

DALI OPTICON

WHITEPAPER



IN ADMIRATION OF MUSIC

INTRODUCTION

Designing a performance speaker series accessible to a wide audience is not just difficult – it is a huge challenge. Doing it the DALI way, with an unyielding focus on audio reproduction, construction quality and using the latest breakthrough technologies, only adds to the challenges.

Nonetheless, this was exactly the task we set out to solve. We wanted to develop a speaker series manufactured at our factory in Denmark with parts either produced by DALI or sourced from some of the best manufacturers in the world. We wanted to be in control of not only the design, development, construction and manufacturing of this speaker series, but also to keep as many of the parts in-house as possible and thereby have an even tighter control over the quality.

While accomplishing all this, we also wanted to implement our latest advances in magnet motor systems using SMC materials in the most important parts of the driver, and to top it all off, we wanted a visual design that matched the performance of the speaker and a design that would fit into the modern homes of today. All of this at a price most Hi-Fi lovers can afford.

In short, we wanted to build a true

DALI speaker series. A speaker series that surprises its listeners with a clear, undistorted and coherent sound perfectly matching music, TV or movies. A speaker series that caters to every need, from a compact stand mount to a huge floor standing, and a wall mounted to a centre channel. This series has a speaker for every room and every occasion.

It is with great pride we introduce the DALI OPTICON series.



With an eye on every detail OPTICON both plays and looks the part.



OPTICON is a true DALI speaker with DALI manufactured parts and is assembled in Denmark.

CABINET



Rigid cabinet structure and separated chambers for the drivers.



Cutting the MDF boards for OPTICON cabinet production.



Placing V cuts along the MDF board before the folding of the final cabinet.

Keeping the manufacturing of the OPTICON series firmly in the hands of DALI we utilize our large and efficient woodworking facility in Denmark to handle everything from cutting out the Medium Density Fibre board (MDF) cabinet to applying the vinyl. The mounting of the drivers and the final tests and approvals on each and every speaker is also handled directly at our own assembly lines in our Danish factory.

The floor standing cabinets employ a very rigid construction with solid bracings across the inside of the cabinet for reinforcement. This contributes to the stiffness and practically eliminates resonance within the cabinet. However, excessive internal bracing can disturb and hinder the crucial airflow inside a speaker cabinet, thereby adversely affecting sound quality. Therefore, great care is taken in the layout and application of internal bracing - in order not to reduce

the internal volume of the cabinet unnecessarily.

The high-grade vinyl is carefully selected among the finest available. Extensive testing is carried out to make sure that the surface and joints of the cabinet will stand the test of time. Through strict in-house control of every aspect of production, OPTICON achieves a level of fit and finish typically found only well beyond its price point.

BAFFLE



Meticulous attention to CNC milling of the front baffle creates more space between the screw fix points, ensuring a free airflow behind the woofers.

The baffle sports a black or white high-gloss finish, for a more exclusive look and feel. The slim-line design of the front baffle contributes to the stereo perspective. And the 'clean' surface is not only pleasing to the eye; it reduces diffractions to an absolute minimum.

The OPTICON series' front baffle form a rigid base for the drivers, which are screw-mounted directly into the 25 mm thick MDF. To ensure the best possible hold on the woofer and thereby integration with the cabinet, the 5 screw holes are placed along the arms of the woofer chassis. The tweeter module is held securely in place with 6 screws to eliminate vibrations and resonance.

The front grille is attached to the front

baffle via elegantly hidden inserts integrated into the tweeter and woofer fronts. This secures the grilles to the speaker eliminating unwanted resonance and leaves the baffle clean without unnecessary visual marks.

Another significant detail is the milling of the woofer cut-out in the baffle. Instead of the usual method of milling the rim full circle of the woofer perimeter, we have milled away the rim, leaving the five screw fix points intact. We do this to ensure a firm grounding of the woofer within the rim and at the same time to allow free airflow inside the cabinet.

A rubber gasket is placed between the woofer and the milled out rim to ensure a 100% airtight fixture.

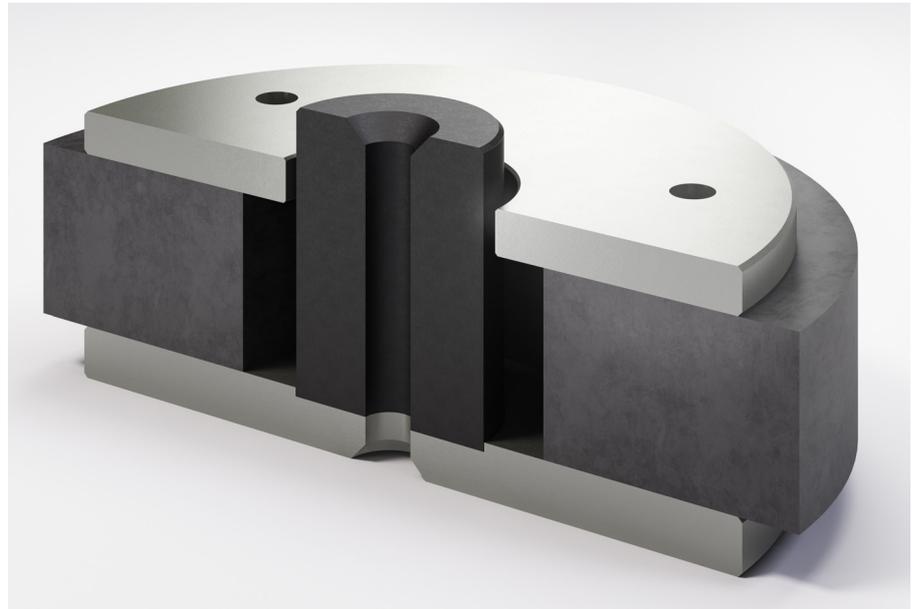


Elegantly hidden inserts integrated into the tweeter and woofer fronts and leave the front baffle clean when used without grilles.

WOOFER



Every part in the OPTICON woofer is carefully chosen for its low-loss abilities..



The SMC pole piece set the OPTICON woofer apart for the competition with significant reduction of eddy currents and hysteresis.

Design

The OPTICON woofer is designed with a strong focus on DALI sound principles of low-loss, low distortion and low colouration of the reproduced sound. The ideal speaker plays just what the amplifier intended, with nothing added and nothing subtracted.

To meet these ideals every part in the OPTICON woofer is carefully chosen for its low-loss abilities. The cone is made from a pulp mix of paper and wood fibre that ensures very low surface resonance and gives the cones their distinctive colour. The cone terminates in a rubber surround that is chosen for its soft and very flexible properties. This gives the cone free movement with very low dampening effect, and leaves control of the cone movement to the

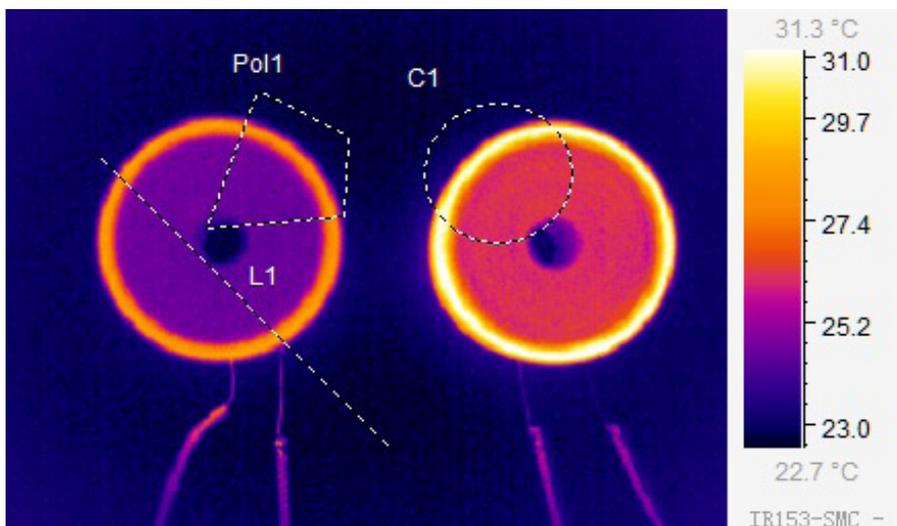
magnet motor. The rubber surround is attached to an aluminium chassis that, due to the properties of aluminium, offers almost no interference to the magnetic field surrounding the magnet motor. The magnet motor itself consists of a large ferrite magnet that surrounds a pole piece made entirely of the unique material SMC. The pole piece and the ferrite magnet are secured between two soft iron plates. This forms a close to optimum environment for the 2 layer voice coil to work within. The voice coil is therefore able to transform the signals from the amplifier in to an undistorted, uncoloured and very well timed reproduction of the original signal, leaving the listener with a close to live experience.

SMC

Soft Magnetic Compound (SMC) is a coated magnet granule that can be shaped into any form that you would want. SMC has many advantages, and used in a speaker's magnet motor system it results in a significant reduction of distortion from mechanical loss. SMC's unique ability to deliver a

high magnetic conductivity and a very low electrical conductivity delivers all the wanted qualities of a really good speaker magnet without the traditional downsides. The result is a significant lowering of the colouration of the reproduced sound.

In the OPTICON woofer magnet motor system the pole piece is purely constructed of SMC. This important addition to the ferrite based motor system is paramount to the audio performance of the OPTICON series. In the following, we go on to explain why this is the case.



The left SMC based pole piece stays cool compared to the iron based pole piece on the right even after extensive use causing much less mechanical distortion.

Eddy Currents

Eddy currents are an issue that occurs in most speaker designs. It is the creation of small localised magnetic fields alongside the pole piece caused by the movement of the voice coil. The nature of these local magnetic fields is to apply an opposite directed force onto the moving voice coil.

To exemplify what eddy currents do let's look at how it is used for practical purposes. The phenomenon of eddy currents is used in induction hot plates.

It is a very quick and energy efficient way of generating heat. Eddy currents are also put to good use in trains and busses, as very effective brakes. Both braking and heat is something that is not welcome in a speaker magnet motor system. They both cause distortion in the audio signal that is being reproduced. This type of distortion is not welcome and DALI has worked hard to minimize the effects of eddy currents.

With the introduction of SMC as the material used for the pole piece eddy currents are greatly minimized removing a very important distortion factor in the OPTICON magnet motor system. The non electrical conductivity of the SMC ensures that few local eddy current fields build on the surface of the pole piece and as a result the heat and resistance normally caused by these fields are minimized in the OPTICON woofers.



The individually coated magnet granules makes it possible to mold a pole piece that is not electrical conductive.

Hysteresis

When using iron based magnets in speakers, the magnetization and demagnetization introduced by the shifting current directions doesn't happen at the same pace. The demagnetization process is often slower than the magnetization.

This phenomenon is called hysteresis, and is a known problem in almost all speaker magnet motor systems. The problem with hysteresis is that it introduces an unintended resistance

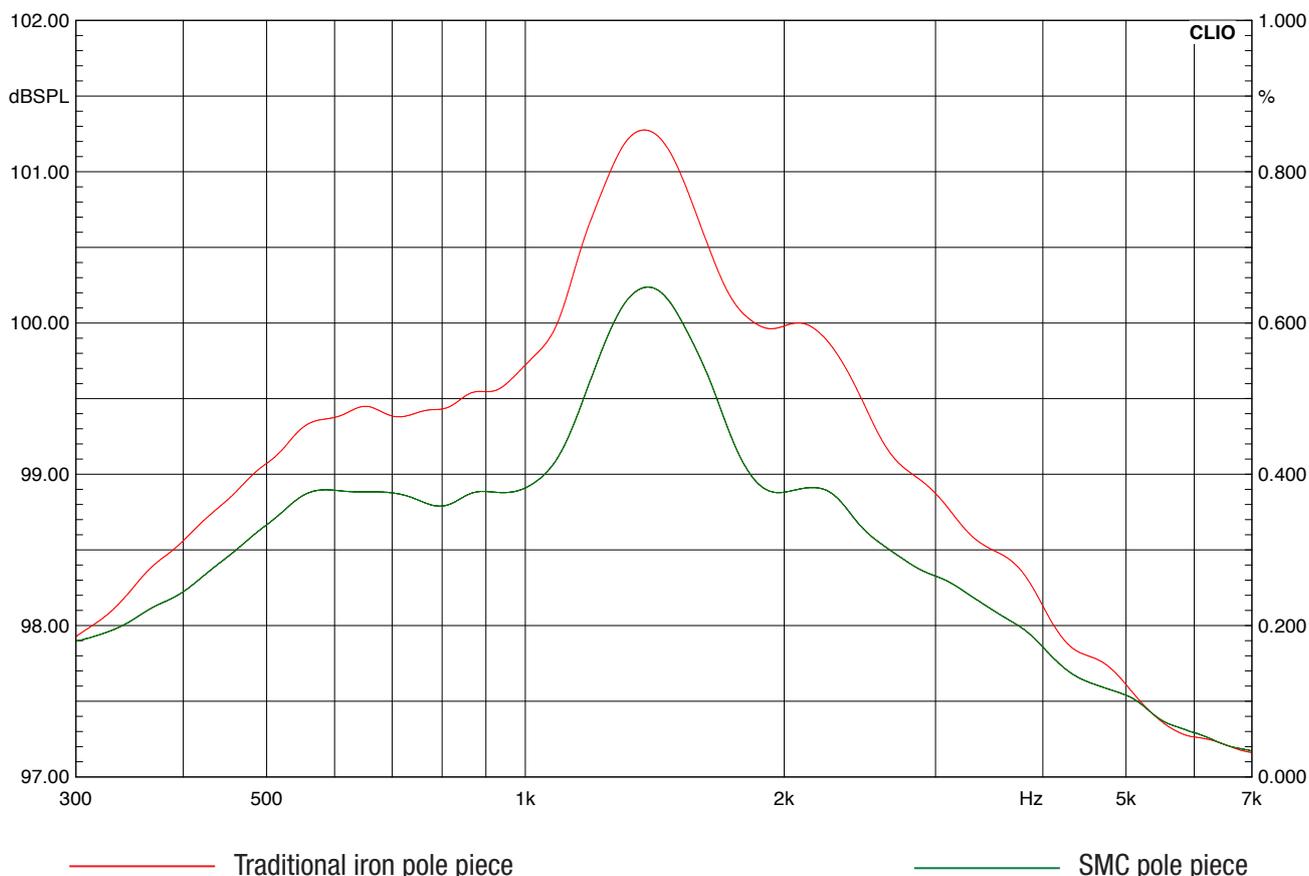
to the voice coil, meaning unwanted distortion. The reason hysteresis occurs is that iron is not only magnetically conductive, but also very electrically conductive.

SMC on the other hand is very highly magnetically conductive, but has a very low electrical conductivity (approx. 1/10.000's of iron). The result of using SMC is almost no hysteresis, and therefore no distortion.

Woofers optimisation

Every woofer is configured to match the model they are destined for. This is done, using the OPTICON 8 as an example, by optimising the bass drivers for long excursion, and the midrange driver for a large useful frequency range, so roll-off is handled in the crossover and not in the driver. This same type of optimisation is done for the entire range of woofers used in the other models.

OPTICON 6 woofer, 3rd order distortion



TWEETER

DALI has a long and well proven tradition for using a hybrid tweeter module. It is a combination of a dome tweeter working together with a ribbon tweeter for an amazing rendering of the high frequencies, and a dispersion of high frequency sounds that outperform all other tweeter technologies.

In the OPTICON series, DALI makes use of both the soft dome working alone, and the hybrid tweeter configuration. Due to the size of the OPTICON 1 a more compact soft dome had to be used in the smallest of the OPTICON speakers. The OPTICON 2 makes use of the larger soft dome module, and the rest of the OPTICON series use the hybrid tweeter module.



DALI's trademark hybrid tweeter is used in all the floor standing OPTICON models and in the OPTICON LCR and VOKAL.

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 2.0 - 2.5 kHz, depending on the model. And the dome is allowed to operate up to its high frequency limit well beyond 20 kHz without being rolled off in the crossover.

Incorporating an ultra-thin magnetic fluid for cooling, the fluid 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.



The soft dome tweeter consist of a very lightweight dome material, a large ferrite magnet and a voice coil surrounded by an ultrathin magnetic fluid.



RIBBON

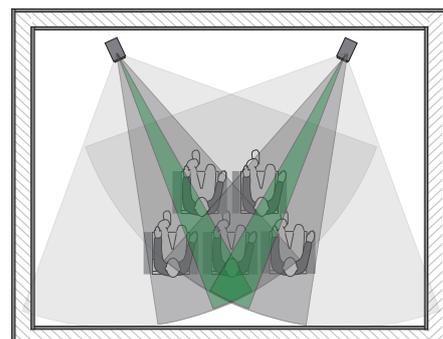
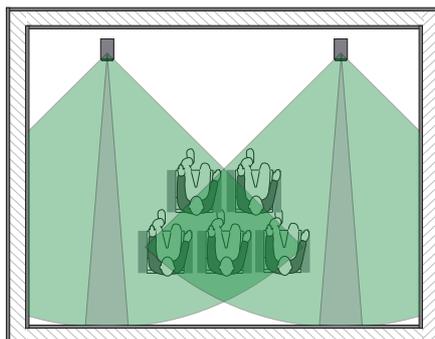
The ribbon tweeter features a broad frequency band and superb dispersion in the higher frequencies. Gently rolled in above 10 kHz, the ribbon reaches full contribution from 14 kHz to well beyond 30 kHz, far above the audible range.

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 of 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.



DALI speakers is build for wide dispersion, filling the room with the best quality audio and enlarging the listening sweet spot.

BASS REFLEX PORT

All speakers in the OPTICON series rely on the bass reflex principle. The bass reflex port has been tuned to minimize distortion from the woofers, and to control the time response of the roll-off from the bass system.

On the OPTICON LCR, DALI has taken bass port design to a new level. Wanting to maximize inner cabinet volume we moved the bass port to back of the speaker. Using most of the back of the OPTICON LCR and the wall to control the bass port airflow the OPTICON LCR delivers bass at a level not expected from such a compact wall mounted speaker.

Timing is the absolute keyword when tuning bass ports. Correct timing without any unwanted interaction between the drivers and frequencies creates a holographic soundstage. Research clearly shows that speakers with superior time coherence deliver enhanced sonic realism.



The OPTICON 1 bass port is integrated into the terminal tray to maximize inner volume.



The bass drivers in the OPTICON 8 have individual bass ports to help the woofer deliver timed and undistorted deep bass.



The unique bass port system in the OPTICON LCR leaves the maximum volume inside the cabinet.



Venting the bass ports on the front of the OPTICON VOKAL makes it possible to place it in a TV furniture with little or no space for rear bass ports.

SIGNAL PATH

The shorter the signal path, the better. That is why we have mounted the crossover directly onto the terminals – minimizing potential signal loss from the terminal to the crossover.

Due to the high quality wideband drivers used in the OPTICON series, the crossover can be kept relative simple, pertaining as much of the original

electrical signal as possible. The separated signal then travels the last short distance to the driver in carefully selected cables optimised for lowest possible signal loss.

The terminals have been developed especially for this series and feature sturdy, gold-plated binding posts. OPTICON 1, 2, LCR and VOKAL are prepared for single wiring; the rest of

the series feature bi-wiring terminals with a heavy power bridge (included) for single wiring. The binding posts will accept banana, spade and cable.

For optimal, long-lasting and low-loss connectivity between the driver and the crossover we use gold-plated spades on the internal DALI specified cable from the crossover to the drivers.



Single wire terminals are used on the stand moud OPTICON's and the OPTICON LCR and VOKAL.



All the floor standing OPTICON models dual use terminals for bi-wiring or bi-amping.

ACCESSORIES

All floor standing OPTICON speakers come with spikes made of black chrome steel. These are mounted in the aluminium cast 'feet'.

For use on 'sensitive' floors, we have also included vibration absorbing feet which will leave soft surfaces - such as a wooden floor - untouched.

Tools for mounting the aluminium feet and spikes are included.



PRODUCTS

The DALI OPTICON series consist of no less than seven individual speakers. They are all build around a DALI manufactured SMC based woofer and uses either a soft dome tweeter or the hybrid tweeter module, which DALI is so well known for. The cabinets are available in three finishes, Silk matte White, Black, and Walnut.



OPTICON 2 is a mid-sized stand mount speaker. The 6½" woofer and the more voluminous cabinet make this speaker a true 2-way compact performer. The size of the woofer is matched with a large 28 mm soft dome tweeter to bring out every detail in the audio signal. Expect nothing but a dynamic, well-defined and powerful audio reproduction from his speaker.



OPTICON 5 is the smallest floor standing speaker in the OPTICON family. Maximising the potential of DALI's 2½-way system, the OPTICON 5 draws the full potential from the 6½" Wood Fibre woofer by giving it just the perfect amount of volume. Rendering sharp, precise and detailed low frequencies, the 6½" woofer blends perfectly with the hybrid tweeter module to complete the soundstage with a coherent and open mid-range. If you want a compact speaker, but love the performance of a floor standing, OPTICON 5 is the way to go.



OPTICON 1 is a compact stand mount speaker, designed to be placed close to the wall or mounted on it. Constructed around a 4¾" Wood Fibre membrane secured to a SMC based magnet system, and the well-known soft dome tweeter module, the compact cabinet holds almost 5 litres of air for the drivers to work in. This, together with the rear mounted bass port, enables this compact speaker to deliver a clear and detailed midrange and an impressive bass performance for its size.



OPTICON LCR combines the best of all technologies into a slim wall mounted cabinet that works wonders with sound. The advanced bass port system in synergy with the 6½" woofer and the rotatable hybrid tweeter module delivers an impressive bass performance despite the compact cabinet. With airy highs, a detailed mid-range and a surprising bass, this on-wall speaker delivers a larger than life performance.



OPTICON 6 has all the virtues of the OPTICON 5 with the added power of an extra 6½" woofer. Combined with the larger volume inside the cabinet, the OPTICON 6 reaches lower into the deep bass producing an even more impressive soundstage. Its high sensitivity and even impedance load together with its impressive ability to reproduce undistorted audio makes the OPTICON 6 the perfect balance between size and performance.



OPTICON 8 is the powerhouse of the series with no less than two 8" woofers to render the deep bass and a 6½" woofer to handle the mid-range altogether with the DALI hybrid tweeter module. This impressive 3 + ½-way system leaves nothing out and fills even large rooms with a punchy bass, refined mid-range and high-definition high frequencies. The OPTICON 8 is the ultimate choice in performance audio.



OPTICON VOKAL ties an OPTICON surround system together. Designed to fit most Hi-Fi furniture, the 43cm/17" OPTICON VOKAL should easily feel at home anywhere you can fit your electronics. The front facing bass ports makes it possible to hide away most of the OPTICON VOKAL if that is the wish, but it will work just as well out in the open. The 6½" Wood Fibre woofer works together with the hybrid tweeter module to deliver a voice focused audio rendition that is just perfect with any of the compact speakers in the series, but at the same time powerful enough to match the OPTICON 8.

TABLE 2 - OPTICON TECHNICAL SPECIFICATIONS

	OPTICON 1	OPTICON 2	OPTICON 5	OPTICON 6	OPTICON 8	OPTICON LCR	OPTICON VOKAL
Frequency Range [+/- 3] dB [Hz]	62 - 26,000	59 - 27,000	51 - 32,000	49 - 32,000	38 - 32,000	72 - 32,000	47 - 32,000
Sensitivity [2.83V/1m] [dB]	86	87	88	89	88	90.5	89.5
Nominal Impedance [ohms]	4	4	4	4	4	4	4
Maximum SPL [dB]	105	107	107	110	112	109	109
Recommended Amplifier Power [Watt]	25 - 100	30 - 150	30 - 150	25-200	40 - 300	30 - 150	30 - 150
Crossover Frequency [Hz]	2,000	2,000	2,400 / 14,000	800 / 2,200 / 14,000	390 / 2,300 / 14,000	2,200 / 14,000	2,300 / 14,000
Crossover Principle	2-way	2-way	2+½-way	2½+½-way	3+½-way	2+½-way	2+½-way
High Frequency Driver	1 x 26 mm soft dome	1 x 28 mm soft dome	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 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 28 mm soft dome 1 x 17 x 45 mm ribbon
Low Frequency / mid-range Driver(s)	1 x 4¾"	1 x 6½"	1 x 6½"	2 x 6½"	2 x 8" / 1 x 6½"	1 x 6½"	1 x 6½"
Enclosure Type	Bass reflex	Bass reflex	Bass reflex	Bass reflex	Bass reflex (mid-range closed box)	Bass reflex	Bass reflex
Bass Reflex Tuning Frequency [Hz]	61.5	46.5	43.0	42.0	29.5	45.5	43.5
Connection Input(s)	Single	Single	Bi-wire / Bi-amp	Bi-wire / Bi-amp	Bi-wire / Bi-amp	Single	Single
Recommended Placement	Stand/Shelf/Wall	Stand/Shelf	Floor	Floor	Floor	On-wall/Shelf	Shelf
Recommended distance from rear wall to speaker's rear panel [cm]	2 - 80	10 - 80	20 - 80	20 - 100	30 - 150	0 - 10	0 - 30
Dimensions (H x W x D) [mm]	261 x 152 x 231	351 x 195 x 297	891 x 195 x 310	1001 x 195 x 330	1141 x 241 x 450	482 x 285 x 128	201 x 435 x 312
Dimensions (H x W x D) [inches]	10.4 x 6.1 x 9.2	14.0 x 7.8 x 11.9	35.6 x 7.8 x 12.4	40.0 x 7.8 x 13.2	45.6 x 9.6 x 18.0	19.3 x 11.4 x 5.1	8.0 x 17.4 x 12.5
Weight [kg/lb]	4.5 / 9.9	7.8 / 17.2	15.6 / 34.4	18.9 / 41.7	34.8 / 76.7	8.3 / 18.3	8.8 / 19.4
Accessories	Rubber feet, manual	Rubber feet, manual	Spike set, rubber feet, manual	Spike set, rubber feet, manual	Spike set, rubber feet, manual	Rubber feet, manual	Rubber feet, manual

All technical specifications are subject to change without notice.