high performance look and feel of the entire speaker, not just the front
- Seamless integration with the wall and room

To meet these goals we had to deliver our very best every step of the way, coming up with multiple ingenious solutions and striking the perfect balance between construction and performance.

In the following we will describe the decisions and solutions used to fulfil the goals we set out, touching on every aspect of the design, from cabinet layout to the driver construction.





## CABINET

Constructing a shallow back cabinet for the PHANTOM S series was a challenge in more ways than one. With a depth of only 103 mm (4 inches) getting the perfect inner volume for the woofer(s) had to be found both in the height and width of the speaker, but also internally. The visual appearance of the speaker had to be both pleasing in form, small enough to blend in with the room and made for optimum listening.

The rear chamber is constructed from a solid MDF frame that holds the dogleg mounting system and the terminals. The back of the cabinet, like the frame, is made from MDF and is entirely clad in a high quality black vinyl to complete the look from the front of the speaker. On the front, the drivers are mounted in a large, black painted MDF front baffle.

The front baffle and the back of the cabinet are designed with a careful eye on getting the thickness solid enough to not resonate, yet thin enough to allow for the precise inner volume. Using accelerometer measurements to analyse the different combinations helped to get the thickness just right and locate the best placement for the inner bracings used in all three models.

The front of each speaker integrates elegantly with the wall via the extruded aluminium frame. The frame forms the connection with the wall, and its picture frame design helps to ensure a large termination point between speaker and wall without a visually dominating footprint.

The magnet mounted, floating front grille forms the visual presence of the PHANTOM S series speaker. The discreet, simple, but modern design is nonintrusive and at the same time pleasing to the eye.

The easy to use dogleg system secures the speaker to the wall and the aluminium frame ensures integration with the wall or ceiling extending the front baffle.



# WOOFER

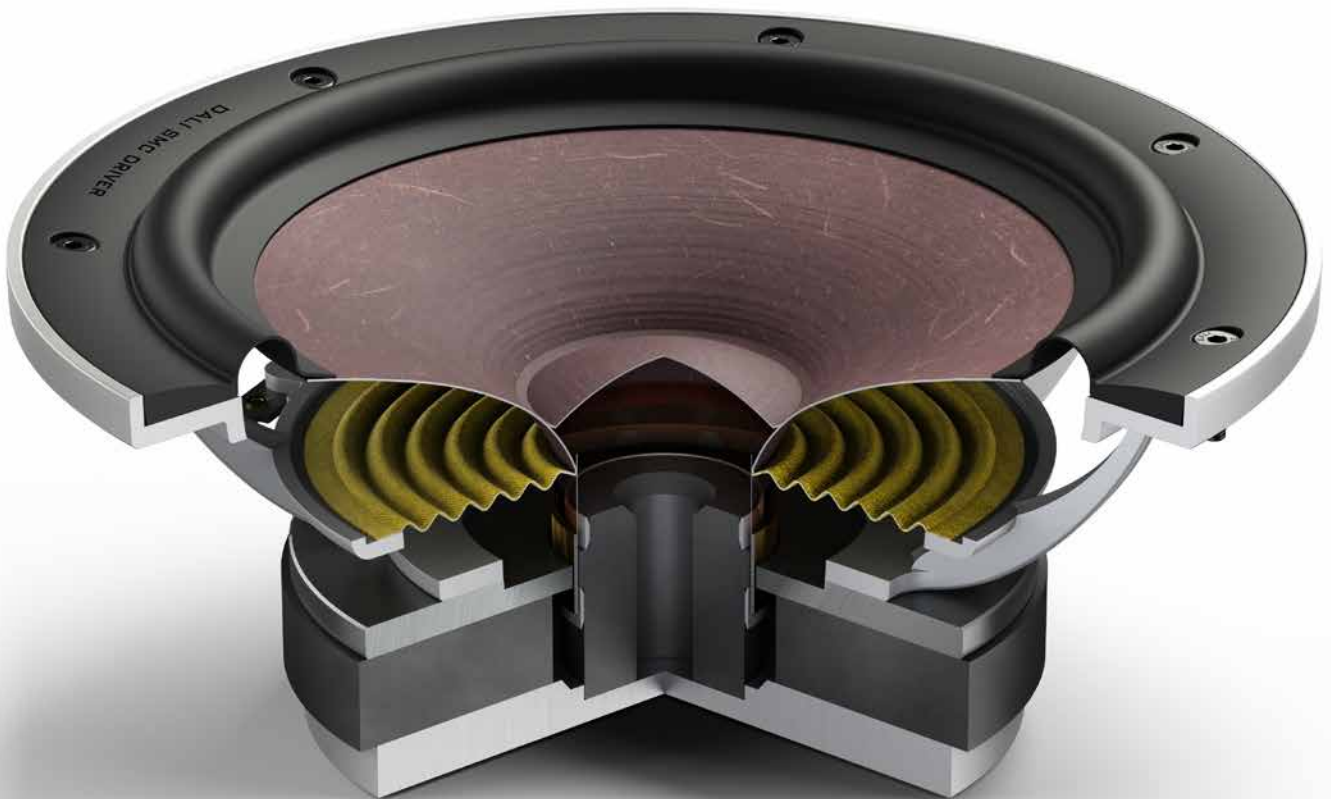
With the aim of generating a high frequency span and obtaining optimum sound pressure from all models, it was decided to design an 8" bass/midrange driver specifically for the PHANTOM S series. Offering 70% more surface area, the 8" woofer is able to move more air and deliver a higher sound pressure at very low frequencies compare to a traditional 6½" woofer. All this whilst still delivering detailed information and rich mid-range sound.

Limited by the 103 mm depth of the cabinet, every trick in the book was used to minimize the depth of the woofer. A special aluminium chassis was created based on our RUBICON series, and the magnet system was constructed to be as flat as possible without losing strength. Despite all our best efforts shortening the woofer enough while keeping the wanted excursion

range, simply was not possible. Going back to the drawing board, the idea to let the magnet system penetrate the back of the cabinet was formed. A soft rubber gasket surrounds the magnet and keeps the cabinet completely airtight, whilst ensuring the woofer movements are decoupled from the cabinet, keeping the construction strong and resonant free.

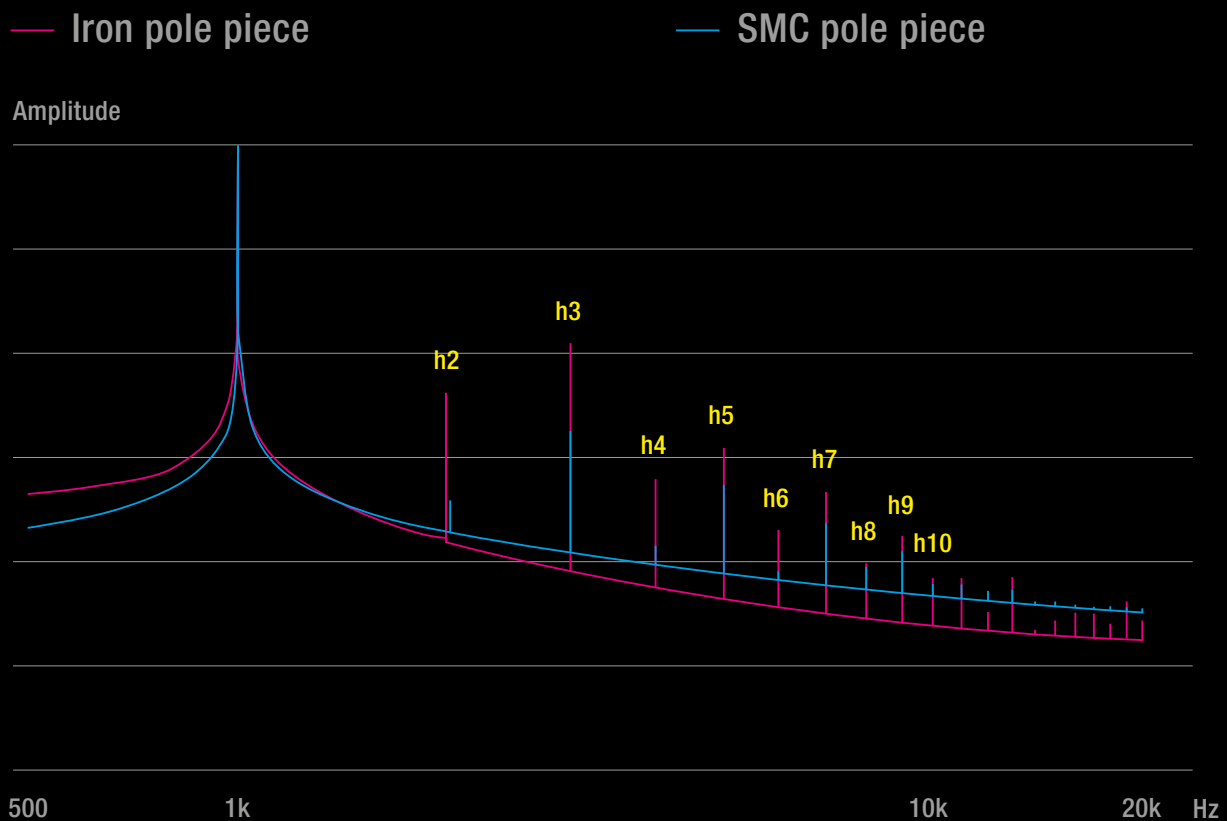
Optimising an 8" woofer for optimal integration with the hybrid tweeter module took numerous adjustments. Giving the needed superior precision and minimal distortion, the SMC based EPICON 8 magnet system was chosen as the base for this woofer.

SMC (Soft Magnetic Compound) has the unique ability of delivering very high magnetic conductivity and very low electrical conductivity, thereby dramatically lowering the



The 8" woofer is designed and optimized specially for the PHANTOM S series using the EPICON 8 magnet motor system.

## POLE PIECE DISTORTION SPECTRUM



effects of hysteresis and eddy currents around the pole piece. While at the same time delivering all the wanted qualities of a good magnet system.

Utilising the SMC pole piece surrounded with aluminium rings and the 1.5" four-layer voice coil, optimal control, low distortion and high power handling was achieved. The low loss surround and the cone structure is optimised for midrange performance, and likewise the dust cap. The smaller than usual dust cap has been arched outward as part of the woofer depth optimisation.

Every single part combines to deliver a high bandwidth reproduction with amazing detailing and the ability to deliver well-controlled bass and midrange reproduction.

The fine grain SMC material is an important building material in the materialization of the high performance magnet system.



## PASSIVE RADIATOR

True low frequency performance in a small cabinet is almost impossible to achieve, and the remedy is usually the integration of a bass port. Using a bass port in a shallow installation cabinet serves up two big challenges, getting the bass port the correct length, and controlling airflow through the front grille. By integrating a passive bass reflex woofer the above challenges were eliminated without losing the ability to generate true bass.

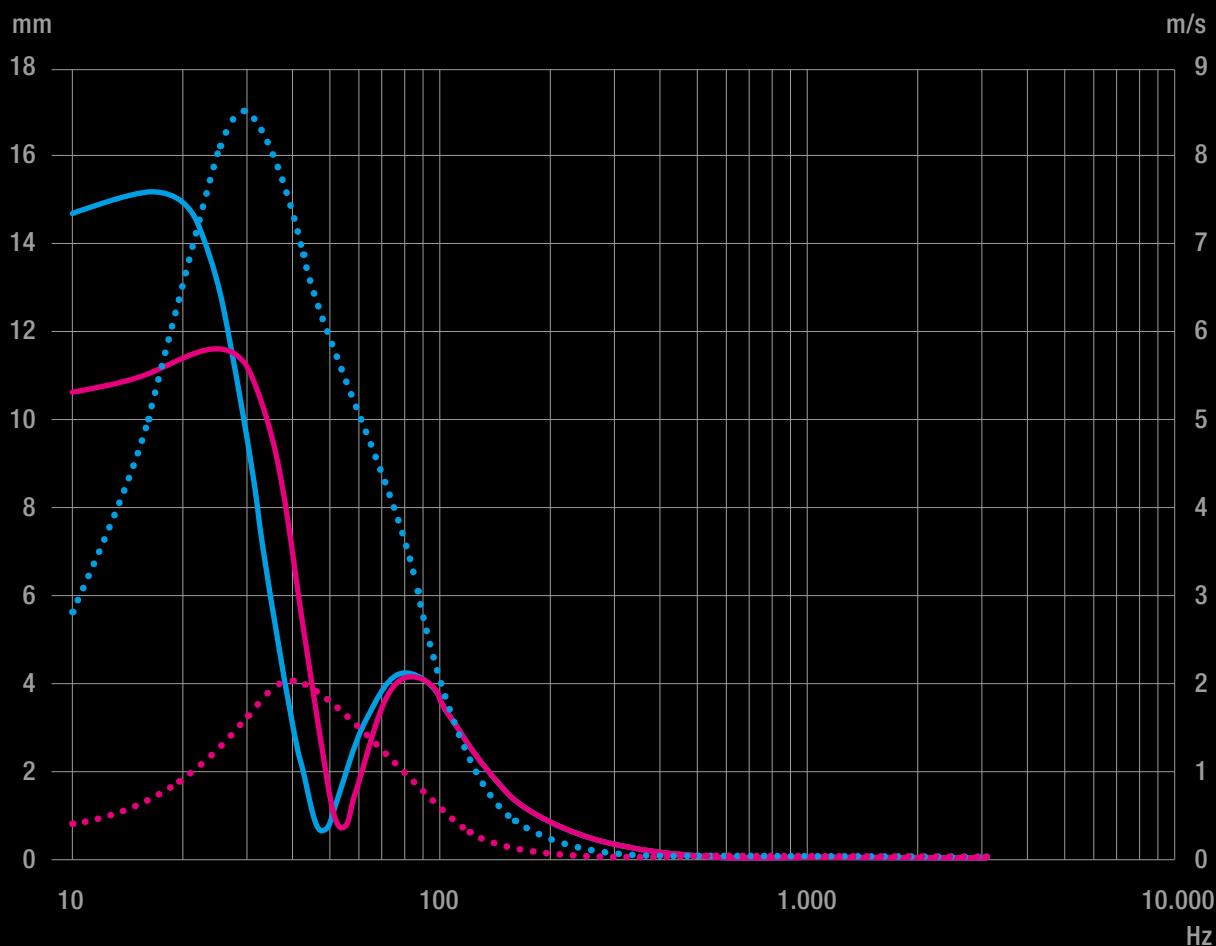


Utilizing a passive driver reduces air flow woofer excursion dramatically.

## AIR SPEED

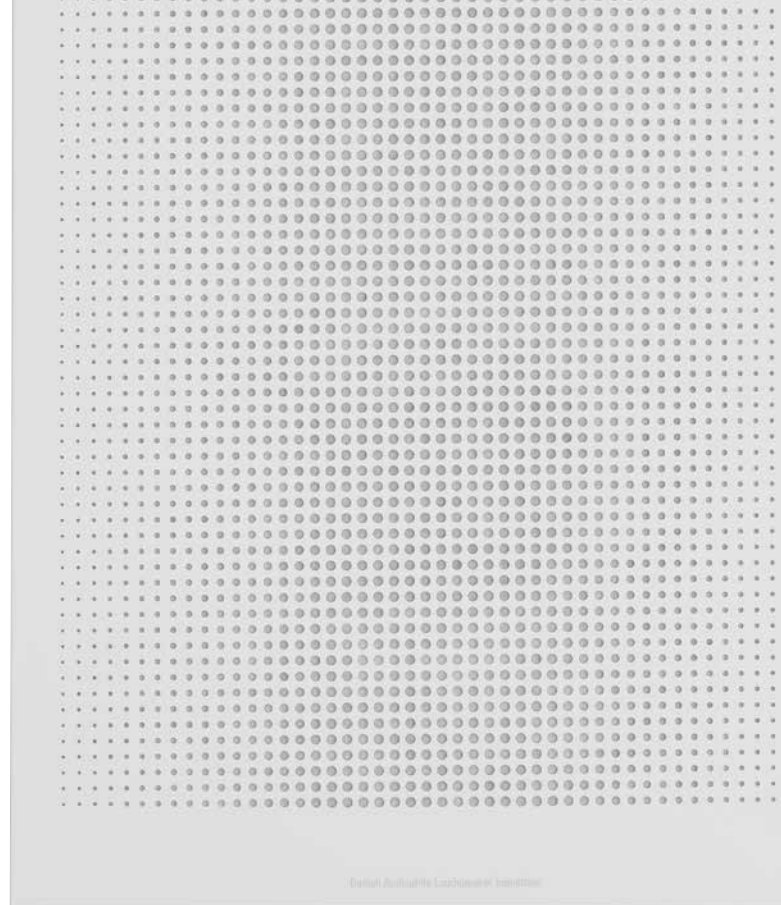
— 8" Excursion - Slave  
— 8" Excursion - Ported

Slave Speed .....  
Air Speed .....





Building on the passive radiator used in our high-end subwoofer SUB P—10 DSS, the passive radiator for the PHANTOM S series was created. Using the same aluminium chassis, soft surround and very well behaving carbon fibre cone, the passive radiator lets the PHANTOM S-180 and PHANTOM S-280 reach deep down into the lower frequencies to deliver a believable large boxed speaker sound.



## PORTED (BASS REFLEX) SYSTEM

The woofer and the passive driver integrates perfectly for a smooth frequency response.



## TWEETER

DALI has a long and well proven tradition for the use of hybrid tweeter modules. This is the combination of a soft dome tweeter working together with a ribbon tweeter for an amazing rendering of the high frequencies, and dispersion of high frequency sounds that outperforms other tweeter technologies.

### DOMES

Low resonance frequency, high power handling, and exceptional headroom for high sound pressure levels and extreme excursions, are all characteristics of the soft dome tweeter. It is rolled in carefully around 2.8 - 3.0 kHz, depending on the model, and the dome is allowed to operate up to its high frequency limit of well beyond 20 kHz, without being rolled off in the crossover.

Incorporating an ultra-thin magnetic fluid for cooling, which has a very high flux saturation point for greater power handling. This also means superb control of coil movement - even at very high sound pressure levels.

The dome material itself is very lightweight, and actually so thin that a coating has to be applied to hold the material together and uniform.

### RIBBON

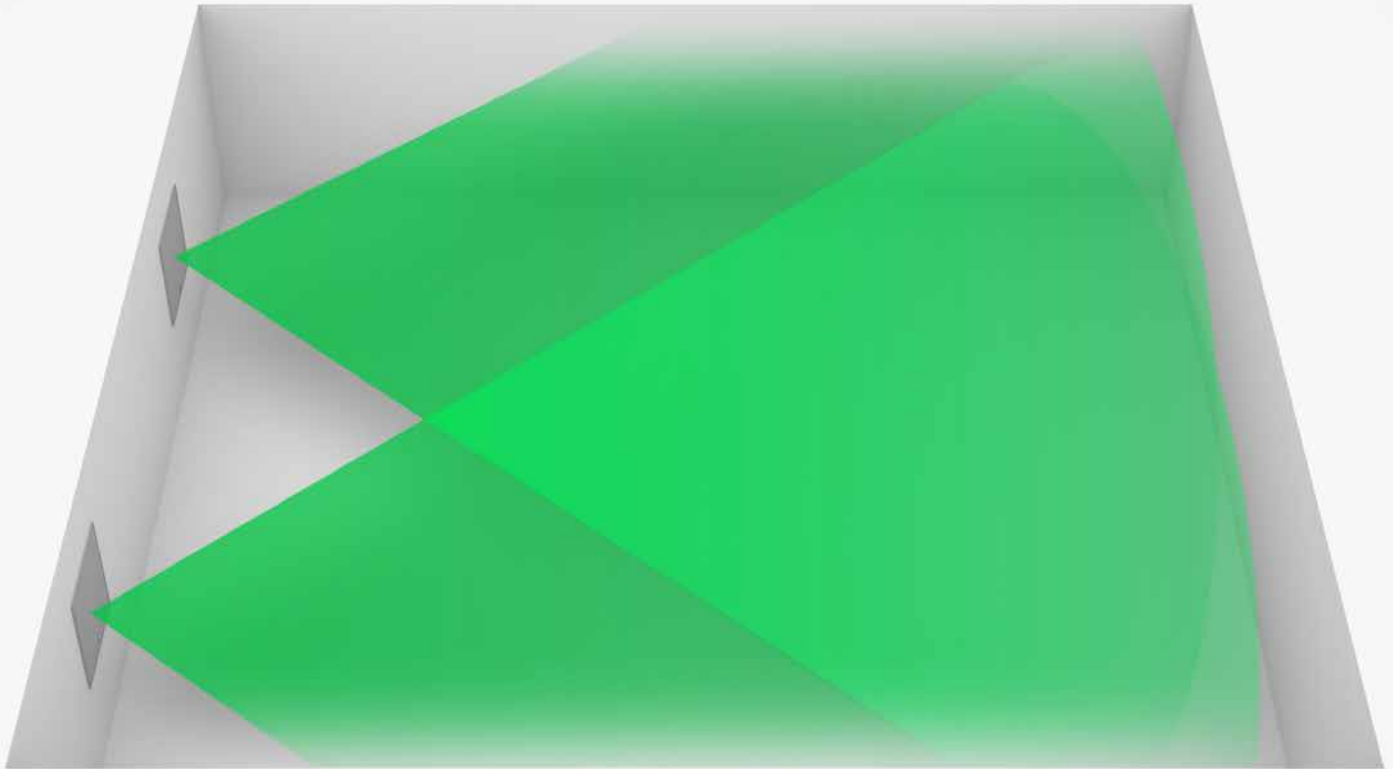
The ribbon part of the hybrid module is a magneto-static type tweeter. Four bands of conductive material make-up the active diaphragm that is controlled by a strong magnetic field formed around it. Equipped with a rear chamber fitted with rigid bracing, the ribbon is shielded from the disruptive influence of the woofers. The DALI ribbon tweeter is a true master in horizontal distribution of high frequencies, and a superb partner for the soft dome tweeter's unique ability to reproduce frequencies from 2 kHz upwards.

In our view, the hybrid tweeter module is the perfect high frequency solution. Both the soft dome and the ribbon tweeter are free of artefacts, e.g. resonances and high Q peaks within their working range. The hybrid tweeter module features an extremely smooth and wide horizontal dispersion - one of our sound design trademarks. Even the detailing of the faceplate for the tweeter module is designed for optimal horizontal dispersion.

Enclosed in a separate chamber the planar ribbon diaphragm supports the soft dome way above the audible limit of the human ear.



The rotatable hybrid tweeter module makes it possible to use the PHANTOM S series as either the left or right channel, or as a centre speaker.



DALI's wide dispersion technology fill every corner of the room with high quality audio and let the listener experience the music even if he is not placed in the sweet spot.

## WIDE DISPERSION

By designing our drivers for wide dispersion, we make our loudspeakers easy to integrate into any room, delivering a smooth and well integrated sound for a wider listening position.

This technology is perfect for the PHANTOM S series, since they are always mounted flush against a wall. Working with the off-axis optimisation ensures that the listener will have a large sweet spot where the soundstage is perfect, but also that the sound received when away from the sweet spot is still of a very high quality.

By optimising the audio signal for off-axis distribution, both the signal reaching your ear directly and the signal reflected off the room surfaces will have the same high quality. This means a consistent high quality of sound, across a much wider listening area.

The uniform dispersion over a wide range of listening angles ensure a smooth, uniform energy distribution within the listening room, which is another crucial factor for a coherent and well balanced tonality.





The magnet mounted, floating front grille forms the visual presence of the PHANTOM S series speaker. The discrete, simple, but modern design is nonintrusive and at the same time pleasing to the eye.

## APPLICATION

The PHANTOM S series delivers true Hi-Fi performance, elegantly integrated into any room. Delivering high quality audio previously only achieved through large boxed speakers, the PHANTOM S sets new standards for in-wall performance.

The three models offer full flexibility when integrating audio into any situation. The high quality performance of the PHANTOM S series makes them perfect for everything from office installations that demand only the best in audio quality, to living room installations and the ultimate in home cinema experience.

The shallow depth of the PHANTOM S series makes it possible to install them in many standard walls without

the need for special rework. The larger models will in some situations need extra support and wall bracing to eliminate wall vibration.

The PHANTOM S series enables you to get the experience of true high-end Hi-Fi or home cinema, without giving up precious floor space.

The rotatable hybrid tweeter adds the flexibility to mount all of the models in either landscape or portrait aspects, and the full range performance of all the models will in most cases eliminate the need for a subwoofer when listening in stereo.

# TECHNICAL SPECIFICATIONS

PHANTOM	S-80	S-180	S-280
Frequency Range +/-3dB [Hz]	59 - 25,000	49 - 25,000	44 - 25,000
Sensitivity (2.83V/1m) [dB]	88	89	89
Nominal Impedance [ohm]	6	6	8
Maximum SPL [dB]	108	109	112
Crossover Frequency [Hz]	2,800 / 15,000	2,800 / 15,000	3,000 / 15,000
Recommended Amplifier Power [Watt]	40 - 200	40 - 200	40 - 350
High Frequency Driver	1 x 28 mm soft dome 1 x 17 x 45 mm ribbon	1 x 28 mm soft dome 1 x 17 x 45 mm ribbon	1 x 29 mm soft dome 1 x 17 x 45 mm ribbon
Low Frequency Driver	8" Wood Fibre Cone	8" Wood Fibre Cone	2 x 8" Wood Fibre Cone
Connection Input	Single Wire	Single Wire	Single Wire
Enclosure Type	Closed Box	Passive Radiator Box 10" Slave	Passive Radiator Box 2 x 10" Slave
Recommended Placement	Front/Centre/Rear/ Surround	Front/Centre/Rear/ Surround	Front/Centre
Dimensions (H x W x D) [mm]	648 x 403 x 110	898 x 453 x 110	1,527 x 527 x 110
Dimensions (H x W x D) [inches]	25.5 x 15.9 x 4.3	35.4 x 17.8 x 4.3	60.1 x 20.7 x 4.3
Cut-out Dimensions (H x W x D) [mm]	615 x 370 x 103	865 x 420 x 103	1,495 x 495 x 103
Cut-out Dimensions (H x W x D) [inches]	24.2 x 14.6 x 4	34.1 x 16.5 x 4	58.9 x 19.5 x 4
Weight [kg/lbs]	13.5	18.5	35.0
Finish	White Lacquer Grille	White Lacquer Grille	White Lacquer Grille
Accessories	Manual, Cut-out Template, Allen Key	Manual, Cut-out Template, Allen Key	Manual, Cut-out Template, Allen Key

All technical specifications are subject to change without notice.