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1. Innovation from passion

The intensive development work which we began in 2005 has transformed us into one of the world's leading specialists in air motion transformers. The fascination for these unusual sound converters has been a major part of our lives since 2005 and any obstacles in our path only serve to intensify our commitment.

There have been times where the entrepreneur in me has been very critical of the immense level of input in terms of time and money. For example, investment in this technology in 2011 was way over € 200,000. Over the seven-year development period, a significant sum of money has been invested.

In the end, the passion for development and the belief in the benefits of this transformer principle is what won through. Thanks to our extensive expertise, we are now in a position to select the optimum components from a multitude of different variations and elements and combine them depending on the particular application.

The transformers presented in the current 2012 product range are impressive proof of the potential of air motion transformers. "Acoustic pressure to the *n*th degree" is the statement behind the MUNDORF PRO AMT product range. Take a look for yourself!

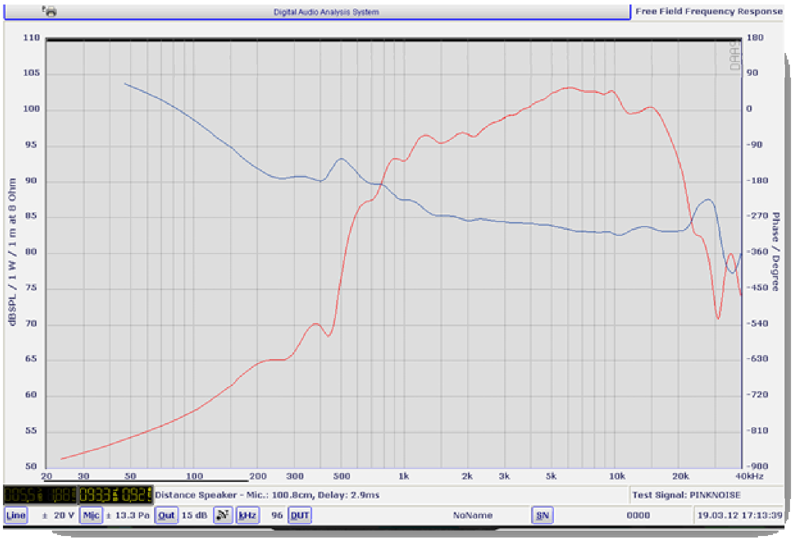
Above image: The line array shown here was developed during a final year project at the Düsseldorf University of Applied Sciences. It consists of a total of 16 MUNDORF® PRO AMT® 197PP27R-740-121-FA. You can find the full report on page 14.

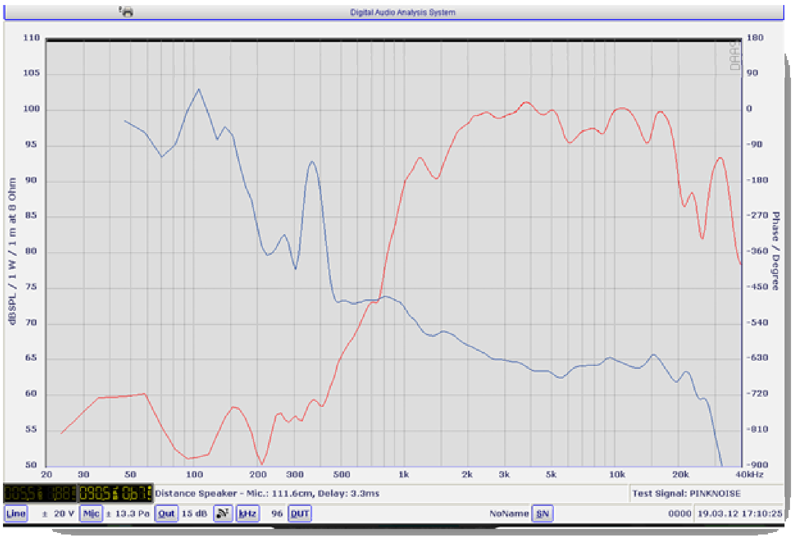
2. THE BENEFITS OF THE AMT®

In general terms, the acoustic benefits of the AMT can be described through the **extremely-low distortion**, **outstanding micro-dynamics** and a **very natural and stress-free listening experience**.

The extremely-quick response time of the membrane and the excellent phase behaviour are a further plus point for the AMT.

The phase contains all information about the chronological sequence of the signal. We react very critically to any errors in the phase sequence because the brain is specialised in evaluating this information very precisely. The chronological sequence of an acoustic event provides people with information relating to spatial orientation, and sudden changes could be signs of potential dangers. People's perception is just as sensitive in this area. Distortions in the chronological sequence are therefore perceived as being extremely irritating and unpleasant. The AMT® supplies all this information in its original form. There are particular benefits in the rendering of percussion instruments thanks to this unique ability.

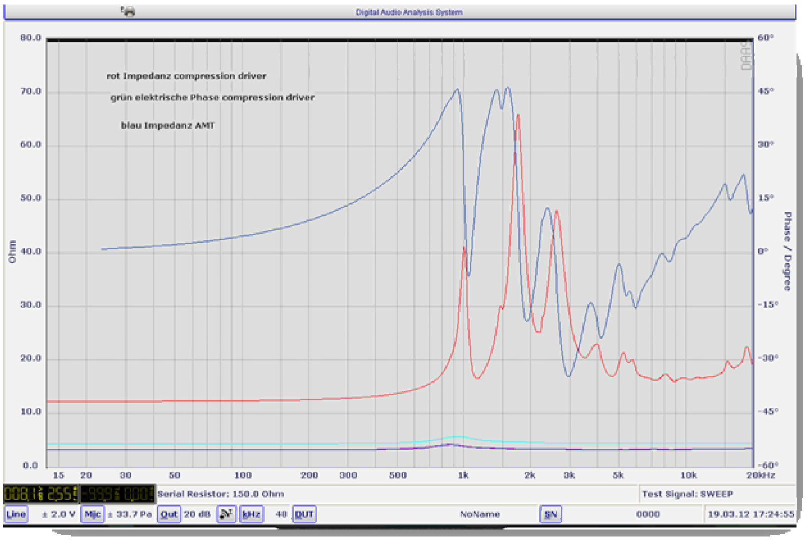




The diagrams above illustrate SPL and the acoustic phase of a compression drive and the SPL and the acoustic phase of a typical Mundorf® AMT®. The phase sequence of the AMT is extremely uniform through the entire transmission range, including the mid-range transmission frequency. Alterations are either close to or underneath the perception threshold of **15° per octave**.

In contrast, the phase of the compression drive changes from 130° to 670**°** and again changes direction. In the 1kHz to 2kHz and the 2kHz to 4kHz octaves, the difference is between 90° and 100°!

So with the compression driver, the difference in large ranges is significantly greater than with our AMT, which leads to a perceivable blurring of the impulses that were originally accentuated. In worst case scenarios, a short, dry "tock" sound is transformed into an intense whistle.



On the right is a comparison of the impedance and electrical phase of the compression drive and of the AMT®.

The curve at the bottom is the extremely-uniform curve of the AMT® whilst the progression of the compression drive is shown above. Under 3kHz, the compression driver's fluctuations make the correct connection of the transformer to the mid-range impossible. Although the compression drive still provides ample acoustic pressure under 3kHz, it can only provide high-quality rendering from 3kHz and above. The AMT® is completely different: the practically non-existent impendence hub and the smooth progression of the electrical phase makes connection to the (deep) mid-range simple even in the resonance range.

The capacity of the AMT® to effortlessly render the shortest of impulses and the finest of nuances together with the extremely-low distortion levels enables music playback at the highest possible level.

Thanks to optimised membrane characteristics, optimum dimensioning and the forced cooling described below, the quality of the music rendering is now also possible at very high levels which were previously only able to be handled by compression drivers.

For usage in line array applications in acoustic technology, there is a further advantage that the AMT is an acoustic line source and therefore fully satisfies the physical conditions required for correct line array emission, also without **complicated waveguides**.

3. High vertical range of manufacture as the basis for successful development work.

In order to be able to reach our ambitious development targets, we did not just invest in extensive measurement technology and qualified personnel, but also in a complete, in-house membrane manufacturing system.

Here, a basis material specially developed by us is processed into membranes. Processes such as the exposure, etching and folding of the membrane all take place in-house. We also have a modern metal processing system and corresponding CNC milling machinery for the immediate creation of prototypes.

In close cooperation with selected customers and technical research institutions, developments have taken place over the last few years which now form the basis of the products presented in the current catalogue.

There is actually a whole range of ideas which we want to realise in the future. Nevertheless, we believe we have now reached a point where we can present the latest innovations to the general public in the form of a standard product range.

This standard product range consists of a systematic grid which allows individual customer-specific variations to be created.

The partnership with you as an ambitious customer has given us great enjoyment over the past few years and we are confident that we will continue to be able to build on this cooperation.

For interested readers, the next few pages contain a short introduction into the structure of the product range depending on application and on budget. It would be a great pleasure to accompany you on this journey into the world of air motion transformers.

4. Technical principles

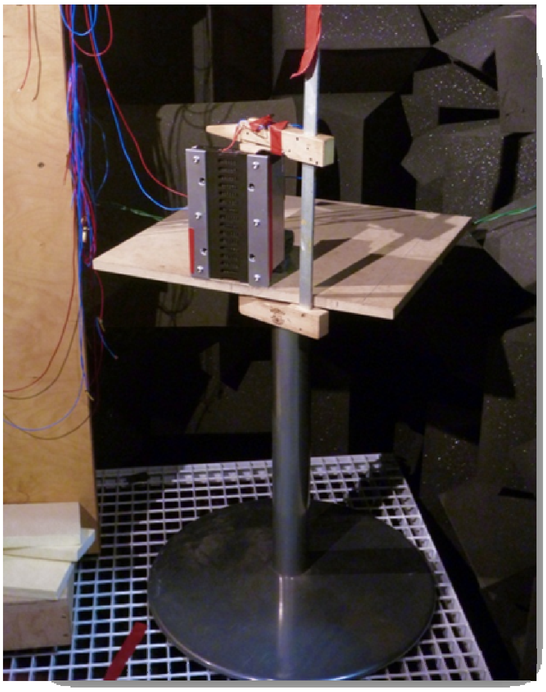
4.1 The membrane. By modifying a range of parameters, it is possible to optimise the AMT for certain purposes. Membrane geometry and membrane materials are major factors in determining the properties of the driver.

In the Mundorf-AMT, we predominantly use **Kapton®** (polyamide) as an extremely temperature-resistant membrane material in conjunction with aluminium for the conductor paths.

On this basis, the geometric shape of the membrane is what determines the **upper and lower threshold frequencies**. Distortion properties and linearity are highly dependant on the optimum geometric design of the membrane.

Over the last few years, hundreds of different combinations of membrane shapes and membrane materials have been manufactured and evaluated in our own laboratory. 200 membranes were evaluated in the second half of 2011 alone. The findings obtained from these tests are reflected in the products optimised for a variety of applications which are available in 2012. One thing they all have in common though is extremely-low harmonic distortion.

4.2 Loading capacity is also dependant on the membrane surface and the flow characteristics in the individual folds of the membrane, together with the use of the aforementioned stabilisers. The **use of a fan** can increase the thermal rating by a factor of five with relatively little effort. So that the fan remains silent, we offer fan control adapted to the noise level. The "passive" variation is particularly convenient here as it obtains the required energy from mid/high signals and no separate power supply is required.



Complex protective circuits are also available to further increase operational safety. We also offer both passive and active solutions in this regard too. They will be available in summer 2012.

4.3 THE MAGNET STRUCTURE.

Together with the membrane, the combination of pole plates and magnets and the rear damping of the membrane also determine the characteristics of the transformer. In order to keep the dimensions as compact as possible, all Mundorf AMTs contain neodynium magnets and, apart from a few exceptions, the extremely powerful N50 variants are used. In order to retain the compact shape in the presence of larger magnets, a **U-shaped pole plate geometry** was developed and successfully registered as a patent.

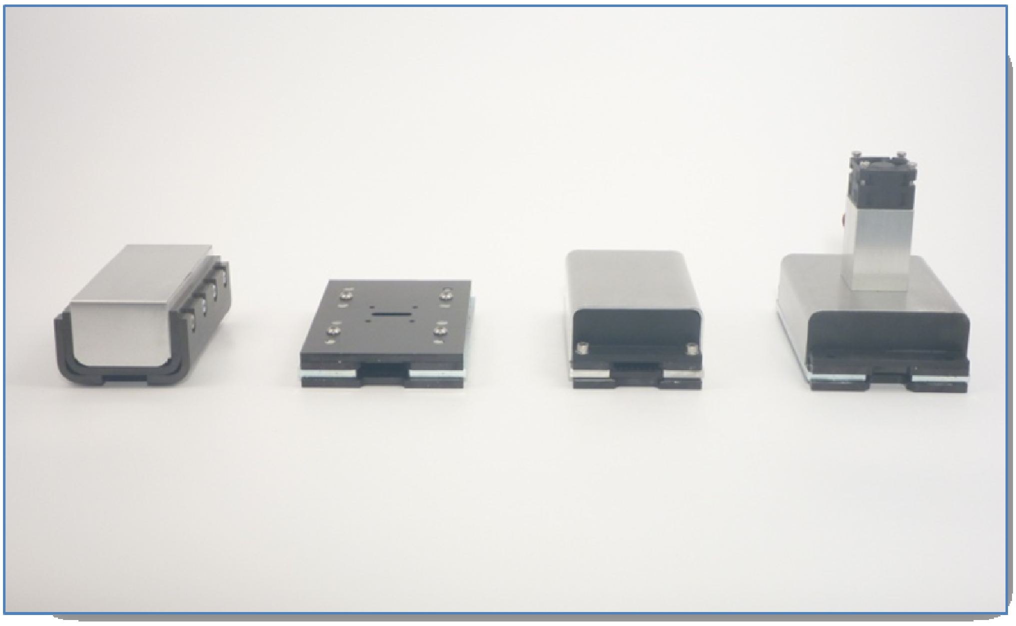


Image 1: Rear sides of various drivers. On the far left is the particularly-compact U-shaped component. To the right is a flat system without an external cavity, followed by a system with an external cavity and a system containing a fan.

4.4. THE DAMPING.

There are three different alternatives when it comes to rear damping. The first, namely not implementing any damping, leads to the special topic of the AMT as a **dipole**. Those familiar with this special construction will be pleased to hear that several Mundorf AMTs have already been developed in this form. Market entry is planned for High End 2012 or mid-2012 at the latest. The successful application of the AMT as a dipole element makes a whole range of addition measures necessary. We therefore expressly advise against removing the cavity from a "normal" closed AMT and operating it as a dipole.

Two types of damping are currently available. The first possesses a **rear chamber** filled with special insulation material. The insulating material absorbs rear sound and plays an important role in the optimum membrane set-up. Each pole plate/membrane combination requires a separate combination of insulation materials. Making the right selection requires high levels of experience and expertise. With correctly-sized and optimally-dampened chambers, drivers can be realised with starting frequencies far below 1,000Hz.

In the case of the second rear damping variation, an **additional uncut rear pole plate** is applied. This strengthens the magnetic field and reduces the volume to a much smaller degree as it is only formed by the slots in the first rear pole plate.

This way, the membrane is dampened in lower frequency ranges meaning that the starting frequency is around 2 to 3kHz for this construction. This means that extremely efficient transformers can be realised for three-way applications.

4.5 Dispersion behaviour

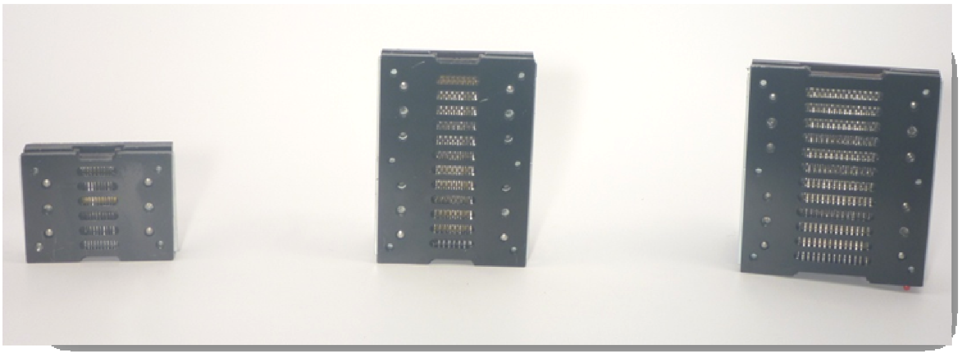


Image 3: Systems with different-sized membranes

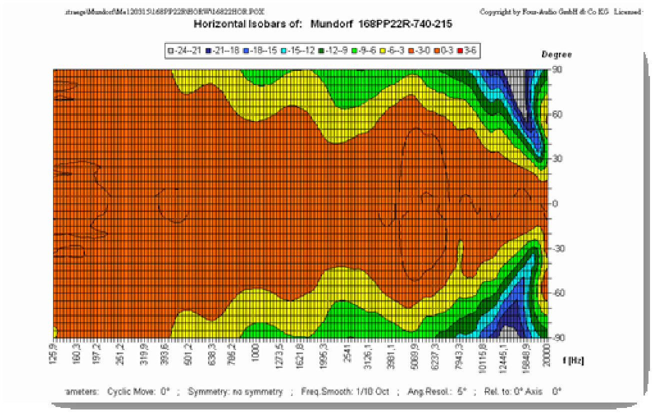
The horizontal and vertical orientation of the membrane is a decisive factor in sound dispersion behaviour. The wider the membrane, the greater the horizontal plane of the radiated sound and the narrower the membrane, the greater the angle of aperture.

Depending on the application, a wide variety of levels of focus are required. Those who value precise spatial reproduction particularly highly, such as in a Hi-Fi application for example, should avoid indirect sound which is generated by reflecting off walls, ceilings or floors. In this case, more-aligned, narrower dispersion characteristics would be appropriate. Those who want to fill a room with sound move away from precision and look to distribute the sound as widely as possible.

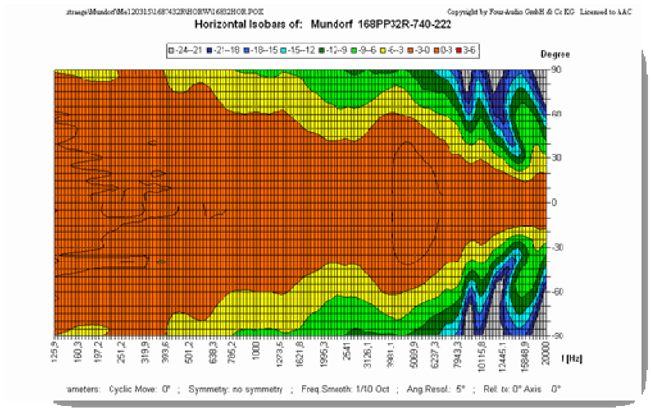
In terms of public address systems, there are a variety of requirements depending on the particular application. Membrane height and membrane width are just as important when selecting a suitable driver.

Membrane width [mm]	Max. horizontal angle of aperture in degrees
22	100
27	90
32	80
56	40

Driver height [mm]	Max. vertical angle of aperture in degrees
88	40
168	20
248	10

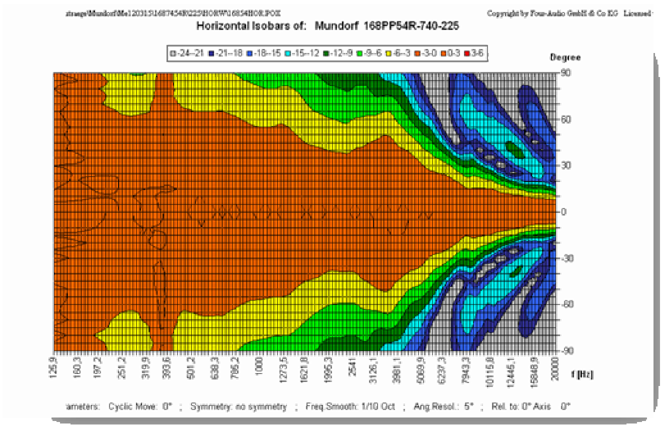


Horizontal dispersion of a 22mm-wide membrane



Horizontal dispersion of a 32mm-wide membrane

The table provides an overview of the angles of aperture able to be achieved with various membrane dimensions. Furthermore, we also have calculations for horn attachments with a variety of angles of aperture. Please request these if required.



Horizontal dispersion of a 56mm-wide membrane

4.6 Conflict of objectives and solutions.

It's clear that conflict objectives can occur with such a variety of parameters. For example, a high level of loading capacity can be achieved through a larger membrane surface area, but the membrane should be as narrow and short as possible for the greatest possible angle of dispersion in a horizontal and vertical direction, which means restrictions in the membrane size. This is where strong magnet systems and forced cooling come into play in order to realise high sound levels with small membranes.

If you want to take advantages of the AMT as a line source with a line array and dispense with the need for complicated waveguides, the horizontal dispersion characteristics can be adapted by selecting the right membrane width in conjunction with a simple horn. The larger the angle of aperture needs to be, the narrower the membrane. As the height is predefined, the membrane surface area is therefore reduced along with the loading capacity, whilst the thermal levels remain the same. On the other hand, the sensitivity of the driver increases with narrower membranes provided that the magnet insert remains constant. As the gap in which the membrane is positioned becomes smaller, the magnetic field within the gap increases under the same conditions resulting in the transformer being more sensitive. As a result, a louder acoustic signal can be generated using the same amount of electrical energy. The lower thermal capacity of the smaller membrane is compensated for up to a certain point. In terms of the maximum noise level, the wider membrane is preferred to the narrower variation as the narrow membrane reaches the thresholds of maximum mechanical deflection earlier.

If there is no way around selecting a wide membrane for a wide-dispersing driver for reasons of higher loading capacity, there are two solutions worthy of consideration: Either a "phase plug" is added to the driver which, applied in front of the membrane, ensures that the sound isn't dispersed in such a targeted manner or a **coaxial membrane** is selected instead. This patented construction involves a membrane divided into at least three different segments, whereby the narrow middle segment is responsible for rendering the higher frequencies. This way, undesired restriction at high frequencies is avoided.

During a final year project, a technical solution for this concept was successfully realised using a Mundorf AMT with a 54mm membrane width. We would be happy to furnish you with the results from this final year project. A phase plug is currently in development.

4.7 Overview of a variety of available components.

In principle, the following models can be differentiated from one another:

4.7.1 Pole plate models

4.7.1.1 **Planar**, closed rear systems whose pole plates, magnets and membrane form a flat unit.
In terms of planar, a further differentiation is made between systems with an installed cavity for deeper starting frequencies and extremely-flat systems without a cavity with an additional, closed rear pole plate.

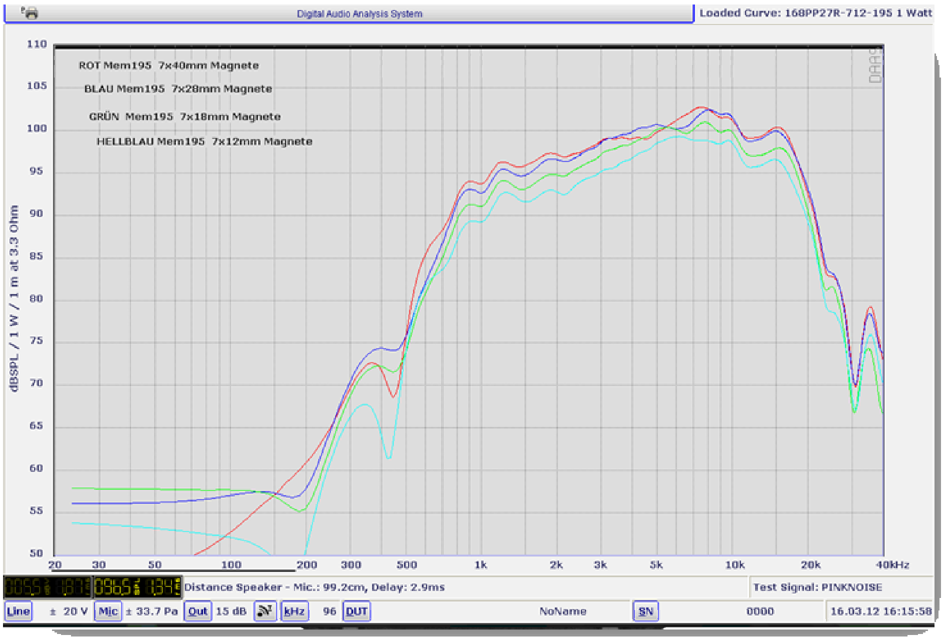
4.7.1.2 Systems with **U-shaped** pole plate.

4.7.2 Membranes. There are also a range of variations within these two model series which have different membrane heights and widths. Currently, membranes with 22, 27, 32 and 54mm widths are used meaning that a broad spectrum of horizontal angles of aperture is available (100°, 90°, 80° and 40°).

4.7.3 Magnet volumes. Magnet volumes vary from 8 to 40mm in width and from 6 to 7mm in height. This means that it is possible to adjust the sensitivity of the driver with a given membrane width and membrane height. For example, a 100dB driver with a membrane width of 27mm and a membrane height of 160mm can be realised with a 28mm-wide magnet or, in the case of a membrane height of 320mm, with a 15mm-wide magnet.

Above image: The same membrane in a magnet systems of varying strengths

Below: The sensitivity of magnet systems with magnets of varying widths and the same membrane.



5. Structure of the article numbers.

The possible combinations result in a dense product grid which can be used to determine the optimum solution for a variety of applications. The structure of the article numbers reflects this and is explained here using an example.

168PP27R-740-199-FA-X

"168"” The first three figures indicate the height of the driver in millimetres.

"P" stands for the Pro Audio application and the second "**P**" stands for the Planar model.

"27" indicates the membrane width and therefore provides information about the horizontal dispersion characteristics.

"R" stands for the model with a cavity (**R**ear Cover) and indicates a two-way driver. An **"F"** indicates the flat three-way variant.

"740" indicates a magnet profile of 7 x 40mm. The 7mm height implies a very low starting frequency, as with planar systems this also determines the height of the gap and therefore the height of the membrane.

"199" indicates the respective membrane type. No membrane characteristics are included in this number. A corresponding code would disrupt the article number structure. Impedance and threshold frequency must be taken from the data sheet.

"F" (**F**an) indicates forced cooling, whilst the **"A"** indicates the type of power supply for the fan (A = none, B = integrated passive control, C = integrated active control). The index X is reserved for various types of assembly.

The especially-compact U-shaped model is explained in the following article number:

328PU54R-1428-210-FA-X

The driver is 328mm high and is part of the U-shaped Mundorf ProAMT range. It has a rear cavity (R). Membrane 210 has been used. The magnet structure comprises 14mm-high and 28mm-wide magnets.

In terms of the U-shaped pole plates, the magnet dimensions do not provide any information as to the membrane used. Larger magnets can also be accommodated without any major difficulties in this compact model, meaning that the PU model can keep pace with the loudest drivers. A fan is installed without a control board.

6. Use of the product overview provided.

The information published in the product overview has been prepared to the best of our knowledge and belief. Due to the multitude of variation, it has, however, not been possible to construct all of the variations so that a significant amount of data must be interpolated due to the existing measurements. Measurement values only exist for the lines marked in blue. This is the reason why the published information cannot be seen as representing legally-binding product characteristics. This table with a convenient filter function is available for download here: www.mundorf.com/amtnews.

7. Final year project: Line array with 16 x MUNDORF® PRO-AMT®

Just before leaving for the ProLight & Sound 2012, the student's final year project arrived in our inbox in the early hours. Due to the effort that has gone into the project, we obviously wanted to do him justice so we have enclosed the document with this brochure in unedited form.

Left: The Mundorf®- Pro AMT® 197PP27R-121-740-FA used (16 units)

Attention! Please note, that most of the data are based on calculations. Only the blue colored lines are results of measurements!
We will supply an updated list for download at www.mundorf.com/amtnews

Product	mechanical data		dispersion		electro acoustical data									power handling			
														without fan		with fan (ad "-FA" to product code)	
	height [mm]	width [mm]	horizontal dispersion [degree]	vertical dispersion [degree]	nominal impedance [Ohm]	impedance [Ohm]	further available values of impedance [Ohm]	fres [Hz]	fxmin [Hz]	fmax	sensitivity [dB @ 1 Watt/Meter]	Max SPL w/o fan [dB]	horn required	continuous-power [W]	peak power [W]	continuous-power [W]	peak power [W]
88PP22F-728-248	88	87	100	40	8	8	4,5	1300	3000	21 kHz	100	121	nein	18	150	35	350
88PP22R-728-249	88	87	100	40	8	8	4,5	800	800	16 kHz	97	118	Ja	18	150	35	350
88PP27F-728-242	88	92	90	40	8	8,7	5,5	1300	3000	21 kHz	97	119	nein	22	185	44	430
88PP27R-728-250	88	92	90	40	10	9,7	5,5	800	800	16 kHz	94	116	Ja	22	185	44	430
168PP22R-628-255	168	87	100	20	4	3,5	5,5 / 8	1100	1100	20 kHz	100	125	nein	33	280	65	700
168PP22R-728-215	168	87	100	20	4	3,5	5,5 / 8	900	900	16 kHz	98,5	123,5	ja	33	280	65	700
168PP22F-728-215	168	87	100	20	4	3,5	5,5 / 8	900	2000	16 kHz	101,5	126,5	nein	33	280	65	700
168PU22R-1240-256	168	70	100	20	4	3,5	5,5 / 8	800	800	17 kHz	106	131	ja	33	280	65	700
168PP27R-628-244	168	92	90	20	4	4,5	7 /10	1150	1150	17 kHz	98	123	nein	40	350	80	850
168PP27R-728-245	168	92	90	20	4	3,5	5,5 / 8	780	780	17 kHz	98	123	ja, unter 2kHz	40	350	80	850
168PP27F-728-244	168	92	90	20	4	4,5	7 /10	1150	2000	18 kHz	101	126	nein	40	350	80	850
168PP27F-728-245	168	92	90	20	4	3,5	5,5 / 8	850	2000	17 kHz	99,5	124,5	nein	40	350	80	850
168PU27R-1240-257	168	75	90	20	4	3,5	5,5 / 8	800	800	17 kHz	105	130	ja	40	350	80	850
197PP27R-740-121	197	116	90	10	4	3,8	5,5/8	850	850	17 kHz	102	127	ja	60	525	120	1275
197PU27R-1240-269	197	75	90	10	4	3,8	10/16	800	800	17 kHz	109	134	ja	60	525	120	1275
248PP22R-628-260	248	87	100	10	4	4	7 / 11	1150	1150	17 kHz	104	128,5	nein	50	420	97,5	1050
248PP22R-728-261	248	87	100	10	4	4	7 / 11	850	850	17 kHz	104	128,5	ja	50	420	97,5	1050
248PP22F-728-262	248	87	100	10	4	4	7 / 11	850	2000	17 kHz	107	131,5	nein	50	420	97,5	1050
248PU22R-1240-263	248	70	100	10	4	4	7 / 11	800	800	17 kHz	109	133,5	ja	50	420	97,5	1050
248PP27R-628-248	248	92	90	10	6	4,9	9 / 16	1150	1150	17 kHz	101	126	nein	60	525	120	1275
248PP27R-640-248	248	116	90	10	6	4,9	9 / 16	1150	1150	17 kHz	102	127	nein	60	525	120	1275
248PP27R-728-157	248	92	90	10	6	4,9	9 / 16	850	850	17 kHz	101	126	ja	60	525	120	1275
248PP27R-740-157	248	116	90	10	6	4,9	9 / 16	850	850	17 kHz	102	127	ja	60	525	120	1275
248PP27F-728-248	248	92	90	10	6	4,9	9 / 16	850	2000	17 kHz	104	129	nein	60	525	120	1275
248PP27F-740-248	248	116	90	10	6	4,9	9 / 16	850	2000	17 kHz	105	130	nein	60	525	120	1275
248PU27R-1240-248	248	75	90	10	6	4,9	9 / 16	800	800	17 kHz	109	134	ja	60	525	120	1275
336PP27F-618-109	336	72	90	5	6	5	-	2000	2500	18 kHz	105	132	nein	60	600	100	1000

Measurement report

Red Line Array, prototype with Mundorf AMT

tested at the Düsseldorf University of Applied Sciences
by Dipl. Ing. (cand.) Arne Muscheites

Measurements were taken on:

12.03.2012 – 19.03.2012

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2 Measurements..3
2.1 Measurement of individual channels 3
2.2 Measurement of the entire system..5
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3 Measurement of the complete system 10
4 Technical/physical specifications 12

1 Task

At the Düsseldorf University of Applied Sciences, a line array prototype was developed within the framework of a final year project. This was equipped with two 8" woofers and an air motion transformer tweeter made by Mundorf in an asymmetric orientation.

The calibration of the system ends with the measurement, ascertainment and documentation of the system parameters. For the purposes of this, the characteristics of the single channels are determined and then measurements are taken from the system as a whole.

2 Measurements

All measurements were taken in an anechoic room at the Düsseldorf University of Applied Sciences. The measurement programme Monkey Forest was used along with the associated Robo front-end. A ECM 8000 microphone from Behringer was used. All measurements were taken at 48kHz in 24-bit resolution.

All speakers are actively filtered through a controller belonging to the system, the HD2 made by Four Audio. The system-specific FP14000 from Lab.Gruppen are used as amplifiers.

2.1 Measurement of individual channels

The single is operated and equalised as a three-channel system. The deep- and mid-range channels have the same chassis with the same bass reflex calibration. They compliment each other in the deep range up to around 500Hz. Only the mid-range channel is above this.

Woofer SICA Z005351 – 16 ohms
Mid-range unit SICA Z005351 – 16 ohms

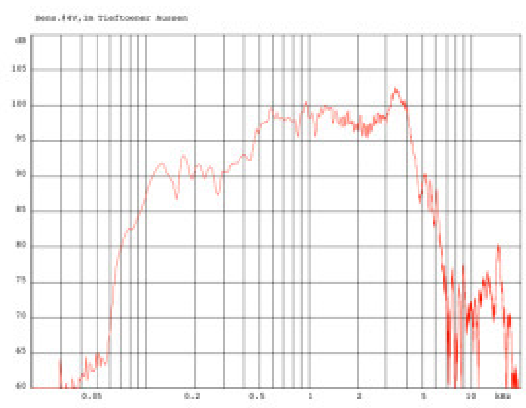


Figure 1: Frequency response for woofer

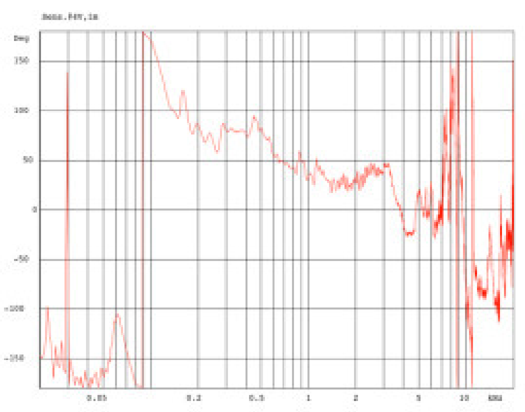


Figure 2: Woofer phase

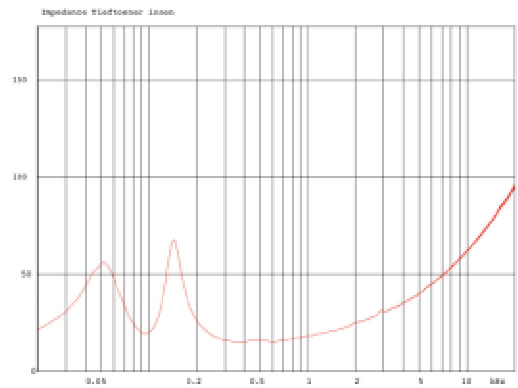


Figure 3: Impedance of woofer/mid-range unit

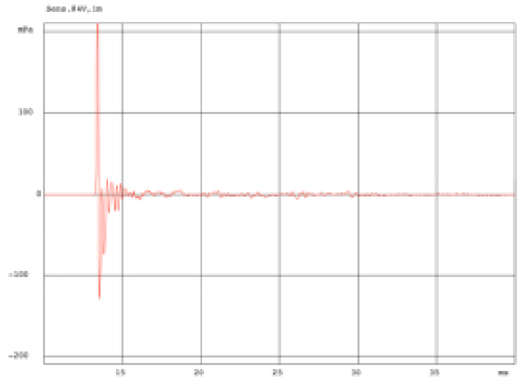


Figure 4: Impulse response of woofer/mid-range unit

The AMT 197PP27R ribbon tweeter made by Mundorf operating according to the air motion transformation principle is used as a tweeter.

Tweeter – AMT 197PP27R-740-121-FA 4 ohms

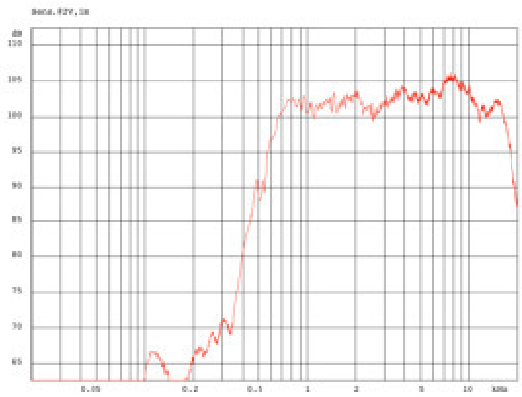


Figure 5: Frequency response of tweeter

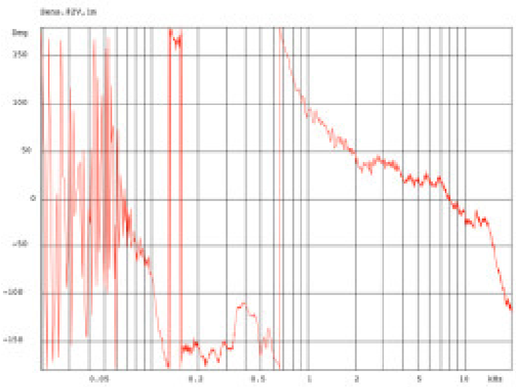
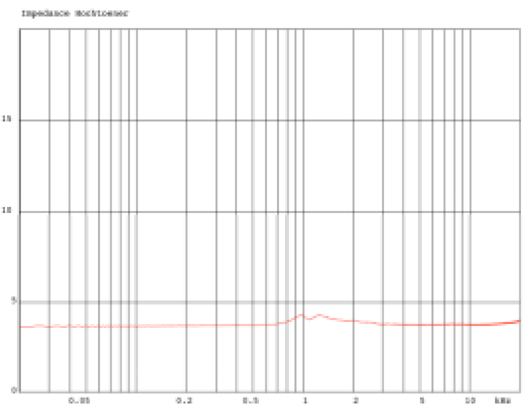


Figure 6: Tweeter phase



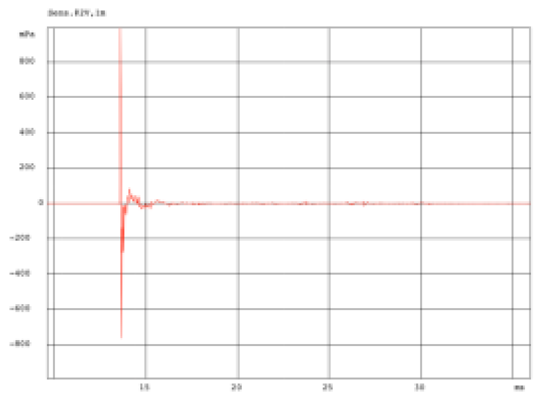


Figure 7: Impedance of tweeter

Figure 8: Tweeter impulse response

2.2 Measurement of the entire system

A HD2 made by Four Audio is used as a controller. The filters were realised as FIR filters. In the deep range channel, the controller works with 1008 taps and fourfold down-sampling, in the mid-range channel with 496 taps and twofold down-sampling and in the high-range channel also with 496 taps but without down-sampling.

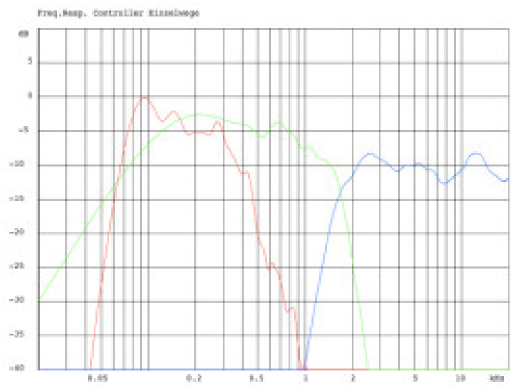


Figure 9: Frequency responses of controller channels

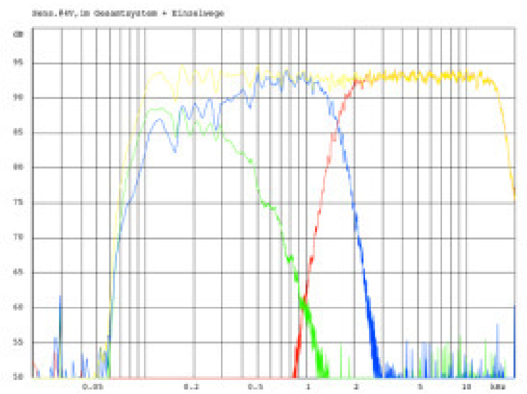


Figure 10: Frequency responses of single channels and the whole system

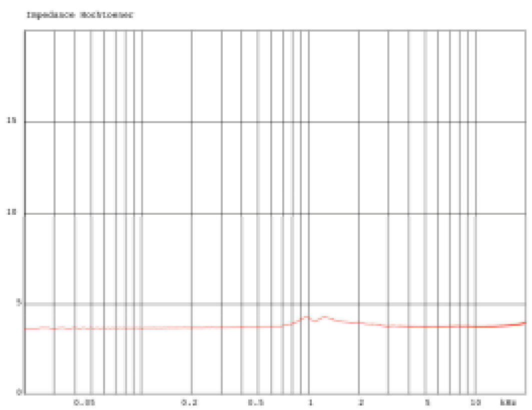


Figure 11: Impulse response of whole system

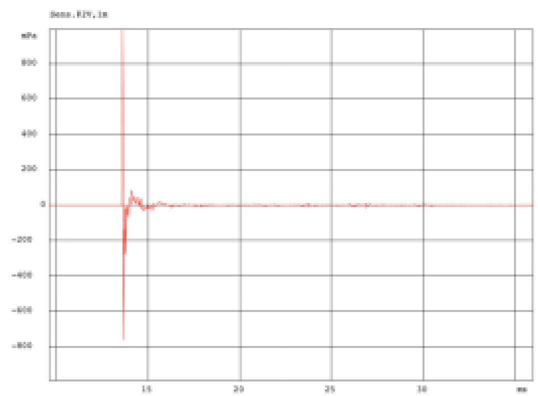


Figure 12: Impulse response of individual channels overlaid.

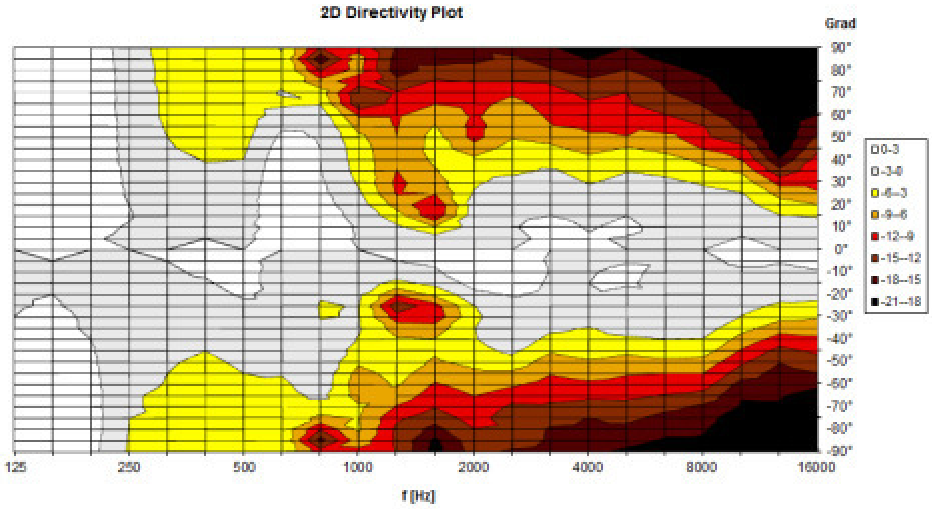


Figure 13: Polar diagram, horizontal, 1 speaker

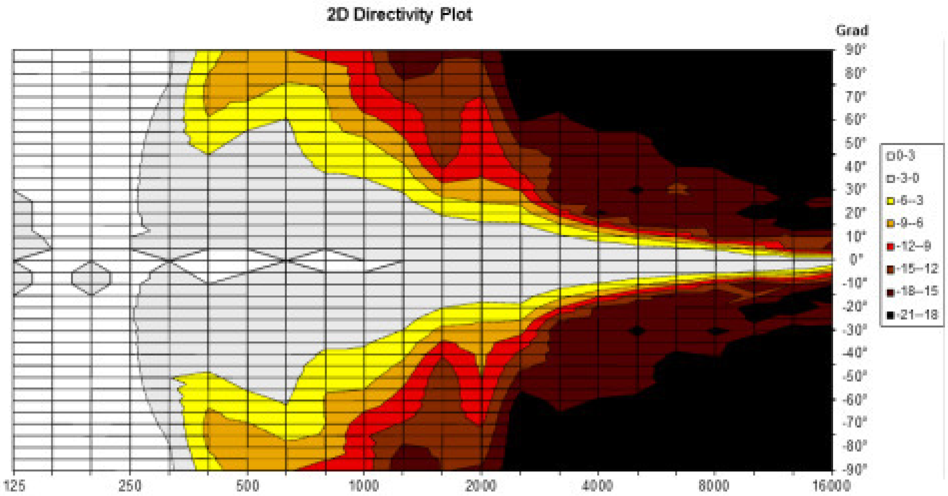


Figure 14: Polar diagram, vertical, 1 speaker

The system was designed for an angle of dispersion of 90°. The decisive factor here is the -6dB threshold which was well held at 90° in the horizontal plane. The drop in quality is unavoidable in the transition frequency due to the chassis layout. In the vertical plane, the angle of dispersion adds up to the nominal 5°.

2.3 Measurement of efficiency

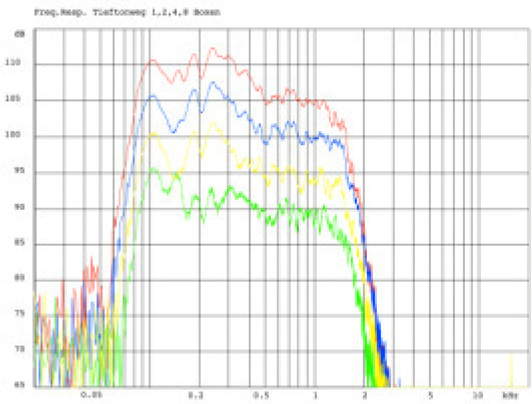


Figure 15: Coupling in deep and mid-range channels with 1, 2, 4 and 8 speakers

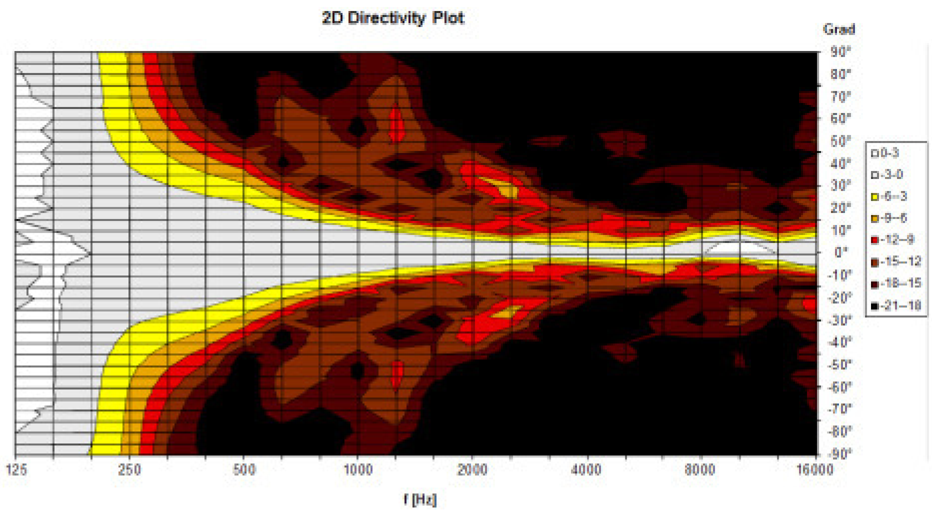


Figure 16: Polar diagram, vertical, 3 speakers with 0° angulation

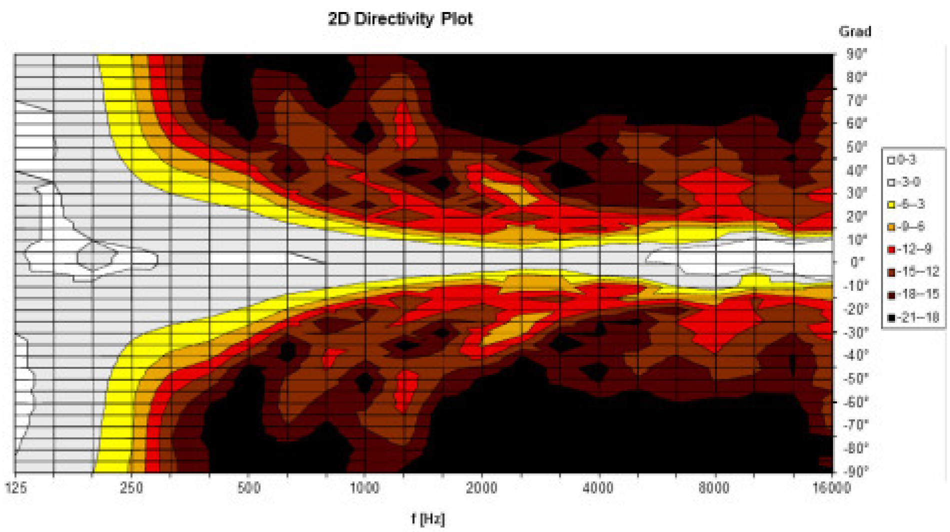


Figure 17: Polar diagram, vertical, 3 speakers with 3° angulation

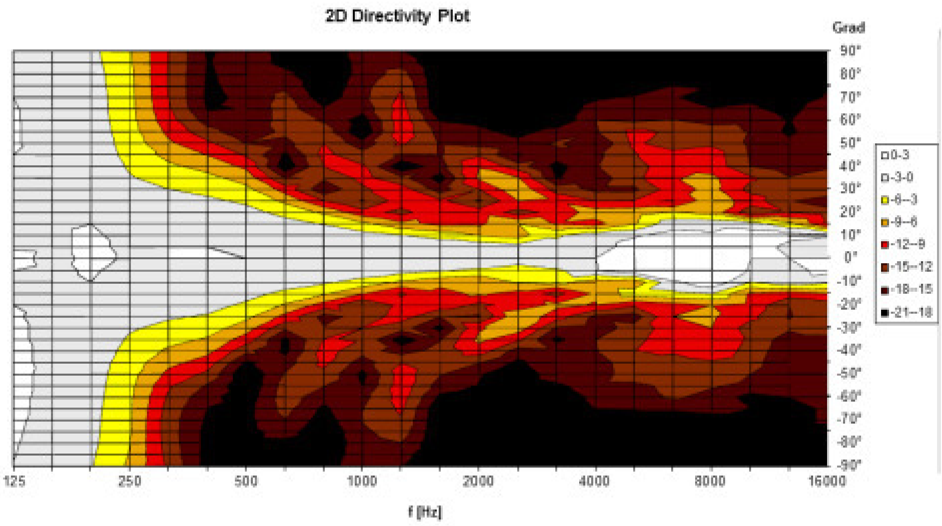


Figure 18: Polar diagram, vertical, 3 speakers with 5° angulation

The vertical angle of dispersion is expanded to 15° when 3 speakers are angled 5° to one another. Despite this, a roughly-coherent wave front is formed.

Max. SPL complete system max. 1kW

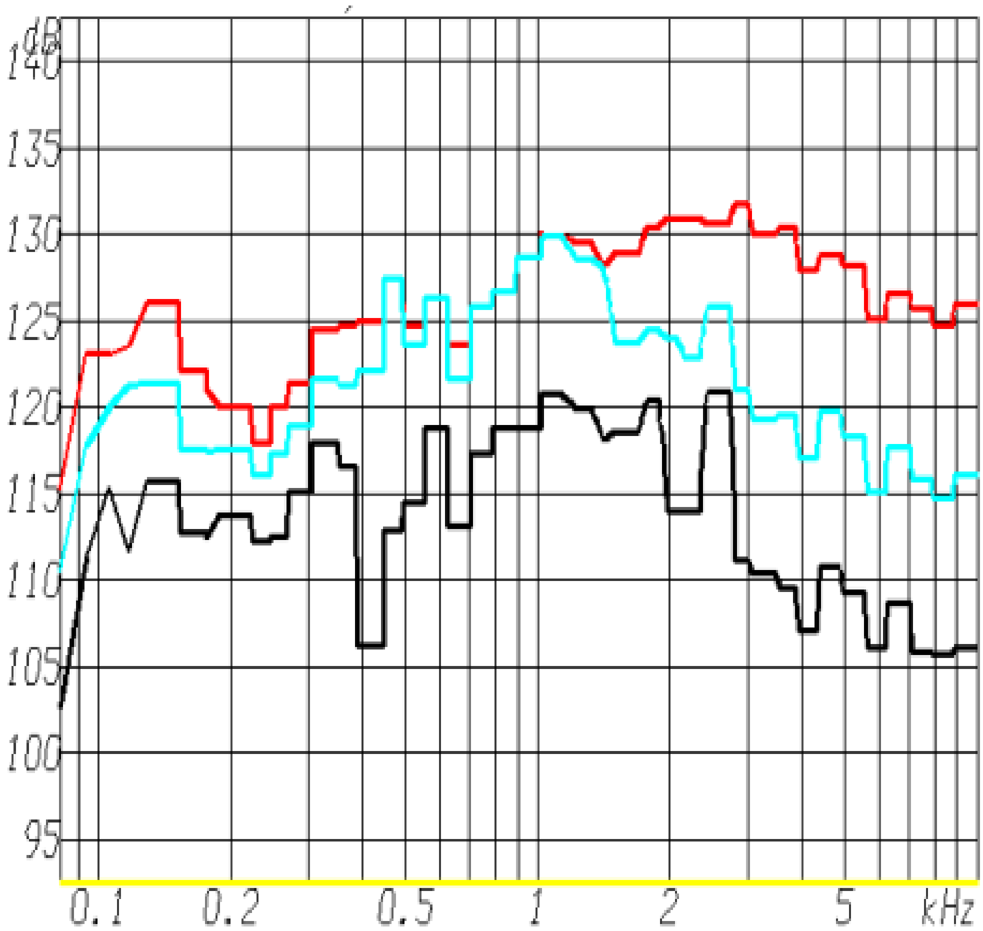


Figure 19: Maximum level for 1 speaker

The maximum level measurement was carried out with sinus bursts of 20ms. Threshold values were represented by THD values of 1% (black), 3% (turquoise) and 10% (red) in addition to the power input of a maximum of 1kW. Here, 1 speaker already reached an SPL of 130dB. Through coupling in the line formation, the deeper frequencies in particular are significantly increased.

3 Measurement of the complete system

In order to have the opportunity to use the full potential of the system, it was constructed as one line array consisting of 16 speakers. The entire line was controlled in mono.

In this configuration, the validity of the cylindrical wave dispersion was able to be confirmed. In addition, a maximum level test was carried out.

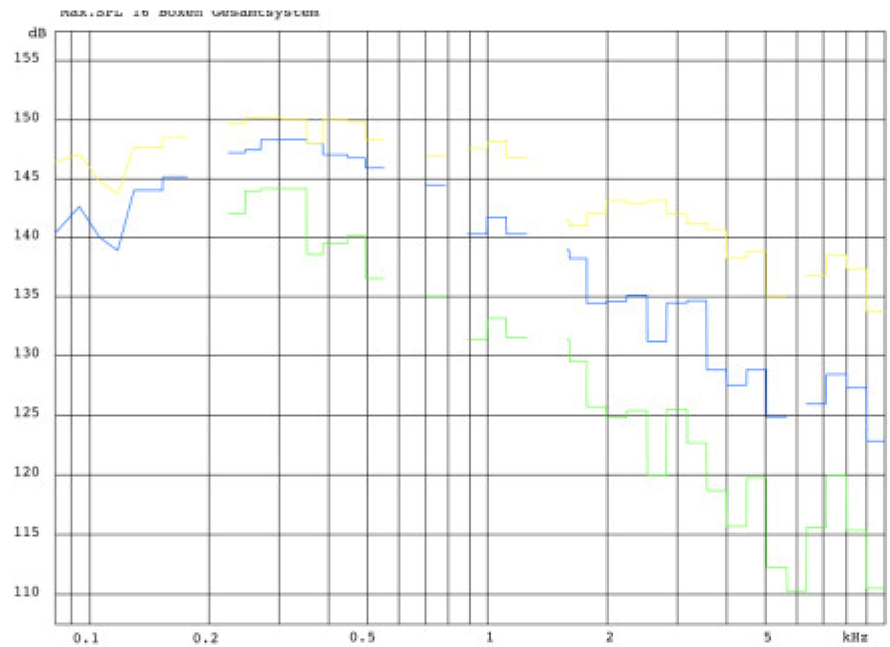


Figure 20: Maximum level test with 16 speakers

The measurements were taken from a distance of 8 metres and then automatically converted to 1m distance values by the measurement programme with the 6dB rule. For this reason, 9dB must be subtracted from the levels illustrated here in order to obtain the actual sound pressure levels at a distance of 1m. The measurements were performed using 170ms sinus bursts. Some frequencies did not provide valid results because of the construction of the system. The yellow curve indicates the threshold for 10% distortion. Blue stands for 3% distortions and green for 1% distortions. 7kW was available as the maximum level.

4 Technical/physical specifications

Physical specifications

System:	2-way
Filtering:	active (external controller)
Drivers LF	2x 8" SICA Z005351, vented
Driver HF	Mundorf AMT 197PP27R-740-121-FA
Connectors	4 x Speakon NL4
	Input LF/Input HF/2x Link
Physical dimensions	
Height	220mm
Width	770mm
Depth	380mm
Weight	19.8kg
Vertical angular adjustment	0° – 5°

Technical specifications

Frequency response	+/- 3dB	90Hz – 17kHz
Sensitivity (SPL 1W/1M)	LF 98dB @ 1kHz	
	HF 102dB @ 2kHz	
Nominal impedance	LF 16 ohms	
	HF 4 ohms	
Maximum peak power	LF 130dB @ 1kHz	
	HF 131dB @ 2kHz	
SPL Program/Peak		
Horizontal dispersion	90°	
Vertical dispersion	5°	