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REVIEW FROM ISSUE **1 I 2020**

Kompaktes
PA-System
Meyer Sound-
Ultra-X40

KOMPAKTES PA-SYSTEM

Meyer Sound Ultra-X40

The Ultra-X40 uses modern electronics from the LEO family in combination with an acoustically optimised, concentric driver arrangement. How does this successor to the UPA, one of the most successful sound reinforcement products, perform?

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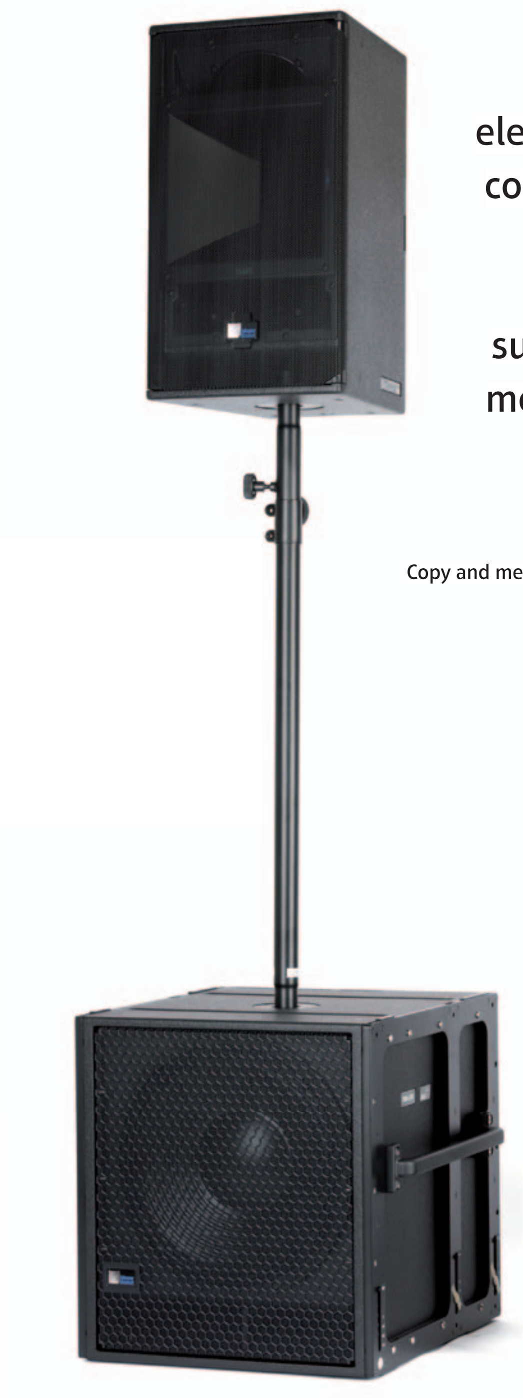


New and supposedly better products come out constantly at a fast pace. From a business point of view, this speed purportedly leads to rapid product devaluations, making solid investments complicated. It is extremely pleasant when a product like Meyer Sound's UPA has been on the market for 35 years in more or less unchanged form. Then as now, the UPA enjoys a high reputation among sound engineers. The term "industry standard" is therefore quite fitting in this case: virtually everyone in the industry knows the product, they know exactly what to expect from it and that reliability is one of its key features. In addition, it is available worldwide.

Source: Meyer Sound

Exploded view of Meyer Sound's Ultra-X40 with the removable front unit carrying both woofers and tweeter

Now, a lot has been developed over the last 35 years: digital signal processing opens new possibilities and has found its way into almost all aspects¬¬ of audio technology. Drivers have become better thanks to new measuring methods and materials, while simulation methods have improved and accelerated the overall development of loudspeakers. This does not call into question that good loudspeakers were built even 40 years ago. Nevertheless, it makes sense to redevelop proven products such as the UPA using state-of-the-art technology – and Meyer Sound in Berkeley has done exactly this: with the Ultra-X40 and -X42 models, the company has brought two new compact universal PA speakers to the market. They also officially succeed the UPAs, whose production ran out at the same time.

The dimensions of Meyer Sound's X40 and X42 are 567 × 318 × 391 mm (H × W × D), making them somewhat more compact than the UPA. More importantly, the weight has been reduced by 11 kg to 23.6 kg compared to the self-powered UPA. Also new is the concentric design with two 8" woofers and a large 3" compression driver mounted to a rotatable horn located in the middle of the enclosure. The coaxial design shares a common central axis between both ways to prevent the otherwise unavoidable interference in the transition area which are caused by angle-dependent level and time offsets. Additionally, the speaker can be operated both vertically and horizontally without loss of performance.

For the test, we opted for a pair of X40s with a 110 × 50 degree dispersion angle. The X42 model with a narrower radiation has a nominal angle of 70 × 50 degrees. In both cases, the horn can be turned if necessary. The rotation can be carried out after loosening the grille as well as the horn's four screws. The X40 is equipped with the in-house compression driver MS 1203L featuring a 3" coil and neodymium drive, already known from the LINA system. The two 8" woofers, located in a V-shaped arrangement behind the horn, also originate from Meyer Sound's own production.

Together with the V-shaped front panel, the large horn forms an acoustic bandpass chamber for the woofers, which partially leads to a significant increase in sensitivity. Another, equally important aspect of the V-shaped arrangement is the reduction of the two woofers' effective radiating area, thus avoiding too pronounced bundling up to the crossover frequency. The arrangement is quite similar to a conventional coax driver, but in terms of directivity it offers more possibilities to match a horn with a wide horizontal and a narrow vertical dispersion angle.

On the outside, the electronic module has cooling fins for heat dissipation – the X40 manages without active ventilation

The electronics, also known from LINA, are used to control the drivers, consisting of three Class D amplifiers, a DSP and various peripheral circuits for loudspeaker monitoring. The data sheet specifies the amplifiers' peak power as 1950 W. Peak values are of particular importance to Meyer Sound as the company places special emphasis on an undistorted and non-compressed reproduction of individual peaks in the signal, which ultimately determines the dynamics in the reproduction.

The two woofers with 4 Ω nominal impedance are each driven by an amplifier; the third amplifier supplies the compression driver. The cooling profile on the outside of the electronic module is sufficient for heat dissipation. A fan is not required, allowing the X40 to be used in quiet environments close to the audience. Power is supplied to the three Class D amplifiers via a switching power supply unit which is mounted as a separate module on the amplifier block. The easily removable electronics as a whole and their modular design ensure that individual components can be replaced quickly and safely in the event of servicing.

The connection panel is also modular, with two possible configurations: the standard module and the Remote Monitoring System (RMS) module. The X40s in our test were equipped with the standard module, which features a Powercon power connector with link output and a three-pin XLR socket, also with link output, for the audio signal. The RMS module also has two orange Weidmüller plugs and, instead of the standard XLR, a 5-pin XLR connection with link output. In addition to the audio signal, the XLR socket on pins 4 and 5 also carries the RMS signal for remote control and monitoring of the speakers.

In addition to the acoustic properties, corresponding possibilities for placement or installation are required for use as a universally applicable sound reinforcement loudspeaker. For this purpose, Meyer Sound offers various tools that can be attached to the enclosures using eleven rigging points (M8). Six M8 threads are located on the top of the enclosure and another five on the bottom. The tripod sleeve on the bottom with an integrated M20 thread can be converted to another M8 rigging point using an adapter, allowing the speaker to be set up or fixed horizontally using a U-bracket. With the help of a rod (35 mm with M20 threads for lengths from 927 to 1524 mm), the X40 can

In everyday use, the two large and easy-to-grip (removable) handles prove to be very practical

Connection panel of the subwoofer with exchangeable input module, here with RMS function

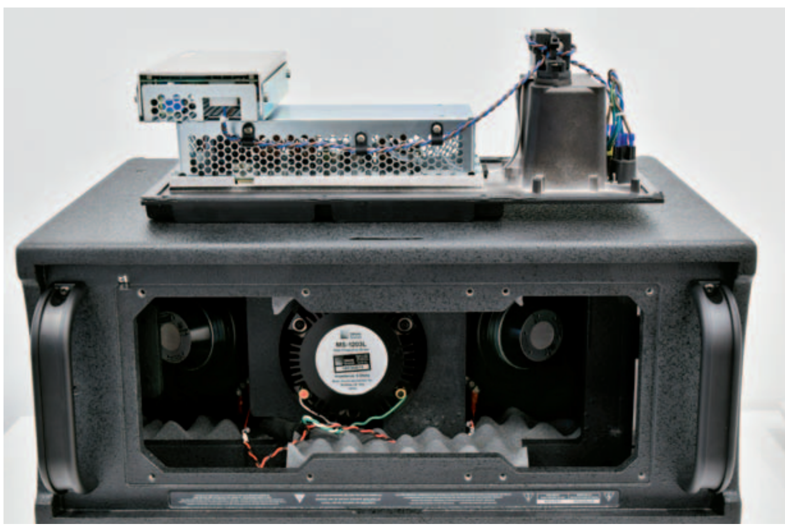
be set up straight and securely on a corresponding subwoofer. Inside the rod, a gas cylinder generates a lifting pressure for a weight of up to 18 kg. With this support, the 23 kg heavy X40 can then be easily adjusted in height. The two large and easy-to-grip handles on the rear also prove to be very practical in everyday use. They can also be removed for fixed installations.

The mounting yoke can be used to suspend or set up the box in a tilted position. It is screwed to the top of the enclosure at three rigging points. If users want to form arrays consisting of two or three X40s, Meyer Sound offers cluster plates for horizontal arrays or for vertical arrays with horizontally hanging X40s as well as top channel links, with which up to three X40s can be hung underneath each other and angled as required. A beautifully animated video from Meyer Sound on this topic shows what rigging and installation options are available and how to make the best use of them. Alternatively, users can also find all the necessary information in the exemplary operating instructions. Further accessories include solid or foldable rain protection hoods for the connection panel.

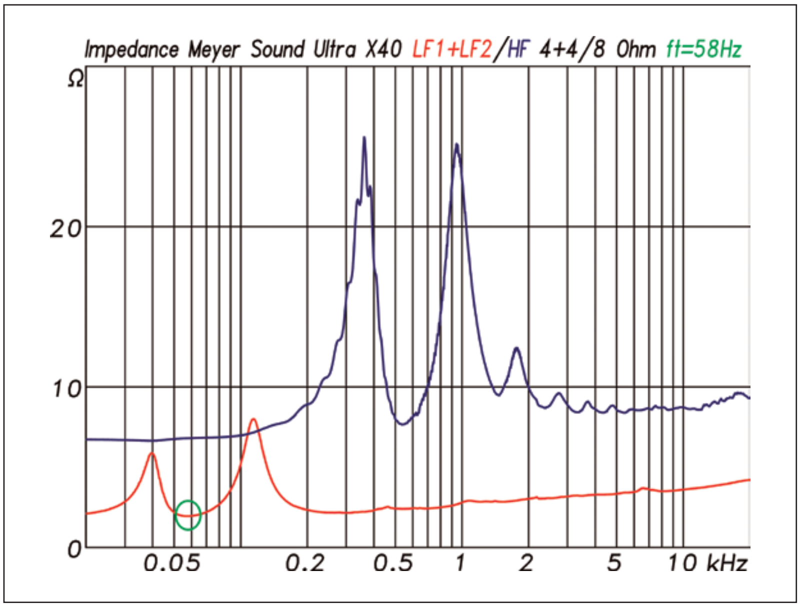
Electrical and acoustic base values

Measurement-wise, we will start by briefly looking at the raw data. This data clearly reveals how the overall result came into existence. Specifically, we will begin with the individual electrical and acoustic responses of both ways and their controller's filter functions. Fig. 1 shows the impedance curves for both ways. For the measurement, the two woofers were operated in parallel on the measuring amplifier. In normal operation, each woofer has its own amplifier, but these are driven by the same signal, which functionally leads to the same result. With the 4-Ω drivers, the two amplifiers for the X40's woofers can be optimally used. The amplifiers do not require a particularly high supply voltage to do so, nor are there any problems with line losses, as the cables are only a few centimetres long. Both are solid arguments for self-powered loudspeakers. On the other hand, there are of course also good reasons for external amplifiers and controllers. In this respect, one cannot speak of "better" or "worse", but rather of "more or less suitable for one purpose or another".

Back to the actual measurements: Fig. 1 shows that the two woofers in the bass reflex cabinet are tuned to 58 Hz, which means that the X40 is aiming for full-range capability.



Deep inside the Ultra-X40's enclosure, the two 8" woofers with neodymium magnets; in the middle, the 3" 1203L compression driver known from the LINA series. The electronic module with three amplifiers and DSP system; the power supply unit is mounted on the amplifiers



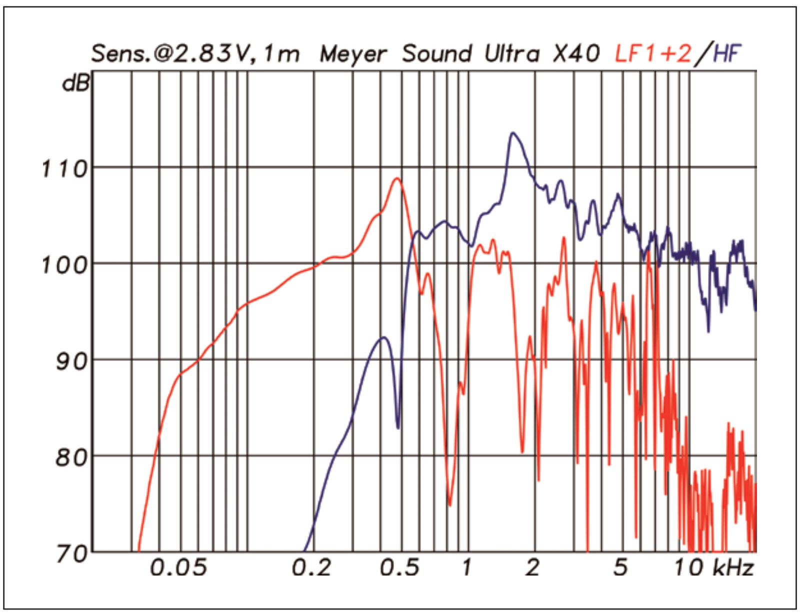
Impedance curve of the two woofers (red, 2 × 4 Ω) with a tuning frequency of 58 Hz and the tweeter (blue, 8 Ω). For the measurement, both woofers were operated in parallel (Fig. 1)

The woofers' impedance minimum, considered individually, is nearly 4 Ω. The 1203L high-frequency driver – already known from LINA – is an 8-Ω system with an equally good-natured minimum of 7.7 Ω above 150 Hz. The frequency responses for both ways measured without controller are shown in Fig. 2. Again, both woofers were operated in parallel, so that for the LF way's 1 W/1 m sensitivity, 6 dB have to be subtracted from the 2.83 V/1 m value. For the 8-Ω HF way, the 1 W/1 m sensitivity corresponds to the graphic's 2.83 V/1 m value.

Looking at the woofers first, the steep drop below 50 Hz, which is typical for a bass reflex cabinet, sets in – this fits in well with the bass reflex tuning to 58 Hz. Above this, the sensitivity increases continuously and reaches 100 dB at 200 Hz at 2.83 V/1 m. Just below 500 Hz, the acoustic bandpass in front of the woofers produces a powerful maximum where the curve reaches 109 dB. However, within the same pass band, this gain comes at the expense of a no less pronounced drop between 600 Hz and 1 kHz. The immediate look that follows is anxiously directed at the HF section in this frequency range, which, thanks to the large size, is already fully operational at 600 Hz and thus lends itself to filling the gap. With the X40's widely dispersing horn, the HF driver subsequently reaches an average sensitivity of 105 dB (1k-10k). For the 8-Ω compression driver, the 2.83 V/1 m sensitivity also corresponds directly to the 1 W/1 m value.

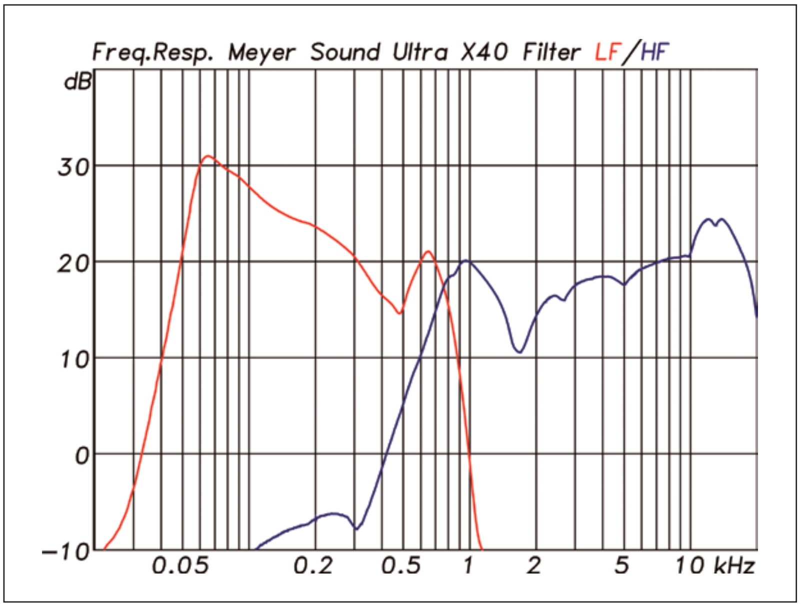
Electronics and filters

DSP technology is of course used for the X40's signal processing. However, users cannot digitally feed signals via an audio network or AES3, just as there is no direct user access to the DSP for setting possible filters or adjustments to subwoofers. Both are in line with Meyer Sound's philosophy of limiting user processing (if any) to an optional external controller. In Meyer Sound's portfolio, these are the Galileo GALAXY 408 and 816 with four and eight inputs respectively as well as eight and 16 outputs respectively, which can be used for loudspeaker management. The signals can be fed in analogue, digital in AES3 format with sample rate converter as well as via audio network. Meyer Sound relies on the open-source AVB format. The Galaxy processors are Milan-certified, which guarantees smooth interaction with other Milan-certified devices. Regardless of the external processors, Meyer Sound loudspeakers are each fully tuned and can be used to their full potential without further processing, including possible combinations with subwoofers. The processors are only used for more complex systems.



Frequency response with sensitivity related to 2.83 V/1 m for the woofer (red) and the tweeter. As the woofers are two 4-Ω systems that were operated in parallel for this measurement, 6 dB must be subtracted for 1 W/1 m (Fig. 2)

Fig. 3 shows which filter functions are set in the internal DSP. The functions realised with a combination of IIR and FIR filters invert the loudspeakers' basic progressions within the desired frequency ranges. However, extreme raising or lowering and also a correction of the fine structure is deliberately avoided as these would only be "laboratory cosmetics" and bring no advantage in terms of sound. On the contrary, exaggerated filtering can also lead to sound deterioration. Unfortunately, it is not known exactly what kind of calculation Meyer Sound uses for the combination of the two filter types. However, the partial use of FIR filters makes it possible to equalize the loudspeakers' amplitude and phase responses as well as to calculate linear-phase high and low pass filters. In the X40, the filters are used in such a way that despite a very short latency, a largely phase-linear response is achieved from 100 Hz upwards. Fig. 5 shows the X40's phase response as a whole. A stronger phase rotation occurs only below 100 Hz, which is caused by the acoustic and electrical high-pass behaviour. This could not be compensated without causing corresponding latencies that would then no longer be acceptable in live operation.



Filter functions of the internal DSP controller for the LF (red) and HF way (blue, Fig. 3)

Fig. 4 shows how filter and loudspeaker act together. The separation between horn and woofer takes place at 700 Hz. The corner frequencies are located at 56 Hz at the lower end and at just below 19 kHz at the upper end. Overall, the response is very smooth with an unsmoothed variation of less than ±4 dB over the entire frequency range. Together with the phase response from Fig. 5, this results in a transfer function that would also do credit to a studio monitor.

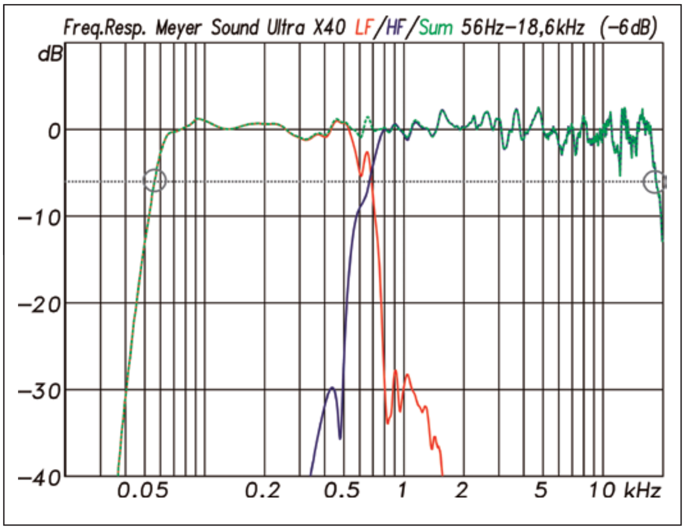
The spectrogram shows that the X40 is largely free of resonances. The horn behaves exemplary over its entire working range. Only at approximately 650 Hz does a narrow resonance emerge, which already appeared as a small peak in the woofers' frequency response and which is probably caused by the chamber forming between the woofers and the horn.

750 LFC subwoofer

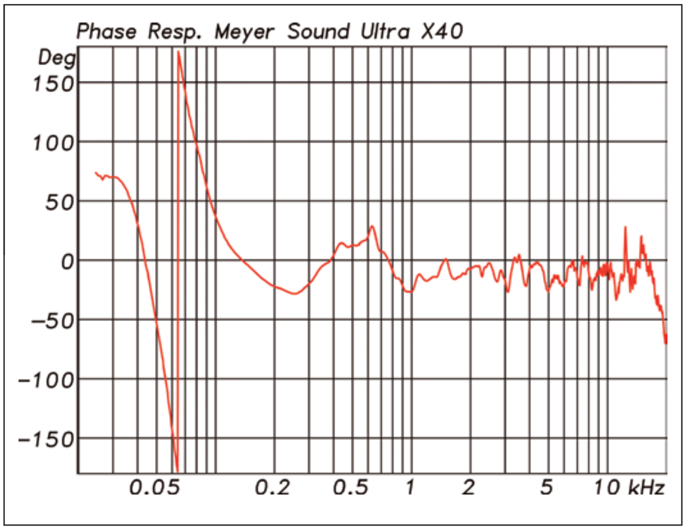
Depending on the application, the X40 may need support for low frequencies. Of the various Meyer Sound subwoofers, the 750 LFC is the ideal choice. This is a 15" system in a compact bass-reflex cabinet featuring a special double voice coil chassis with two 2-Ω coils, one coil wound on the inside and one on the outside of the carrier. The integrated electronics include two Class D amplifiers, each of which supplies one coil. Similar to the X40's woofers, the low impedance makes very good use of the amplifiers and allows them to deliver high power at 2 Ω even at a rather low output voltage. For the circuit this means: semiconductors and capacitors with lower dielectric strength can also be used. The otherwise unavoidable problems found in 2 Ω operation with high cable and contact losses do not exist here as the amplifiers are located in the immediate vicinity of the loudspeaker.

Measured directly without a controller, the 750 LFC's woofer delivers a 1 W/1 m sensitivity of 90-92 dB in the relevant frequency range. The achievable maximum level, measured with sine bursts, is about 125 dB from 60 Hz upwards. The 750 LFC – with dimensions of 519 × 471 × 530 mm (H × W × D) – can optionally be equipped with an externally mounted flight mechanism and carrying handles. The 750 LFC weighs 47.6 kg with the rigging kit and 40.3 kg without. Further details and measurements for the 750 LFC can be found in our LINA review in Production Partner 6/2019.

An already mentioned special feature of combinations with subwoofers in Meyer Sound systems is the possibility of simply operating tops and subwoofers in parallel without further processing and also without a necessary setup. The idea behind this is to make the combination as simple and as safe as possible for the user. A prerequisite for this is that the tops

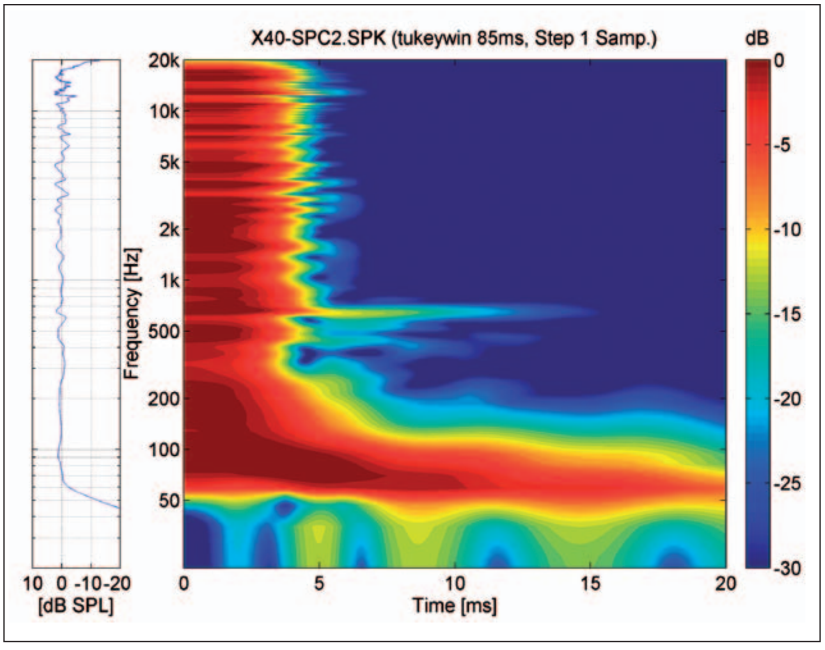


Overall result LF (red) and HF way (blue) with controller and their sum function (green). Overall, the X40's frequency response is very even with corner frequencies of 56 Hz and 18.6 kHz (-6 dB, Fig. 4)



Phase response of X40 with a largely linear phase response from about 120 Hz upwards (Fig. 5)

are not tuned too extremely at the low frequencies, so that they are not overloaded even if the subwoofer is to be fully utilised at the same time. The usual procedure in combination with a subwoofer would be to relieve the tops with a high pass filter and to leave the low frequency range completely to the subwoofer. At Meyer Sound, however, the subwoofer in simple parallel mode is seen more as an extension of the lower frequency range. Fig. 7 shows how this is achieved with the combination of X40 and 750 LFC. In addition to the extended frequency range, the bass level is also increased by 7-8 dB. This makes the sound considerably "fuller" compared to a lone X40. The idea behind this is probably that the customer's expectations regarding a subwoofer can be "felt" directly. Simply extending the frequency range by one octave downwards while keeping the progression straight would probably not be spectacular enough and might disappoint the prospective customer in his or her first listening impression.



Spectrogram of the X40. A small resonance can be seen at 600 Hz – the tweeter behaves exemplary (Fig. 6)

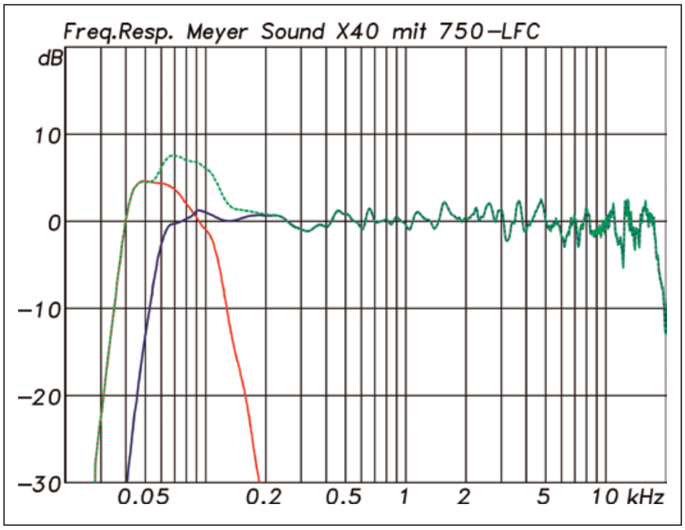
Directivity

Meyer Sound attaches particular importance to loudspeaker directivity, which should be uniform over the widest possible frequency range. For this purpose, the X40 is specified as a system with nominal 110 × 50, where the horn can be rotated by 90° if necessary. With the help of a suitably designed horn, the aforementioned requirements for medium and high frequencies can usually be well met. However, it becomes difficult when one takes a look at the lower frequencies. The X40's crossover lives at 700 Hz, where, especially for the 50° plane, a large horn is already necessary if one wants to achieve the narrow dispersion angle. As the images of the X40 without a grille show, a relatively large horn is used in the X40.

The next critical point is the transition to the woofers. The tiresome problems in the vertical plane – when transducers are arranged one above the other – have already been elegantly solved at Meyer Sound by arranging the two woofers concentrically with the high frequency section. The use of two woofers, instead of one larger driver, also makes it possible – as a further design trick – to achieve a wide horizontal and a narrow vertical dispersion pattern in the woofers. A continuous transition without jumps in the isobars can thus be achieved more easily. As a further constructive measure to optimise directivity, overlapping high and low pass filters can also be used in the crossover. However, this would not have made sense here due to the woofers' rapid level drop above 600 Hz.

The X40's isobars were initially measured in the standard 110 × 50 configuration. Fig. 8 and 9 show the graphics for the horizontal and vertical plane. Except for a small narrowing around 1.8 kHz, the 110° in the horizontal plane are almost perfectly maintained from about 600 Hz upwards. Even at the highest frequencies near 20 kHz, no relevant narrowing can be identified and the crossover frequency at 700 Hz is unrecognisable from the isobars. As expected, it is somewhat more difficult to maintain the narrow 50° angle in the vertical plane: strictly speaking, 60° would have been more accurate as nominal dispersion angle. The angle is largely maintained from about 1.5 kHz upwards. Towards the lower frequencies, the isobars widen from -6 dB onwards, so that one can identify approximately 90° at 600 Hz. After the transition to the horn, the isobars again widen a little more. In principle, however, the desired behaviour is generally well achieved. For the horizontal, the isobars deliver an almost perfect result, and for the vertical, the target value of 50° achieves what is feasible for both the size of the speaker and the tweeter horn.

If the horn is rotated by 90°, the measurements result in the isobars shown in Fig 10 and 11. Almost somewhat surprisingly, the results look almost as good as in the standard 110 × 50 setting. In the horizontal plane, the speaker delivers a narrow directivity that slightly increases with frequency, while the directivity in the vertical plane is not quite as perfect but is still quite even. The X40 therefore clearly fulfils the ambitious development goal for directivity mentioned at the beginning of this paragraph.

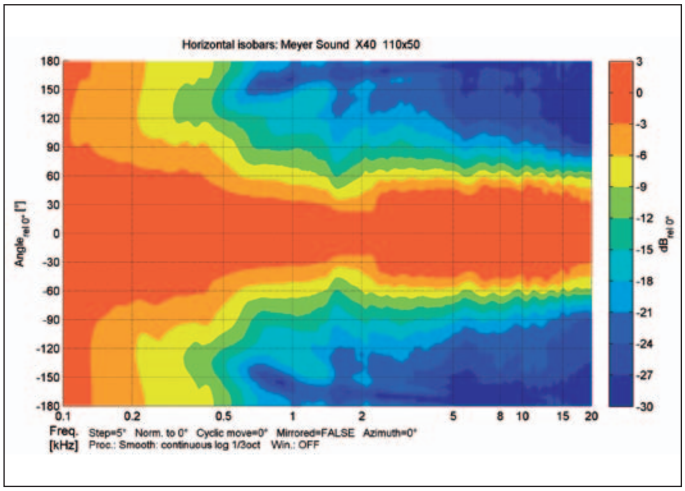


X40 with 750 LFC subwoofer In total, the subwoofer results in a bass boost of 7-8 dB, which – depending on the type of music – definitely has a positive effect on the listening impression (Fig. 7)

750 LFC subwoofer 15" system in a compact bass reflex enclosure with a special double voice coil chassis with two 2-Ω coils

Max. SPL measurements and data sheet values

Two proven methods for the precarious determination of the achievable maximum level in the lab have been used for our reviews for quite some time: on the one hand, the measurement with sequential 185 ms long sine bursts. Here, the level is increased using a sinusoidal signal until a certain amount of distortion, typically 3% or 10%, is reached. The average sound pressure recorded for the duration of the measurement is documented. This measurement is performed over a predetermined frequency range in sequential 1/12th octave frequency steps. As soon as the measurement algorithm detects a limiter, in other words, when output level no longer increases with input level, and distortion also no longer increases, the measurement sequence is stopped. In this case, the distortion limits might not be reached and the curves for 3% and 10% can coincide. This is exactly what happens in Fig. 12 between 300 Hz and 600 Hz, where both curves coincide. For those frequencies, distortion reaches 3% and stop conditions are met primarily because of the limiter. For lower frequencies, the curves differ again due to increased diaphragm excursion that causes more distortion.

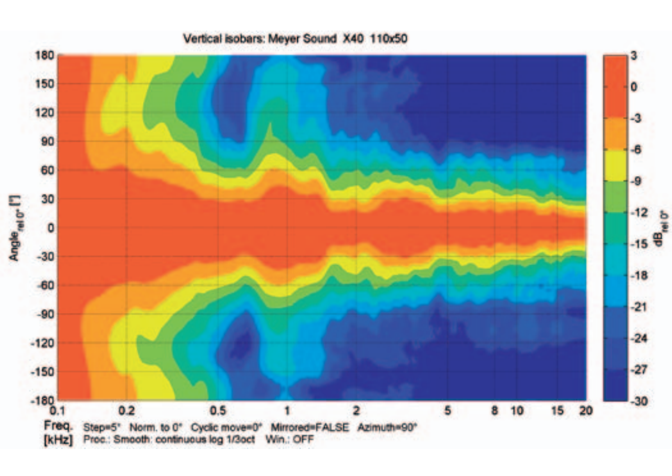


Horizontal isobars of X40 in the 110 × 50 setting: except for a small narrowing of 1.8 kHz, the 110° are well maintained from 600 Hz upwards (Fig. 8)

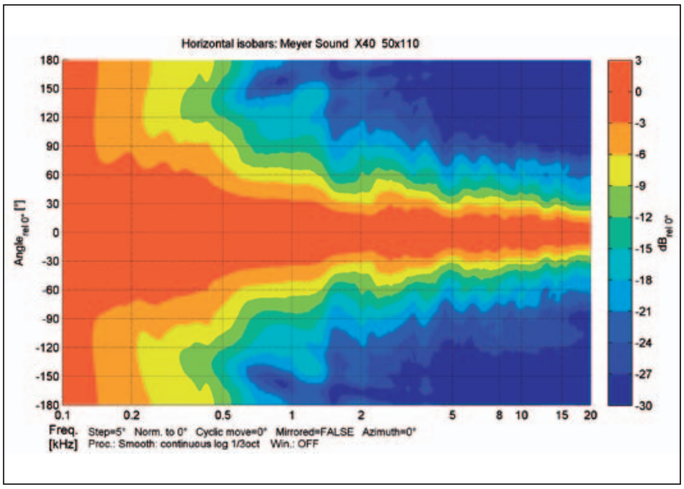
The separation to the woofer in the X40 is carried out at 700 Hz, where a large horn is required especially for the 50° plane in order to achieve the narrow dispersion angle there

Above 600 Hz, the mid and high frequency transducer comes into play, and in the form of compression driver primarily produces second order distortion that is reflected in the 3% and 10% curves, separated by 10 dB. Noticeable is the dip at 850 Hz, where the mid and high frequency transducer is a bit overstrained and causes the level to drop. As the frequency responses for both ways in Fig. 2 already showed, this frequency range lacks the necessary support by the LF driver. Then again, the dip is both very narrow and – as shown in the single way measurement at 850 Hz – and distortion is primarily of the benign even order kind. Thus, if one overlooks the dip, then the X40 offers a balanced curve with peak values of 120 to 125 dB for this type of measurement with sequential 185 ms long sine bursts. Below 100 Hz, the maximum level curve drops to values around 110 dB. If one wants to reach 120 dB or more here, then the combination with a 750 LFC subwoofer is a good idea.

A second maximum level measurement – that is somewhat more meaningful in practice – is the multitone measurement. The basis of the multitone signal consists of 60 sinusoidal signals with random phase, whose spectral weighting can be set as desired. For the X40's measurements, a weighting according to an average music signal (green curve) was chosen. For a measurement signal synthesized this way, its crest factor, which describes the ratio of the peak to average values, equals a practical value of 4 which corresponds with 12 dB.



Vertical isobars of the X40 in the 110 × 50 setting (Fig. 9)



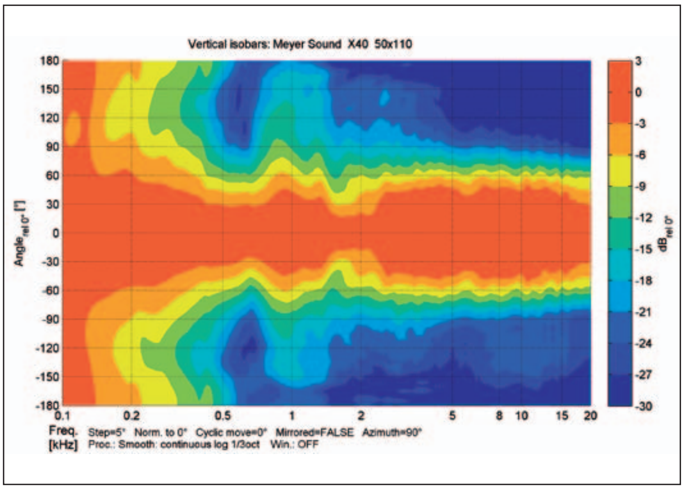
Horizontal isobars of the X40 in the 50 × 110 setting (Fig. 10)

For the sole distortion value derived from this type of measurement, all spectral lines that are not present in the excitation signal, in other words those that have been added as harmonic or intermodulation distortion, are summed together. In the graphic, these are the blue lines and their 1/6th octave banded sums. Like before, also with this type of measurement, the level is increased until total distortion (TD) reaches a limit of 10% where total distortion considers all harmonic distortion (THD) and all intermodulation distortion (IMD). When this stop condition is met, the X40 achieves a peak level of 129 dB and an average level of 116 dB for a typical music spectrum according to EIA-426B at a distance of 1 m in free field under full room conditions. The X40's data sheet states 132 dB peak level with the M Noise signal. With 18 dB, M Noise's crest factor is 6 dB higher than that of the multitone signal used here, which explains the higher peak level. For pink noise with a 12.5 dB crest factor, the data sheet states a peak level of 130 dB and is in good agreement.

Audio test Meyer Sound Ultra-X40

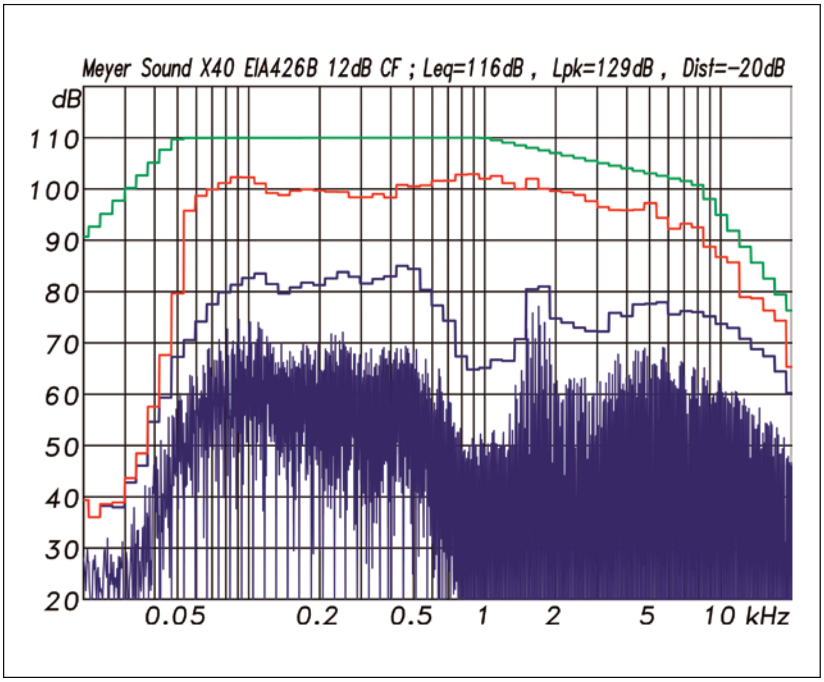
For the audio test, a simple stereo setup, consisting of two X40s (110 × 50) and two optional 750 LFC subwoofers, was used. The signal feed came from a Meyer Sound Galileo GALAXY loudspeaker management system without further filtering. The set up took place in a near anechoic room, which is not necessarily "typical", but has the advantage of having no influence whatsoever, so that the loudspeaker can be heard in its pure state – a state that is otherwise only possible outdoors. Certain properties such as directional behaviour or tonal neutrality can be assessed well with this approach without having to dissociate room influence. A further advantage of this acoustically "sterile" environment is comparability, as one always has exactly the same conditions for the audio tests.

Initially, the X40 was listened to by itself without the support of the subwoofers. Based on this audio test, these compact speakers can already be certified as full-range capable without restrictions. As expected, the listening impression was tonally neutral and balanced. So far, this would not be unusual, if there were not a precision in the tonal image that has rarely been heard before. It is difficult to say at this point, exactly what this characteristic is based on. This could be due to the largely linear-phase tuning or to the clearly defined radiation pattern over a wide range – or a combination of both. In the 110 × 50 setting, the speaker also ensures that there are only minor reflections from the sound-reflecting floor. During the audio tests, the main area in front of the loud-



Vertical isobars of the X40 in the 50 × 110 setting (Fig. 11) speakers was covered with Basotect absorbers (20 cm), but not completely.

Together with the 750 LFC subwoofers, the combination then adds a lot of bass. What the measurement already indicated was confirmed in the auditory impression: the bass was now very pronounced, which had a positive effect especially on rock music and EDM and provided the desired pressure. For somewhat more sensitive jazz recordings, however, it was perhaps a bit too much. What remained, however, was the precision in reproduction. The reason for this "pronounced" tuning is probably that the user expects not only an extended frequency range and more reserves for combinations with a subwoofer, but also a corresponding sound impression with more bass. This is exactly what has been achieved here, without at the same time crossing the boundaries of good taste.



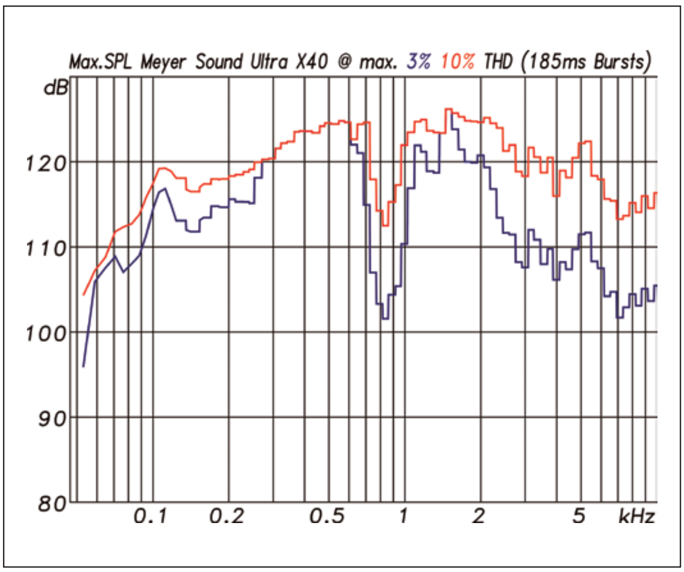
Multitone measurement of the X40 with an EIA426B spectrum and a crest factor of 12 dB. Based on a distance of 1 m in free field, 116 dB are achieved as average level and 129 dB as peak level (Fig. 13)

Summary

With the Ultra-X40 and X42, Meyer Sound is launching the successors to the legendary UPA models after more than 35 successful years. The bar for the new development was therefore high, as the UPAs were still good loudspeakers even at the end of their long life – speakers that were now to be improved with modern technology. In addition to new neodymium drivers, the electronics with DSP system and Class D amplifiers already known from the LEO product family were used for this purpose. Similar to the LINA line array, the X40 and X42 are now also designed with a concentric driver arrangement: a woofer with two 8" drivers and the well-known 3" compression driver (also from the LINA system) with its large horn (110 × 50 in the X40 and 70 × 50 in the X42). With this design approach, it was possible to perfect the directivity for a frequency range that is wide for the loudspeakers' size. Furthermore, the clever filtering and the high amplifier performance contribute to a successful overall concept that delivers the best measurement results and is more than convincing in the audio impression.

We should also not forget to mention the extensive range of accessories for set-up and installation. Together with the MAPP prediction software, the Galileo GALAXY loudspeaker management system platform and the Compass control software, the combined result is what ultimately distinguishes a professional sound reinforcement system from a simple loudspeaker. It is therefore not hard to predict that the Ultra X40 and X42 will also have a long future as an industry standard. ■

[11662]



Maximum level of the X40 for maximum 3% (blue) and 10% (red) total harmonic distortions (THD). All in all, the curve is even and practical. A weakness, which is caused by the tweeter, can be identified only at 850 Hz (Fig. 12)