KEF R&D

LS LUXE

CONTENTS

Introduction

LS LUXE represents the culmination of six years of innovation and development by the KEF R&D team since the launch of LS50 Wireless II in 2020. Over the years, while LS50WII has remained an exceptional benchmark in this category, listeners have continued to demand more performance, deeper bass extension and an even more engaging listening experience within the same compact two-way system topology.

Drawing on key technologies introduced across KEF's flagship ranges, LS LUXE builds on the strengths of LS50WII while introducing a new level of performance, integration and refinement to KEF's LS active wireless platform.

This white paper highlights the design philosophy behind LS LUXE, the technical challenges that shaped its development, and the improvements achieved across critical performance areas and metrics. Particular emphasis is placed on KEF's latest Velocity Control (VECO) Technology, and its accompanying custom current-drive amplification stages, which play a central role in the technical design of LS LUXE.

In addition to its refined industrial design by Ross Lovegrove, LS LUXE incorporates the following key technologies:

- A larger 12th Generation 6.5" Uni-Q® driver array with MAT®
- KEF's latest Velocity Control (VECO) Technology®
- Custom current-drive amplification stages for both the LMF and HF drivers
- An FEA-optimised Flexible Decoupling Chassis on the LMF driver
- FEA and CFD-optimised Flexible Port Technology
- A smooth, low-diffraction cabinet form using a high-strength BMC composite material
- An advanced implementation of KEF's Music Integrity Engine (MIE)

Philosophy

"Of all art, music is the most indefinable and the most expressive, the most insubstantial and the most immediate, the most transitory and the most imperishable. Transformed to a dance of electrons along a wire, its ghost lives on. When KEF returns music to its rightful habituation, your ears and mind, they aim to do so in the most natural way they can… without drama, without exaggeration, without artifice."

Raymond Cooke, KEF founder

KEF's approach to loudspeaker design has always been guided by the goal of reproducing music as naturally and faithfully as possible. Achieving this requires careful control over every part of the electro-acoustic system, from the behaviour of the drivers to the way the sound radiates into the listening environment.

In LS LUXE, this philosophy is realised through a fully integrated active system architecture. Advanced driver and system engineering are combined with custom current-drive amplification, instantaneous velocity feedback, and DSP optimisation to enable more precise control over the system behaviour and acoustic output.

Combined with controlled on- and off-axis radiation behaviour and a more acoustically and mechanically optimised cabinet design, these technologies establish a new performance benchmark for KEF's compact active systems. The result is a system that plays deeper, louder and cleaner than any previous KEF two-way system.

Current Drive Amplification

Most loudspeaker systems are designed for use with conventional voltage-drive amplification. In this mode of operation, the amplifiers, whether external or in-built, are designed to have very low output impedance. This means that the audio signal is presented as a voltage at the loudspeaker terminals, and the current drawn by the loudspeaker driver is determined solely by its electrical impedance.

The relationship between a driver's electrical impedance and voice-coil current is shown in Figure 1. The impedance is not constant with frequency, and current through the voice coil is inversely proportional to the impedance such that lower impedance results in higher current drawn from the amplifier.

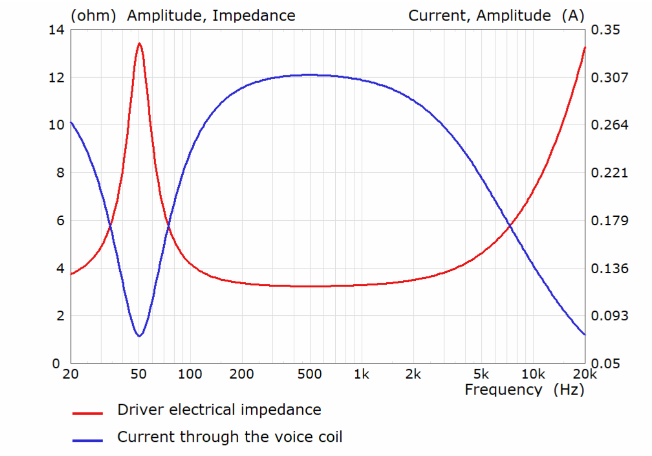

Figure 1. Relationship between driver electrical impedance and the current flowing through its voice coil under conventional voltage-drive operation.

Voltage-drive amplifiers strictly regulate the voltage applied to the driver terminals but play no part in directly controlling the voice-coil current. This is significant because the force generated by the driver motor system is directly dependent on the voice-coil current, rather than on the applied voltage.

In practice, loudspeaker drivers are imperfect devices, and their electrical impedance is not well behaved under normal operating conditions. The voice-coil resistance varies with temperature, which increases driver impedance and reduces electrical efficiency. Similarly, the voice-coil inductance varies with position and is further affected by nonlinearities in the motor magnetics. Nonlinear distortion of the voice-coil velocity and variation in the motor force factor also modulate the motional component of the electrical impedance.

When driven by a voltage-drive amplifier, these factors distort the instantaneous voice-coil current, and that distortion is transferred directly into the acoustic output heard by the listener.

Current-drive amplification, in comparison, operates on the principle of directly controlling the electrical current delivered to the loudspeaker driver, as shown in Figure 2. This is achieved using negative current feedback, which presents the driver with a high amplifier output impedance, and the current output is set primarily by the amplifier itself rather than by the driver.

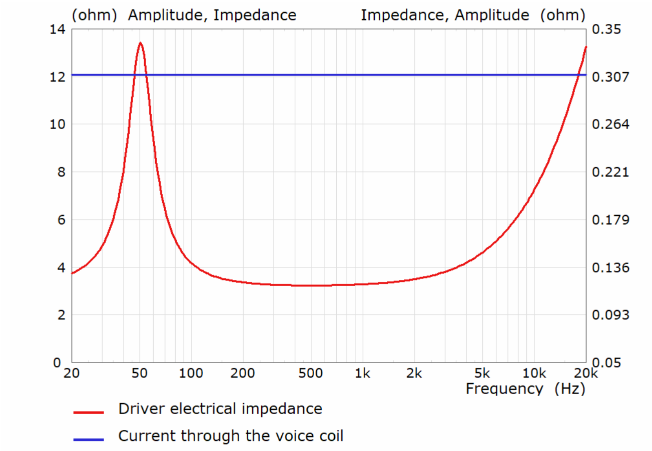

Figure 2. Relationship between driver electrical impedance and the current flowing through its voice coil under current-drive operation.

As a result, the electrical and mechanical behaviour of the driver no longer modulate the instantaneous current through the voice coil, and much of the current-related distortion is significantly reduced.

In addition to reducing distortion, controlling the driving current in this way reduces thermal compression. As the voice-coil temperature rises during operation, its resistance increases which reduces the driver's overall electrical efficiency. Figure 3 compares the normalised acoustic output reduction due to thermal compression with voltage- and current-drive amplifiers connected to the same loudspeaker driver.

Despite these dramatic advantages, current-drive amplification is rarely used in loudspeakers of any kind. The reason is that current drive suffers from a fundamental problem that is best illustrated with an example. Figure 4 shows the simulated acoustic pressure radiated by the same driver when connected to voltage- and current-drive amplifiers. With current drive, the pressure exhibits a large low-frequency peak, which would cause the bass to sound extremely coloured and poorly controlled.

This peak is caused by the fundamental mechanical resonance of the loudspeaker driver. With voltage drive, as the driver approaches its resonance frequency, the corresponding peak in electrical impedance reduces the driving current drawn from the amplifier. This, in turn, reduces the force applied to the voice coil and prevents the driver motion from becoming uncontrolled. This "electrical damping" effect arises from the back electromotive force (back-EMF), which is generated in the voice coil as it moves through the magnetic gap of the driver motor system.

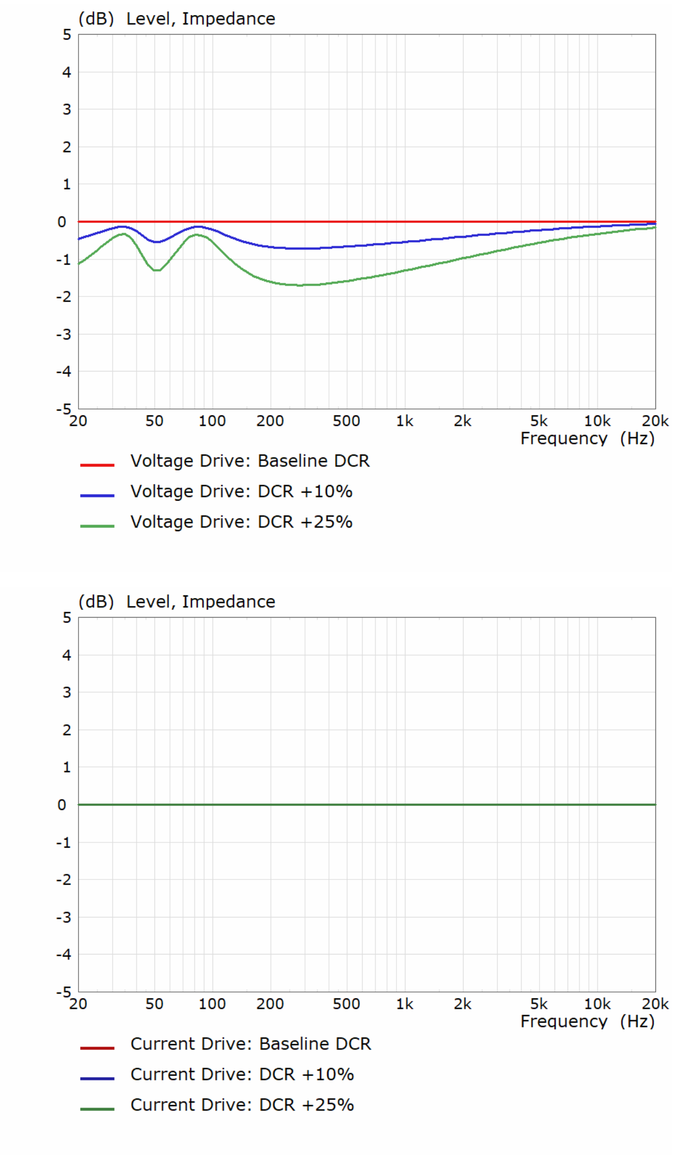

Figure 3. Normalised acoustic output reduction with (top) voltage- and (bottom) current-drive amplification due to thermal compression.

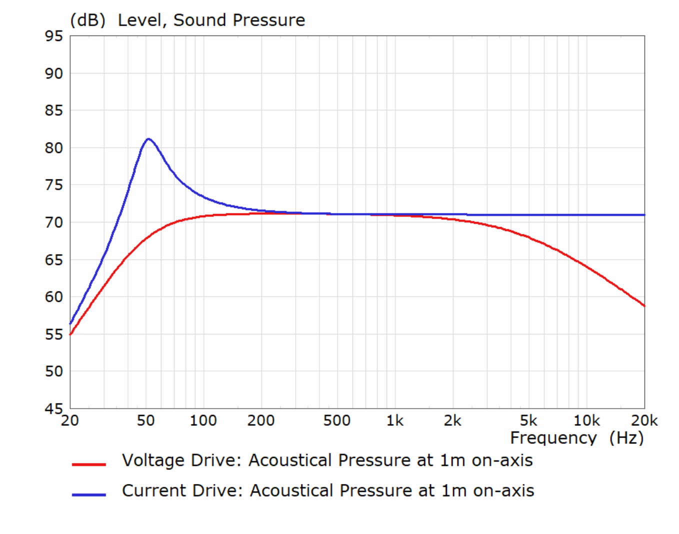

Figure 4. Acoustical pressure at 1m on-axis using voltage- and current-drive amplification with the same loudspeaker driver in free-air conditions.

With current drive, the situation is fundamentally different. The amplifier regulates current rather than voltage, and consequently, the back-EMF no longer directly reduces the driving current. Instead, the amplifier adjusts its output voltage to maintain the intended driving current through the voice coil. The absence of back-EMF “electrical damping” results in a large peak in the sound pressure response, along with increased displacement-related distortion. When a ported system is used with a current-drive amplifier, two large peaks appear in the sound pressure response, corresponding to the driver’s in-system and the port’s resonance frequencies. Distortion due to turbulent airflow or chuffing through the port also increases with playback levels.

Furthermore, while current-related distortion is reduced with current drive, other distortion mechanisms arising from the displacement-related stiffness $K_{ms}(x)$ and motor force factor BL(x) are still present in the system. Since the driver’s fundamental resonance is no longer controlled by back-EMF, distortion due to these effects increases in the region around the resonance. While a static EQ could be used to compensate for the low-frequency response peaks, the underlying distortion mechanisms would still result in higher overall low-frequency distortion than conventional voltage drive at equivalent output levels [1].

Velocity Control Technology (VECO)

To overcome the challenges with current-drive amplifiers, KEF developed the brand-new VECO Technology. VECO is a patented electromagnetic velocity sensor that tracks the motion of the voice coil in real time while the driver is operating. The sensor signal is used in a negative feedback loop around a custom current-drive amplification stage. This has two important effects: first, it controls the voice-coil motion in a similar way to the back-EMF effect from a conventional voltage-drive amplifier. Secondly, the negative feedback from the sensor has a general linearising effect on the driver velocity resulting in a reduction of distortion, especially at low frequencies where driver velocity is high. The combined effect of the current-drive amplification and velocity feedback is dramatic and provides a very significant performance improvement.

The underlying concept is not new. In the 1970s, Philips introduced loudspeakers that used accelerometers to measure driver motion and in the late 80s, Hawksford and Mills published papers on the topic of current-drive amplifiers combined with motional feedback [2]. However, and unfortunately, this concept fell out of popularity. A significant barrier is the complexity of such systems and finding or developing a suitable motion sensor for practical integration.

Developing VECO was a major engineering challenge, as the sensing mechanism not only had to operate in real time, with near-zero latency, but it also had to be small

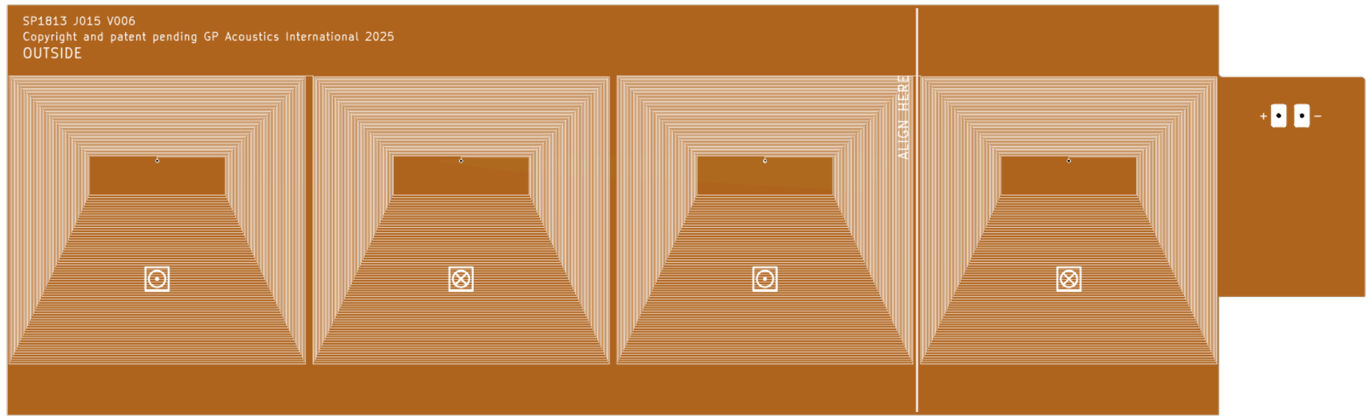

Figure 5. LS LUXE VECO sensing coil printed on a multi-layer flexible PCB (FPCB). Total track length across all four loops on both sides is approximately 55m.

enough to fit inside a driver’s motor system, including inside a Uni-Q. In addition, most commercially available motion sensors require external power which further increases the complexity of their integration.

VECO’s patented velocity sensor is based on the principle of electromagnetic induction: the physical phenomenon where a voltage is generated when a conductor moves in a magnetic field. This is achieved by placing a sensing coil and a sensing magnetic system within the primary motor system of the Uni-Q driver array. The sensing coil shown in Figure 5 is printed on a flexible PCB and replaces the conventional former of the low-mid frequency (LMF) driver voice coil. It therefore takes up no extra space and by operating passively, requires no external power.

The overlapping placement of the sensing coil to the primary voice coil means that, without appropriate treatment, the two coils would behave as an electrical transformer. In that case, the electrical voltage applied to the voice coil would result in the same signal appearing on the sensing coil, thereby contaminating the velocity measurement. This is a well-known issue and has been discussed in previous papers on velocity feedback systems [2]. The key innovation in VECO is the sensing coil’s specialised winding geometry, which comprises four separate loops with alternating winding directions. Each loop has a winding axis that’s perpendicular to that of the primary voice coil. This arrangement eliminates the electromagnetic coupling between the two coils and operates in a manner that is conceptually similar to how inductor placement is used to avoid crosstalk within passive crossover components. The alternating winding directions also prevent the sensing coil from interacting with the magnetic field of the loudspeaker motor system. This is important as it allows the sensitivity and linearity of the VECO sensor to be independent from the motor system design.

The sensing motor arrangement must similarly match the unusual winding geometry of the sensing coil. It comprises eight small neodymium magnets and two steel rings, which form the internal and external magnetic circuits, as shown in Figure 6.

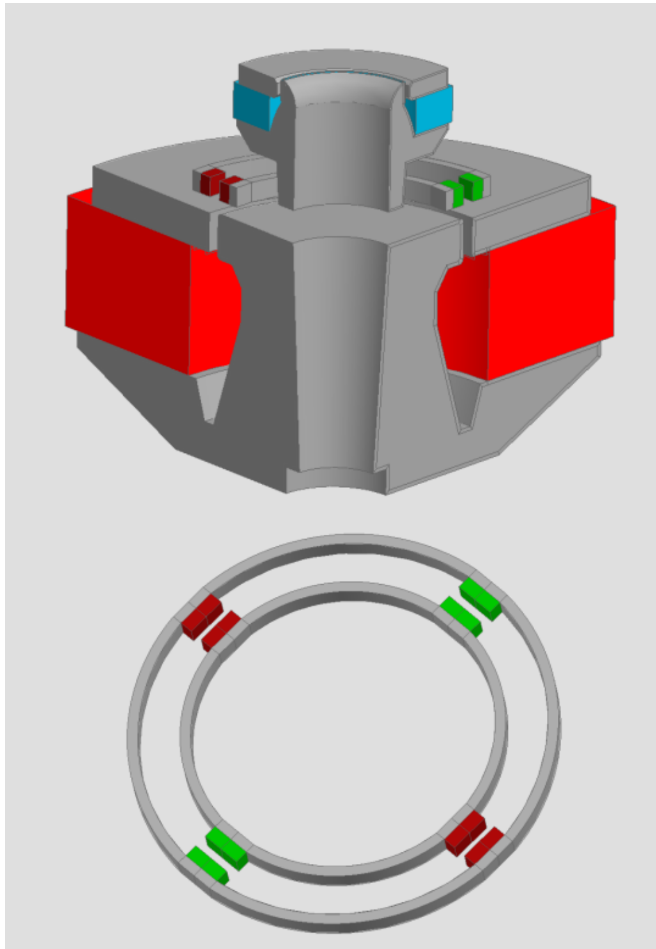

Figure 6. Primary (top) and sensor (bottom) motor systems within the LS LUXE Uni-Q driver array. Only the steel and magnet parts are shown for clarity.

The result is four regions in which the sensing magnetic field is strongly focused on each of the four sensing-coil loops. The geometries of the sensing coil and motor are carefully optimised using 3D FEA simulation and custom software tools developed in-house at KEF. These tools allow the engineering team to optimise the sensor’s sensitivity and linearity across the full excursion range of the drivers. They also automate the flexible PCB design process, which would be extremely difficult to complete manually; the LS LUXE sensing coil has a total track length of 55m distributed across both the front and back of the FPCB (flexible printed circuit board).

LS LUXE is the first product to apply VECO to a ported loudspeaker system. A unique advantage of this approach is that the gain and bandwidth of the feedback signal present additional degrees of design freedom for achieving the desired low-frequency system alignment, rather than relying solely on the passive properties of the acoustic system. This allows the combined electroacoustic system to be optimised more precisely for the target response and distortion reduction, while maintaining better-controlled low-frequency behaviour of the driver and the port.

Figure 7 shows a comparison of the low-frequency alignment of a prototype ported system with increasing levels of feedback gain. As more velocity feedback is applied, electrical damping increases, resulting in a more damped and controlled low-frequency alignment.

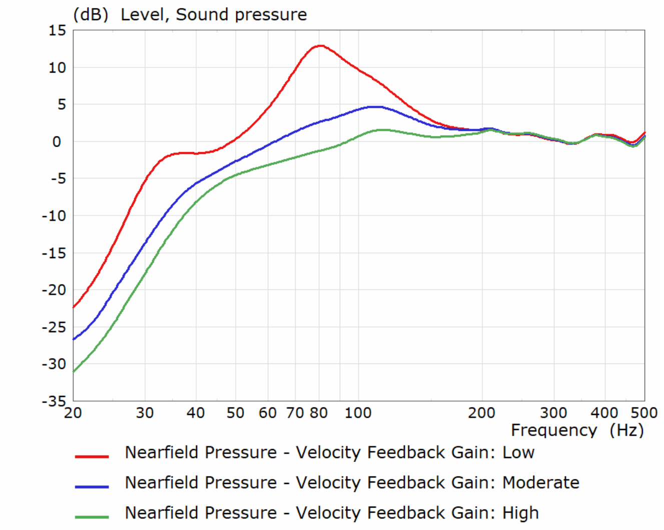

Figure 7. Comparison of the low frequency system alignment using different levels of velocity feedback gain on a prototype ported system.

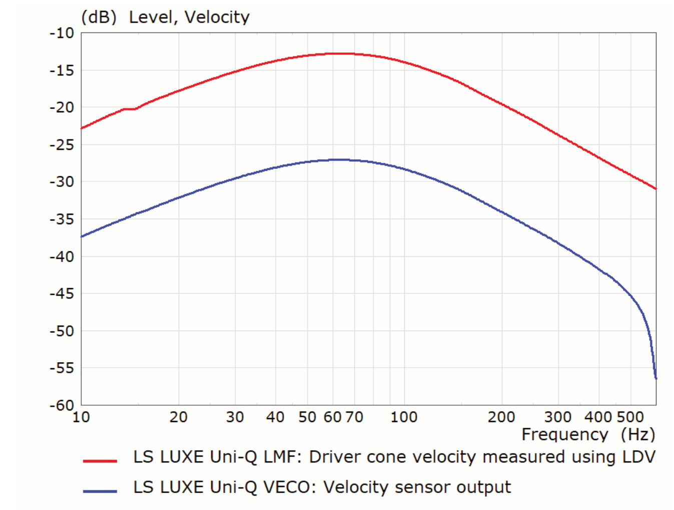

Figure 8. Comparison of driver cone velocity and the VECO velocity sensor output using the LS LUXE Uni-Q LMF in free-air.

Finally, Figure 8 compares the cone velocity of the LS LUXE Uni-Q LMF driver, measured using a Laser Doppler Vibrometer, or LDV, with the output of the VECO velocity sensor. The sensor output closely follows the cone velocity up to 400Hz. The level difference between the two traces are down to the differences in the sensitivity of the primary and sensing motor systems.

12th Generation Uni-Q

Low-Mid Frequency Driver

LS LUXE uses a specially designed 12th Generation Uni-Q driver array with MAT. Based on the LS50 Meta and Wireless II Uni-Q, the LS LUXE Uni-Q uses a larger 6.5" LMF driver cone for higher maximum volume displacement. In addition, the internal volume of the LS LUXE cabinet is approximately 50% larger than the LS50. The combination of the larger radiating area, enclosure volume and VECO means that LS LUXE can deliver deeper bass extension, higher LF efficiency and lower distortion across all playback levels.

Comparisons of the system response and total harmonic distortion of LS LUXE and LS50WII up to 500Hz are shown in Figure 9 and Figure 10 respectively. These measurements were taken with the two systems level-matched at approximately 84dB SPL at 1m. Below 40Hz, LS LUXE gains approximately 8-10dB more acoustic output than LS50 Wireless II. This is complemented by significantly lower total harmonic distortion, with reductions of between 6 to 14dB found throughout the bass and midrange.

Beyond harmonic distortion reduction, the benefit of current-drive amplification can also be observed in the context of multitone playback, where multiple frequency components are reproduced by the driver simultaneously. The results of such a test involving 32 discrete mid-frequency tones with the LS LUXE Uni-Q in voltage- and current-drive amplification are shown in Figure 11. Many of the multitone distortion products in the mid-frequency range are significantly reduced in the order of 10-20dB.

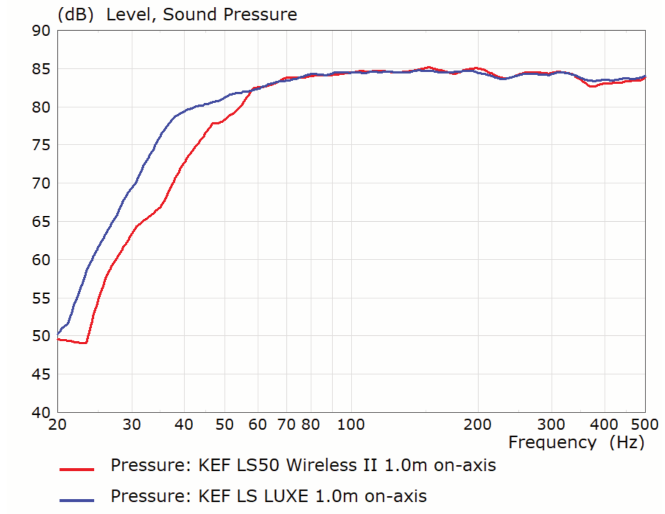

Figure 9. System response comparison of LS50W2 and LS LUXE.

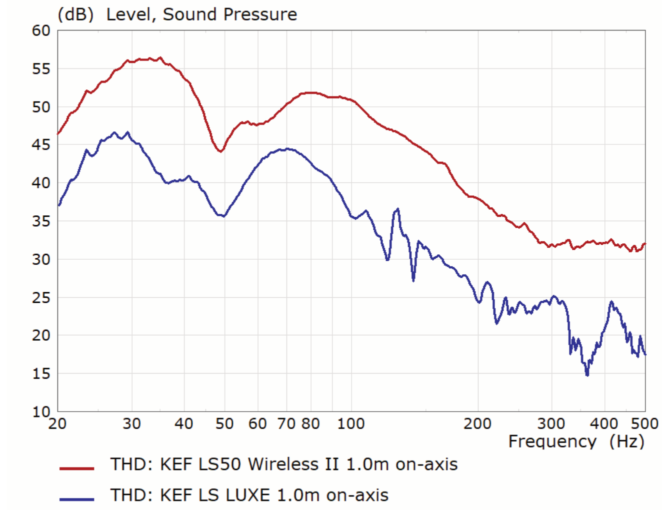

Figure 10. THD comparison of LS50W2 and LS LUXE.

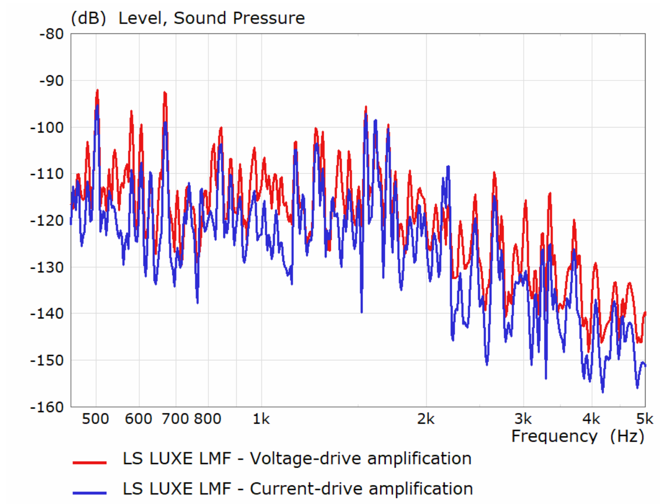

Figure 11. Multitone FFT using LS LUXE LMF with voltage- and current-drive amplification. Input tones have been removed for cleaner visualisation.

Flexible Decoupling Chassis

Flexible Decoupling Chassis technology was first implemented in the LS60 Wireless Uni-Q driver array. Since then, the concept has been adapted to suit the chassis for BLADE and THE REFERENCE META, R Series with MAT and Q Series with MAT Uni-Q drivers. Its purpose is to mechanically decouple vibrations generated by the motor system from the cabinet panels, reducing the leakage of unwanted vibrational energy through the enclosure.

The design of the Flexible Decoupling Chassis consists of two key components: the stiffness of the flexible interface and the properties of the damping material. Together, these determine the operating frequency range of the assembly as well as the effectiveness of the decoupling mechanism. Since the LS LUXE Uni-Q is a two-way Uni-Q driver array, it is considerably larger and heavier than the Uni-Qs mentioned previously. As a result, the mechanical-resonance frequency of the motor system is lower, requiring the target decoupling frequency and stiffness of the flexible interface to also be considerably lower than previous designs.

This is achieved through FEA-optimised geometry design, in which the requirement for high compliance is carefully balanced against mechanical strength by minimising local stress concentrations and distributing stress points more evenly. A comparison of the stress analysis conducted on one of the intermediate designs and the final one is shown in Figure 12.

The geometry and material selection of the damping pads are similarly customised to suit the lower decoupling frequency target and the wider range of operating temperatures of the LS LUXE Uni-Q assembly. This is necessary because LMF motors typically reach much higher maximum temperatures than the three-way Uni-Q MF motors discussed previously.

Therefore, while the working principle of this technology remains unchanged, several application-specific optimisations were required to achieve the isolation performance shown in Figure 13, where the vibration velocity of the LS LUXE Uni-Q motor is compared to that of the chassis lip. The difference between the two curves indicates the degree to which the vibrations of the motor are prevented from exciting the cabinet through the mounting points around the chassis lip.

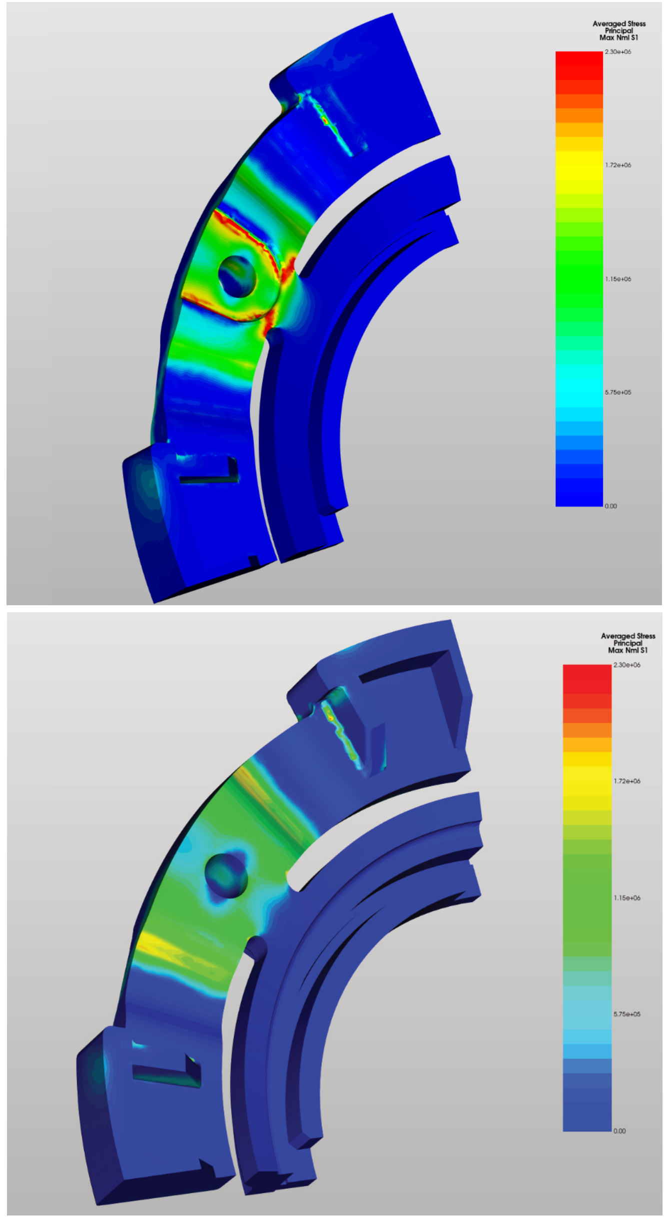

Figure 12. Comparison of the stress analysis conducted on an intermediate chassis design (top) against the final optimised version (bottom).

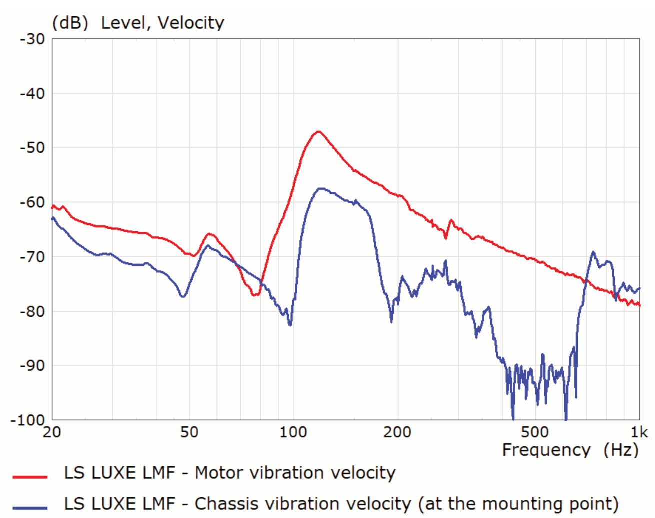

Figure 13. Vibration velocity comparison of the motor and the chassis using the Flexible Decoupling Chassis.

High Frequency Driver (Tweeter)

The tweeter in the LS LUXE Uni-Q is closely derived from the LS50 Meta and Wireless II tweeter. MAT continues to be most effective option for absorbing the unwanted rear radiation from the tweeter dome. However, in the context of current-drive amplification, it serves a further acoustic purpose.

The highly effective absorption provided by the MAT increases the acoustic damping of the tweeter system, thereby reducing the Q of the tweeter resonance compared to a conventional tweeter. One indication of this damping is the height and sharpness of the resonance peak in the electrical impedance of the tweeter. An example of this is shown in Figure 14, where the electrical impedance of the LS LUXE tweeter is compared with a conventional tweeter with a vented pole.

When such a tweeter is used with current-drive amplification, the lower system Q results in a similarly less prominent peak in the pressure response than a conventional tweeter arrangement with lower acoustic damping, as shown in Figure 15. This makes the integration of the tweeter much more straightforward and enables LS LUXE to use current drive amplification for both the driver sections, despite not having VECO on the tweeter.

Like the LMF, the benefits of current drive for the HF can similarly be observed in the Multiltone FFT over the high-frequency range (Figure 16).

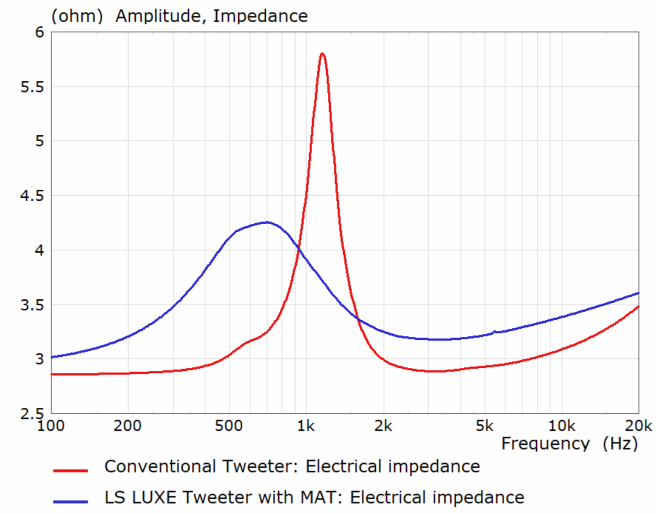

Figure 14. Electrical impedance comparison of a conventional tweeter with a vented pole and the LS LUXE Uni-Q tweeter with MAT.

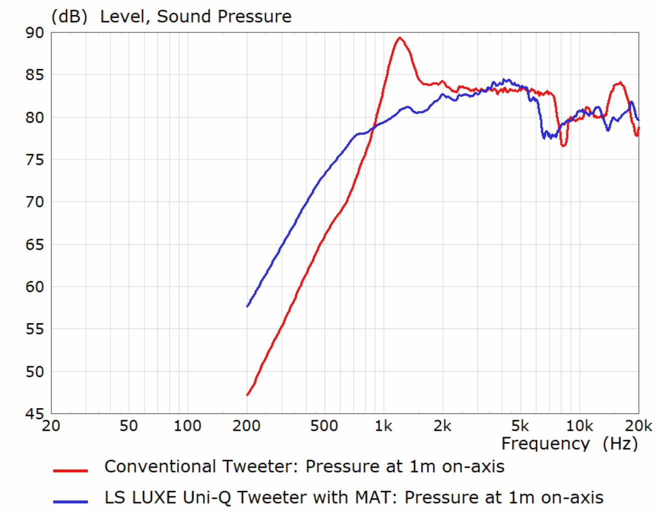

Figure 15. Pressure response in an infinite baffle at 1m on axis with current-drive amplification.

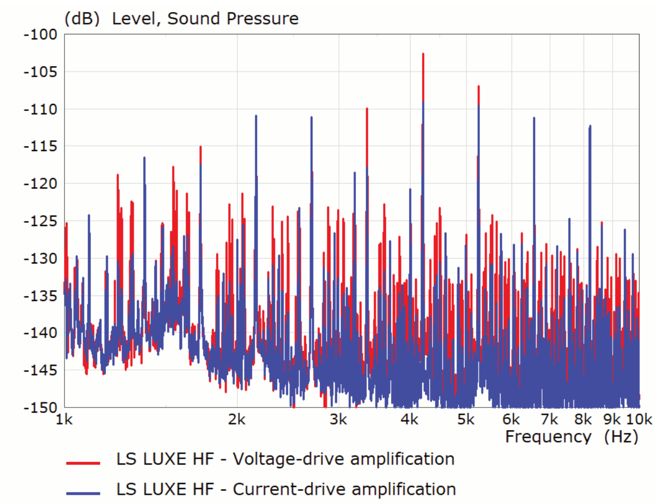

Figure 16. Multitone FFT using LS LUXE HF with voltage- and current-drive amplification. Input tones have been removed for cleaner visualisation.

Cabinet Design

The LS LUXE cabinet is designed to approach the acoustical ideal of a rigid sphere as closely as possible. This target geometry minimises the influence of external surface features, such as edges and other discontinuities, on the radiated sound field. Accordingly, the assembly is designed with no fixings or additional parts such as trim rings or badges around the driver in all directions.

A comparison of the diffraction behaviour of an ideal sphere, a conventional rectilinear cabinet and the LS LUXE cabinet is shown in Figure 17. The diffraction behaviour of the LS LUXE cabinet is much closer to that of the ideal sphere, and significantly better than a conventional rectilinear cabinet.

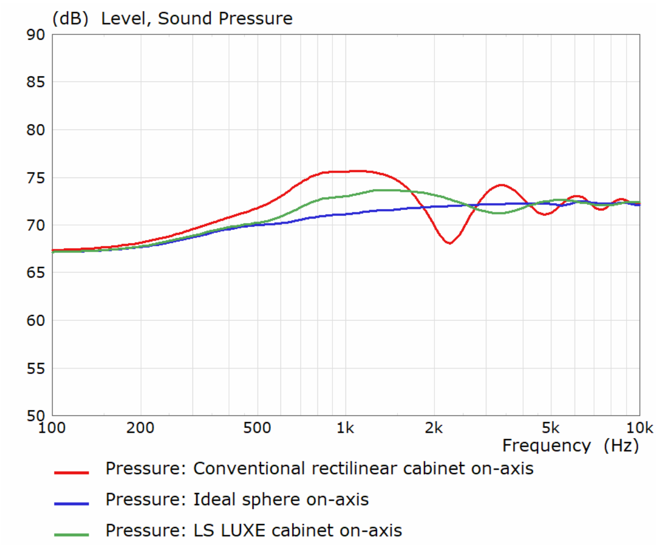

Figure 17. Diffraction behaviour of a conventional rectilinear cabinet, an ideal sphere and the LS LUXE cabinet.

By eliminating causes of diffraction in this way, the LS LUXE cabinet becomes considerably less visible to the acoustic wavefront propagating from the Uni-Q LMF and HF drivers. This helps preserve the unique matched directivity behaviour of the Uni-Q driver array more faithfully and allows the radiated sound field to remain more uniform over a much wider range of angles, as shown in the directivity contours (See Section: Model Information, Specifications and Measurements).

The controlled directivity ensures that, in a typical room environment, the direct and reflected sound remain spectrally smooth, balanced and more consistent. This enables LS LUXE to project more realistic and stable sound images within a more expansive three-dimensional soundstage.

To achieve the smooth geometrical form, an appropriate cabinet material was required. As well as dimensional accuracy, one of the additional requirements for this product was a high quality of finish. For this reason, a custom blend of glass fibre-reinforced BMC (Bulk Moulded Compound) was developed. This is the same material used for the front baffle of the LS50 Meta and Wireless II loudspeakers.

The benefit of using BMC, over other mouldable materials such as plastic, is that it offers very high mechanical strength. Combined with the Flexible Decoupling Chassis used on the LMF driver, the LS LUXE assembly provides a strong and inert foundation for the drivers without requiring bulky internal bracing. The volume saved by doing this is instead used as additional LF enclosure volume.

A comparison of the cabinet vibration performance of the LS LUXE and LS50WII is shown in Figure 18. The curves represent the cabinet panel vibration velocity averaged over the entire surface area of the cabinet (36 equidistant points) in response to 2.82Vrms driving their respective Uni-Q LMFs.

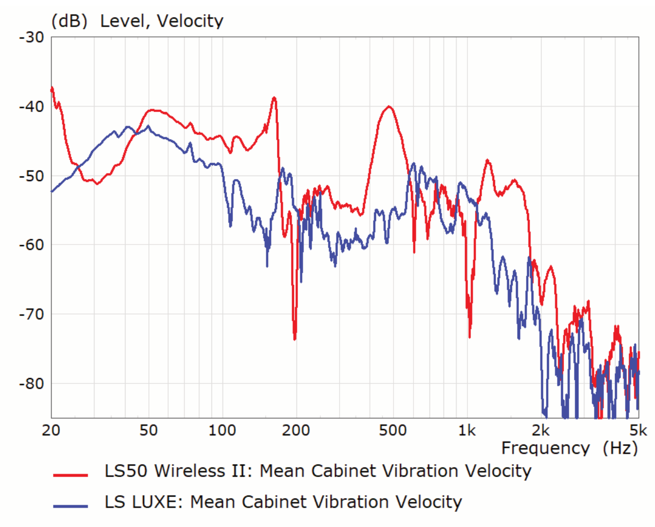

Figure 18. Mean cabinet vibration velocity comparison between the LS LUXE cabinet and the LS50W2.

Figure 19. Large diecast aluminium heatsink on the rear of the LS LUXE cabinet. The flared port opening is incorporated within the aluminium fins.

On the rear is a large aluminium heatsink (Figure 19) that is incorporated to provide significant thermal mass and surface area to efficiently dissipate the heat generated by the active electronics that are mounted directly behind it.

Within the folds of the aluminium fins, is a flared port opening. The size, shape and construction of the port are designed to encourage laminar airflow through the openings on either side. Additionally, LS LUXE uses the Flexible Port Technology present in THE REFERENCE, LS50 Wireless II and R Series with MAT. In this arrangement, the straight walls of the port are made from a flexible material to suppress internal acoustic resonances through localised deformations of the enclosing geometry. Figure 20 illustrates this technique using FEA, where the colour scale from blue (low) to red (high) indicates the air pressure magnitude.

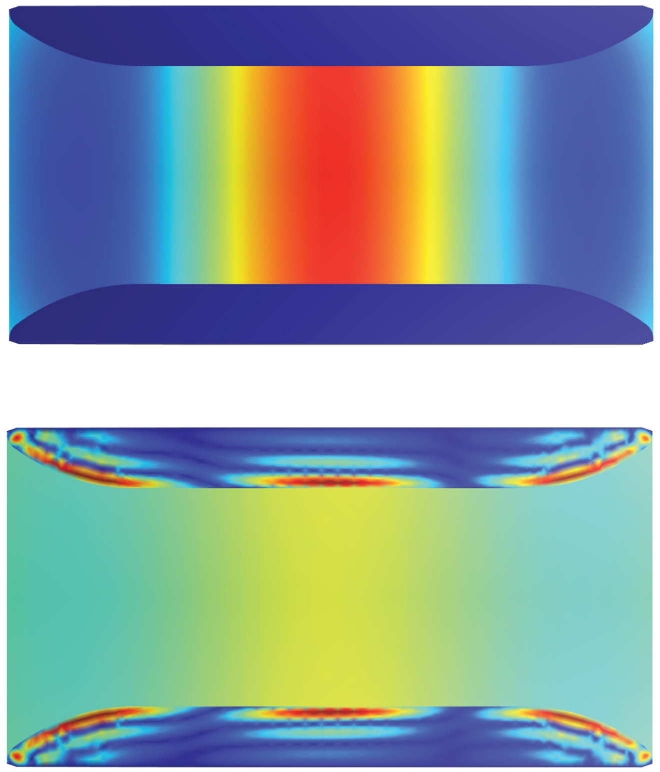

Figure 20. FEA modelled air pressure distribution using rigid (top) and flexible (bottom) port walls.

KEF Connect Integration

LS LUXE's user experience is designed around KEF's W2 wireless platform and the KEF Connect app. In addition to convenient initial onboarding and routine control, KEF Connect provides a range of user-adjustable EQ settings that helps adapt LS LUXE's performance to the room in which it is used.

Starting with the subwoofer presets, a collection of crossover presets have been designed specifically for integrating LS LUXE with KEF subwoofers, using either the standard cable or KW1 wireless connection. Differences in gain and latency are compensated

automatically within the app. Similarly, the Phase Correction FIR filter is optimised specifically to suit the DSP EQs and physical acoustic characteristics of LS LUXE. A comparison of the system impulse response with and without phase correction is shown in Figure 21. Much of the overshoot after the main impulse peak has been reduced, which is the result of improved phase alignment of the system components at the microphone position. The result of this is more accurate reproduction of transient details through the system.

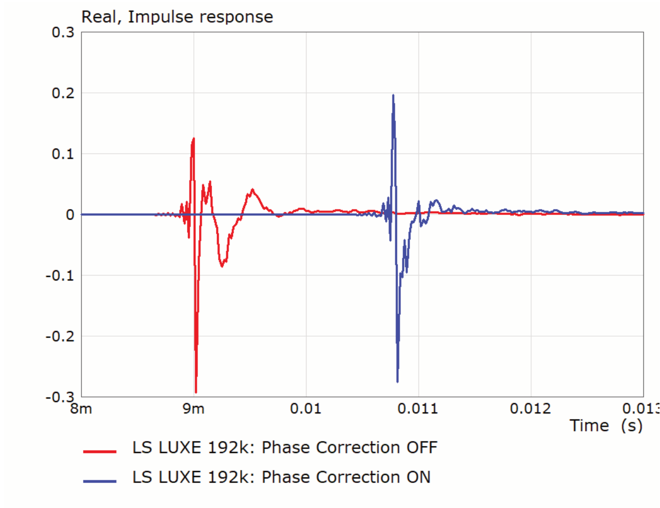

Figure 21. LS LUXE system impulse response with Phase Correction ON and OFF in anechoic conditions.

Bass extension modes in Expert mode, shown as Room size in Normal mode, allow users to adjust the low-frequency alignment of LS LUXE to suit their rooms. Three modes are supported: More, Normal and Less. The system response in each of these modes is shown in Figure 22.

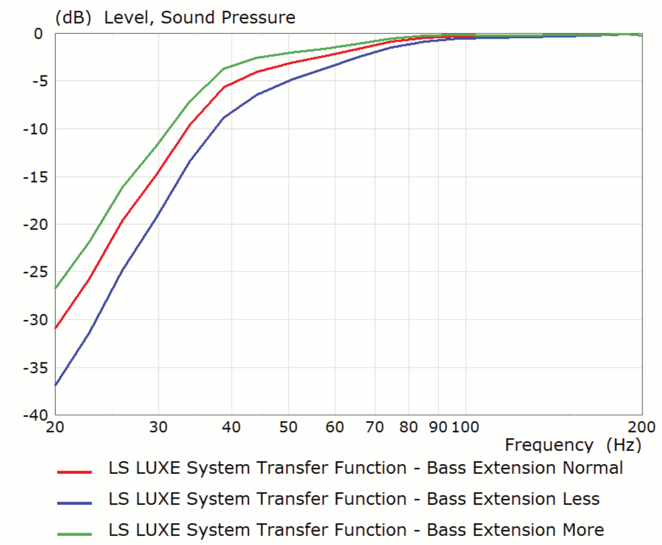

Figure 22. LS LUXE system response in the three bass extension modes supported in KEF Connect.

A further degree of bass control is provided through Wall and Desk Mode EQ settings. Wall Mode is intended to compensate for the broad LF output boost due to placing the speaker close to large reflection surfaces, such as walls. Desk Mode is a more targeted EQ intended to reduce the acoustic loading effect of large reflection surfaces under the speakers, such as desks or meter bridges. A comparison of wall and desk mode EQ transfer functions at the -3dB setting in KEF Connect is shown in Figure 23.

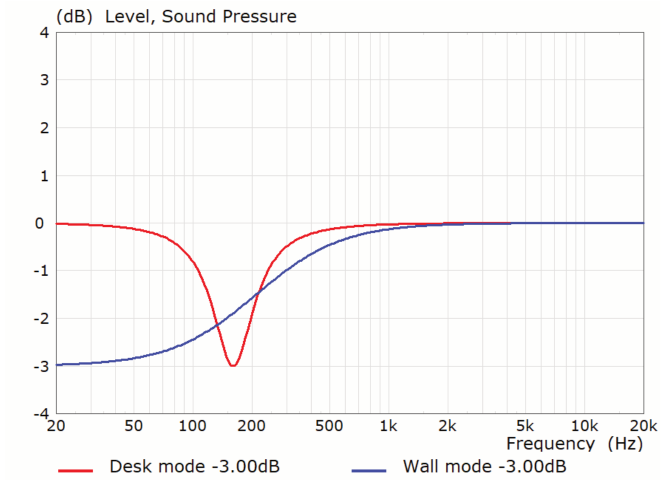

Figure 23. EQ transfer function comparison. Wall mode and desk mode at -3dB setting in KEF Connect.

Finally, for mid and high frequency control, the Treble Trim EQ has been redesigned to provide greater control over the broadband spectral slope of LS LUXE's in-room response, helping to compensate for differences in room absorptivity and or programme material. The trim may be applied in either direction and is intended to be used in relatively dead and lively rooms, respectively. One indication of the absorptivity of rooms is the average reverberation time (RT60) through the mid to high frequencies. RT60 times in the range of 0.3-0.35s may be considered typical for moderately sized rooms, and Treble Trim adjustments can be referenced against this threshold as a starting point. The transfer function of the Treble Trim EQ at +3dB and -3dB setting is shown in Figure 24.

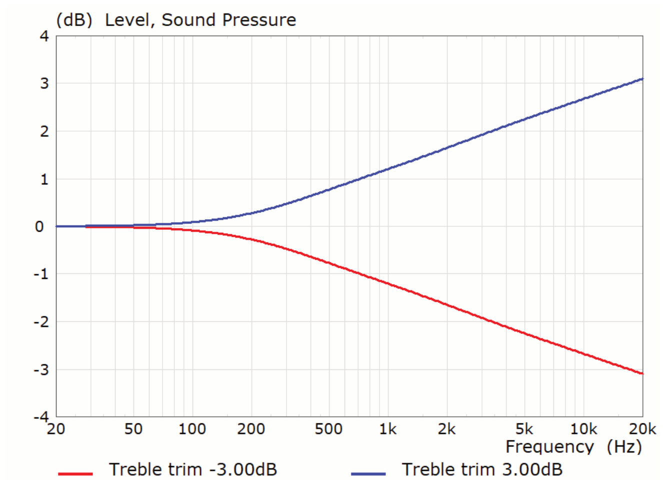

Figure 24. Treble Trim EQ transfer function at +3dB and -3dB setting in KEF Connect.

Summary

Through rigorous engineering and the application of advanced technologies, LS LUXE establishes itself as KEF's flagship two-way active wireless loudspeaker system.

While this white paper has focused specifically on LS LUXE, many of the technologies implemented here were first debuted across other KEF product ranges. Readers interested in the underlying technical principles are encouraged to refer to the following references for further details:

- Metamaterial Absorption Technology (MAT)®: [3], [4]
- Uni-Q Driver Array® and improvements specific to the 12th Generation including Tangerine Waveguide, Tweeter Gap Damper and Cone Neck Decoupler: [5], [6]
- Flexible Decoupling Chassis: [4], [5], [6]
- Flexible Port Technology: [3]
- Digital Phase Correction: [3]

References

[1] J. Backman 'Comparison of Dynamic Driver Current Feedback Methods', 145th Audio Eng. Soc. Convention, October 2018

[2] P.G. Mills and M. J. Hawksford, 'Distortion Reduction in Moving Coil Loudspeaker Systems Using Current-Drive Technology', J. Audio Eng. Soc., Vol 37,p. Paper 129-148, March 1989

[3] KEF Research and Development, 'LS50 Collection White Paper'

[4] KEF Research and Development, 'Q Series with MAT White Paper'

[5] KEF Research and Development, 'KEF Blade, The Reference Meta White Paper'

[6] KEF Research and Development, 'R Series with MAT White Paper'

LS LUXE

Model Information, Specifications and Measurements

LS LUXE

Two-way Active Wireless Speaker System

Technical Specifications

Model	LS LUXE
Drive units	Uni-Q driver array: HF: 25 mm (1 in.) vented aluminium dome with MAT# LF/MF: 165 mm (6.5 in.) aluminium cone
Frequency range (-6dB) measured at 85dB/1m	35 Hz - 47 kHz *Depends on EQ settings
Frequency response (±3dB) measured at 85dB/1m	42 Hz - 28 kHz *Depends on EQ settings
Amplifier output power (per speaker)	LF: 280 W HF: 100 W
Amplifier class (per speaker)	LF: Class D HF: Class AB
Max SPL measured at 1m	110 dB
Source resolution	Network up to 384 kHz/24 bit Optical up to 96 kHz/24 bit Coaxial up to 192 kHz/24 bit HDMI eARC up to 192 kHz/24 bit *Depends on source resolution
Interspeaker connection	Wireless: all sources resampled to 96 kHz/24 bit PCM Wired: all sources resampled to 192 kHz/24 bit PCM
Supported format (network)	DSD, FLAC, WAV, AIFF, ALAC, AAC, WMA, MP3, M4A, LPCM and Ogg Vorbis
Dimensions (HWD per speaker)	336 × 223 × 298 mm (13.2 × 8.8 × 11.7 in.)
Weight (per set)	20 kg (44.1 lbs)
Power input	100 – 240VAC 50/60Hz 200W
Power consumption	200 W (operating power) <2.0 W (standby power)

KEF reserves the right, in line with continuing research and development, to amend or change specifications. E&O.
#MAT (Metamaterial Absorption Technology) is a joint development with Acoustics Metamaterials Group.

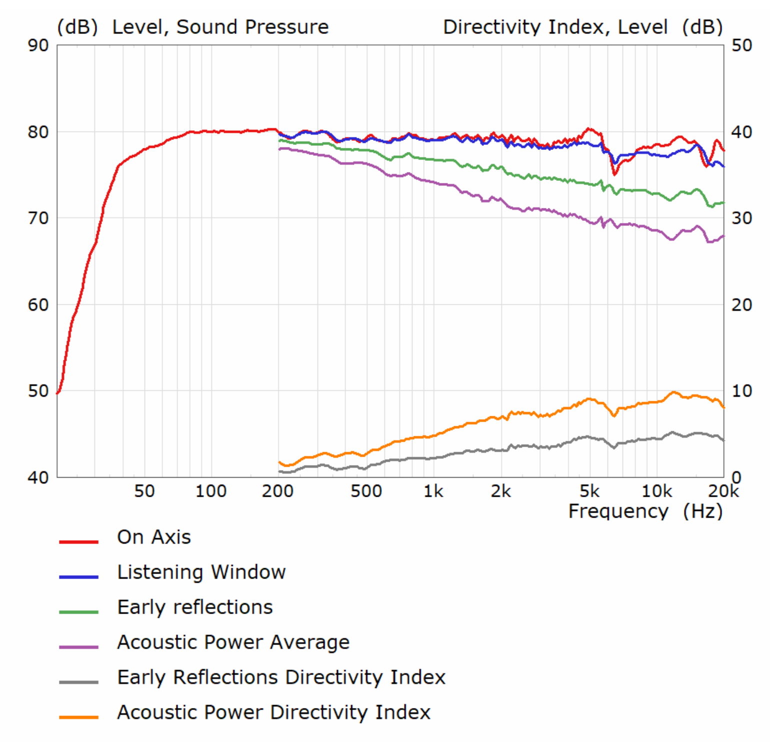

Figure 25. LS LUXE Spinorama curves measured at 1m in anechoic conditions.

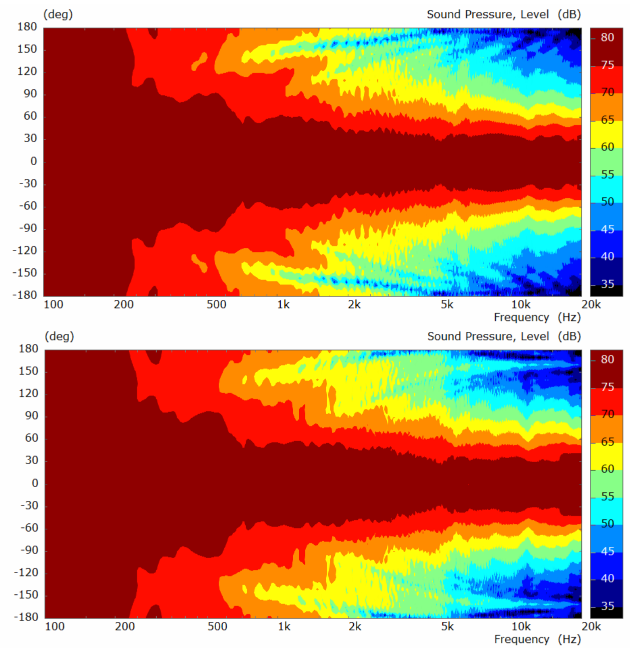

Figure 26. LS LUXE (top) horizontal and (bottom) vertical directivity contours.

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