

# **DALI HELICON MK2**

## **TECHNICAL WHITE PAPER**



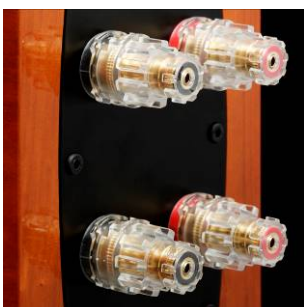
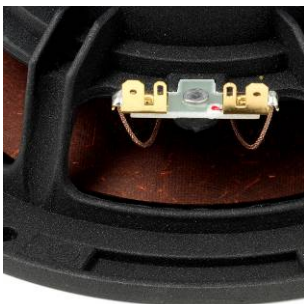


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## Introduction

HELICON is the name of a series of loudspeakers from DALI which has inherited a great deal of technology and technical features from the DALI premium series, DALI EUPHONIA. The second-generation HELICON speakers are optimized for even better performance than their predecessors.

HELICON is a location in the Greek mountains that played a certain role in ancient Greece. According to the myths, it was there that the tutelary deities (also called MUSES) for the arts and sciences had their resort. There were nine beautiful muses, all daughters of the god Zeus, who, according to the myth, appeared with singing and music. The muses were worshipped because of their artistic abilities - they were the source of inspiration. The meaning of *muse* can be seen today: it is our common term for sounds put together in a special way: MUSIC!

Today, music is often reproduced through a music system and ultimately brought to life through a pair of loudspeakers. With the HELICON MK2 speakers, DALI offers an exceptionally high level of performance, made possible through stunning design, careful selection of materials and excellent craftsmanship. All in all, a series of loudspeakers that will satisfy demanding music lovers or movie enthusiasts, who appreciate excellent sound and fine Scandinavian design.

In the following chapters you can read about the technical principles used in the HELICON MK2 speakers.





## Brief Description of the HELICON MK2 Series

When making the second generation of a very successful and highly praised loudspeaker series, it is difficult to come up with a successor. Therefore, we decided to retain the basic features of the original HELICON speakers. But we have still found room for improvement:

- Some of the drivers have been co-developed
- The crossovers have been upgraded and refined
- The binding posts are new
- The design of the cabinet is made more exclusive

## Driver Technology

The design and development of high performance loudspeakers requires outstanding components. This is why DALI designs our own drivers, which are specifically developed to match our design philosophies and the specific loudspeaker in question.

There an extensive list of specifications that a driver must fulfill before it can be part of a high performance speaker system. If we take as an example the woofer for a 2½-way loudspeaker like HELICON 300 MK2; it must be able to reproduce signals from levels bordering on the threshold of audibility all the way up to levels bordering on the criminally insane. Also, it must be able to reproduce a frequency range from 30 – 10,000 Hz – at full volume level, without audible distortion and at a voice coil temperature of 150°C/300°F.

Add to that, the long term stability requirements of the materials, which will make it possible to enjoy the speakers for many years to come.



In terms of acoustics, DALI drivers are designed to be true to the recording. The driver must not add or subtract anything from the reproduced signal. If there is a transient sound of a cymbal, it must be reproduced without compromise. Likewise, if there are subtle details in the recording, they must be reproduced as the artist originally intended it.

This is why DALI speakers are designed and developed – IN ADMIRATION OF MUSIC.

## *Low Frequency Drivers*

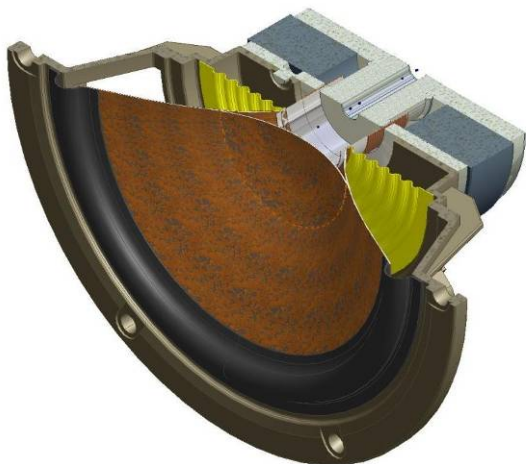
### **Low Loss Cones**

The cone of a driver must put air in motion to create sound waves in the air that surround us. 100% of the energy (music signal) that causes the cone motion must be transformed into sound waves – otherwise something is lost.

DALI drivers are designed with very stiff, lightweight cones that do not require much energy to be put in motion. The cones are made of paper pulp, which is reinforced with chopped



wood fibers. This gives a unique ratio between stiffness, mass and low internal loss in the cone geometry. Actually, the cone is so stiff that it will tend to resonate (add to the reproduced sound). However, this can be cured with a delicate amount of coating without adding significant mass – therefore, the cones are coated. The chopped wood fibers are randomly orientated which will help distribute the energy from the voice coil in different directions. This will also help suppress resonances in the cone. The result is clear, crisp undistorted sound.



### Low Loss Suspension

To achieve the goal of high performance, much more than resonance control in the cone is required. The rubber surround and spider are also important components that control cone excursion and ensure alignment of the voice coil in the voice coil gap. The negative effects of the spider and the rubber surround are that they apply counteracting forces to the cone motion. In the HELICON MK2 drivers, a lot of effort has been put into reducing these counteracting forces by using a very soft rubber material and soft, impregnated linen for the spider.

The geometry of both components is optimized for large excursion to deliver deep, undistorted bass. Because the counteracting forces from the suspensions are minimized, even small cone movements will be transformed into audible music components, improving the micro-dynamics of the speaker system.

### Class A Magnet System

Because the cone/surround/spider assembly of a HELICON MK2 woofer/midrange driver is very easy to put in motion, it is easy to control cone motion by use of interacting forces from the magnet system and the voice coil. However, it is not a trivial task to design a magnet system and voice coil that together will give clean, undistorted sound. The task becomes even more difficult when dynamic phenomena are considered.

In the HELICON MK2 drivers, dynamic distortion is minimized through the use of a T-shaped pole piece and two oversized ferrite magnets. When the pole piece is T-shaped, the magnetic flux field will be tightly focused in the voice coil gap. The magnetic field is so powerful that it will saturate the iron parts of the magnet system. This has several advantages over non-saturated iron parts:

- The voice coil inductance is kept constant when rocking back and forth, leading to constant impedance.
- Modulation distortion is reduced due to the constant impedance of the voice coil.
- Asymmetrical stray flux is greatly reduced, resulting in a





constant force factor within the linear working range of the woofer.

- Modulation of the crossover frequency will be eliminated due to constant impedance with cleaner midrange reproduction as a result.

A direct outcome of the voice coil/magnet system design described above is lower distortion, which e.g. can be heard as very neutral reproduction of voices when the woofers are working at large excursion. Another direct outcome is significantly improved dynamic capabilities – still at very low distortion levels. Often, a listener will actually choose to play at louder volume levels than normal, because the sound is so clean and crisp.

The driver components are assembled in a solid die cast aluminum chassis. Aluminum cannot conduct magnetic flux – therefore, it will not compromise the magnetic field by radiating the magnetic field in different directions.

Because of the dual magnet configuration, the surrounding magnetic field is also greatly reduced. Therefore, the HELICON MK2 loudspeakers can be positioned relatively close to a CRT TV without distorting the TV image.

### **Midrange Drivers**

In HELICON 300 MK2 and 400 MK2, the 6½” drivers reproduce the frequency range for both woofer and midrange. This is one of the reasons why DALI designs drivers with a large useful frequency range. Another

reason is that roll-off phenomena are well beyond the frequency range across which the driver contributes to the total sound. Specifically for the HELICON 800 MK2, dual 8” woofers and a 6½” midrange are used. The 6½” midrange driver is basically designed according to the same principles as the woofers. The differences are that the suspensions, voice coil and magnet system are optimized for lower excursion (and a higher lower limiting frequency). Also, the voice coil is, of course, impedance matched to the woofers and the hybrid tweeter module for seamless integration of the total speaker system.

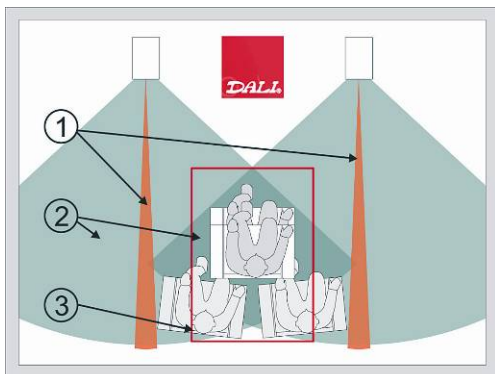
### **High Frequency Drivers**

In most DALI speakers, hybrid tweeter modules consisting of a soft dome tweeter and a ribbon tweeter are used. This is to get the best of both worlds in the quest for superior high frequency reproduction. The same principle is used in HELICON MK2.

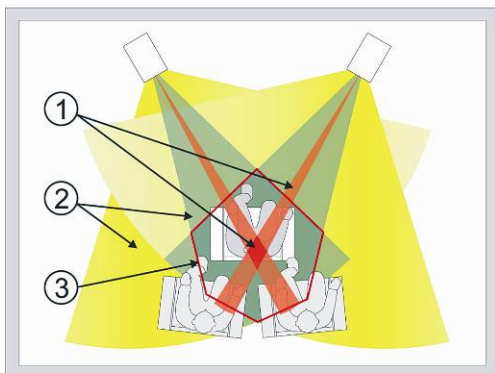


The reason for not using only the dome or the ribbon is that a dome tweeter with a perfectly flat frequency response up to – say 25 kHz – will not

be flat when listening just slightly off axis. Some tweeters even start to drop off at 13 – 15 kHz, when listening off axis. With such a design, the listeners would have to sit precisely on axis between the speakers to enjoy the full spectrum of the music – which will off course not be the case in many normal living environments. To make up for this, DALI uses a ribbon tweeter which is inherently excellent at reproducing high frequencies – even at large off axis angles.



- 1) High distortion/diffraction (on axis)
- 2) Uniform sound field (green zones)
- 3) Large listening area with good sound



- 1) High distortion/diffraction (on axis)
- 2) Non-uniform sound field (green/yellow zones)
- 3) Reduced listening area with compromised sound

The ribbon is not used alone because excursion is limited at low frequencies – introducing distortion and seriously

compromising dynamics and power handling.

Advantages of the hybrid tweeter module are:

- Excellent off-axis frequency characteristics with full frequency range.
- Better integration in normal living rooms.
- Low distortion.
- Larger listening area, where the full spectrum can be enjoyed.

The soft dome tweeter and the ribbon tweeter are bolted to a solid die cast aluminum faceplate. The rear of the face plate has a recess of different depth for each of the drivers, which aligns the acoustical centers of the drivers. Alignment will prevent phase/timing blur/smear, making it possible to reproduce the cues that will enable perception of soundstage and imaging in music. In other words, abrupt phase changes will not occur.

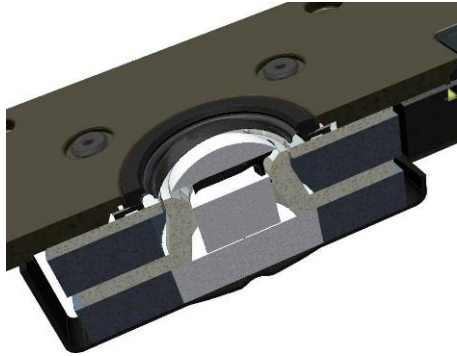
### Silk Dome Tweeter

The 1" dome tweeter of the HELICON MK2 speakers is made with a very thin silk fabric. In fact, it is so thin and open that one can see through it. After a shaping process, a thin/lightweight coating is applied to the silk. The silk alone cannot be considered a dome because it is so open that it cannot put air in motion.



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The low mass of the silk/coating assembly add almost 2 dB of increased sensitivity compared with a traditional dome. Going further, an acoustic chamber behind the dome will lower the resonance frequency to approximately 700 Hz - two octaves from the typical crossover frequency, eliminating coloration of the sound. The acoustic chamber is filled with three pieces of felt (tuned by ear), which optimizes coupling and airflow to the dome. The large chamber will also prevent air compression, when reproducing signals with micro- and macro dynamic content.

The magnet system uses two identical ferrite magnets to produce a very powerful magnetic flux field, which will surround the underhung voice coil. Besides having a focused magnetic field around the voice coil, double magnets will enable use of the speakers very close to a CRT TV without disturbing the TV image.

To eliminate thermal compression due to rising temperatures in the voice coil (which will lead to higher voice coil impedance and thereby reduced sound pressure levels), low-viscosity Ferrofluid (oil with magnetic particles) is used in the voice coil gap. This will eliminate spontaneous or continuous voice coil temperature rise – the heat

will be dissipated by the magnet structure and the aluminum faceplate.

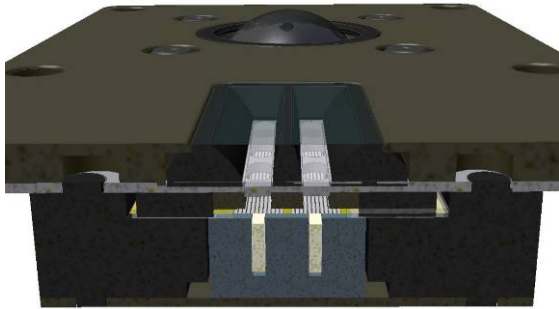
## Ribbon Tweeter

The ribbon tweeter is of the magnetostatic type; a thin polymer base is used as a diaphragm with thin conductors of aluminum. A very powerful magnetic field surrounds the diaphragm.



The magnetic flux field originates from as many as six rod magnets; three ferrite magnets behind the diaphragm and three neodymium magnets in front of the diaphragm.



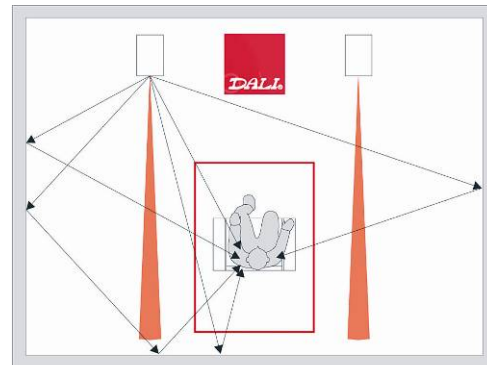


The combination of a low mass diaphragm with a powerful magnetic field will make reproduction up to 28 kHz possible. But that will not make it alone. – In front of the front magnets/diaphragm are an aperture grille and an acoustical lens. These are carefully designed for wide dispersion of the sound, so the full spectrum is reproduced at even extreme off axis angles in front of the speaker.

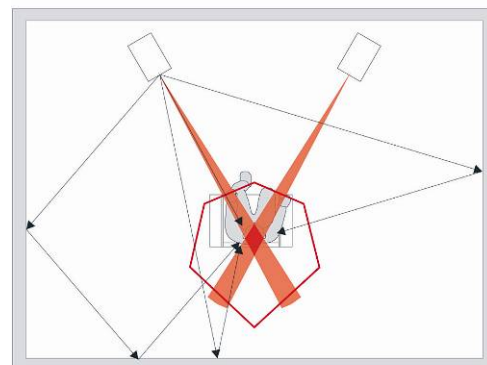
Wide dispersion is important, because:

- It will give better sound in a larger listening area.
- The frequency response of the reflected sound will be more similar to the direct sound from the loudspeaker.

The last point above is important, because under normal living room conditions, as much as 60% of the sound heard is reflected sound (from walls, floor and ceiling), whereas only 40% is directly heard from the loudspeaker.



Direct and reflected sounds have same characteristics. The auditory part of the brain will easier perceive the sound as originating from a natural source. Diffraction and distortion are significantly reduced.



Direct and reflected sounds have different characteristics. It will be difficult for the auditory part of the brain to believe that the sound is from a natural source. The sound is compromised by distortion and diffraction.

## Crossovers

The basic task of the crossovers in the HELICON MK2 speakers is to filter out frequency content not meant to be reproduced by the driver in question. The desired result is achieved by a unique combination of driver and crossover, for a seamless blend of the sound from two “neighboring” drivers. The crossovers are relatively simple in terms of the number of components (made possible by high quality, wideband driver design). Because of “simple” filtering/short signal path, it is possible to preserve as much of the original electrical signal as possible;



preserving as much musical information as possible (contrary to doing heavy filtering or damage control of poor driver design, where a lot of energy is lost in the filter).

In the DALI HELCON MK2 speakers, the unique combination of crossovers and drivers will form a very easy impedance load as seen from the amplifier. This is possible only because certain characteristics of the drivers and the crossovers are a perfect match, allowing flat impedance characteristic. Flat impedance results in reduced distortion and increased amplifier control as the easy impedance load eliminates significant amplifier distortion.

All crossover components are of a very high quality. The woofer sections of the crossovers have been upgraded with even better capacitors, resulting in even tighter bass reproduction. All components are secured with glue and cable ties to a black Medium Density Fiberboard (MDF) for a highly stable mechanical construction. Electrically, each component is hardwired (soldered) directly to other components for low loss and shortest possible signal path. The component layout is optimized by ear to minimize component crosstalk. As an example, the inductors are individually positioned away from each other and their axes differ to avoid crosstalk between the electrical fields surrounding the inductors. The result is a more clean and natural sound.

### ***Binding Posts***

The connections from the amplifier to the crossover are made through the

binding posts. On HELCON MK2 bi-wiring is an option to use separate cables for the woofer- and midrange/tweeter section. Alternatively, it is also possible to run the speakers with bi-amplification, depending on listener preferences.



The binding posts are newly developed for increased performance. The base of the binding posts is a laser-cut aluminum plate screw-mounted to the cabinet with six hex-screws. The binding posts themselves use a large vice grip design that will accept the following connections:

- Bare, uninsulated wire ends
- 4mm banana plugs
- Spade lugs

Fine thread on the binding posts will enable extra torque and a nice feel. On the outer surfaces the binding posts are covered with transparent polymer, which will prevent contact with conducting parts, as well as short circuiting the amplifier(s).



On the floor-standing speakers, the binding posts are very close to the floor, making camouflage of the cable runs easier.

The HELICON MK2 speakers come with jumper cables for use when the speakers are not bi-amplified or bi-wired.

## Cabinets

The HELICON MK2 cabinets are beautifully crafted in real wood veneered MDF cabinets. The veneer is high gloss lacquered and polished for a stunning furniture finish.

The cabinet incorporates curved side panels and a two-layer sandwich baffle – very similar to the construction of the DALI EUPHONIA Series.



The drivers are screw-mounted in the black, high gloss lacquered sandwich baffle. The black MDF baffle is attached to the main cabinet with adhesive to minimize vibrational energy from the cabinet. This effectively isolates the drivers from coloration caused by the cabinet walls.

The geometry of the curved side panels makes the cabinet more rigid and will significantly reduce standing waves inside the enclosure. This is due to non-parallel cabinet walls, which significantly reduce cabinet coloration of the sound. The curved side panels consist of four sandwich layers of MDF to eliminate resonance.

Internally, the cabinets are partitioned with enclosures for each driver for two reasons; the backpressure on the cones from different drivers will not load other drivers and the panels separating the enclosure volumes provide internal bracing of the cabinets, suppressing resonance even more. Because of the asymmetrical shapes of the curved side panels, dominant cabinet resonances are effectively eliminated.

The floor-standing models HELICON 800 MK2 and 400 MK2 have separate chambers for the crossovers to minimize vibration of the crossover components caused by extreme internal air pressure build-up. Even it's a small difference, it contributes to a more stable stoundstage and imaging.

## Grilles

The grilles for the HELICON MK2 loudspeakers are made with large asymmetrical cut-outs around the



driver positions to minimize reflection and diffraction. The grille cloth has been chosen for maximum acoustic transparency. Listening with minimum loss is possible with the grilles mounted on the speaker.

### **Base**

The floor-standing models HELICON 800 MK2 and 400 MK2 feature an integrated base made of solid, black, high gloss lacquered MDF. The base has integrated threaded inserts for M10 spikes (standard metric thread).



HELICON 300 MK2 can be used with the HELICON STAND, which is available in the same finish as the HELICON MK2 speaker cabinets. The stand will position the speaker at the correct height for listeners seated in normal furniture.

### **Positioning/Use of HELICON MK2**

Position the HELICON MK2 speakers at least 25cm/10" from the rear wall with the rear of the speakers parallel with the wall. Do not toe in the speakers towards the listening position, unless you are listening at extreme off axis angles. For optimum results, the speakers should be placed

at least 60cm/25" from side walls. Speakers should be positioned to avoid so-called mirror sources (direct reflections from the loudspeaker to a wall to the listening position). If you have mirror sources, the effect can be minimized e.g. by placing a plant, tapestry or other object with an irregular surface at some point in the reflection's path.

If possible, improvement can almost always be made by experimenting with the loudspeaker and listening positions. Just a few centimeters/inches can make a difference because of different room coupling.

For critical listening, the listener should always be seated on the center axis between the two loudspeakers and with the same distance to each speaker. In the optimal listening setup, the distances from left speaker to right speaker, from right speaker to the listening position and from the listening position to the left speaker should all be equal, forming an equilateral triangle.

Vertically, the optimal listening position (ear height) is approximately 1m/40" above the floor.

### **Amplifier Selection**

Generally, the HELICON MK2 speakers have high sensitivity, which does not require a powerful amplifier. However, to exploit the full dynamic capabilities of the speakers, a powerful amplifier is desirable, because the peak level of the music signal can be many times the average power level.



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A high performance amplifier with a high current power supply and low output impedance (high damping factor) is recommended. The HELICON MK2 speakers are very revealing of the equipment in the signal path. Therefore, any weaknesses or special characteristics of the amplifier and source components will be reproduced.

If the speakers are bi-amplified, use the same type of amplifier and cables for both the low- and high frequency sections to avoid tilting the tonal balance of the speaker.

### **Cable Selection**

Select cables with neutral characteristics to preserve the voice matching of the speakers. If the speakers are bi-wired, use the same type of cable for both the low- and high

frequency sections to avoid tilting the voice matching.

### **Accessories**

The floor-standing models of the HELICON MK2 range can be fitted with M10 (metric standard thread) spikes which are included with the speakers.

For use with a single-wire cable, DALI CONNECT jumpers are included to connect the low- and high frequency sections of the speaker.

### **Packaging**

All HELICON MK2 speakers come in heavy-duty cardboard packaging for maximum protection during transport. All speakers are packed in single cartons – the speakers are matched stereo pairs with respect to the grain pattern of the real wood veneer.





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## Technical Specifications

	HELICON 800 MK2	HELICON 400 MK2	HELICON 300 MK2
Frequency Range +/- 3 dB (Hz)	31 – 27,000	31.5 – 27,000	37 – 27,000
Crossover Frequencies (Hz)	580 3,000 13,000	(700) 3,000 13,500	3,400 13,000
Sensitivity 2.83V/1m (dB)	89.5	88.0	86.0
Nominal Impedance (Ohms)	4.0	4.0	4.0
Minimum Impedance (Ohms)	3.6	3.7	4.3
Maximum SPL (dB)	113	111	108
Recommended Amp. Power (W <sup>1</sup> )	50 - 400	50 - 300	50 – 200
Terminals	Bi-wire	Bi-wire	Bi-wire
High Frequency Drivers (mm)	Soft dome <sup>2</sup> Ribbon	1 x 25 1 x 10 x 55	1 x 25 1 x 10 x 55
Midrange Driver(s)	1 x 6½"	-	-
Low Frequency Driver(s)	2 x 8"	2 x 6½"	1 x 6½"
Bass Reflex Tuning Frequency (Hz)	28.5	32.0	34.5
Distance from Rear Wall (cm/inch)	> 25 / 10	> 25 / 10	> 25 / 10
Dimensions (H x W x D) (cm)	112.6x30.4x53.9	102.6x26.7x50.1	43.5x20.8x40.2
Dimensions (H x W x D) (inch)	44.3x12.0x21.2	40.4x10.5x19.7	17.1x8.2x15.8
Weight (kg/lbs)	42.4/93.5	32.0/70.5	10.5/23.1
Accessories	M10 spikes DALI Connect shunt cables	M10 spikes DALI Connect shunt cables	DALI Connect shunt cables
Finishes	Real wood, high gloss lacquered Rosewood or Cherry		

All technical specifications are subject to change without notice.

<sup>1</sup> RMS Watt

<sup>2</sup> Silk



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## The HELICON Series

Also available in the HELICON design are the following products. All products will be available in updated MK2 models except for W200:

- HELICON C200 Center Channel Speaker



- HELICON W200 On-Wall Speaker



- HELICON S600 Subwoofer



- HELICON STAND for HELICON 300 and HELICON 300 MK2



Please see the DALI website at [www.dali.dk](http://www.dali.dk) or visit your authorized DALI dealer for more information and a personal demonstration of the HELICON MK2 speakers.