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COLUMN LINE ARRAY

Voice-Acoustic Venia

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PA loudspeakers in the shape of slim columns offer low space requirement and inconspicuous appearance for small and medium sized venues while providing performance comparable to a line array. Installation and dismantling are simple and the purchase costs are comparatively low. Voice Acoustic meets the increasing demand with the powerful "Venia".

Text and measurements: Anselm Goertz | Photos: Anselm Goertz, Voice Acoustic (2), Reto Streit, BCM Veranstaltungstechnik (1)

Elegant appearance, fast set-up and dismantling, reliable and powerful performance - Stefan Rast from Voice-Acoustic recognised this demand some time ago when he started developing the VENIA series together with Henry Dahmen. By the beginning of 2022, four loudspeaker models had thus been created in the series: The VENIA-8 with a 4x8"+4x1" configuration and the VENIA-6 with a 4x6.5"+3x1" configuration. Both are available in a self-powered version as well as for operation with a separate system amplifier. The larger VENIA-8 is always actively driven and therefore requires two amplifier

Typical conference application Venia on its extension

channels. The smaller VENIA-6 has an internal passive crossover and can be driven with only one amplifier channel. Both VENIAs utilize a curved tweeter line in the form of a mini-line array that covers an angular range from 0° to -20° and is equipped with 3 or 4 drivers. The woofers are arranged in a straight line and cover the frequency range below 1 kHz, resulting in a vertically narrow and horizontally wide dispersion system. The horizontal coverage angle is given in the data sheet as 100°. Due to the slightly vertically inclined dispersion of the tweeter unit, the VENIAs are ideally suited for placement on a stage in front of a slightly rising or flat audience area. Designer Henry Dahmen recommends aligning the columns with the top tweeter facing the last row of the audience. The 20° downward-opening dispersion angle then usually reaches the first rows as well. The principle of operation is thus similar to a line array, except that the curving and the length are fixed.

Benefits of the column concept

The big advantage of column loudspeakers compared to conventional line arrays of compact design is therefore mainly the easy handling and the small space requirement. Even the larger of the two VENIA models with the 4x8" configuration has a cabinet width of only 245 mm. The height of the enclosure is 1336 mm. With a weight of 35 kg (self-powered 40 kg), handling is also sufficiently easy thanks to a variabel number of handles that can be attached in various positions at the backside at one of the many threading inserts, or omitted completely. The smaller VENIA-6 weighs 27.9 kg and has a height of 1,050 mm and a width of 213 mm.

Besides the size, there is also a small difference in the acoustic concept between the two models. The VENIA-8 is designed as a “real” top unit for high levels and long ranges and requires subwoofers for support below 100 Hz for full-range use. The smaller VENIA-6 with long-throw woofers, on the other hand, reaches further down and can be used without a subwoofer if necessary, but does not reach the high maximum levels and range of the VENIA-8. However, following this evaluation a full-range setup was also announced for the 8 which covers speech applications very well, but also takes music recordings into account. Typical

Near-field measurement directly in front of the cone of one of the four woofers

applications for the VENIA-6 would therefore be conference rooms, hotel bars, school auditoriums, DJ monitors and much more. A pair of large VENIA-8s together with a number of subwoofers, on the other hand, already forms a quite powerful PA, as required by top-40 or gala bands and for DJ acts. Stefan Rast reports that a pair of VENIA-8s is often combined with 8 to 12 18"-subwoofers and is then sufficient for stages with up to 1,500 people.

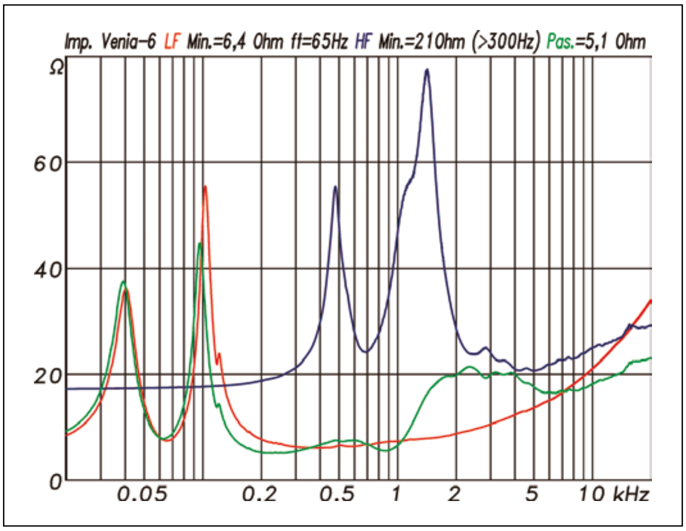
Accessories

For mobile operation as well as for fixed installations, besides the acoustic quality of the loudspeakers, the available accessories for set-up or mounting are an important aspect. Voice-Acoustic offers a wide range of accessories, starting with cases or transport bags for mobile use, U- and C-brackets for mounting as well as various ceiling and wall brackets up to the X-Tension Kit. The latter is a column-shaped base in the shape and dimensions of the VENIA-8 or VENIA-6, which is attached either to a steel base plate or to a subwoofer to raise the VENIA to the required height. Compared to a stand rod or other constructions, the X-Tension Kit provides an elegant and tidy appearance. It is mounted on a subwoofer via an M20 thread and connected to the VENIAs via a stacking adapter that is fixed to the bottom of the speaker and secured to the X-Tension with locking bolts. The cabling can be routed invisibly downwards inside the extension.

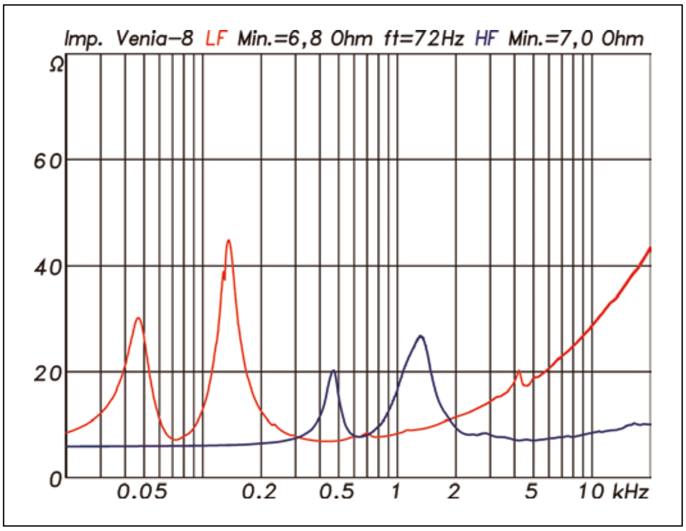
All subwoofers in the Voice-Acoustic range can be used to extend the low frequency range of the VENIAs. Crossover frequency and phase are always compatible. The usual models are the Paveosub-118 with a 1x18" or the Paveosub-218 with a 2x18", which, like the VENIAs, are available for use with external amps or in a self-powered version with or without a Dante interface. Details about the Voice-Acoustic system amplifiers can be found in the corresponding subchapter.

Measurement data

In order to get an overview of the speakers' characteristics, the VENIAs were first measured without the associated system amplifier. Figures 1 and 2 show the impedance curves of the LF and HF path and for the VENIA-6 also for the complete speaker with passive crossover. Both VENIAs work with four woofers each, which are connected in series and in parallel as an 8 Ω unit. The impedance minima for a nominal 8 Ω loudspeaker are 6.4 Ω and 6.8 Ω respectively. Differences between the two VENIAs can be found in the concept of the tweeter unit. The tweeter arrays, equipped with drivers from the Bulgarian manufacturer Oberton, work in the VENIA-6 with three drivers connected in series and in the VENIA-8 with four drivers in series-parallel connection. The relatively high-impedance tweeter section in the VENIA-6, with 24 Ω nominal impedance, offers some advantages in the design of the passive crossover and also brings the significantly louder tweeters somewhat in line with the woofers in terms of level.



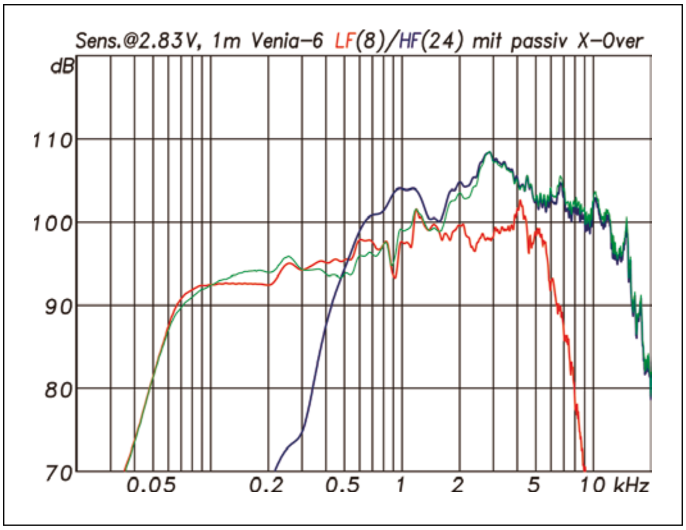
Impedance curves of the VENIA-6 LF (red) and HF (blue) paths. measured individually without crossover and as a complete system with crossover (green), the three 8-Ω tweeters are connected in series here. (Fig. 1)



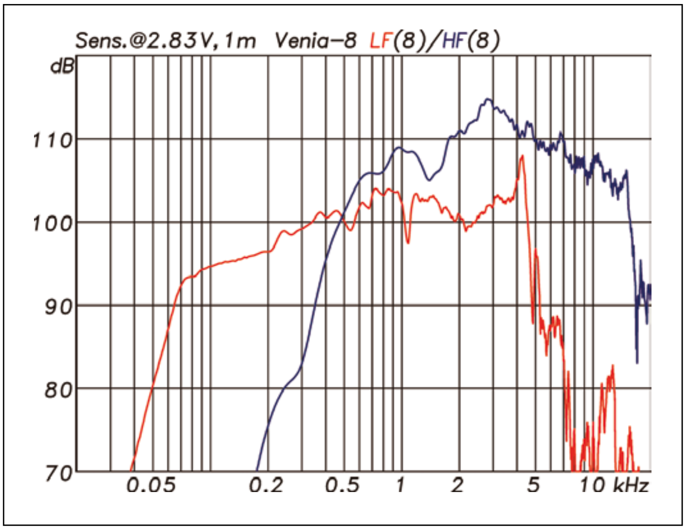
Impedance curves of the VENIA-8 Both paths LF (red) and HF (blue) have a nominal impedance of 8 Ω due to the series-parallel connection of the drivers. There is no passive crossover in the VENIA-8. (Fig. 2)

The curved tweeter arrays are made up of Oberton's WS4 elements, which are already designed for use in line arrays and are equipped with ND2545 neodymium drivers. The three or four WS4 elements span a total angle of 20°, with the top element perpendicular to the front of the cabinet defining the 0° axis. In total, this results in a nominal dispersion angle of 0° to 20°. In the VENIA-8, both paths are always driven directly by the system amplifier. The VENIA-6, on the other hand, is equipped with a passive crossover and requires only one channel of the system amplifier. For the passive version with crossover, the impedance curve drops slightly compared to the single paths, resulting in an impedance minimum of 5.1 Ω, which should be kept in mind at least in the case of parallel connection of several VENIA-6 to one amplifier channel.

The pure frequency responses of the VENIAs without system amplifier can be found in Figures 3 and 4. The level values in the graphs refer to 2.83V/1m throughout, so that the tweeter unit of the VENIA-6 initially appears



Frequency responses of the VENIA-6 LF (red) and HF path (blue), each measured without crossover and as a complete system with crossover (green). By displaying the sensitivity in relation to 2.83 V/1 m the curve for the 24-Ω HF path is 4.77 dB lower compared to the value 1 W/1 m. (Fig. 3)

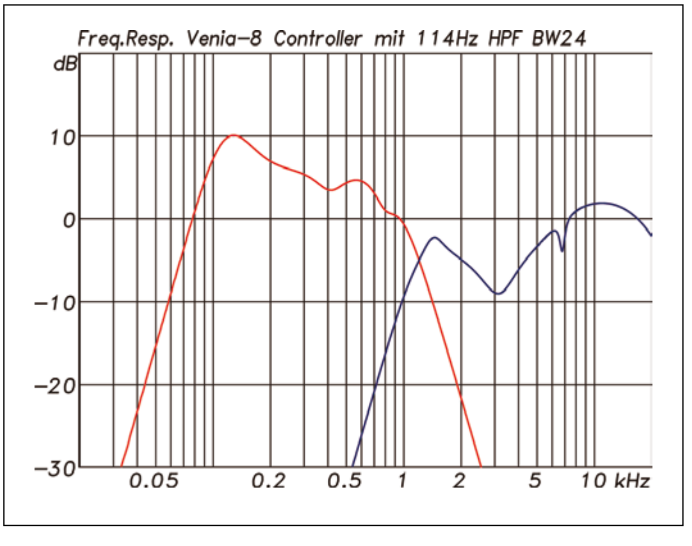


Frequency responses of the VENIA-8 LF (red) and HF (blue) paths measured individually without filters. Both paths have a nominal impedance of 8 Ω, so that the sensitivity of 2.83 V/1 m corresponds to the 1 W/1 m value. (Fig. 4) unusually quiet in comparison, which is explained by the 24 Ω series connection. For a direct 1W/1m comparison, 4.77 dB have to be added. For both VENIAs, the individual measurements of the LF and HF sections show widely overlapping frequency ranges that allow for good interaction.

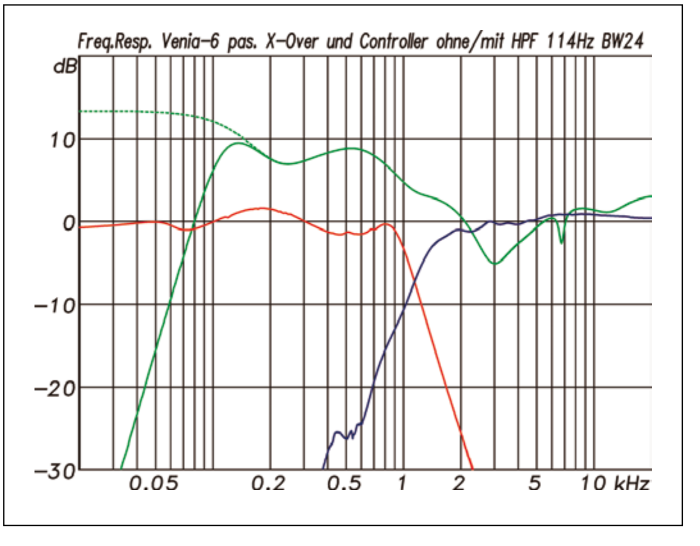
The frequency responses of the woofer units show the conceptual differences of the VENIA-6 and -8. The 8" drivers of the VENIA-8 achieve an average 5 dB higher sensitivity between 100 Hz and 1 kHz. Below 100 Hz, however, the two curves quickly converge, as the smaller 6.5" drivers of the VENIA-6 are tuned lower at 65 Hz than the 8" drivers of the VENIA-8 at 72 Hz. The low tuning of the 6.5"s is possible thanks to the soft suspension and the large linear excursion of the diaphragms. The latter, however, is at the expense of sensitivity.

System amplifier

Same as the Paveo subwoofers, the VENIAs offer a choice between a self-powered version with integrated electronics and models that are operated with a system amplifier. There is no difference in their acoustic characteristics, as the power amplifiers and the DSP system are identical. The power amplifiers used are X-Pro modules from the Danish manufacturer Pascal Audio, the DSP is from ALLDSP in Hamm. Inside the self-powered VENIAs there are X-Pro2 modules with 1x 2400W and 1x 800W power at 4 Ω. In the VENIA-8, the large power amplifier supplies the woofers and the smaller one the tweeter unit. The VENIA-6 is also equipped with the passive crossover in the self-powered version and then only requires the 2400W path of the power amplifier. The second unused channel is led out and can be used independently to operate another passive speaker, e.g. monitors or fills. Regardless of this, a second passive speaker without its own electronics can still be connected in parallel to the VENIA-6 and also to the VENIA-8 via a Speakon connection. The available power per speaker is then not as high, but this is not always needed. The two test systems were delivered together with an HDSP-6A system amplifier, which is equipped with two X-Pro3 modules and two DSP systems. Both units operate completely independently of each other, right down to the power switch. For the VENIA-8, one channel with 2400 W and one with 800 W are also required. For the VENIA-6, it is possible to operate it either on a “large” 2400 W channel or on one of the two “small” 800 W channels.
A full load is no longer possible, but there is the attractive possibility of operating a stereo + mono subwoofer set via a three-channel amplifier module, where the 2400W channel then feeds the subwoofer.



Frequency responses of the filters in the system amplifier for the VENIA-8, LF (red) and HF (blue). For the combination with a subwoofer, a 4th order high pass filter is set in the standard setup. (Fig. 5)



Frequency responses of the internal passive crossover for the VENIA-6, LF (red) and HF (blue). The passive filters are only used for the X-Over function. The system equalisation is then done for the box as a whole via the DSP in the power amp (green).
As with the VENIA-8, there is also a 4th order high-pass filter for the combination with subwoofers. (Fig. 6)

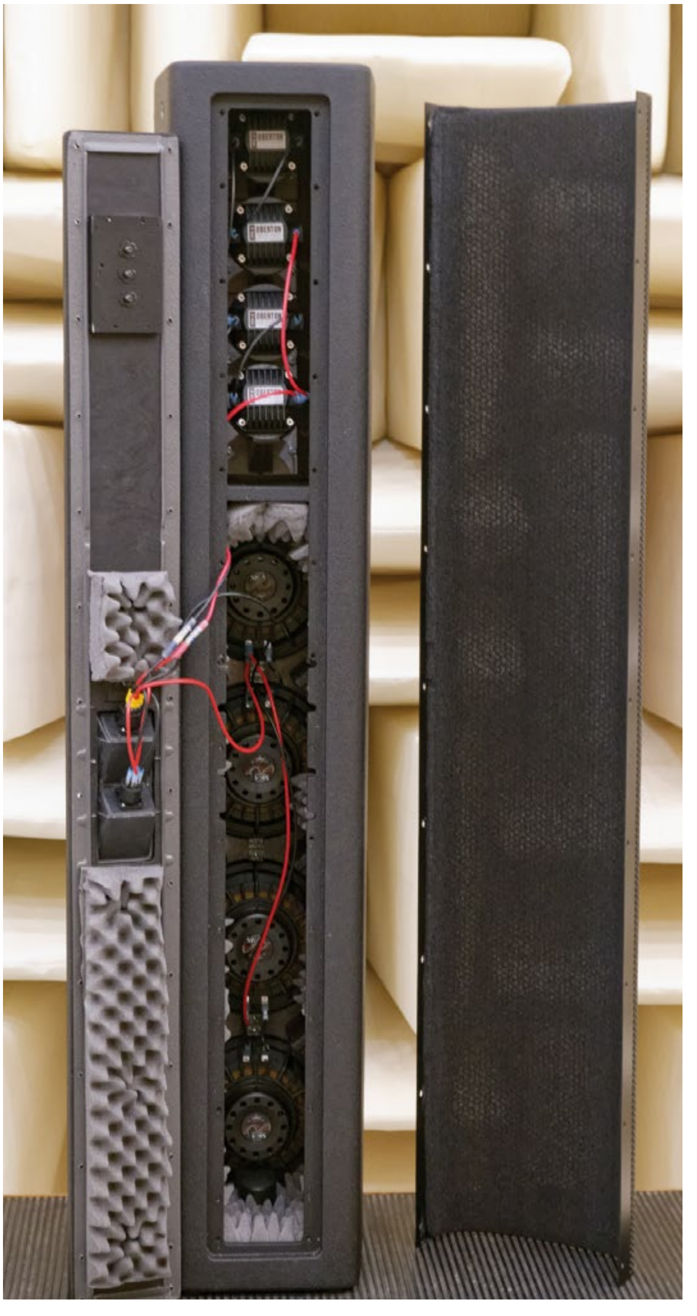
Figures 5 and 6 show which filter functions are set in the DSP systems. For the VENIA-8, there is only one variant including high-pass filtering for crossing over to the subwoofer at 100 Hz. For the VENIA-6, the high-pass filtering could be shifted to a lower cut-off frequency if operation without a subwoofer is desired. Which cut-off frequency is set for the high-pass filter is at the discretion of the user and the task of the loudspeaker. The lowest reasonable setting is about 50 Hz. Fig.6 shows the filter curve, once with high-pass filter for the 100 Hz cut-off frequency and once completely without high-pass filter. On the subject of electronics, it should be mentioned that both the system amplifiers and the self-powered loudspeakers are available in a version with or without a Dante interface.

As the latest and third variant, there is also the option of using the VENIAs with Powersoft amps and Armonia+ setups provided by Voice-Acoustic, which should certainly be an interesting alternative for one or the other rental company with Powersoft equipment.

Overall system

Let's look at the VENIAs as a complete system with system amplifier or in the self-powered version. VENIA-6 (Fig.8) and VENIA-8 (Fig.7) are very similar across the whole frequency response with high pass filter. Only in the high-frequency range above 5 kHz does the VENIA-8 show a slight high-frequency boost of 2-3 dB, which is useful at greater distances from the audience to compensate for air attenuation. The VENIA-6's frequency response without high-pass filter is also shown, which clearly shows that the speaker can be used down to about 50 Hz if required. However, a high-pass filter should be set there at the latest.

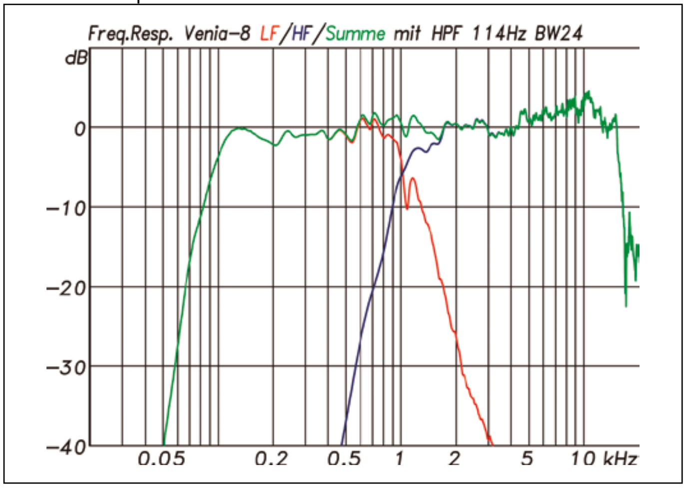
If we take a look at the VENIA-8's phase response and spectrogram as a representative, there are no conspicuous features here either. The two paths match very well in phase around the crossover frequency at 1 kHz and then add up accordingly to a straight course in the sum. The spectrogram shows some small resonances in the working area of the woofers. Despite the complex construction with four drivers, the tweeter unit works almost perfectly and shows no resonances, which speaks for the good choice of drivers as well as for the waveguide.



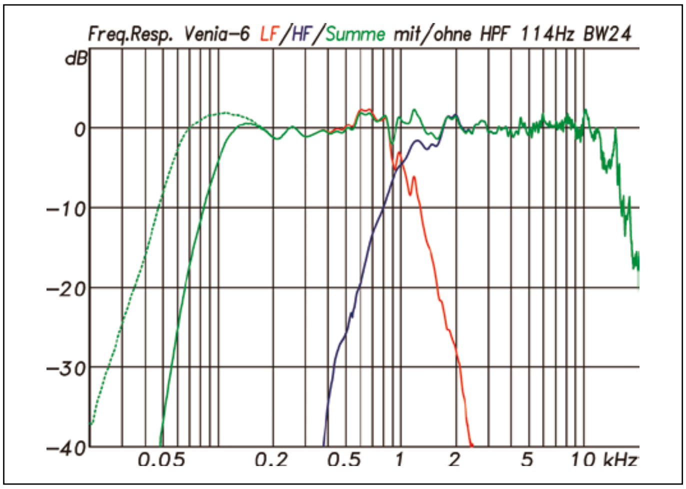
A peek inside Venia-8

Directivity

For the visualisation of the directivity, only the measurement results of the VENIA-8 are shown, which differ only insignificantly from those of the VENIA-6. The data sheet shows a nominal directivity of 100° horizontally and 0° to -20° vertically. The vertical dispersion below 1kHz is determined below by the linear arrangement of the four woofers and above 1 kHz by the four tweeters, which are curved from 0° to -20°. The downward tilted dispersion therefore only applies to the tweeter's working range. The horizontal



Frequency response VENIA-8 as a complete system with the associated system power amplifier. The crossover between the two paths is at 1 kHz. The slight boost at 10 kHz should be useful with regard to longer ranges. (Fig. 7)

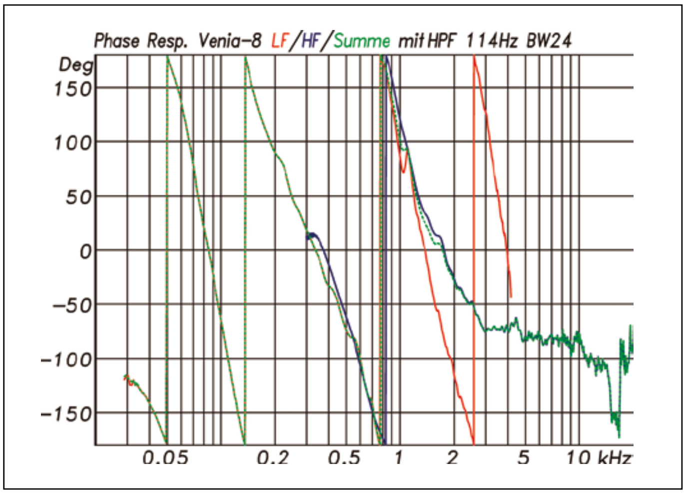


Frequency response VENIA-6 as a complete system with the associated system power amplifier. The overall response is very balanced, which is also reflected in the listening impression. (Fig. 8)

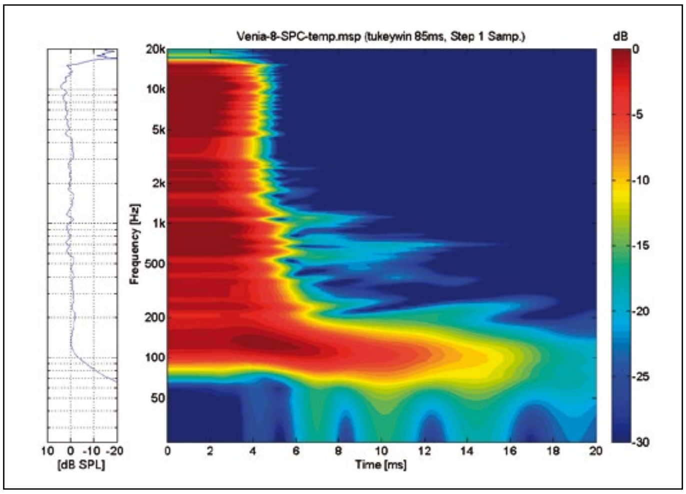
aperture angle is determined by the radiation pattern of a woofer and by the aperture angle of the waveguide in front of the curved tweeter line source.

The isobar graphs in Figures 11 and 12 show that the concept works. Horizontally, the 100° are well maintained from 2 kHz up to about 10 kHz. For even higher frequencies, the isobars then tighten slightly. Below 1 kHz, the dispersion inevitably widens, as it is only influenced by the cone size of the woofers and the cabinet width. Narrowing the dispersion in this frequency range would have required a different concept, e.g. cardioid radiators, which would have made the speaker weaker in the bass.

In addition to the isobars, the Spinorama graph in Fig.13 is also worth a look. In addition to the frequency response on axis, the spinorama also shows an average frequency response in the typical listening window, the angular range where listeners are typically located, and which should therefore adhere as close as possible to the on-axis response, for the angular range of early reflections and for the sound power level. Due to the directivity of the loudspeaker, the latter two curves drop more or less compared to the on-axis curve. Particularly important is that the curves for the sound power level and its Directivity Index (DI) should run as evenly as possible over a wide frequency



Phase responses of the VENIA-8 separately for the two paths LF (red) and HF (blue) and for the entire system (green).
The phase responses coincide over a wide range around the crossover frequency, so that the two paths add up optimally. (Fig. 9)

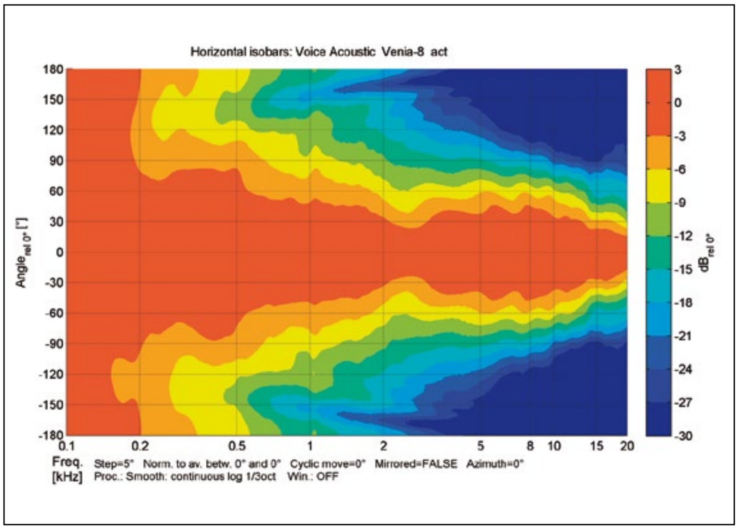


Spectrogram of the VENIA-8 with some small resonances in the working range of the woofers.
Despite the complex construction with four drivers, the tweeter unit works almost perfectly. (Fig. 10)

range and not show any outliers. Towards low frequencies, where the directivity of the speaker decreases, both curves will converge, which means the DI is approaching 0, which again should happen as evenly as possible. The VENIA-8 fulfils both requirements perfectly, so that early reflections, if any, as well as the diffuse field in the room are tonally similar to the direct sound component and do not lead to sound colouration. In the listening window, the frequency response changes only slightly compared to the response on axis.

Maximum level

For the maximum level measurements, the well-known method with sinusoidal burst signals was used first. For frequencies below 1 kHz, 171 ms long burst signals were used, and above 1 kHz 85 ms long bursts were used. At lower frequencies a longer time is required to achieve sufficient

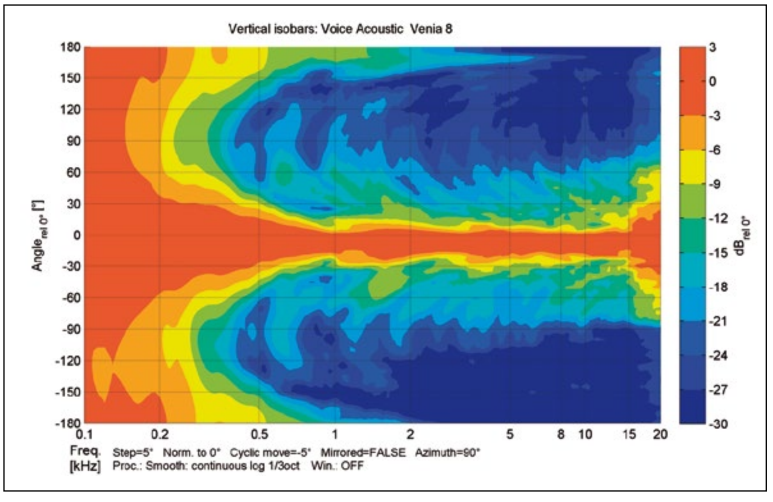


Horizontal isobars of the VENIA-8 The data sheet specifies a nominal radiation angle of 100°, which is well maintained on average. (Fig. 11)

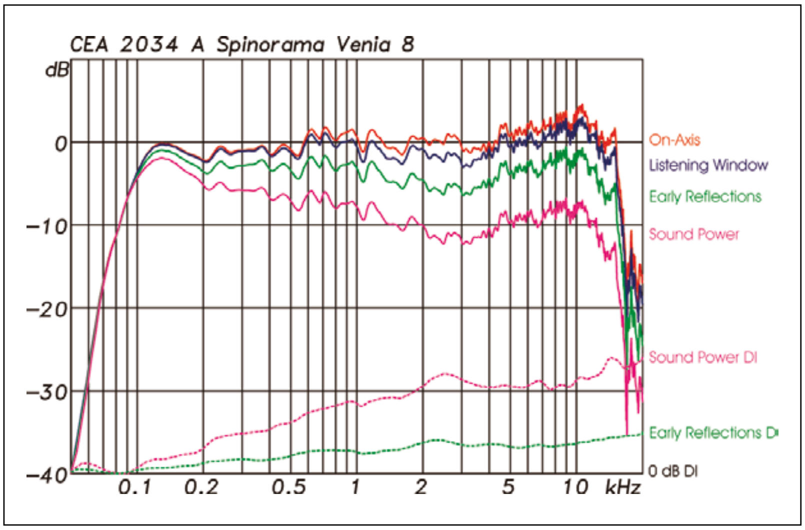
The challenge of vertical measurement

For the vertical isobar display a little trickery was necessary. The measuring distance from the speaker's centre of rotation to the microphone is 8 metres. However, the 0° axis of the tweeter unit is at the top edge of the 1.33 m high cabinet, so that there is already an angle to the microphone of barely 5°. That means for the tweeter the 0° measurement is actually already the -5° measurement. The measurements for the isobar graph in Fig.12 were therefore shifted by 5°. This is not quite correct either, because the problem for the woofer is by far not as pronounced, but has the opposite effect. From a measurement point of view, one could circumvent this problem in three ways.

1) Measure at a much greater distance, but this is unrealistic as there are no such large measuring rooms.
2) By taking separate measurements for the tweeter and woofer units, each of which would then be rotated around its own centre. This would require building two separate enclosures for the woofers and tweeters for a speaker of this size, which could then be centred on the machine. The overall behaviour could then be computed correctly from the two measurements and via data of the geometric conditions in the box.
3) By performing a near-field scan of the entire box and calculating the spherical harmonics to describe the radiation behaviour. This would be exactly comparable to 2), but very time-consuming and expensive to carry out. As can be seen from the isobars in Fig.12, method 1) is a good compromise at a reasonable cost, which represents the vertical radiation behaviour very well.



Vertical isobars of the Venia-8 with a nominal aperture angle of 0°.-20°. The measurement series was shifted by -5° because the main radiation axis of the tweeter at the upper end of the cabinet already has an angle of 5° at 8 m measurement distance (Fig. 12).



Spinorama of the VENIA-8 with exemplary parallel offset curves. (Fig. 13)

frequency resolution in an FFT based evaluation. In this measurement the harmonic distortions are evaluated, for which limits of a maximum of 3% and 10% were set. The sound pressure level achieved at these distortion limits, referred to 1 m distance in free-field for the full-space, then results in the final measured value.

Fig. 14 shows the SPL values over frequency achieved by a VENIA-8 using this measurement method. Where both curves coincide, the 10% distortion is not reached before a limiter in the DSP intervenes.

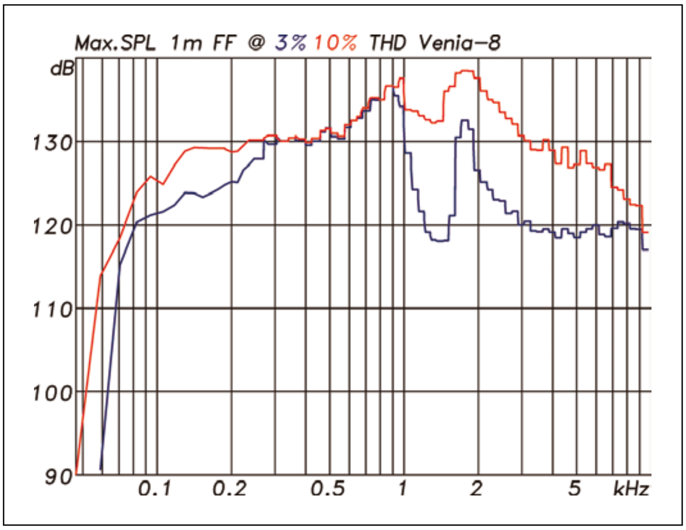
Although this measurement is not very meaningful for the values that can be achieved in practical use, it is very well suited for pointing out weak points. Ideally, the curves measured in this way should run as evenly as possible and not show any major dips in their course. The VENIA-8 does this very well. If anything, there is a small weak point at 1.5 kHz, but it is not of major importance.

The second series of measurements on the topic of maximum level uses the well-known multi-tone signal with an EIA-426B spectrum and 12 dB crest factor for measuring the maximum level. The limits for this measurement are defined in such a way that the distortion may not exceed -20 dB (10%) and the power compression of several adjacent frequency bands may not exceed 2 dB or in individual bands with a width of 1/6 octave may not exceed 3 dB.

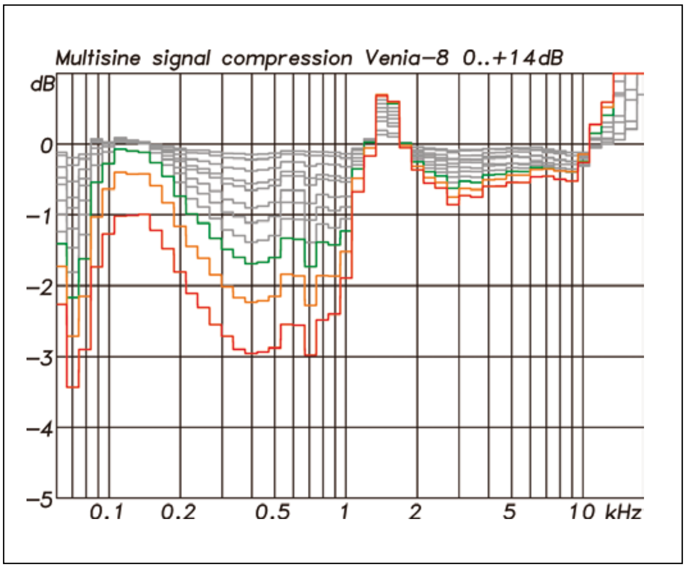
For the series of measurements in Fig.15, the level was first increased in 2 dB steps and then in 1 dB steps up to +14 dB, starting in the linear working range of the loudspeaker at 0 dB signal level and a sound pressure of 116 dB referred to 1 m distance. The curves in Fig.15 show the level loss for these measurements compared to the calculated value for

Tweeter unit of Venia-8 with four line array elements WS4, equipped with ND2545 drivers

Venia-6 and Venia-8 in direct comparison

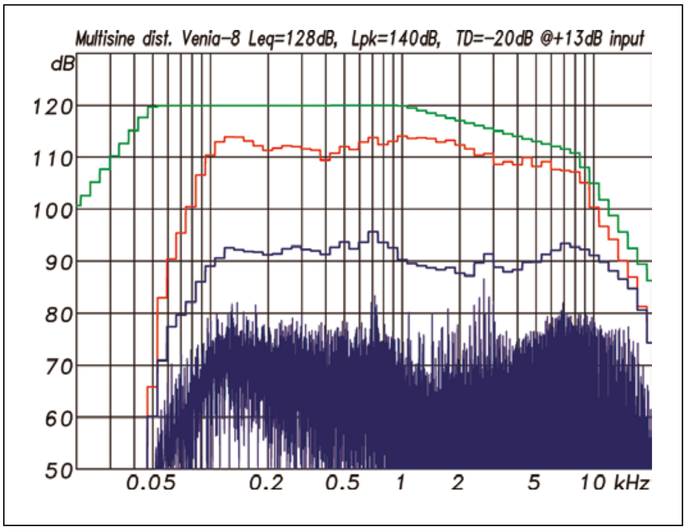


Maximum level with sine burst signals for maximum 3% THD (blue) and for maximum 10% THD (red). For the woofers the level is limited from 300 Hz upwards by the limiter in the power amplifier. (Fig. 14)

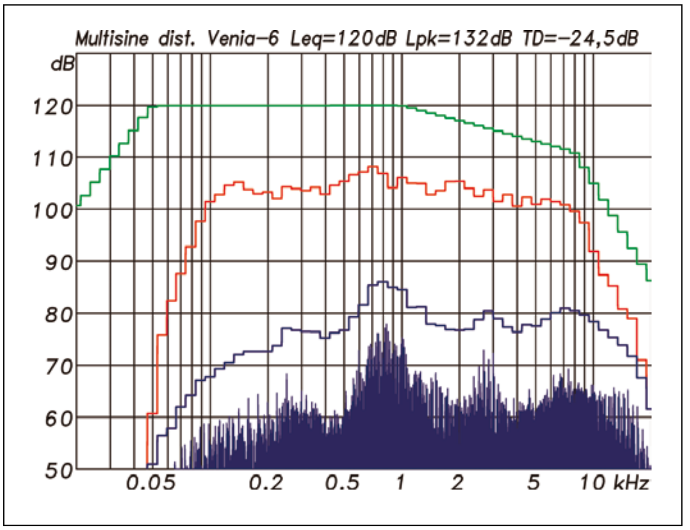


Power compression VENIA-8 with a multitone signal and EIA-426B spectrum starting at an average L_{eq} level of 116 dB. Based on this reference measurement, the input level was first increased in 2 dB steps and then in 1 dB steps up to a total of 14 dB. The green curve shows the progression at +12 dB and the red curve at +14 dB. If a broadband power compression of maximum 2 dB is allowed, then the red curve clearly exceeds the limit, whereas the green curve still shows some headroom. The measurement for the graph in Fig. 16 was therefore derived from the orange curve as a compromise. (Fig. 15)

the level range from 0 dB to +14 dB. The green curve was determined at +12 dB, where the system of amplifier and loudspeaker still works well within the limit of maximum 2 dB compression. The orange curve then slightly exceeds this value and the red curve clearly in the working range of the woofers. The sound pressure measured for the orange curve as average level L_{eq} is 128 dB and the peak value L_{pk} 140 dB (Fig.16). Fittingly, the distortion level here is also exactly -20 dB. These figures also refer to full-space at a distance of 1 m. The data sheet gives a value of 139 dB peak, so there is good agreement here.



VENIA-8 intermodulation distortion with a multitone signal with EIA-426B spectrum and 12 dB crest factor for a maximum of 2 dB power compression or a maximum of 10% total distortion. In relation to 1 m in free-field, a level of 128 dB as L_{eq} and 140 dB as L_{pk} is achieved. (Fig. 16)



Direct comparison of VENIA-6 intermodulation distortion. At 1 m in free-field, the VENIA-6 reaches a level of 120 dB as L_{eq} and 132 dB as L_{pk}. (Fig. 17)

An identical measurement for the VENIA-6, also limited by the maximum compression of the signal, yields a peak value L_{pk} of 132 dB and an average level L_{eq} of 120 dB. The peak level is just 2 dB below the value in the data sheet. However, the distortion is only -24.5 dB. If one were to disregard the limitation by the signal compression and look only at the the -20 dB distortion limit, then 134 dB peak value would also be reached. (Fig. 17).

Listening test

The listening test took place in the familiar way with both VENIA systems in an anechoic chamber. Despite or perhaps due to its not quite typical room acoustics, the room is well suited for listening tests. There are hardly any influences of any kind from the room, the room's behaviour is always the same and it allows listening at distances of up to 8 metres. In addition, due to the absence of a diffuse field, the loudspeakers have to be quite powerful for high levels, which meets the requirements of a PA loudspeaker.

Both VENIAs were characterised by a very even and pleasant high-frequency reproduction even at high levels during the test. Developer Henry Dahmen explains that this was exactly his goal and that he found the right drivers at Oberton after a long search. The dispersion behaviour from 0° to -20° was easy to follow, where outside this angle the entire mid-high range was almost faded out.

Also available
selfpowered version

System Amplifier HDSP-6A with proven Pascal modules

Particularly with the VENIA-8, its reputed long range could be easily be verified by an absolutely precise and direct delivery to the listener. As expected, the VENIA-8 didn't produce any low bass, as operation below 100 Hz is not intended and it should be supported by one or better several subwoofers. The not so powerful VENIA-6, on the other hand, was able to elicit quite respectable bass with a high-pass filter lowered to 50 Hz, which meant that the sound was moving in the direction of a large hi-fi system. If no extreme levels are required and if the system should be suitable for music without a subwoofer, then the VENIA-6 should be the first choice. If level and range are important, then VENIA-8 with a suitable number of subwoofers would be the right choice.

Conclusion

With the VENIA-6 and VENIA-8, Voice-Acoustic, a manufacturer based in Dörverden in northern Germany, expands its well-structured and comprehensive product range with two column line array speakers. This still relatively new type of speaker closes a gap between classic point source systems and line arrays. The two models with a 4 x 6.5" or 4 x 8" configuration plus 20° tweeter unit cover many typical applications and provide the user with a highly effective yet easy-to-use tool. The performance of the VENIA-8 in particular, together with appropriate subwoofers, is easily sufficient for typical city halls and smaller open-air venues. The very good acoustic properties are rounded off by a wide range of accessories and an all-round professional build quality that leaves nothing to be desired for both mobile use and fixed installations. Both VENIA models and the matching subwoofers are available with external system amplifiers or self-powered versions with completely integrated electronics. The often-discussed question of self-powered or not is therefore not a decision making criterion with Voice-Acoustic, as everyone can choose one or the other variant according to their preferences, and those variants are also 100% compatible with each other and can be combined in any way. ■