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Dynacord Vertical Array

"...The rig is impressive in every respect – from the measurement readings to the aural impression, handling, production quality and finish. In practice, what is likely to prove its salient advantage is its narrow vertical and wide horizontal dispersion pattern, which is ideal for a great many applications – most notably the provision of sound reinforcement in acoustically problematic rooms..." (excerpt from the Conclusion)

The TS400 is a compact array said to be suitable for the provision of sound reinforcement under difficult acoustic conditions. We have examined its functioning and show how it differs from a classic 12/2 box

Recent years have seen two emergent trends in the development of sound reinforcement loudspeakers: the use of line arrays and the arming of loudspeakers with integrated power amplifiers and controllers. The second development was made possible by modern HF switching power supplies and PWM power amplifiers, which can get by without giant mains transformers and large arrays of heat sinks and therefore do not contribute significantly to the weight and volume of the loudspeakers. Regarding the line arrays, it all began with the large touring systems but the technology is increasingly being applied to smaller and smaller devices, so that today line arrays are being used for small stages, fill systems, dance floors and even as monitor systems. You don't have to look far to see why – or, rather, you don't have to look much further than room acoustics to see why, as these usually pose problems that have to eliminated and are most easily eliminated through the use of loudspeakers with a pronounced directional characteristic.

The fundamentals of line arrays

For typical sound reinforcement applications, what is wanted is a dispersion pattern with a fairly broad horizontal angle but a narrow vertical one: the audience or spectators are generally on the same level but spread widely, and the aim is therefore to provide good and even coverage of the audience area while avoiding as far as possible everything else.

It is the ability to do just this that constitutes the peculiarity of line arrays, the vertical dispersion of which, furthermore, if composed of separate units, can be further adjusted through curving. Here, of course, it starts to get more complicated, as questions arise as to how the line-array should best be configured and aligned. For many typical small applications in smaller venues, therefore, a simple loudspeaker with a broad horizontal and narrow vertical dispersion pattern, that requires no further adjustment, represents pretty much the ideal solution. But how best to satisfy such a requirement? Horns are of limited usefulness when a very narrow dispersion angle is sought and only of much use at all at higher frequencies – otherwise they would need to be really large. One possible solution is therefore Dynacord's combination of a line radiator plus a horn for the higher frequencies.

TS400: Line source of frequency-dependent length plus horn

This is the combination implemented in the Dynacord TS400. Four 6" woofers are arranged in a line and combined with a 90° x 40° horn. The horn comes into play at 2.6 kHz and attains almost

The TS400 is constructed from an aluminium strand-cast profile and weighs a mere 17 kg

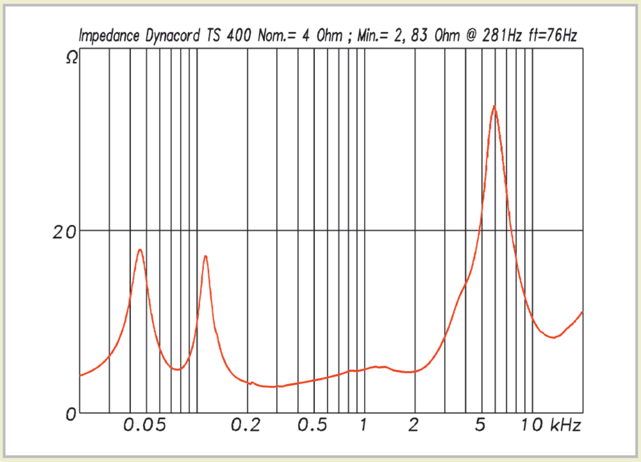


Fig. 1: Impedance curve of the TS400 top. The nominal 4 Ohm system exhibits a really low minimum of 2.83 Ohm, but since the system amplifier is specially adjusted to it, this is hardly critical

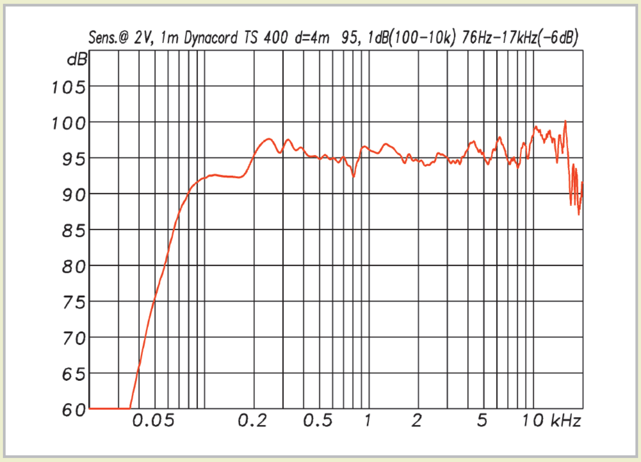


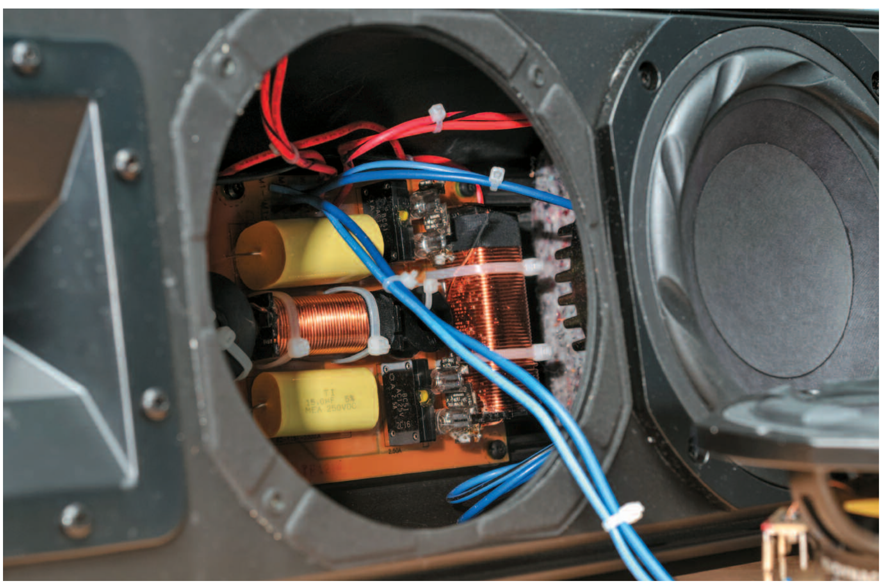
Fig. 2: Frequency response of the TS400 top, with an average sensitivity of 95.1 dB (from 100 Hz to 10 kHz) and what is overall a very beautiful, even curve

immediately the desired 40° dispersion angle. If you were to attempt to make effective use of this tight angle also for lower frequencies, the usual combination involving a 12" woofer would be unsuitable, as its dispersion angle rapidly begins widening as the frequency falls. The solution lies, therefore, in distributing the diaphragm area of a 12" woofer between four 6" drivers and arranging the latter in a line, which through its form alone attains almost the desired pattern: width in the horizontal and narrowness in the vertical plane.

What remains is one small blemish, which is that the vertical dispersion angle with a line of this length up to the transition to the tweeter is too constricted. The TS400 is therefore constructed in such a way that two of the four 6" woofers are positioned directly above and below the tweeter. These two drivers are then also operated up to the transition to the tweeter at 2.6 Hz. The two others are further down and also slightly further removed. These two are separated earlier by the crossover and are therefore only effective for lower frequencies and do not constrict too severely the dispersion angle in the upper midrange. In principle, therefore, what is implemented here in a simple way is the same thing as that achieved by modern DSP-controlled loudspeaker lines: an attempt to maintain constant the ratio between the effective radiator length and the wave length of the radiated sound. Properly considered, the TS400 is therefore a 21/2-way box with a line source of frequency-dependent length in the low midrange combined with a classic 90° x 40° horn.

The effective diaphragm area of the four 6" woofers is equivalent to that of a classic 12" driver, so we now have a compact top offering the desired combination of a wide horizontal, but narrow vertical, dispersion angle. What distinguishes it from a normal 12/2 box is the wide bandwidth over which this dispersion pattern is maintained, reaching way down into the low midrange. From an aesthetic standpoint, the concept graces the TS400 with a particularly tall and slim silhouette that is easily accommodated aside the stage.

The 199-mm wide and 935-mm high housing of the TS400 is made from an aluminium extrusion profile, which being only a few millimetres thick allows for an unusually slim and light construction. Weighing only 17 kg, despite the total of five drivers in the box, the TS400 is also therefore effortlessly lifted with the aid of



Looking into the interior of the TS400 at the generously dimensioned passive crossover with light bulbs for overload protection. The housing is constructed from an aluminium extrusion profile

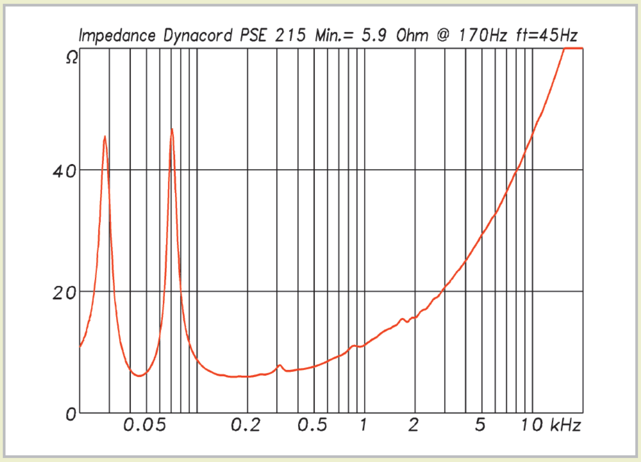


Fig. 3: Impedance curve of the PSE215 passive subwoofer. The minimum impedance is 5.9 Ohm and the tuning frequency of the bass reflex enclosure 45 Hz

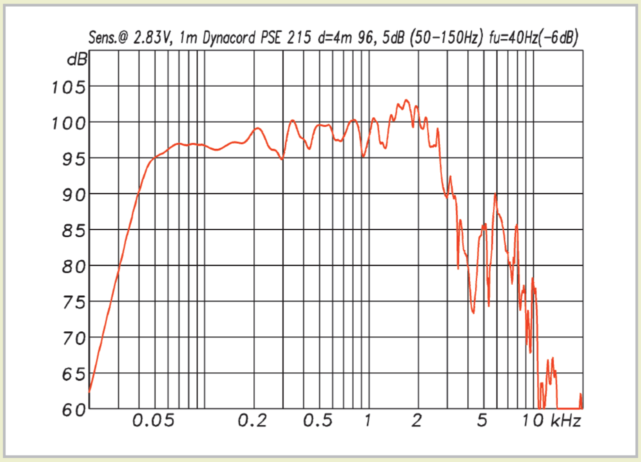


Fig. 4: Frequency response of the PSE215 subwoofer, with an average sensitivity of 96.5 dB (from 50 to 150 Hz) and a lower corner frequency (-6 dB) of 40 Hz

the handle attached to the rear panel and easy to place on a stand. A special tilt adaptor with an adjuster screw that allows you to control the angle of tilt precisely is available as an accessory. Other accessories include a carrier bag and a flying kit for suspending the box.

For the operation of the TS400 there are various possibilities. Firstly, due to its passive crossover, the box is already tuned in such a way as to make operation without a controller a viable option; a high-pass filter should, however, be inserted into the signal chain to protect the box from pronounced deep basses; a sensible solution here would be a 2nd or 4th order high-pass filter at 70 Hz. For use with Dynacord controllers or controller amps, filter settings for IIR or FIR filters as well as the requisite limiter settings are available. The FIR filters can be used with Dynacord's IRIS-Net e.g. in the DSP600 controller or with a power amplifier equipped with an IRIS-Net card.

Depending upon the type of application, you may want to complement the TS400 with a subwoofer. Here the most elegant and simple partner is one of the powered Dynacord subwoofers, PSD215 or 218, with their integrated power amplifiers and controllers, in which case all you have to do is connect the TS400, select the desired setup and everything is already optimally configured. For our test, the TS400 was combined with a PSD215 subwoofer and an additional passive PSE215 bass extension. More on this later.

First, however, let us look at the TS400 on its own from a metrological perspective. The impedance graph reveals the tuning frequency of the bass-reflex enclosure to be 76 Hz and a tweeter strongly attenuated in the transition area and matched to the sensitivity of the woofer by a passive prescaler. The HF driver is the widely used Electro-Voice DH-3 with its 1" throat diameter and 32mm titanium diaphragm. For the four woofers, OEM chassis with neodymium drivers from Eighteen Sound have been used, the latter easily recognizable by their characteristic undulating diaphragm suspensions. The special form of the orrugation reduces partial oscillation of the diaphragm in the midrange and above, which in view of the TS400's crossover frequency of 2.6 kHz represents an important advantage.

The frequency response of the TS400 in Fig. 2 shows a beautifully even curve with an average sensitivity between 100 Hz and 10 kHz of 95.1 dB and corner frequencies (-6 dB) at 76 Hz and 17 kHz at the bottom and top ends. It would have been possible to level out the step in the frequency curve at 200 Hz passively, but only by reducing the overall sensitivity of the box to 92 dB; if we were dealing with a hi-fi box that might be eminently sensible, but not, of course, when the device in question is a PA box, as that would involve squandering a great deal of power in the form of heat. If we leave all further modifications through controllers and the like out of consideration and observe the TS400 in isolation, already we are looking at a good satellite speaker that for many applications is also capable of full-range use.

To protect the box from overload even when operated without a controller, all three signal paths are also equipped with protective circuits. In front of the tweeter, there's the classic light bulb circuit. The two woofer signal paths are protected via relays that open in the event of overload without separating the drivers altogether from the signal but rather controlling them via light bulbs. The advantage lies in the fact that the threatened signal paths are not completely shut down and the crossover consequently does not hang from the amplifier as a pure oscillating circuit. Naturally all the protective circuits in the TS400 are reversible.

To form a complete mini PA, the TS400 is combined with one of the active subwoofers PSD215 or PSD218, which are armed with 15- and 18-inch drivers respectively. To allow full advantage to be taken of the integrated power amplifiers of

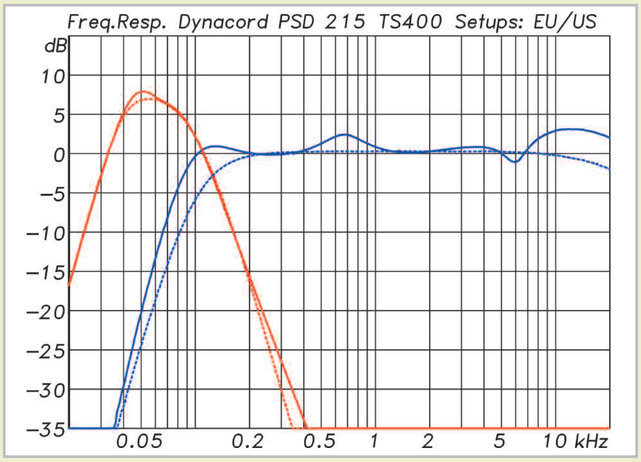
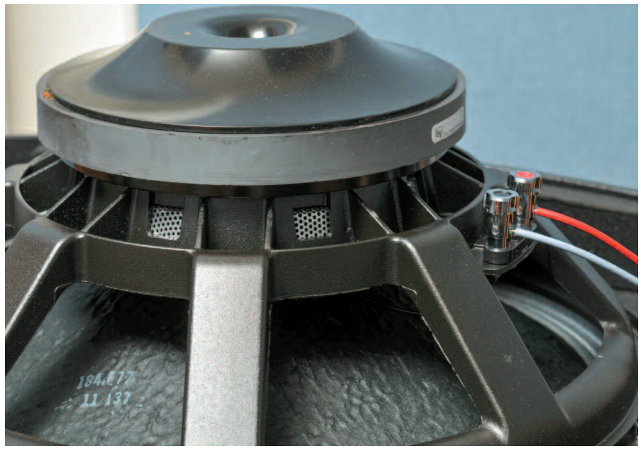


Fig. 5: Controller frequency responses of the sub (red) and the TS400 top (blue) using the EU (solid lines) and US (dotted lines) setups



15" driver from EV in the PSD15. Clearly recognizable are the voice-coil vents with their tiny grilles to prevent dirt getting in

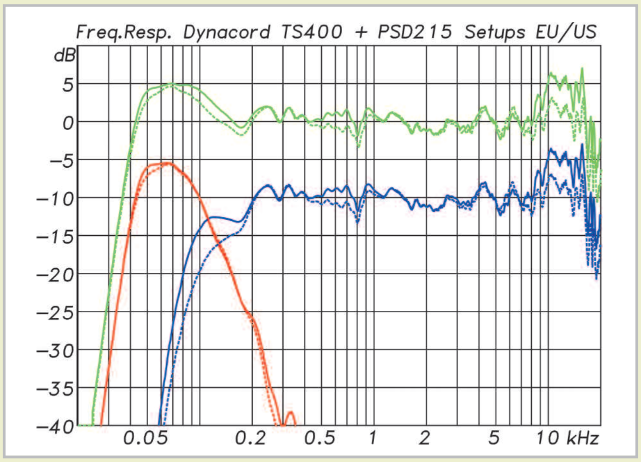


Fig. 6: Frequency responses of the TS400 (blue) and PSD215 (red) as well as their cumulative functions (green) for the EU and US (dotted line) setups

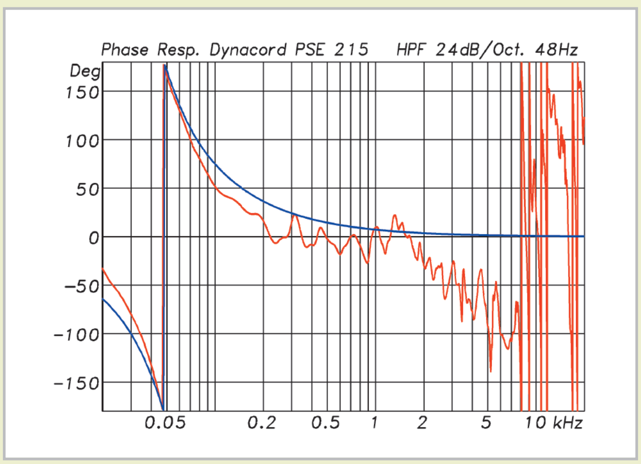


Fig. 7: Phase responses of the combination of TS400 (blue) and PSD215 (red) as well as their cumulative functions (green) for the EU setup

these, a companion passive version of each is available: the PSE215 and PSE218 bass extensions, which are then driven in parallel to the active models' onboard drivers. The passive PSE215 is therefore the ideal subject with which to begin, as it will allow us to measure and assess the performance of the subwoofers as such – i.e. without regard to electronics.

Externally, the active and passive 215 subwoofers can only be distinguished from the rear: their dimensions (640 x 465 x 694 mm) are identical and their weights (39.6 kg with electronics, 33.8 kg without) almost the same. Internally, a 15" chassis from Electro-Voice perform its duties. From its Thiele/Small parameters, the driver is designed for compact bass reflex enclosures and operates here with a tuning frequency of 48 Hz, as can be seen from the impedance curve in Fig. 3. Clearly visible in the photo are the large ferrite magnet and the lateral vents behind the perforated grille that allow the air warmed by the voice coil in the gap to escape.

The frequency response of the PSE215 in Fig. 4 shows between 50 and 150 Hz an eminently respectable average sensitivity of 96.5 dB and near linearity all the way down to 45 Hz. If we base our -6 dB point on this 96.5 dB figure, the lower corner frequency is found at 40 Hz. The PSE215 therefore exhibits the typical characteristics of a classic 15" subwoofer: the frequency range does not extend all that far down but the sensitivity on the other hand is very high. Anyone who wants more deep bass can always opt as an alternative for the larger and somewhat heavier PSD(E)218.

Power amplifiers and controllers

A truly good PA can be recognized not only from measurement readings and good sound but also from its reliability of operation and ease of use. At the end of the day, even the most beautiful rig is no use if it is possible to make substantial errors before you've even finished setting it up: controllers can be erroneously configured, loudspeakers wrongly cabled, and power amplifiers with unsuitable outputs or gain values used. Dynacord avoids the risk of such problems with its combination of powered subwoofer with additional power amplifier for the satellite and integrated controller. This ensures that the controller and power amplifiers and therefore also the limiters in the controller are all safely attuned to one another.

To connect up the loudspeakers, all you need is one – or, with an additional passive subwoofer, two – short Speakon cables, with which you can hardly do much wrong in view of the clarity of the labelling. Since the subwoofer could be combined with a wide variety of satellites, the user needs (once only) to select the right setup for the TS400 and already the rig's up and running. If you do want to tweak the sound, the functions of the small controller include a simple 6-band graphic EQ. To adjust the subwoofer to the top, the controller is equipped with level, delay and polarity controls for the sub channel. As the integrated digital controller is in fact a 1-in-3 device, one signal path is left over, and since it would be a shame not to make use of it, Dynacord has generously provided a line-level output to which e.g. an additional self-powered box could be connected to provide front fill. For this path, there's a high-pass filter, a simple shelving EQ as well as a delay and level control. So they've thought of everything, here, that might be needed on small club stages or even for DJ acts.

Sceptics may be tempted to observe that, even so, plenty of opportunities to make mistakes remain; but, whilst that may not be altogether untrue, the most vulnerable point – the controller amp rack – has been eliminated and the only other components involved are a few short loudspeaker cables. Furthermore the operation of the

The control panel of the powered subwoofer with its simple 6-band EQ

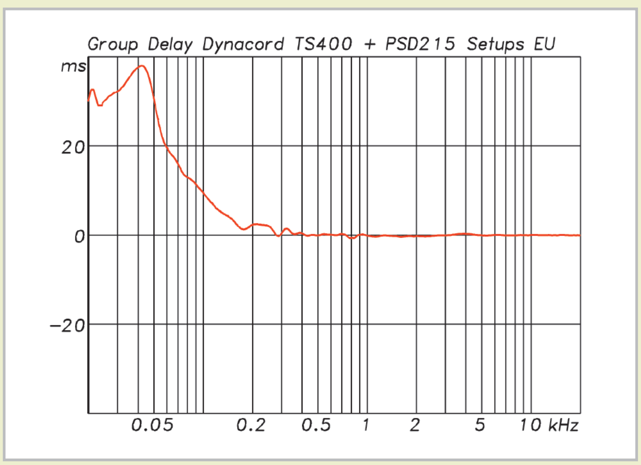


Fig. 8: Propagation time curve of the combination of TS400 and PSD215 from the phase response of the cumulative function in Fig.7

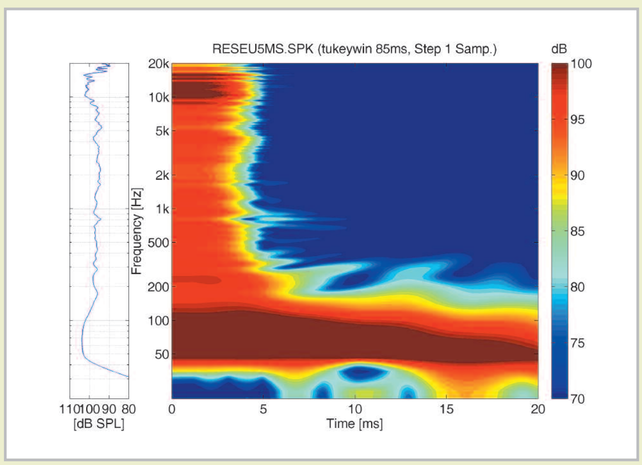


Fig. 9: Spectrogram of the combination of TS400 and PSD215 – the system is largely free from resonance

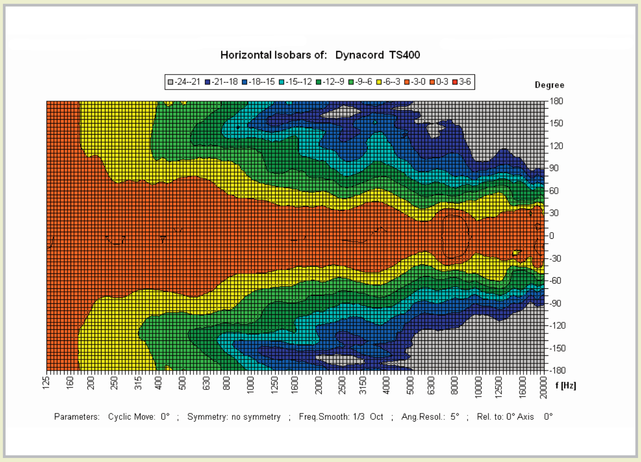


Fig. 10: Horizontal isobar curves of the TS400 with a nominal dispersion angle of 90°

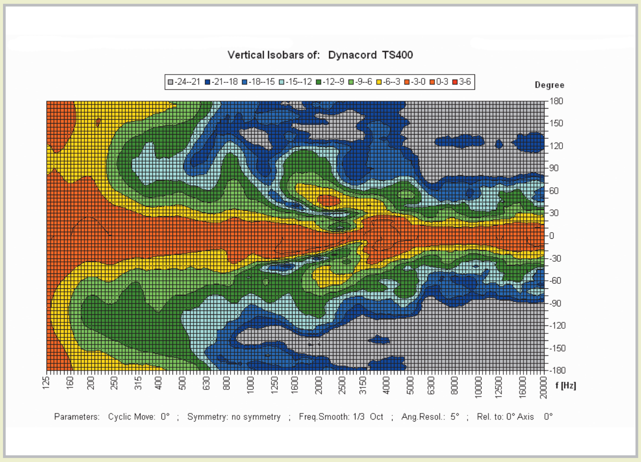


Fig. 11: Vertical isobar curves of the TS400 with a nominal dispersion angle of 40°. The cleverly conceived 21/2-way system allows the very narrow dispersion angle to be maintained over a very wide frequency range down to 300 Hz

integrated controller is so intuitive and simple in its conception that you get the hang of it immediately, without any profound understanding of the technology involved being required.

What the controller does in detail is shown by Fig. 5. Major corrections are not necessary for the pairing of TS400 and PSD215, as the two units are already well attuned to one another. What is interesting, however, is the difference between the EU and US setups, which, one supposes, reflect the respective tastes of the technicians in Straubing and their colleagues at Electro-Voice in the USA. In the US tuning, the high frequencies are boosted rather less forcefully and below 200 Hz some 1-2 dB are missing. Users who prefer their own settings can store them for later use in the memory locations provided for user presets.

The PSD215's power amplifiers feature PWM Class D designs and offer a maximum of 2 x 1,000 watts in each case into 4 Ohm. What this means is that a 4 Ohm satellite and two 8-ohm subwoofers can be connected here, at which point the system will be working to full capacity.

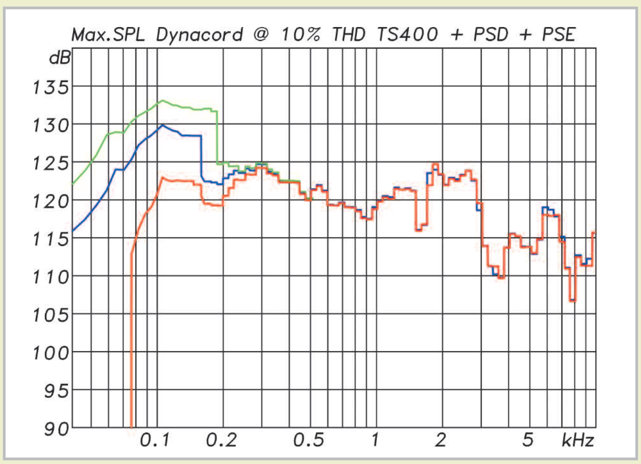


Fig. 12: Maximum level for at most 10% distortion for a TS400 (red) with PSD215 (blue) and with PSD215 plus PSE215 (green)

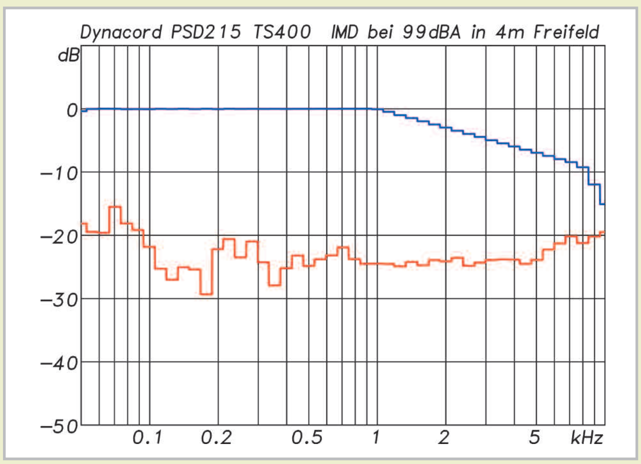


Fig. 13: Intermodulation distortion at 99 dBA Leq at a distance of 4m in the free field. The blue curve shows the spectral distribution of the measurement signal with a distribution according to EIA-426B. The crest factor of the test signal was 12 dB

The phase response: constructive causes and practical repercussions

For every frequency response – or, to be more precise, amplitude frequency response – there is a phase response. The two together form the complex frequency response, which can be derived through a Fourier transformation (FFT) from the impulse response of a system – in this case, the loudspeaker. The phase response in this context is most often ignored or else deliberately mystified. Whenever the sound seems a bit strange and no one is quite sure why, someone inevitably pipes up with the explanation that 'it must have something to do with the phase'.

Here, a number of different phenomena have to be distinguished that are often confused.

On the one hand, people speak of phase problems or phase cancellation when signals from multiple sources overlap and are added and these are not in phase. They could, for example, be two loudspeakers standing next to each other and reproducing the same signal. Depending upon the position of the listener, the signal from one loudspeaker could take longer to reach the listener than that of the other with the consequence that, as the two signals are added, depending upon the frequency of the signal, constructive or destructive interference ("comb filtering") will occur. Comb filtering, because of its pronounced effect on the amplitude response, is easily detected aurally and is often described as "phasing".

The system loudspeaker in itself, however, also has a phase response, which means that signals of different frequencies are not radiated precisely in phase. If you input in parallel one 100 Hz and one 200 Hz sine wave signal, the latter synchronized to the former, to the same loudspeaker and look at the sound pressure waves produced, you will see that in the case of almost all loudspeakers, the two sine waves will be reproduced slightly out of phase. When the phase shift or rotation is exactly 360° (or any integer multiple thereof), the difference is no longer discernible in the stationary time signal, but it is in the phase response over the frequency.

Fig. 1 (red curve) shows the phase response of the 15" woofer of the PSE215 in the bass-reflex enclosure. There is an overall phase shift over the frequency of 360°. Based on the example just mentioned, one can see here that the 100 and 200 Hz sine wave signals are reproduced with a phase discrepancy of 37°. The 360° phase shift here in the low frequency range is typical of a bass-reflex box, which behaves like a 4th order acoustic high-pass filter. The 360° here represent the so-called 'minimum phase element' – in other words, the phase shift that must at the very least be produced by a filter of this type. The calculated phase response of a pure high-pass filter function is shown in Fig. 1 in blue alongside the phase response of the loudspeaker. The real loudspeaker deviates somewhat from the calculated curve because a number of side effects are in play.

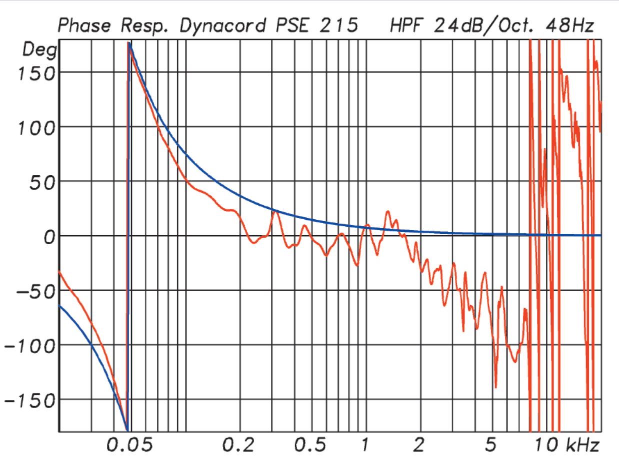


Fig. 1: Phase response of the PSE215 in red. In blue, a calculated curve for a 4th order high-pass filter with a 48 Hz corner frequency

We must make clear at this point that every loudspeaker is also an acoustic filter with a corresponding phase response. To this is added the phase response of the electric filters in the crossover from which the phase of the entire system emerges, just as is the case with the amplitude frequency response.

If as our next step we look at the phase response of the 2-way TS400 top in Fig. 2, we see that here a great deal more is happening. The red curve exhibits at the bottom end the already encountered behaviour of a 4th order high-pass. At the higher frequencies, however, the curve begins to exhibit powerful phase shifts that go way beyond the minimum phase element shown here once again in blue. The minimal phase element here is based on the assumption of a 2nd order crossover filter. Where do the deviations come from? If we take a look inside the box, the cause is immediately apparent. The high-frequency driver, which is horn loaded, is found at the rear of the loudspeaker enclosure, whereas the woofers are further forward on the front panel. This interval of around 9 cm equates to a propagation time delay of 0.27 ms, which in turn gives rise to a phase shift that as the frequency rises becomes increasingly marked. If we look at the red phase curve, between 1 kHz and 11.3 kHz, we find a 3 x 360° phase shift, which results from the 9 cm displacement in relation to a wavelength of 3 cm at 11.3 kHz. This displacement is clearly discernible in the impulse response of the loudspeaker in Fig. 3. Here, the impulse portion of the woofer comes first, followed after a 0.27 ms delay by that of the tweeter.

If we reference the phase display to the first signal to arrive, i.e. that of the woofer (the red curve in Fig. 2), the tweeter is now lagging behind, i.e. in the representation of the phase response, the phase falls sharply in the frequency range of the tweeter. If we take the tweeter as reference, now the woofer is in advance and we get a rising phase (the green curve in Fig. 3). It is common to take the first impulse as the reference, as a loudspeaker is a causal system and no non-causal elements should appear in the representation. We can sum

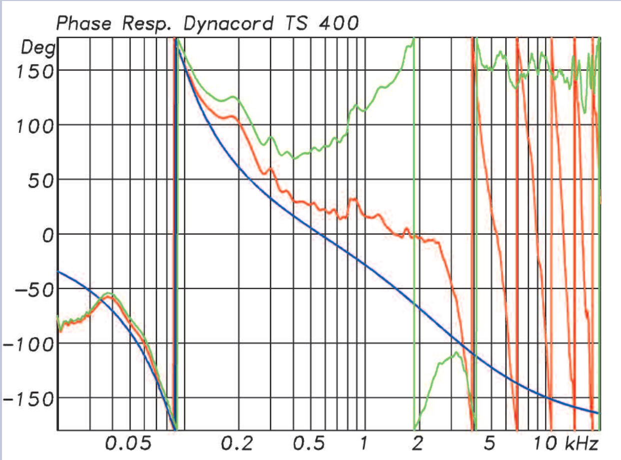


Fig. 2: Phase representation for the TS400, in red referenced to the woofer and in green to the tweeter. In blue, a calculated curve for a 4th order high-pass and a 2nd order crossover filter

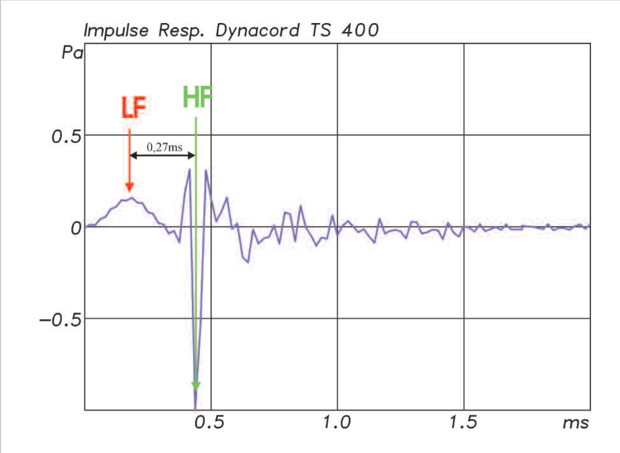
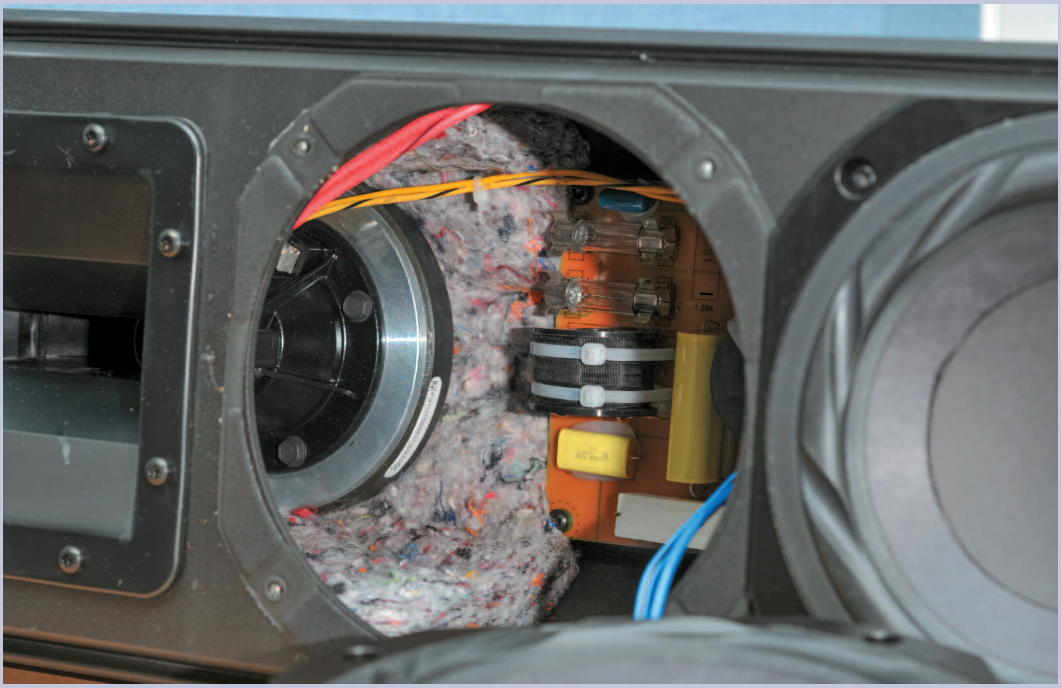


Fig. 3: Propagation time difference between the tweeter (HF) and woofer (LF) of around 0.27 ms corresponding to a spatial displacement of around 9 cm

up by saying that both – the partial sharply falling phase responses as well as the rising phases in the representation – point to a propagation time delay between the two ways of the loudspeaker. The desired curve is generally the inevitable minimum phase element (in Fig. 3, the blue curve). At this point, two questions arise: How can we attain this ideal curve, and, if we cannot, are such discrepancies discernible aurally? If we are dealing with an active box, the propagation time discrepancy can be eliminated easily by introducing an appropriate amount of delay into the signal path of whichever driver is the further forward. If the correction has to be performed using passive filters, however, then what is needed are all-pass filters, and these create a variety of new problems and in addition are complex and expensive to produce. Many – or, to be more precise, virtually all – manufacturers therefore reject this solution. It remains to discuss what the consequences are. The primary consequence is the effect on the phase response. A secondary effect can be a waviness in the frequency response in the crossover region, where also irregularity in the directivity could set in. The last two can be heard indirectly in the frequency response. If we look at the frequency response and the vertical directivity of the TS400, however, we can detect no such irregularities. So the developers in Straubing have got the problem under control. What remains is the primary effect of the strong phase shift from the woofer to the tweeter. Here, fortunately, it is the case that our ability to perceive direct phase shifts with no further impact on the amplitude is very limited. If you were therefore to conduct an aural test comparing two otherwise identical signals that differed only in their phase response (such as the red and blue curves in Fig. 3), it would be very difficult – or, rather, impossible under anything but ideal conditions – to detect any difference in them at all.



The slightly recessed EV DH-3 1” HF driver

21/2-way box comprising a line source of frequency-dependent length for the low midrange combined with a 90° x 40° horn

Top plus sub measured

If we look at everything together, what we get are the curves shown in Fig. 6. When the PSD215 is combined with a TS400, the sum frequency response exhibits a treble and bass emphasis in each case of around 5 dB, making for a powerful and rich sound. The dotted lines, here too, show the US setups. But irrespective of which setup is preferred, when an additional passive subwoofer is used it will be necessary to reduce the level in the sub channel by 6 dB, or it will all be too much. The main point of a second subwoofer is to provide more reserves when the bass needs to be really loud.

The relevant phase responses for the EU setup are shown in Fig. 7. The satellite and subwoofer here are in perfect harmony and therefore complement one another to ideal effect. Over the entire transition range from 50 Hz to over 200 Hz, phase responses of the subwoofer (red) and satellite (blue) coincide. Were that not the case, the addition of the two signal paths would be compromised – something that could still occur (depending upon the placement of the units) as a result of propagation time differences. One could attempt in such cases to bring the two units back into phase using the separately adjustable subwoofer delay and polarity, but doing that is no simple matter. The simplest and best solution is to place the satellite and subwoofer as close together as possible or at least on the same plane e.g. by pole-mounting the satellite atop the subwoofer.

The phase response exhibits a 3 x 360° phase rotation near the bottom end of the frequency range due to the 4th order crossover function, the acoustic high-pass filter in the form of the bass-reflex subwoofer and the additional electrical 4th order high-pass filter. All of these together result in a group delay time (Fig. 8) of just under 40 ms. Naturally this is quite a high value but there is no way of getting round it without the steepness of the slopes of the requisite filters being unduly compromised.

Above 2.5 kHz there is a conspicuous phase rotation. If we look more closely at the satellite, the cause of this soon becomes clear: the HF driver is a few centimetres behind the woofers in the enclosure, which causes a propagation time discrepancy. With a passive crossover, it is possible to eliminate this discrepancy at a great deal of expense using all-pass filters, but this solution itself brings further problems, costs and disadvantages, which is why the designers at Dynacord have decided against it.In the spectrogram (Fig. 9), the combination of PSD215 and TS400 present a benign aspect. The entire HF range is free from resonances – even where the 6" woofer is already in play, which speaks well for the corrugated diaphragm structure. A first small resonance can be recognized at 800 Hz. The cause for this may lie in the enclosure modes, but from this vantage point one cannot say for certain.

Directivity

If we turn to directivity, this is determined by the design of the TS400 satellite, which we have already described in detail. The objective here was a wide horizontal and a narrow vertical dispersion angle over as wide a frequency range as possible. The data sheet gives in this context a nominal dispersion angle of 90° x 40°.

Fig. 10 shows here the isobar curves of the horizontal plane, these being primarily determined by the horn in the treble and the diameter of the diaphragm of the LF driver as well as the width of the enclosure. Here everything accords harmoniously, so that from a central frequency of 1 kHz outwards a -6 dB dispersion angle initially of 120° is established, this then narrowing to 90°at the higher frequencies from 4 kHz upwards.

The considerably more demanding vertical plane is illustrated by the isobar curves in Fig. 11. Here, too, the stated objective is masterfully attained. The desired angle of 40° as the average value between 1 and 10 kHz is only very narrowly overstepped. In the transition area around the crossover frequency of 2.6 kHz inevitably there is a slight amount of turbulence but – that aside – the course of the isobars is regular and straight.

Taking both planes together, the results for what is superficially such a discreet and narrow box –and one, furthermore, equipped with passive filters only – merit a certain respect. Something like this is not the result of accident. Where then does the difference lie between this and a 'normal' 12/2 box for which a nominal 90° x 40° is similarly claimed? In the case of the TS400, the vertical 40° is achieved as early as 1 kHz, and even at 350 Hz the dispersion angle is still as narrow as 80°. For want of radiating surface area, a classic 12/2 box is incapable of achieving this type of dispersion pattern, which is not intended as a value judgement but simply a description of the characteristic features of the different types of design.

Maximum level

For the maximum level measurement, we assembled all three configurations in the measuring room: the TS400 satellite on its own, then with the PSD215, then finally with this and the PSE215 passive bass extension. For the measurements, a distortion boundary value of 10% was used, which for a PA system is considered a practical value. The TS400 with its average sensitivity of 95 dB and maximum amplifier output of 1 kW makes the most of each, skimming along just beneath the 125 dB line. The most surprising reading is 122 dB even at 100 Hz. With one subwoofer, you can obtain 120 dB as early as 55 Hz, a second will add a further 6 dB. In practice, what all this boils down to is that for acoustic instruments, primarily, as well as vocals, the TS400 can manage perfectly well on its own. If bass and drums are added, a subwoofer will be needed. For DJ acts and the like, there is then the option of the bass extension for deep and rich bass sounds.

To measure the intermodulation distortion, the TS400 was operated together with the PSD215 without extension. A level of 99 dBA at a distance of 4 m was set under free field conditions. The linear weighted peak level then reached 116 dB. The rig ran with this setting c. 4 dB beneath the clipping threshold. If we convert this value to a distance of 1 m, the peak level that can be achieved is found to be 132 dB, which is also the value found in the data sheet.

If for the measurement from Fig. 13 we relate all the distortion components to the overall signal, the distortion at -22 dB corresponds to around 8%, the distortion here being evenly distributed throughout the entire frequency range.

Aural test

For the aural test, the Dynacord system was set up in full, with one active and one passive subwoofer plus a TS400 on each side – the typical configuration for a small club, a DJ act or a Top 40 band. Setting up and dismantling the system can be accomplished swiftly and in a relaxed manner. With two subwoofers per side, we took them down 6 dB, since given the already existing 5 dB emphasis in the bass, the low frequency content would otherwise become over obtrusive. For shorter distances, the boost above 8 kHz should perhaps also be reduced. If you are 10 to 20 metres from the loudspeakers, this emphasis works out well. At a distance of 4 to 8 metres, you could simply pull down the 10 kHz band using the 6-band EQ. In our aural test, a value of -4 dB delivered pleasing results.

No sooner is the rig set up and tuned than it proves a total delight. The sound is powerful but not excessively fat, and tonally it is exquisitely even and well balanced. All kinds of music are a joy to listen to with this Dynacord set, and it is also remarkably level-consistent, so that even at a distance of 10 to 20 metres, the sound pressure levels generated remain within bounds considered "officially admissible". And when you further take into account the discreet styling of the rig, it all makes for an extremely pleasant surprise.

Prices

TS400	satellite speaker (top)	€	2,010
PSD215	powered subwoofer	€	3,200
PSE215	passive sub extension	€	1,544
VPM1500	connecting pole	€	52
TA-TS400	tilt adaptor	€	354
WMK-25	wall-mount kit	€	148
CB-TS400	carrier bag	€	77

Conclusion

Dynacord has for decades enjoyed a reputation for building small to medium-sized PAs of an unusually high quality. That this is no myth left over from bygone times is proved by the latest combination of TS400, PSD215 subwoofer and PSE215 bass extension. The rig is impressive in every respect – from the measurement readings to the aural impression, handling, production quality and finish. In practice, what is likely to prove its salient advantage is its narrow vertical and wide horizontal dispersion pattern, which is ideal for a great many applications – most notably the provision of sound reinforcement in acoustically problematic rooms.

This does not make the TS400 a "specialized" 12/2 box but quite simply a superior one. The price of the full set including sub extension, at around € 14,000, may at first sight seem high in comparison with many low-cost mini PAs. The price, however, is fully justified as the rigours of everyday use will quickly make clear, when features like its swift and secure handling will come to the fore and you get down to the nitty-gritty: how to cope with a reverberant hall and whether the rig will still sound great in it. The vexed question these days of what is and is not a sound investment is easily answered in the case of this Dynacord system simply by looking at the numerous devices from the same manufacturer out there that have been performing sterling service for many years now on the road, without as a rule giving their owners the slightest cause for complaint.

Text and measurements: Anselm Goertz
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