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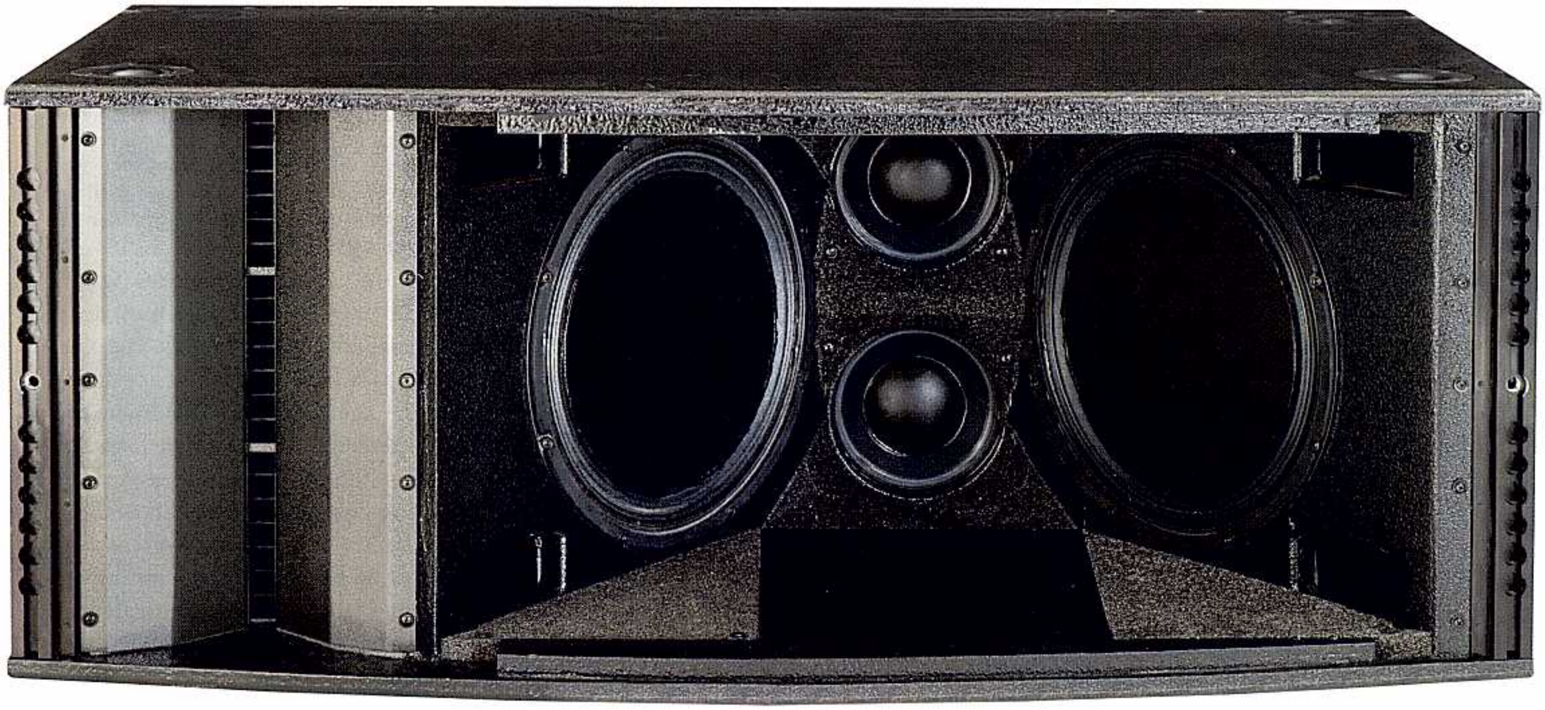
Professionelle Studio- und Bühnentechnik



Line Array

Electro-Voice X-Line

Electro-Voice, too, is following the trend towards line arrays and has developed the X-Line linear sound reinforcement system, which at the moment comprises two different primary enclosures and a subwoofer.

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Photos: Anselm Goertz

That the two X-line models making their debut at the ProLight+Sound were not simply prototypes or laboratory samples was something of which visitors to the show could satisfy themselves by visiting the Powerhouse, an auditorium that had been created in one of the ground floor exhibition halls at the trade fair. There the sound company TSE AG of Berlin, who were responsible for providing the sound reinforcement for the Powerhouse, had set up the first of their newly acquired X-Line systems in front of the eyes of the music trade visitors.

"Not another line array," might be the response of some sound engineers. The trend towards line arrays that began several years ago when L-Acoustics (with no great fanfare) introduced their V-DOSC has really taken off this year, seeing the launch of numerous new models. Some manufacturers have chosen to follow the classic V-DOSC formula of an axis symmetrical arrangement of the two- or three-ways, with the HF components in the centre flanked by the mid-bass components immediately next to them and the LF components on the outside. Electro-Voice has chosen to adopt a different approach, deliberately dispensing with the coaxial arrangement of the acoustic centres of all three ways in order to achieve improved directionality and horn functioning in the individual bands, and this represents an interesting alternative.

Linear sound sources vs. rows — the theory in brief

The fundamental principles underlying the functioning of a line array were explained in detail in the 4/01 edition of PRODUCTION PARTNER, so only a brief introduction is offered here. The term 'line array' as it is used in the science of acoustics refers to a source of sound that is continuous, infinite in length and that radiates uniformly throughout its entire length. A line array that satisfies these criteria will generate a cylindrical wave front that, as a result of the infinite extent of the line, retains its shape regardless of its distance from the source. In reality there are certain limitations. Since a real line array is finite in

extent, in discussing the shape of the wave front, we must distinguish between the nearfield and the far field. In the far field, which roughly begins at

$$r > \frac{L^2}{2\lambda}$$

the wave front even of a line array is spherical. L is the length of the array and _ the wavelength.

The condition for a genuine line array is fulfilled when all the individual transducers with their acoustic centres are close enough together in relation to the wavelength to create a coherent (i.e. in-phase) wave front. For low frequencies that poses no problem whatsoever and can be satisfied by a simple row of normal directly radiating cone loudspeakers. It becomes critical on the other hand in the case of higher frequencies where this condition can no longer be fulfilled with individual drivers and horns. The key element in the design of line arrays is therefore the wave guide, which causes all portions of the sound radiating from a diaphragm to arrive at the slit-like opening at the front at the same time in order to create a flat wave front or 'plane wave'. In all line arrays, this slit runs the entire length of the enclosure so that as one box is stacked upon another the line extends to form a single seamless entity. In this way, interference between the individual sound sources can be avoided as far as possible.

Another principle that holds true for line arrays is that in the horizontal plane the directivity of the array is no different to that of its individual elements, whereas in determining the directivity in the vertical plane, the length of the array is of critical importance. Unlike a simple row of speakers, a linear sound source radiates along its entire length as a single coherent unit. Spatial aliasing effects in its directionality and the divergence from one another of individual sources with ugly phasing effects are therefore avoided, although the entire length of the array is still always active.

The components of the X-Line

The Electro-Voice X-Line consists of four components: a 90∞ top enclosure, a 120∞ top enclosure, a downfill and a subwoofer. In the case of the first two, the Xvls and Xvlt, their names give an indication of their shape and function: 'VL' stands for 'vertical line-array' and the 'S' and 'T' stand for 'square' and 'trapezoidal' respectively. The square enclosure has a horizontal dispersion of 90∞, whereas the trapezoidal enclosure, with a 2.5∞ angle either side, has a horizontal dispersion of 120∞. The reason for the difference in shape of the two enclosures relates to the position they occupy in the array, where typically you will have the 90∞ boxes at the top to cover the far field i.e. the back of the hall (hence their narrower horizontal dispersion) – these boxes usually form a straight line or else there may be a small vertical angle between one enclosure and the next — and the 120∞ boxes curving away from the audience at the bottom so that the entire array forms a 'J'. The wider horizontal dispersion of these trapezoidal boxes is explained by the fact that they are designed to cover the middle-to-front portion of the listening area. For the seats at the very front, that is to say almost directly underneath the flown array, a downfill enclosure, called the Xfil, is provided. It, too, has a 120∞ angle of horizontal dispersion and an asymmetrical wave guide directing the sound downwards. At the time of the test, the Xfil was not yet available, so we will only concern ourselves here with the Xvls, the Xvlt and the Xsub subwoofer.

Rigging system

Each X-Line enclosure is 49 inches (1244.6 mm) wide, 29.115 inches (740.4 mm) deep and 19.5 inches (495.3 mm) high. The Xvls weighs 257 lbs (117 kg), the Xvlt 253 lb (115 kg) and the Xsub 202 lbs (92 kg). There are four generously dimensioned handles recessed at the sides and all enclosures come with rigging hardware to allow them to be flown. The subwoofer alone is available optionally without rigging hardware. The rigging system is based on a system of linking hinges at the back and short chains or metal linking straps at the front. The linking straps at the front allow you to vary the angle between each pair of boxes in 1∞ increments. The range is 0∞-7∞ in the case of the Xvls tops and 5∞-10∞ in the case of the Xvlt tops. The entire cluster is attached to the grid at the top by means of short chains or 'grid straps'. The grid straps at the front allow the angle between the top box and the grid to be varied. Needless to say, all the rigging hardware is held securely together by means of four aluminium bars running top to bottom between the rigging tracks, internally at the back but open to view at the front, to minimize the stress on the wooden enclosures. A maximum of 14 enclosures can be flown in a vertical array with an 8:1 design factor.

As an alternative to the American grid from ATM, a grid is being developed by Marcel Fery that will also allow ground stacking. Unlike the ATM grid, this grid will use hinge elements to fasten the boxes at the back. This will afford a high degree of stability to the entire array even when it is heavily tilted. There will be rigging points on this grid to allow the flexibility of both horizontal and vertical configurations.

For transportation, a dolly is provided that clips on to the front of the enclosure ser-

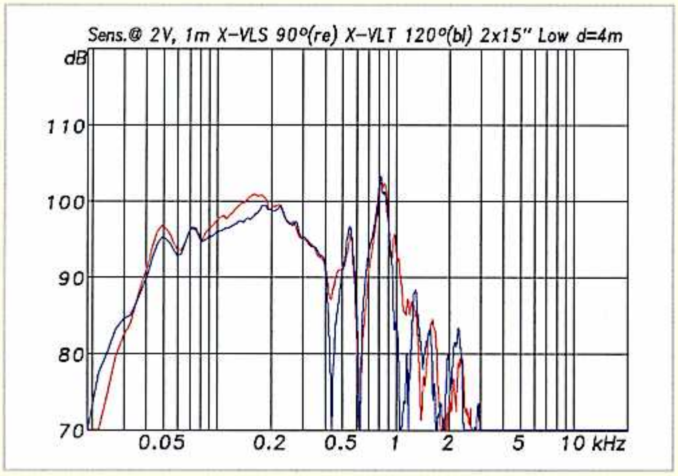


Fig.1: Frequency response with sensitivity of the 2 x 15" bass drivers of the 90° (red) and 120° (blue) enclosures. The undulations beneath 100 Hz are artefacts of the measuring room.

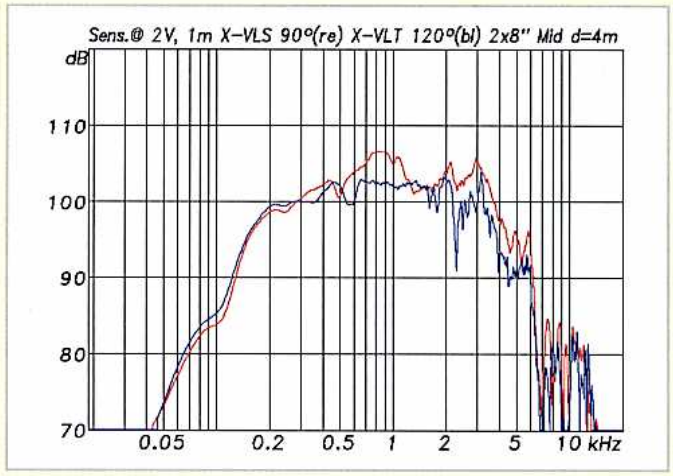


Fig.2: Frequency response with sensitivity of the 2 x 8" mid-bass drivers of the 90° (red) and 120° (blue) enclosures

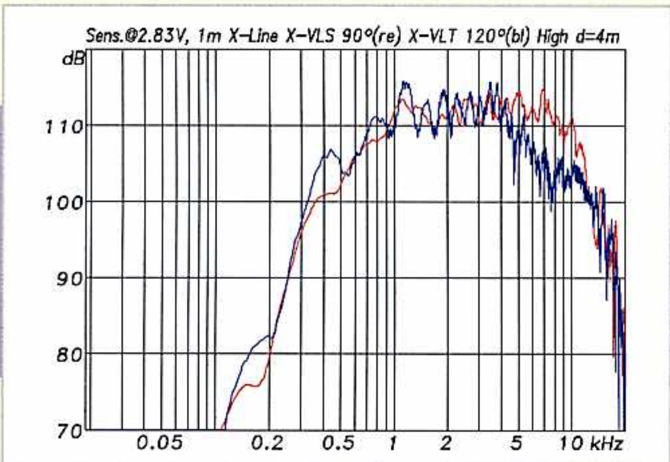


Fig.3: Frequency response with sensitivity of the 3 x 1.5" HF drivers of the 90° (red) and 120° (blue) enclosures. In the 120° enclosure, marked interference due to an internal reflection can be observed.

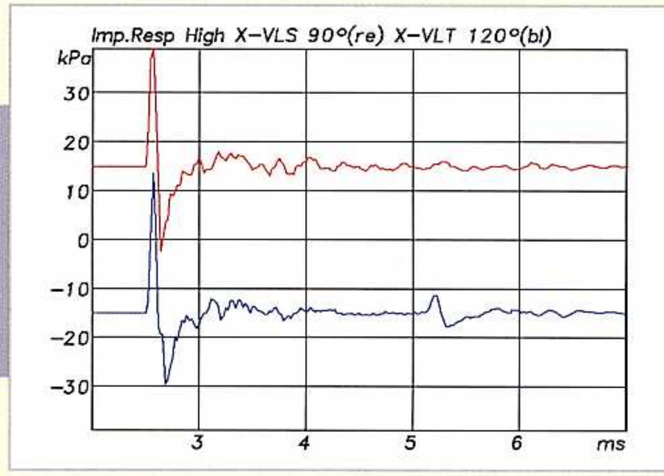


Fig. 4: Impulse responses of the HF drivers of the 90° (red) and 120° (blue) enclosures. There is a noticeable reflection c. 2.6ms after the direct sound

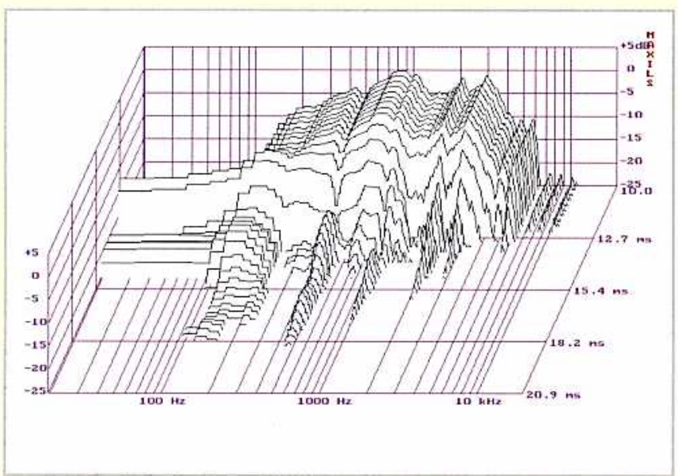


Fig. 5: Waterfall plot of the 2 x 15" bass drivers in the 90° enclosure

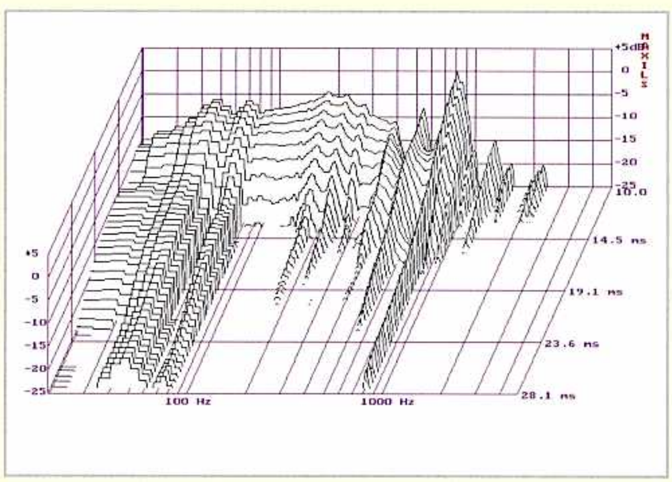


Fig. 6: Waterfall plot of the 2 x 15" bass drivers in the 120° enclosure

ving at the same time to protect the front grille. Alternatively their rectangular shape allows four Xvls or Xsub cabinets to be dropped onto the dolly and raised or lowered in a singe cell. This means that clusters of four units can remain attached during transport. The Xvlt tops, on the other hand, must always be transported face down one at a time on the dolly.

The drivers and their configuration

As a highly respected manufacturer of drivers of all varieties, Electro-Voice (like JBL for the VerTec) has taken advantage of its own design and production facilities to create special drivers tailor-made for these particular enclosures. For the high frequency range, each enclosure offers three of the firm's newly developed ND5A 1.5" neodymium compression drivers. To create a plane wave condition along the vertical axis, Electro-Voice has designed the Hydra wave guide to convert the spherical wave front emanating from the diaphragm into as flat a wave as possible, which is why it is described as a plane-wave generator. Its interior consists of numerous small channels that conduct the sound wave from its point of departure at the opening all the way to the driver to the front of the enclosure along paths of equal length. The inner channels, which would otherwise have less distance to travel to reach the front, are not straight but undulating. The outer channels, on the other hand, slant upwards or downwards in a straight line. Since the undulations alone are not quite enough to ensure that the sound always reaches the front slit at exactly the same time, the internal channels contain foam blocks that help to reduce the speed at which the sound passes through them. These two measures taken together are said by EV to represent a considerable improvement over conventional wave guides. As it leaves the vertically stacked rectangular openings of the Hydra, the sound passes through a V-shaped slit that opens at a 90∞ (Xvls) or 120∞ (Xvlt) angle and serves the same function as a conventional horn. The high frequency components in their entirety are not located centrally but directly to the side of the mid-bass components. The advantage of this arrangement is obvious, since it permits the design of the high frequency section to be optimised to provide the best horizontal dispersion and the functioning of the horn is not compromised by the presence there of other loudspeakers. On the other hand, there is the disadvantage that the arrangement of the three ways is no longer fully coaxial. By way of reminder: JBL's VerTec and the V-DOSC from L-Acoustics are fully coaxial, which means the diaphragms of the mid-bass section are located on the wave-guiding sides of the HF horn. With the VerTec, these are concealed beneath slitted covers, but this in turn creates problems with compression effects. Whichever system is adopted, some degree of compromise has to be accepted. What is essential in the case of the X-Line is that the loudspeakers on the right and left of the stage must be arranged symmetrically, with the HF elements in each case in the most central position i.e. closest to the stage.

With the mid-bass and low frequency sections, EV has also chosen to adopt a new and very promising approach. The two centrally located 8" drivers are furnished with a very large horn with an 86 cm opening. This allows clean control and full horn-loading down to low frequencies. The two 15" EVX-155P (P stands for "plate") bass drivers are mounted on the portion of the mid-bass horn farthest inside the cabinet and feature flat diaphragms specially designed for the X-Line. Their flat acoustic cavity covers serve to eliminate the discontinuities that impair the functioning of the horns where conventional cones are employed. In this arrangement, where the mid-bass and bass drivers share a common horn, the slight discontinuities on the surface of the horn are less harmful than they would be in the high frequency band where wavelengths are far shorter. It is claimed that the two EVX-155P drivers in the X-Line tops combined with the bass-reflex enclosure, which is tuned to just under 40 Hz, give these enclosures a genuine full-range capability. All in all, the X-Line represents a very interesting alternative in terms of design to existing line arrays and would seem to offer advantages above all in terms of horizontal directivity. The compromise involved in placing the high frequency section to one side is a highly defensible one, since a system like the X-Line is obviously not designed to be listened to distances of only a few metres.

We should mention briefly the Xsub subwoofer with its two EVX-180B sub drivers. These are among the finest EV has to offer. With a 4" drive and a maximum diaphragm excursion of ±25 mm, these drivers do all that is required of them.

The X-Line User Guide makes an interesting comparison between ground-stacked and flown bass arrays. The conventional ground-stack array benefits from the additional acoustic power provided by ground loading, but suffers from the fact that when the bass bins are ground stacked, there is a considerable difference between sound pressure levels at the front and at the back of the auditorium. With the same number of subwoofers flown in a vertical array alongside the three-way enclosures, provided the array is long enough, there will be a significant gain in vertical directional control with higher on-axis sound pressure levels. In consequence partly of the height at which the subs are flown, there will also be a considerably more even distribution of SPL throughout the listening area. For example, when you compare a 3 x 4 ground stack with a flown array of 14 Xsubs, you will find that with a flown array, over a distance of 60 metres, only 6 dB is lost, whereas with the ground stack this figure rises to 22.5 dB. Another advantage is that with the subwoofers being right next to the three-way enclosures, such interference as results from sound sources being at unequal distances from the listener are avoided.

Controller and amps

For the controllers and amplifiers, EV has naturally chosen to rely upon products from the Telex/EVI group to which it belongs. The test equipment supplied by TSE of Berlin included a DN9848 controller from Klark Teknik (see the test report in the 10/2000 edition of PRODUCTION PARTNER) which with its eight outputs is capable of controlling an entire X-Line stack of Xsub subwoofers and Xvls and Xvlt tops. At the time of the measurement, only two set-ups were available: one for eight 90∞ systems

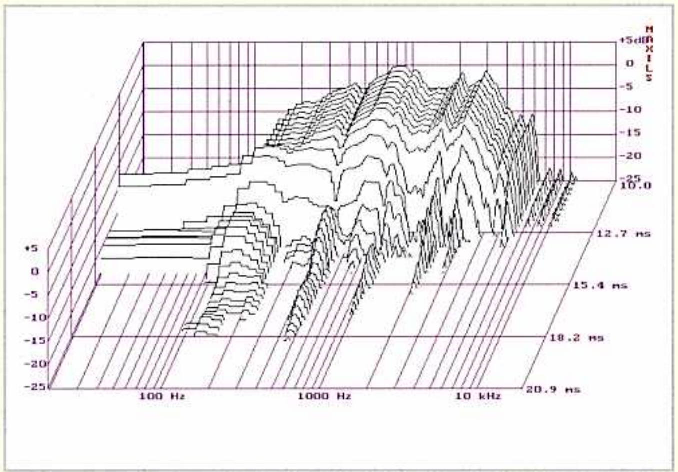


Fig. 7: Waterfall plot of the 2 x 8" mid-bass drivers in the 90∞ enclosure

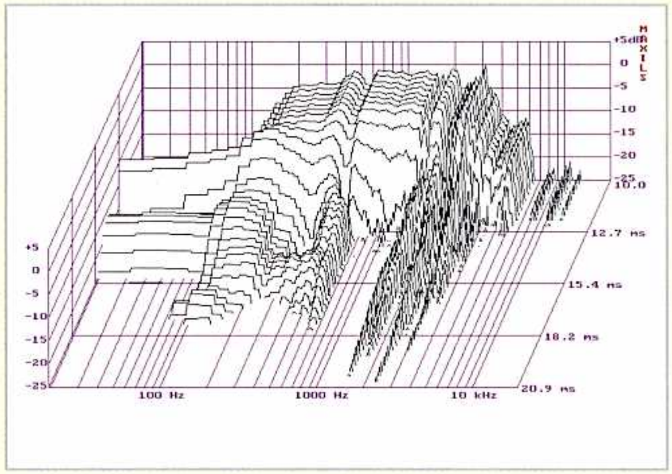


Fig. 8: Waterfall plot of the 2 x 8" mid-bass drivers in the 120∞ enclosure

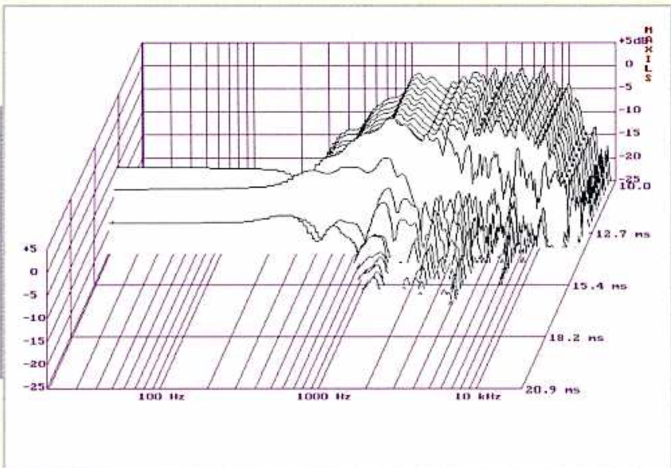


Fig. 9: Waterfall plot of the 3 x 1.5" HF drivers in the 90∞ enclosure

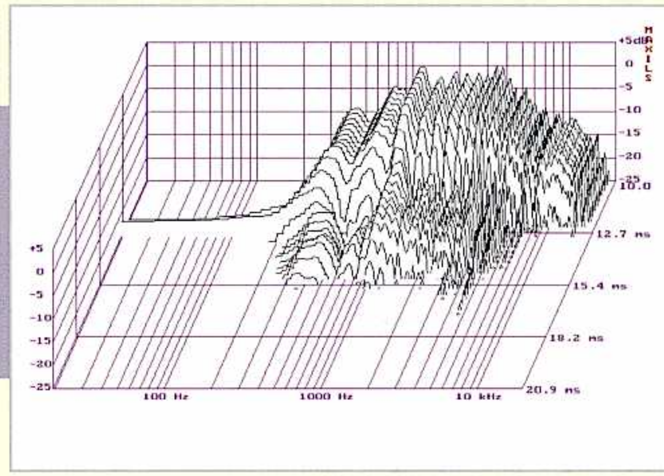


Fig. 10: Waterfall plot of the 3 x 1.5" HF drivers in the 120∞ enclosure

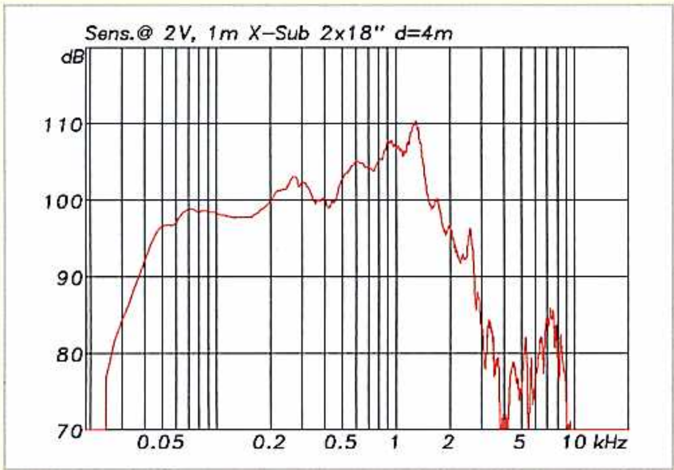


Fig.11: Frequency response with sensitivity of the 2 x 18" bass drivers of the Xsub (beneath 100 Hz nearfield measurement)

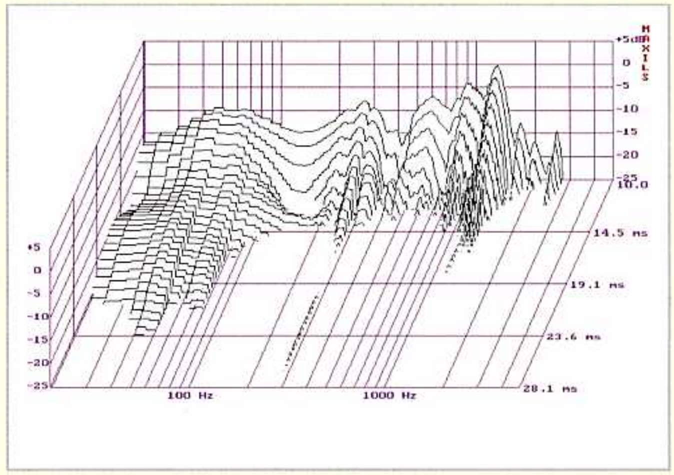


Fig. 12: Waterfall plot of the 2 x 18" bass drivers in the Xsub

and the other for eight 120∞ systems, so the representation in Figs. 13 and 14 cannot be considered definitive. Nor can the results obtained with it be considered indicative of the frequency response of a complete combination, since only one subwoofer and one top were being used for the test, where the controller set-up provided for eight.

EV/Dynacord P3000 power amplifiers were provided for the test. In 4 ohm mode, these are rated at 1200 watts continuous and 1700 watts peak per channel. These power amplifiers have been on the market now for some years and offer outstanding audio quality and a great deal of headroom in peak output. However, due to their conventional power supplies, they weigh a considerable amount. In the works configuration, four of these amps were delivered in an extremely solid flight-rack weighing 200 kilos, and this occasioned a fair amount of cursing in the course of the tests. The internal patch cables allow the amp racks to cater for a wide range of different configurations of subwoofers and Xvls or Xvlt tops. All the loudspeaker leads are on Speakon NL8 connectors.

Individual measurements

The series of tests began with measurements of the individual components of all the enclosures. Since, however, any exhaustive application of this method would have generated a flood of graphs, some limits had to be imposed. For this reason we decided to dispense with graphs for impedance and phase response as well as including two curves in each single graph when depicting the frequency response. Figures 1-3 show the frequency response with sensitivity of each of the three ways of both the Xvls and the Xvlt enclosures. The red curves show the 90∞ system (Xvls) and the blue curves the 120∞ system (Xvlt). In the low frequency band, such differences as there are are slight, as one would expect, except between 100 and 200 Hz where the 90∞ system demonstrates slightly higher sensitivity. Otherwise the results are those typical of 2 x 15" bass loudspeakers. At 40 Hz, a good reading of 90 dB is achieved, demonstrating the full-range capability of the top. The corresponding waterfall graphs (Figs. 5 and 6) reveal the first resonances at 200 Hz but these are of no great significance. The instances of resonance beneath 100 Hz can be traced back to the reflex tuning and those between 50 and 70 Hz to room resonances despite a combined nearfield measurement. The 2 x 8" mid-bass system offers from 200 Hz a sensitivity of 100 dB which at higher frequencies depending upon the horn-loading rise to 103 and 106 dB respectively. The small break-up at 500 Hz for the 90∞ enclosure and 580 Hz for the 120∞ enclosure reveal themselves in the waterfall plots (Figs. 7 and 8) to be small resonances. The self-resonance of the mid-bass drivers in the closed chassis are to be found around 130 Hz. Further resonances do not appear until you get above the envisaged frequency band, and even then it is primarily only the 120∞ horn that is affected. The largest difference in frequency response between the two tops is to be found in the high frequency section. Fig. 3 shows both measurements and Fig. 4 the corresponding impulse responses. Now the cause of the waviness evinced by the 120∞ system becomes apparent: a reflection of the more widely radiating HF horn on the large mid-bass horn can clearly be observed. System Operator Taidus Vallandi, who is in close contact with the developers in the USA, stated in this context that the problem had already been identified and that they were working flat-out to resolve it. Apart from that, the 90∞ horn was particularly impressive with a very high sensitivity of 110-113 dB in the entire frequency area between 1 kHz and 10 kHz. The waterfall plot (Figs. 9 and 10) turns out to be very satisfactory and is free from partial oscillations at high frequencies. The post-oscillation observable in the medium frequency band and especially so for the 120∞ system is caused by reflection emanating from the mid-bass horn, which naturally cannot be altogether avoided with a design of this type.

The last component to be measured individually was the Xsub, which has the classic design of a 2 x 18" bass reflex enclosure. The tuning frequency of the generously dimensioned port is 35 Hz. The measurements in Figs. 11 and 12, as you might expect, reveal no surprises. The characteristics of 2 x 18" systems are well known as they are all resemble one another closely. The first slight resonance is at 290 Hz, which is well-outside the frequency area to be transduced and needs no further comment. The differences between subwoofers usually only crystallize when you come to measure maximum sound pressure levels. More on this subject in the next paragraph.

The measurement of a complete system is intrinsically problematic in the case of line arrays since completely different controller settings can be necessary for different lengths of array. For the X-Line, as already mentioned, all that was available at the time of the test was one set-up designed for an array of 8 tops in a long-throw application, and these conditions could obviously not be reproduced in the measuring room. Figures 15-19 for the Xvls (90∞) enclosure and figures 21-24 for the Xvlt (120∞) enclosure demonstrate nonetheless a very balanced tuning, with no interference problems or phasing errors. The onset of the subwoofer is gradual and involves a good deal of overlapping; this absence of a sharp crossover point can lead to a 3 dB overemphasis of the bass if no further adjustments are made. The overlapping should however be particularly advantageous when the subs are flown directly alongside the tops, since interference attributable to some sound sources being closer to the listener than others will have been largely eliminated. Here there are various philosophies concerning the separation and setting up of subwoofers, and the pros and cons of each method must be evaluated in each individual case based on experience.

Maximum SPL

For the maximum sound pressure level measurements, we rang all the changes with the available X-Line components, measuring the Xvls and Xvlt first individually and then in combination with the subwoofer. The result of the measurements for 3% and 10% THD are very uniform and it is above all remarkable that there are no areas of weakness. The most surprising is the 3% curve which is congruent with the 10% throughout virtually its entire length. The coincidence of the two curves should be

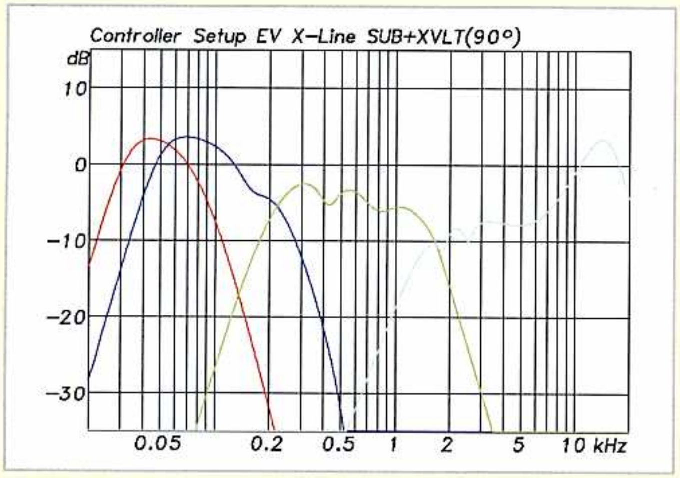


Fig. 13: Controller set-up for the 90° enclosure with subwoofer

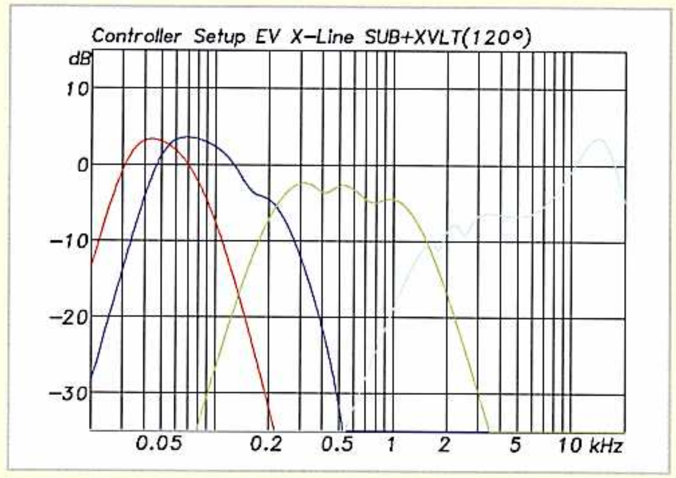


Fig. 14: Controller set-up for the 120° enclosure with subwoofer

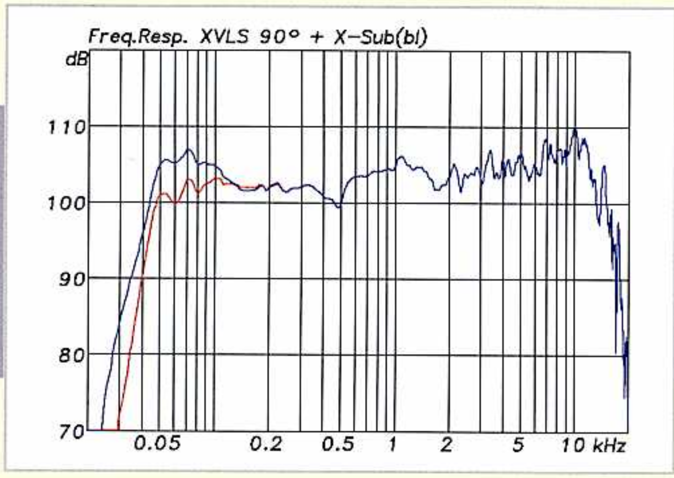


Fig. 15: Frequency response of a 90° enclosure with (blue) and without (red) subwoofer with the controller settings as per Fig. 13

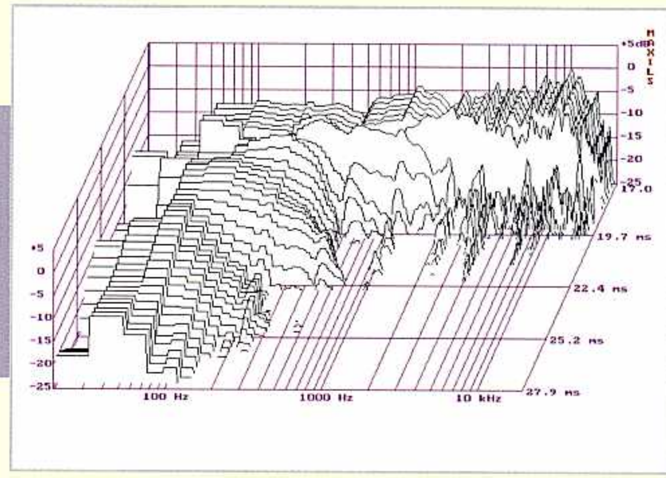


Fig. 16: Waterfall plot of the 90° enclosure without subwoofer

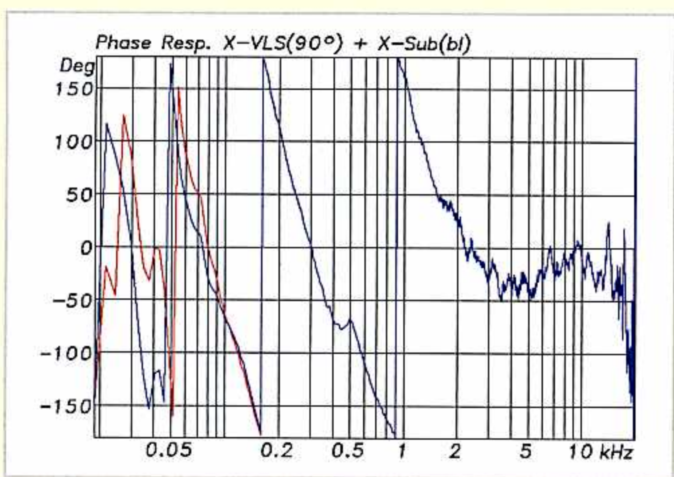


Fig. 17: Phase response of a 90° enclosure with (blue) and without (red) subwoofer with the controller settings as per Fig. 13

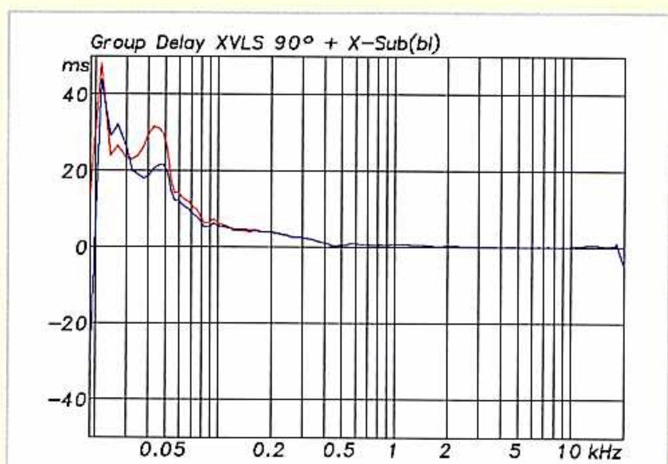


Fig. 18: Delay of a 90° enclosure with (blue) and without (red) subwoofer with the controller settings as per Fig. 13

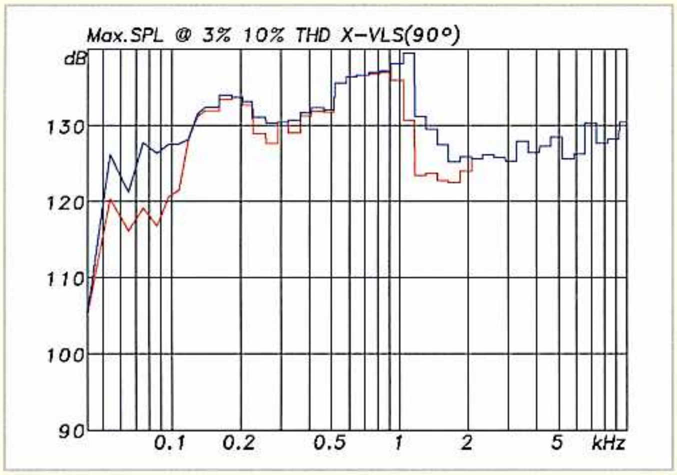


Fig. 19: Maximum SPL of the 90∞ enclosure at 3% (red) and 10% (blue) THD

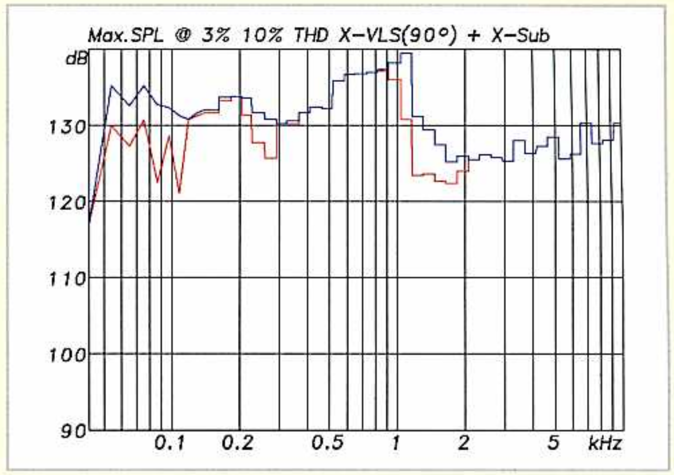


Fig. 20: Maximum SPL of the 90∞ enclosure with subwoofer at 3% (red) and 10% (blue) THD

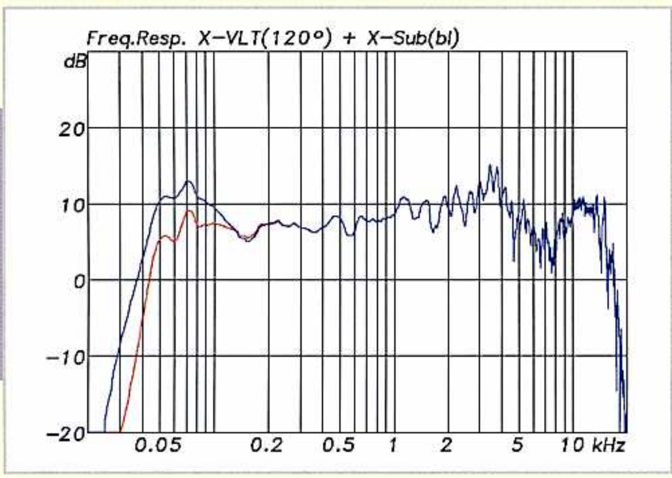


Fig. 21: Frequency response of a 120∞ enclosure with (blue) and without (red) subwoofer with the controller settings as per Fig. 14

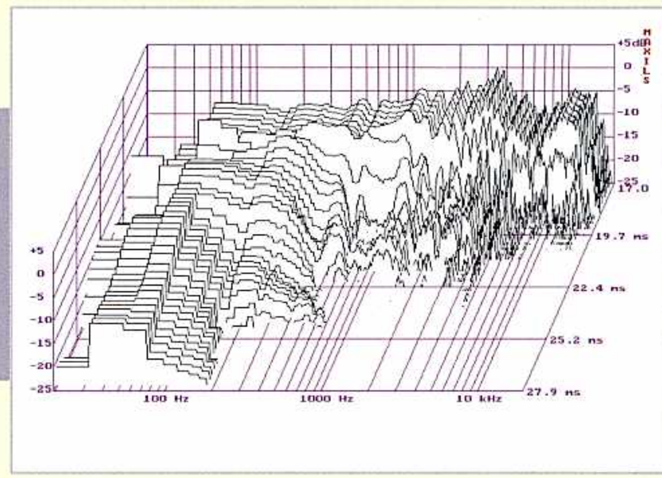


Fig. 22: Waterfall plot of the 120∞ enclosure without subwoofer

interpreted as an indication that here the 10% values were never reached and were controlled at 3% already in other places e.g. through the limiter. The generally high level of the curve with a sensible distribution is already achieved with a very low distortion factor of only 3%. Comparable systems already produce 10% distortion here and also show partial weak points. The X-Line tops were not quite as impressive in the bass region where the maximum level was between 125 and 128 dB. As soon as the subwoofer was factored into the equation, however, the range spread from 134 dB at the top and 50 Hz at the bottom.

Directivity

For the directivity tests, first both the tops were measured horizontally. Figures 27 and 28 show that the nominal values of 90∞ and 120∞ are well maintained and obtain down to the 250 Hz octave. The falling away of level outside the –6dB isobars also proceeds very uniformly. There are no breakaways to be seen or heard. As a result of the non-coaxial configuration of the high frequency elements, some zones of interference are inevitably to be observed near the crossover frequency, and these could be largely eliminated through steeper separation.

For the vertical measurements, two Xvls (90∞) enclosures were available and this allowed the measurement not only of the systems individually but also the arraying of two systems at various angles. In the individual measurements, the isobars revealed a needle point characteristic, since the cylindrical wave radiation typical of line-arrays cannot be correctly reproduced using a turntable: the procedure of measuring a set of orbits centred on the loudspeaker is predicated on the notion of spherical wave fronts and therefore gives a distorted picture of the functioning of a line array. The measurement is nonetheless interesting as you can judge well from the secondary peaks in the isobars where the wave front is bent at the edge of the enclosures etc.

For the measurements with two systems, two tops were positioned with angles of 0∞, 5∞ and 10∞ between them on a turntable that was by now close to its load limit and careful attention was needed to prevent it failing altogether. The resulting isobar representations were in this case not standardized on the 0∞ axis as is the usual practice but represented by an absolute value. The problem here was not the standardisation, since the reference to the centre axis in the case of small slumps leads to

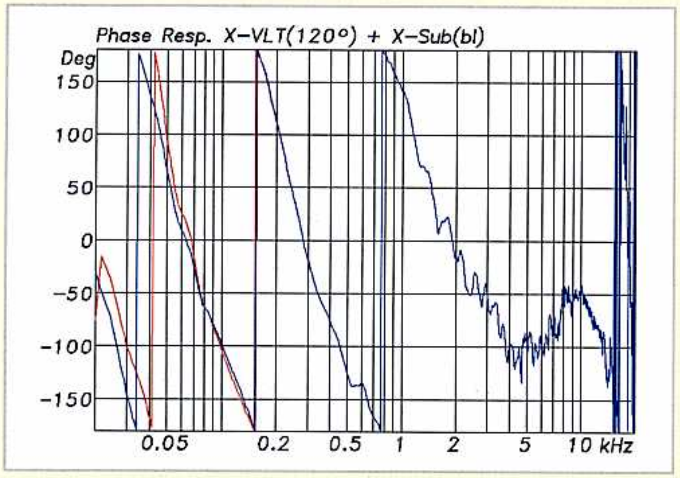


Fig. 23: Phase response of a 120° enclosure with (blue) and without (red) subwoofer with the controller settings as per Fig. 14

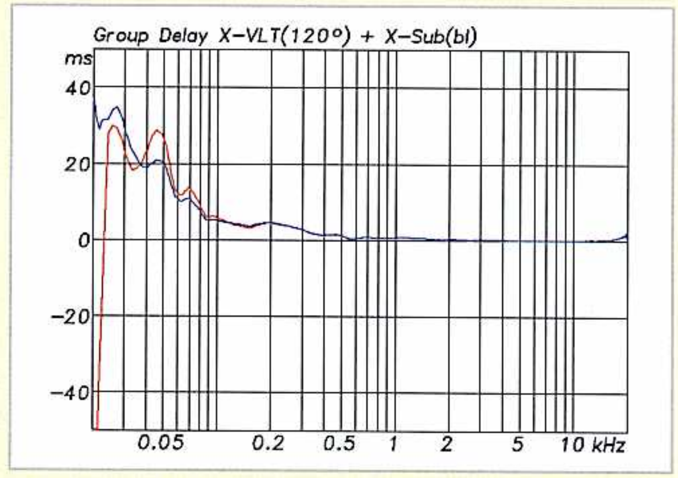


Fig. 24: Delay of a 120° enclosure with (blue) and without (red) subwoofer with the controller settings as per Fig. 14

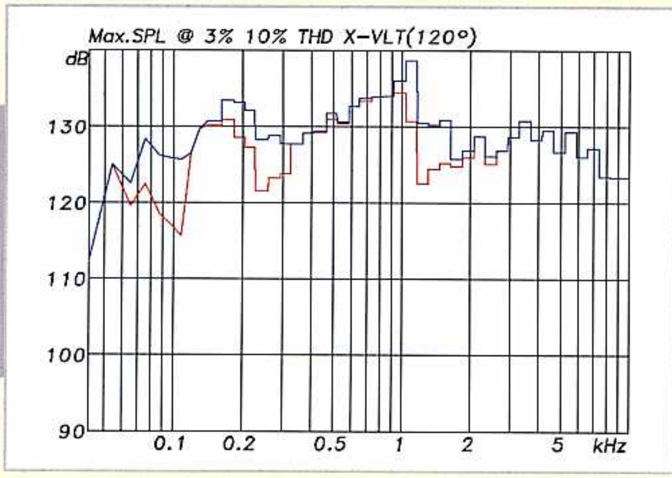


Fig. 25: Maximum SPL of the 120° enclosure at 3% (red) and 10% (blue) THD

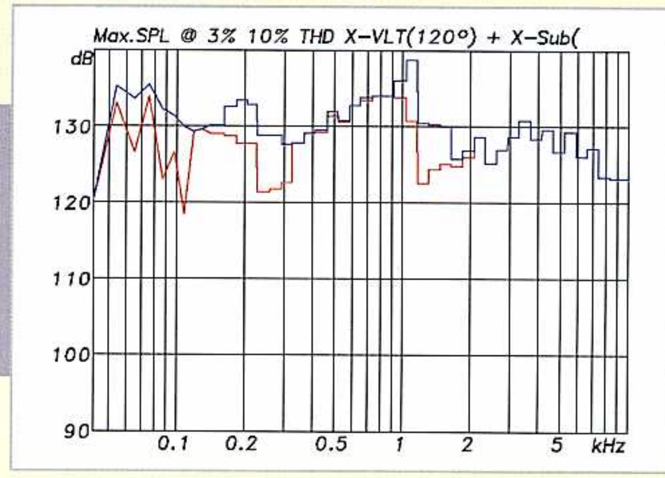


Fig. 26: Maximum SPL of the 120° enclosure with subwoofer at 3% (red) and 10% (blue) THD

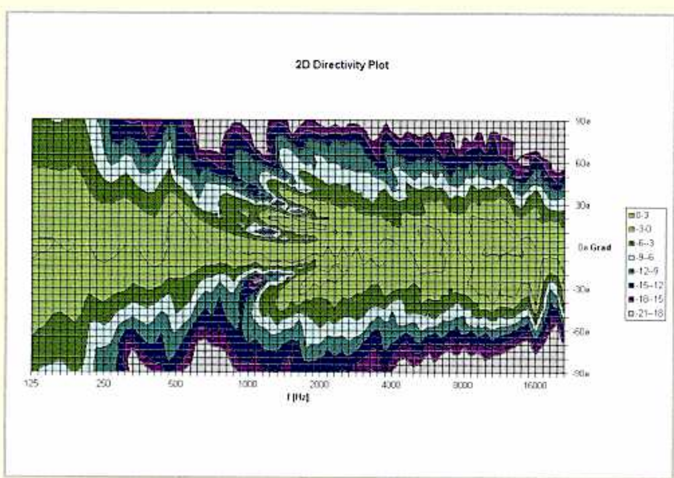


Fig. 27: Horizontal isobars of the 90° enclosure

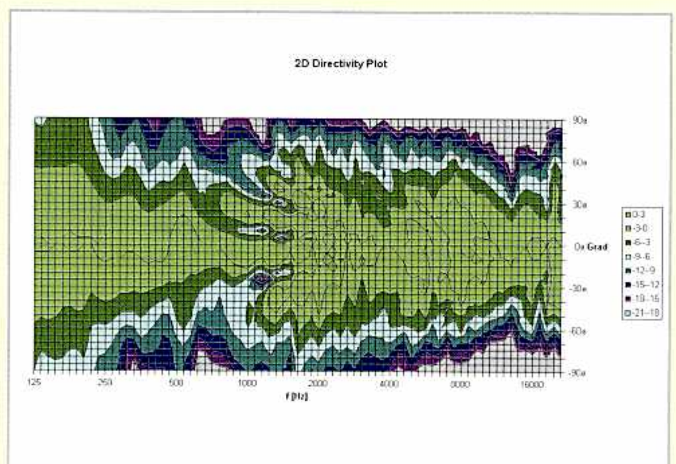


Fig. 28: Horizontal isobars of the 120° enclosure

an apparent widening of the radiation characteristic that is in reality not present. The high frequency area is the most critical one as it is here that the coherent line source first threatens to break up. In the 0∞ position, the summing of the two enclosures is perfect up to the highest frequencies as Fig. 30 demonstrates. When the angle between the enclosures is 5∞, the first fine break between 10 and 16 kHz can be seen on the central axis but this can be disregarded. Only when the angle is increased to 10∞ does the crack penetrate to lower frequencies where it does risks becoming obtrusive. An angle of 10∞ between enclosures is, however, 3∞ over the maximum recommended by Electro-Voice for the Xvls tops. For the trapezoidal Xvlt tops, angles as large as 10∞ are permitted between boxes, though with only one such top available for testing, the results of such an arrangement could not be measured.

When these tests are compared to the tests for the dV-DOSC (PP 2/01) and VerTec (4/01), differences in directivity readings are clearly noticeable, though it is not always possible to make any meaningful comparison. In one case, that of the dV-DOSC, four tops were stacked on the turntable, whereas for the VerTec test, only one system was available and for the X-Line only two tops could be tested. The VerTec on the other hand was tested over the entire height of the area at different distances and this was not done with the other systems. An additional complication was that not all systems were available in sufficient numbers for testing and stacking them on the turntable was often problematic. Be that as it may, the procedure used for the X-Line was the one that proved more practical and it will therefore be followed in the future. In concrete terms, it involves individual measurements on the horizontal and vertical planes as well as some additional vertical measurements with two systems positioned on the turntable at different angles to one another.

At the moment, further measurements of the Electro-Voice X-Line and the JBL VerTec are planned for the very large low-reflection room of the TU Berlin. Under these conditions larger measuring distances and a more detailed series of measurements of complete arrays will be performed. There will be more information on this subject closer to the time.

Live test

One of the first live tests of the X-Line system came at this year's Mayday event in Dortmund. The sound reinforcement was provided by the Berlin firm of TSE under the direction of Carsten "Caschi" Robert. TSE already owns 48 X-Line series tops and 36 subwoofers. For the amplification, TSE used not only the EV-P3000 amps that belong to the system but also 30 Powersoft Digam 7000s, which are extremely compact and lightweight. In Hall 3 of the Westfalenhallen, in each of the four corners of the dance floor, 4 X-Line subwoofers were set up as a ground stack and four 90∞ tops were flown in a line array formation. For the amplification, P3000 racks were selected. These were driven by a GAE controller DSC28 with FIR filters. With special filters for amplitude and phase equalisation, measurements were taken the night before the event and the controller settings adjusted and optimised for the given array configuration. The results were clear for all to see, or rather hear. Free from any phasing and interference effects, the X-Line arrays provided transparent coverage throughout the entire listening area, with a richness of detail and abundance of power that won praise from all quarters. The taut and clean reproduction of the lower frequencies was singled out by many for special mention.

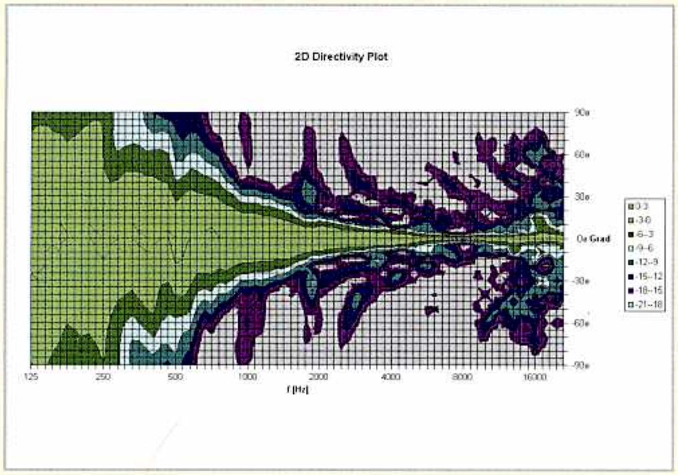


Fig. 29: Vertical isobars of the 90° enclosure

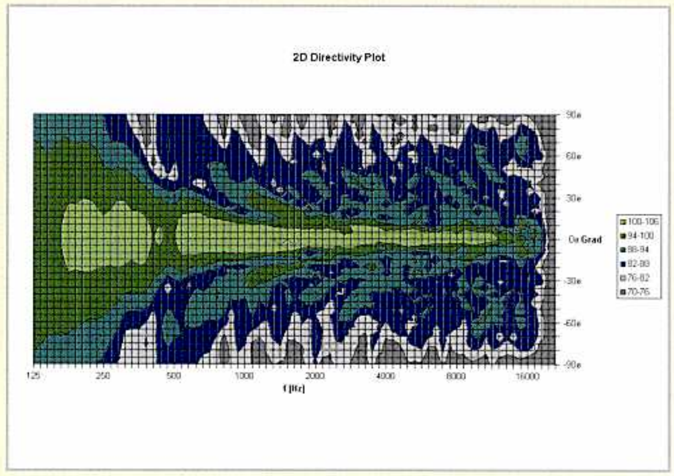


Fig. 30: Vertical isobars of two 90° enclosures with an angle of 0° between the boxes (level representation absolute here and not in relation to the 0° axis)

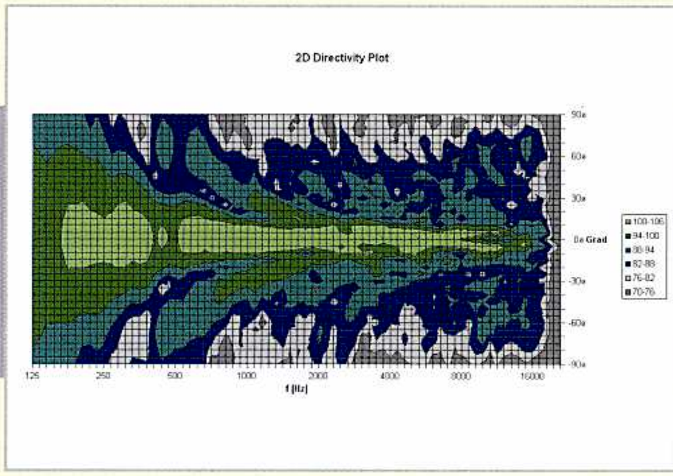


Fig. 31: Vertical isobars of two 90° enclosures with an angle of 5° between the boxes (level representation absolute here and not in relation to the 0° axis)

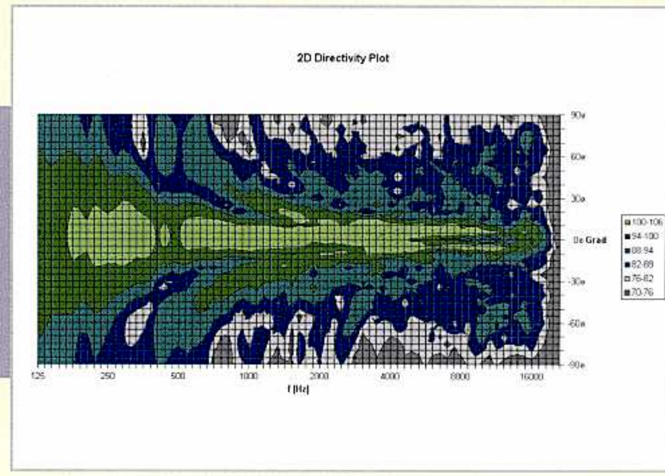


Fig. 32: Vertical isobars of two 90° enclosures with an angle of 10° between the boxes (level representation absolute here and not in relation to the 0° axis)

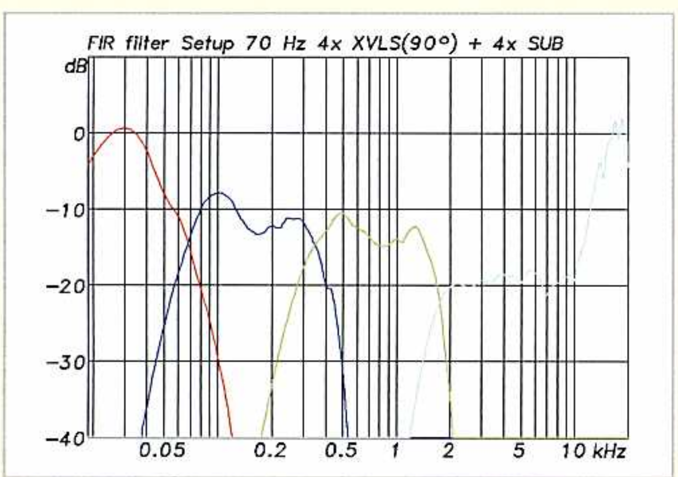


Fig. 33: FIR filter set-up of the 'Mayday Constellation' with 4 tops (Xvls) and 4 subs with crossover at 70 Hz

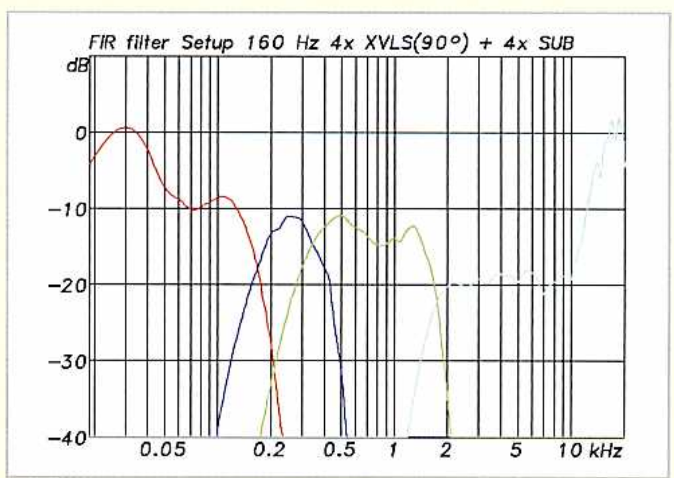
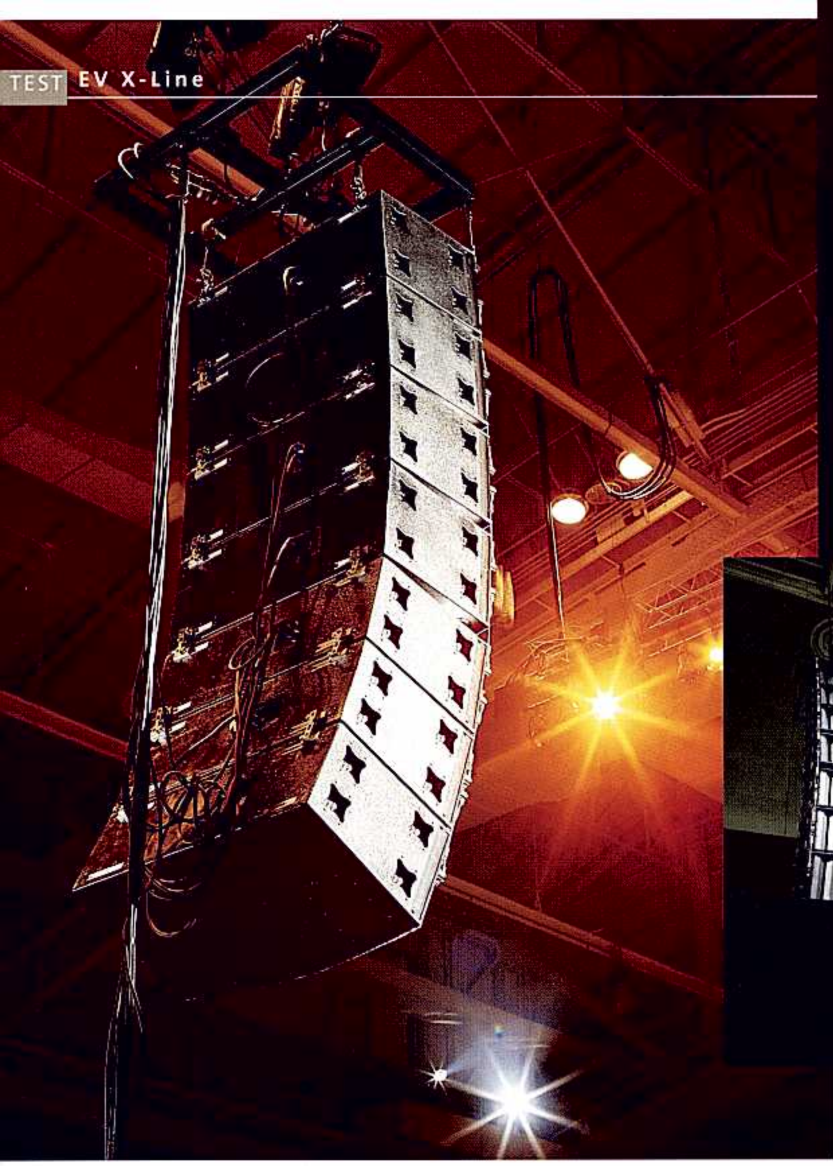
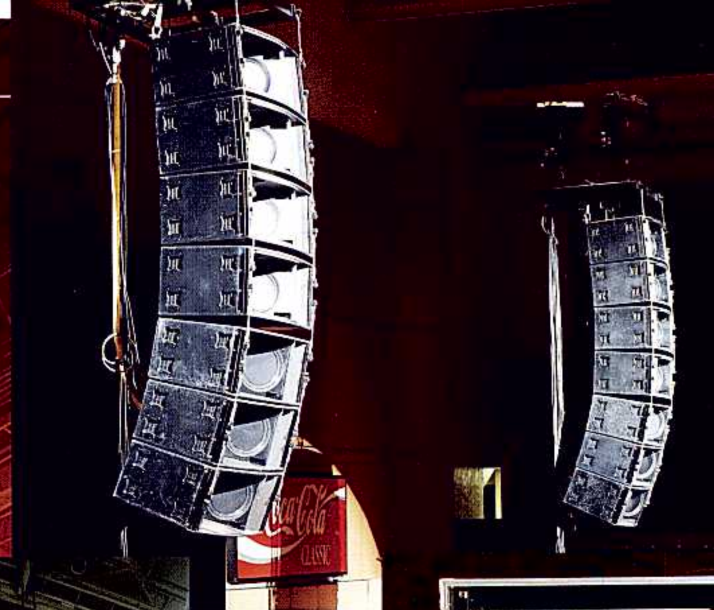
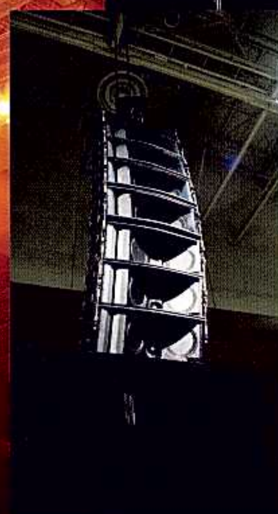
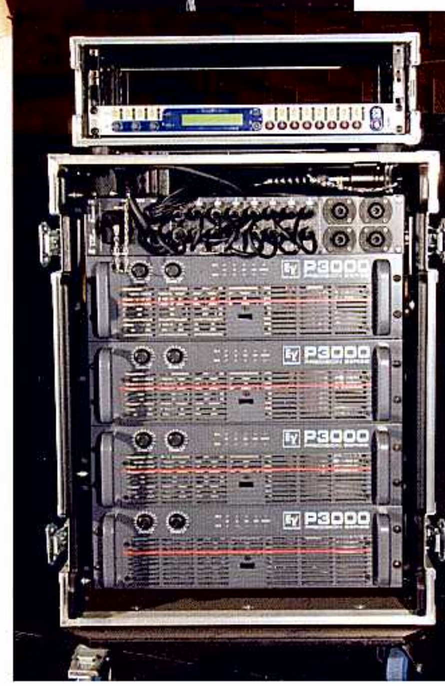


Fig. 34: FIR filter set-up of the 'Mayday Constellation' with 4 tops (Xvls) and 4 subs with crossover at 160 Hz









The sound system with its 48 kW amping had plenty of power in reserve. The X-Line certainly sailed through this first, very difficult test with flying colours.

A word of thanks

The tests in Aachen went flawlessly and we would like to thank Carsten Robert and Marcel Fery of TSE for their logistical support in preparing them, their cooperation at the Mayday event and their important input to the discussions, as well as Thorsten Schulze, without whose patience and application the test would not have been possible.

Conclusions

Electro-Voice's entry into the line array market is spearheaded at the present time by three models: two tops (with 90∞ and 120∞ horizontal dispersion) and a subwoofer, though a downfill to complete the series has been announced for release in the middle of the year.

In the design of the new line array, Electro-Voice has adopted an original and highly interesting approach, adopting a coaxial arrangement for the low frequency and mid-bass elements, whilst opting to locate the high frequency wave guide to one side. As these tests demonstrate, this configuration offers clear advantages in terms of directivity as well as very high maximum sound pressure levels, remarkably free from distortion, throughout the entire mid-bass and low frequency bands. Against these advantages must be offset the slight but almost negligible degree of interference between the mid-bass and high frequency elements that results from this non-coaxial arrangement. The coherent summing of the two Xvls (90∞) enclosures could be observed and measured, regardless of whether they were set at 0∞ (parallel) or at an angle of 5∞ to one another. In addition, the high frequency system with its ND5A drivers and newly developed Hydra wave guide performed impressively, delivering low partial oscillation, high sound pressure levels and very little distortion. The rigging and transportation systems seem well designed, offering uncomplicated handling and the proper degree of stability without becoming unmanageable in terms of weight. The workmanship and manufacturing quality of the enclosures as well as their features and accessories are all you would expect from a top-of-the-line product from an internationally respected manufacturer.

At this point in time, nothing definite can be said about prices — not only is the X-Line is still very new but the components are unlikely as a rule to be purchased singly and the price will therefore be calculated most often on the basis of the complete solution requested.