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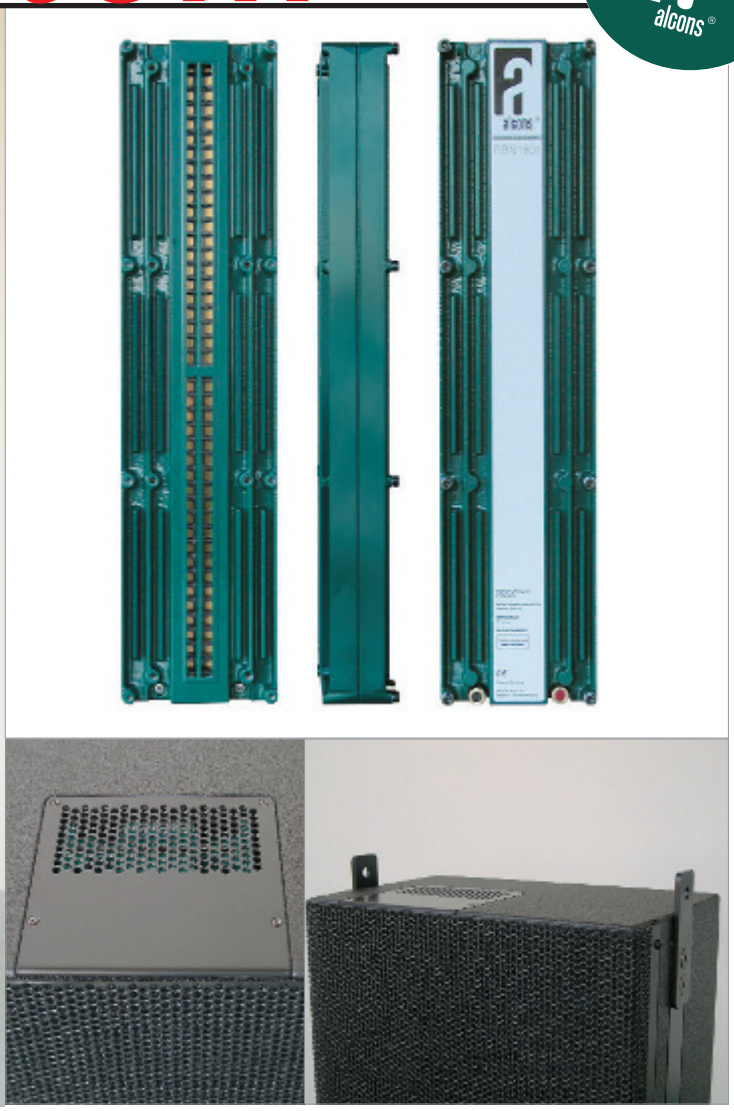
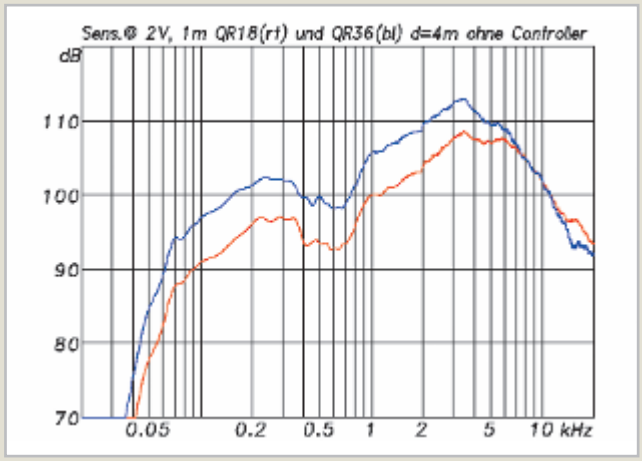


PA-SPEAKER WITH RIBBON-TWEETER

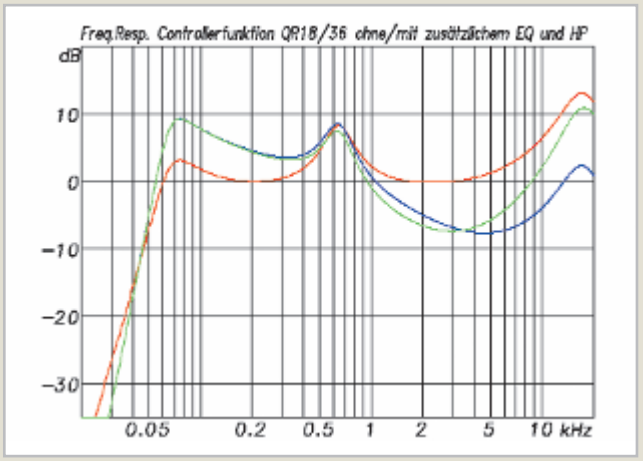
# Alcons Audio Q-series

The two models of the Q-series by Dutch manufacturer Alcons Audio are designed as very high quality speakers for mobile use and fixed installations. The Q-series is based on this manufacturers own 18“ ribbon-tweeter, which is supposed to deliver perfectly linear directivity, which can reach good results mainly in acoustically complicated environments. One QR18 and QR36 each from the first production run was available for extensive tests by the editors of Professional System just before the official presentation during this years Pro Light + Sound show in Frankfurt.

Almost all sound system tasks are aimed at delivering sound as cleanly as possible to the audience without unnecessarily exciting the surrounding room or radiating to strongly reflecting surfaces like ceilings, glass fronts, floors etc. The better this is done, the




Pict.1: Frequency response with sensitivity for QR18 (red) and QR36 (blue). The sensitivity is referenced to 2V/1m, meaning at 1W power for the QR18 (4ohms system) and 2W for the QR36 (2 ohms system). Up to around 3 kHz the QR36 is about 6dB louder as can be expected from a „double QR18“. At the higher frequencies we move into the nearfield area, where the bigger source just lifts the height of the wavefront without a rising level.




Pict.2: Controller and EQ functions for the Q-series. The red graph is equivalent to the filters on the controller card for the Alcons ALC amps. For the listening tests some additional filters were set, which finally resulted in the blue graph for the QR18 and the green graph for the QR36. The additional filters were a high- and low-shelving filter each as well as a highpass filter with a Q-factor of 2.0 at 64 Hz. During the listening tests the Q-factor was reduced to 1.2 since the bass rise seemed to pronounced.

higher is the direct sound reaching the audience from the speaker without any detours. All parts of the sound arriving later either as discrete reflections or a diffuse reverberation are detrimental to good sound and the intelligibility of speech.

With the Q-series Alcons Audio aimed at developing a speaker that fulfils this demand very well and can also fulfil high expectations on the quality. The trademark specialty of the Alcons Audio company,

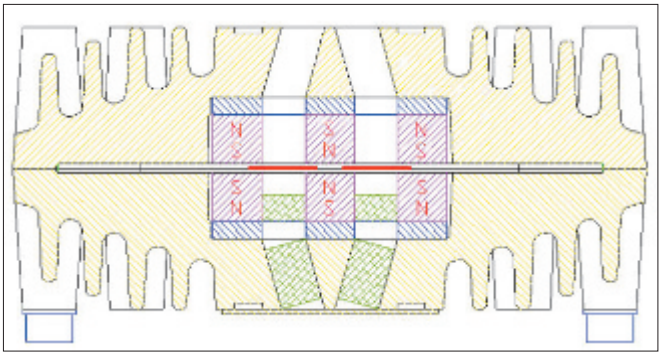
founded 2002, is the ribbon tweeter, a special speaker type also called a magnetostat or ribbon speaker.

## Ribbon tweeter

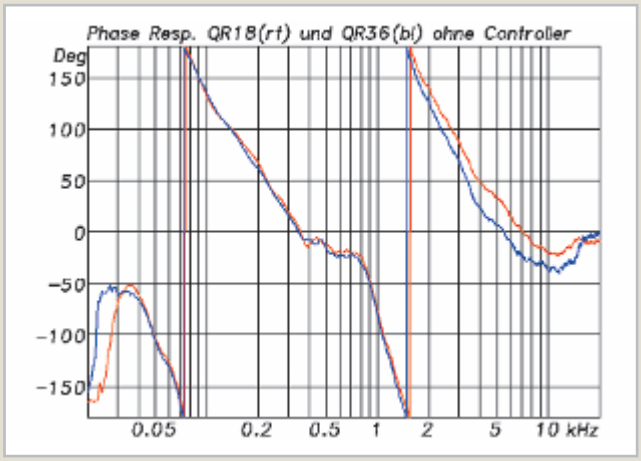
To reach a very cleanly directed projection in one plane, the concept of line arrays has established itself in the past few years. The speakers constructed for this usually work with tightly lined up conical drivers up to a certain frequency. But when the distance between the individual sources grows bigger then half of the wavelength, this line-up starts to have side lobes in the directivity, which are unwanted. A distance above a full wavelength leads to the rise of new real peaks from the edges, which in turn rules out any serious use as a cleanly directive speaker.

For higher frequencies this leads to the use of so-called waveguides. With these it is tried to change to spherical wave front from a normal tweeter into a flat wave front exiting from a narrow opening slit. Several of these slits aligned above each other form a further linear source with a more or less coherent wave front. It is much easier though if the source is already projecting a flat wave. For this, a number of concepts following the principles of electrostats or magnetostats are available. The latter is also called ribbon-speaker or ribbon-tweeter and is a specialty of the Dutch manufacturer Alcons Audio.

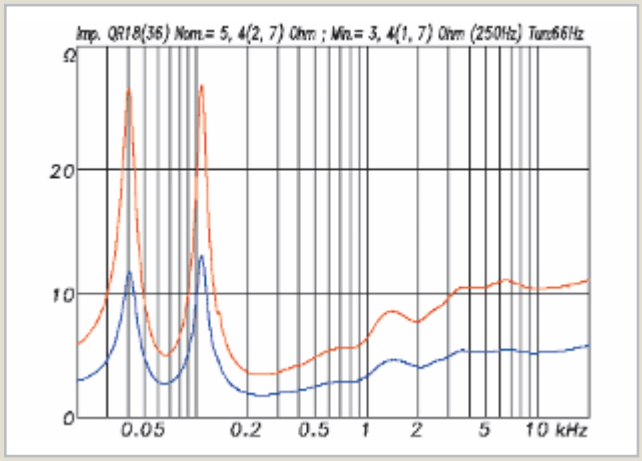
The principle of a ribbon-loudspeaker is both simple and effective. Current flows through fine conductors fixed to a membrane (which is a very thin foil). This current together with the magnetic field generate the force that moves the membrane. In principle this is equivalent to a conventional loudspeaker, where a voice coil is moved in an air gap and the power of the coil has to be transferred to the membrane. Since the coil only effects the edge of the membrane, the membrane only follows the movement of the coil within limits and features some more or less pronounced break-up modes depending on the frequency. These problems can be very pronounced in the case of high-frequency drivers, which have 3“ or 4“ membranes that are overstretched in the frequency range above 10 kHz. In the case of a ribbon speaker the voice coil is unwound and placed on the plane of the membrane – to explain it in simple terms. This results in equally



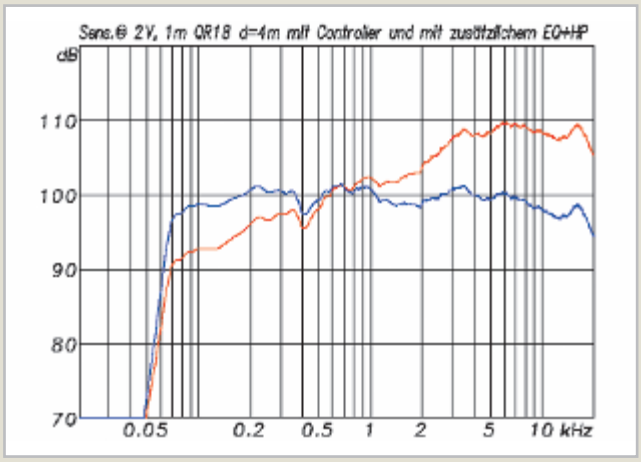
**Cross-section drawing of the RBN-tweeter with aluminium casing (yellow), Neodymium magnets (red) and membrane (red) as well as the acoustic sink (green) on the back of the membrane.**



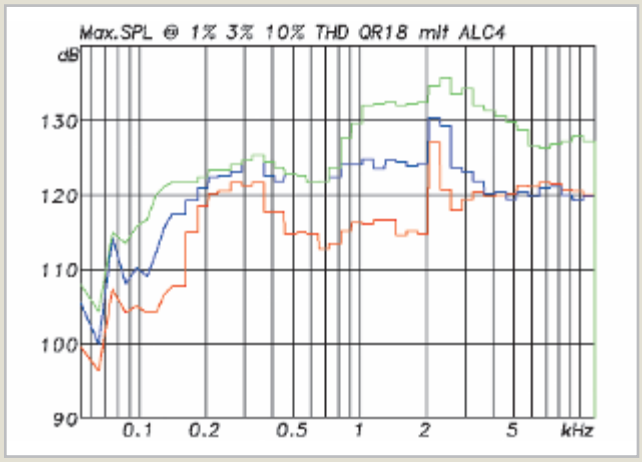

Pict.3: Phase response for QR18 (red) and QR36 (blue). The curves are almost identical except for the HF-range as was expected. The phase response is defined by a 360° shift at the low end of the frequency range caused by the acoustic highpass function of the 4th order of the bass-reflex enclosure and another 360° turn in the area of the cross-over frequency between tweeter and LF unit with a crossover of the 4th order.



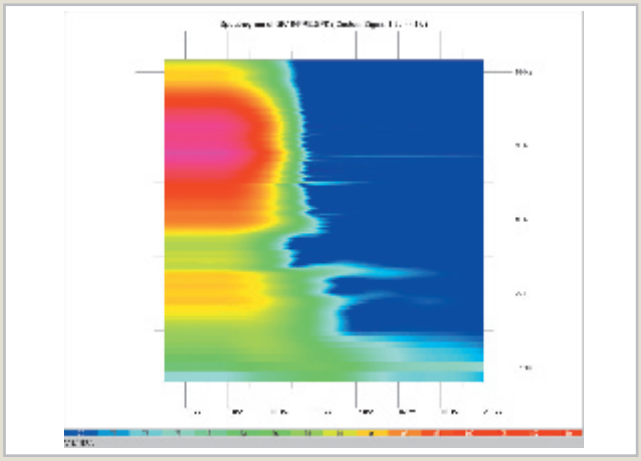

Pict.4: Impedance curve of QR18 (red) and QR36 (blue). The tuning frequency of the bass-reflex system is at around 66Hz in both cases. The impedance minima are rather low with 3.4 ohms and 1.7 ohms, so the QR18 should correctly be called a 4 ohms system and the QR36 a 2 ohms system. In the higher frequency range only the 12 ohms or 6 ohms respectively of the ribbon-tweeters matter.



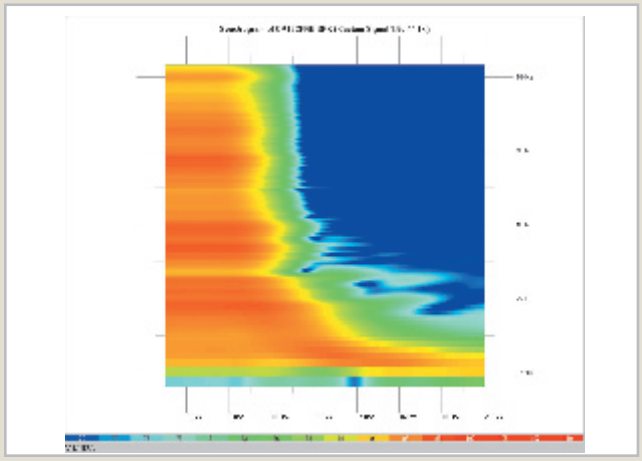

Pict.5: Frequency response of the QR18 with controller card in the amplifier (red) and with additional EQ following picture 2. Dedicated “flat” SDP controller-modules are available for any system configuration.




Pict.6: Maximum SPL of the QR18 referred to 1m distance at 1% (red), 3% (blue) and 10% (green) THD. The maximum power was 1,720W into 4Ohm.



Pict.7: Spectrogram of QR18 without filters. Except for a small resonance at 400Hz which can also be seen in the frequency response, the decay pattern is absolutely perfect up to the highest frequencies.



Pict.8: Spectrogram of the QR18 with filters. The delay time rises in the low frequencies because of the additional highpass-filtering, moving the focus of energy to later time points.

distributed propulsion over the entire membrane. Because of this, break-up modes are not created or arise way out of the audible spectrum.

The membrane of a ribbon speaker vibrates as a long narrow strip and therefore radiates a cylindrical wave with a height equivalent to the length of the membrane. In the horizontal plane the radiation characteristics are determined by the width of the membrane, which leads to beaming at higher frequencies only.

Compared to earlier models of the ribbon-tweeter the new RBN models are noticeably smaller thanks to much smaller Neodymium-magnets. With a weight of only 6.5 kg for the biggest model with 18“ length used in the Q-series we can almost call it “lightweight”. The small Neodymium-magnets also have the advantage of enabling a more compact design with better focussing of the magnetic field in the area of the membrane. Since longer distances have to be covered by the magnetic field in comparison with a „normal“ air gap, reaching a sufficiently high force factor BL is a problem anyhow, so the high weight-saving is not the only argument in favour of a Neodymium-magnet.

The lower mass of the magnets noticeably reduces the capacity to act as a heat sink though. The RBN-models are therefore amply fitted with cooling fins, to be able to easily spread heat through convection cooling. In the enclosures there are openings both on the upper and lower side where the driver is mounted. Therefore there is a ventilation funnel running alongside the fins, enabling effective heat dissipation.

In addition to the big 18“ ribbon RBN1801 there are also two smaller types RBN601 and RBN401 with 6“ and 4“ length respectively. These tweeters are used in the line-array systems LR16 and LR14 by Alcons Audio.

## QR18 and QR36

The base of the Q-series is the powerful ribbon-tweeter RBN1801 already mentioned, which is described in the data sheet with an impressive power handling capacity of 210 W AES and 3 kW peaks for 200 ms. The peak levels that can be reached are specified as 144 dB. Those who know other products of this manufacturer can take these claims as quite serious. In both systems the ribbon-tweeters are crossed-over at 1.2 kHz. The lower frequencies are dealt with by three or six 6.5“ Neodymium drivers working in a bass-reflex enclosure. With a distance of around 165mm between the centres of the membranes this line-up fulfils the already mentioned criterion of a clean projection without secondary peaks up to just above 1 kHz. The enclosures of the Q-series are build completely from multiplex and have a very unobtrusive exterior. The surface is covered with scratch-resistant Durotect™. At the sides of the enclosures flying rails are mounted that can also be used for hanging several QRs above each other. According to the datasheet up to 20 QR18 or 10 QR36 can be flown above each other, making a maximum line of 10m possible.

For large rooms like auditoriums the suitable lengths for the room geometrics can be assembled. The longer the resulting line source becomes, the more the cylindrical near field in front of the speaker is expanded with the result that even acoustically complicated rooms can be controlled well. The horizontal opening of the resulting wave front is 90° in the standard version and can optionally be enlarged with a different horn extension to 120°. The sizes of the QR speakers are 367 x 237 mm (WxD) with a height of 506 mm (QR18) or 1,006 mm (QR36). The weight is 20 kg or 40 kg respectively.

## Amping ALC4

The electric connection of the speaker is done via 4-pin Speakons with link-connectors. Internally the speaker is already prepared for the „Signal Integrity Sensing“ (short: SIS™) of the Alcons power amplifiers. The pins 1+/- handle the signal from the power amplifier to the speakers and the pins 2+/- carry a sense-line from the amp to the speaker. The sense signal is fed to the control loop of the amplifier and enables the amp to act as if the speaker cables were part of the amplifier. The otherwise unavoidable loss in damping through transition resistance can be totally compensated with this method and the theoretical value of the internal resistance of the power amplifier actually is applied to the speaker’s passive internal frequency crossover.

The crossover function is handled by an internal passive cross-over at around 1.2 kHz with 24dB/Octave. System equalisation or level-matching is not done by the passive crossover. These are handled by the controller-module in the power amplifier, where the filtering can be done without a loss of power. The modules called „Speaker Drive Processor“ by Alcons Audio can be inserted individually in a slot at the front panel of the amps. They contain the necessary active filters and all parameters for adjusting RMS- and peak-limiters of the power amp. The user does not have to spend additional thoughts on protective circuits or limiters and can be sure of the optimal matching of the power amplifier to the chosen speaker cabinet.

For our test we were supplied an ALC4 power amplifier which delivers 1,720 W RMS per channel into 2 x 4 ohms. It can also be used continuously with 2,250 W RMS per channel into 2 x 2 ohms.

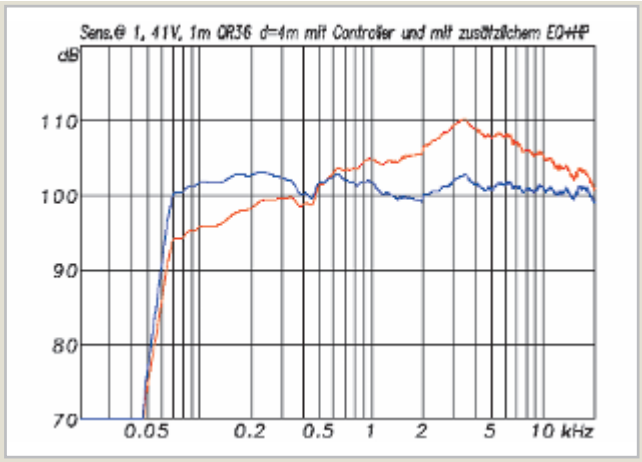
All power amplifiers of the ALC-series are designed in Class-G technology with stepped voltage supply and are fed by a conventional transformer power supply, which leads to a leads to a weight of 35.4 kg in the case of the ALC4.

## Test results

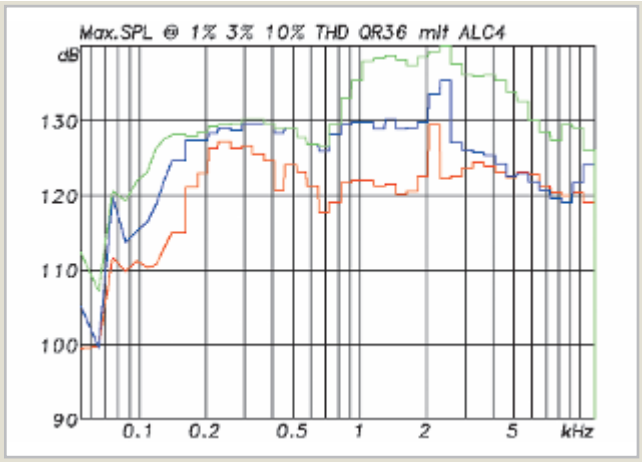
For our lab tests of the two QRs the speakers were first used without controller-amp directly with the lab amplifier. This resulted in the frequency responses in picture 1. The considerably higher sensitivity of the ribbon-tweeter compared to the woofers is clearly recognizable. As mentioned before the suitable system equalization is done actively in the controller-amp in spite of the passive crossovers since the valuable power would otherwise be lost through passive filters in the cabinet. The QRs therefore always have to be used with the matching controller-amplifier!

Both graphs in picture 1 show the measured sound pressure calculated for a distance of 1m for a input voltage of 2 V. This is equivalent to the usual 1W/1m value for the 4 ohms system QR18, while the curve for this 1W/1m value would have to be lowered by 3 dB for the QR36 with 2 ohms nominal impedance.

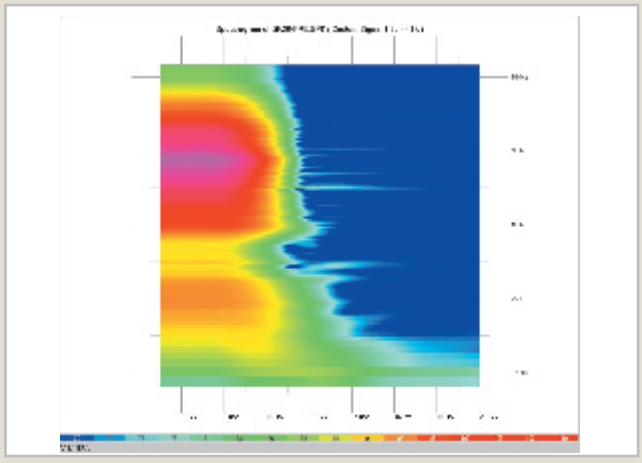
With the chosen display of the level at constant voltage two effects can be observed well. For low frequencies below 3 kHz a measuring distance of 4 m is in the far field of the line source. Doubling the speaker number from QR18 to QR36 therefore leads to a level rise of 6 dB. For high frequencies, where we are still in the near field at a distance of 4 m, the level is not changed, since the longer wave can only be noticed in the spatial expansion of the wave front. If several QR-units were cascaded, the change from near field to far field would move more and more to lower frequencies or extends further into the room for a fixed frequency.



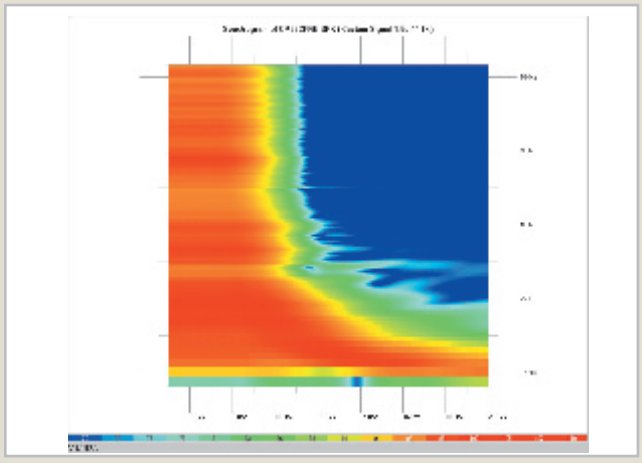

Pict.9: Frequency response of the QR36 with controller card in the amplifier (red) and with additional EQ following picture 2. Dedicated "flat" SDP controller-modules are available for any system configuration.




Pict.10: Maximum SPL of the QR36 referred to 1m distance at 1% (red), 3% (blue) and 10% (green) THD. The maximum power was 2,250W into 2ohm.



Pict.11: Spectrogram of QR36 without filters.



Pict.12: Spectrogram of the QR36 with filters.

In the far-field, which approximately begins at:

$$r > \frac{L^2 \cdot f}{2 \cdot 340 \frac{m}{s}}$$

(length L in m and f in Hz)

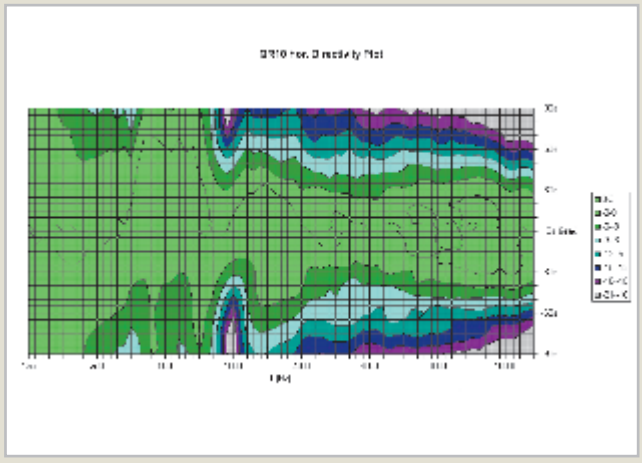
The wave front propagates in spherical form even with a line-array. In the near-field though there is a cylindrical wave with much less loss of level over distance, which ideally is only spreading within one plane.

Back to the Q-series we find the corresponding controller curves in picture 2. The standard setting here is a filter function shown in the red graph, which is to be complemented by two or three additional parametric Eqs depending on the length of the speaker array. For one singular cabinet each the result is the overall graph drawn in blue for the QR18 and in green for the QR36.

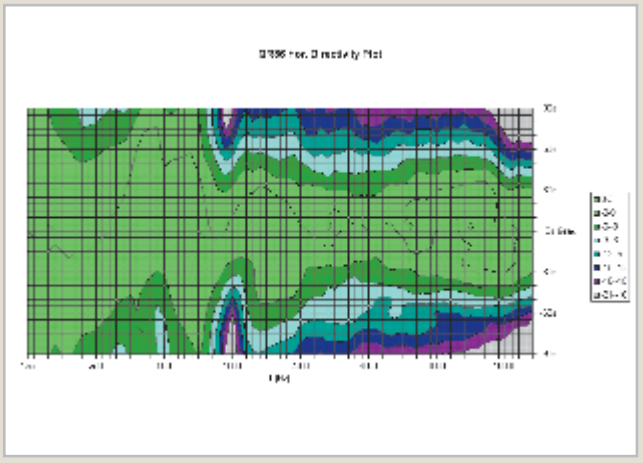
Picture 3 shows the phase response of the QRs, which are almost identical as expected and feature a phase change of twice 360° in total. One 360° turn is caused by the speaker acting as a fourth order high pass filter at the lower end of the frequency band, the other by the internal crossover of fourth order at 1.2 kHz. Additional phase changes or delays between the channels do not exist.

Within the impedance charts in picture 4 the tuning frequency of the bass-reflex cabinet of about 66 Hz can be seen in the low between the two peaks. Because the three or six woofers with a nominal impedance of 16 ohms are connected in parallel, the QRs are officially rated at 5.4 and 2.7 ohms nominal impedance. The minimal values of 2.7 or 1.7 ohms respectively, which can be seen in the graph, are so low that nominal values of 4 ohms for the QR18 and 2 ohms for the QR36 would be more appropriate.

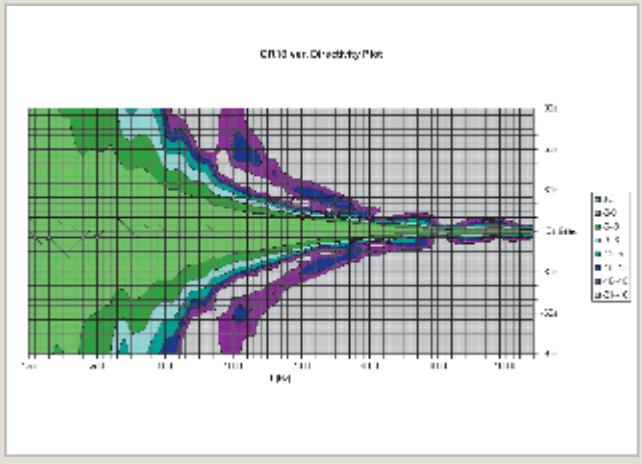
Above the crossover frequency the impedance curve is determined by the nominal impedance of 12 or 6 ohms of the ribbon-tweeter, with the values being completely problem free. Since the QRs are always used with the matching ALC controller/power-amps, the discussion of impedances is unnecessary anyhow. The ALC4 can easily handle a QR36 even with a minimum of impedance at



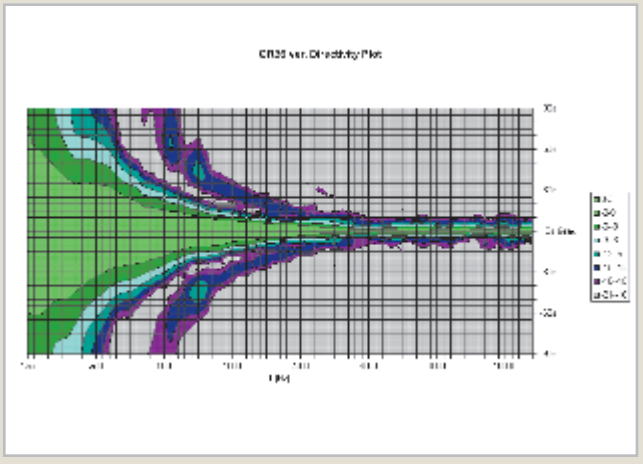
Pict.13: Horizontal isobarics of the QR18. In the range of the ribbon-tweeter a quite constant directivity is reached through the small horn, approaching the nominal 90° very well. At the cross-over frequency there is only a small range of interferences. Below this the directivity widens accordingly.



Pict.14:Horizontal isobarics of the QR36, which are very similar to the QR18 in this plane.



Pict.15: Vertical isobarics of the QR18 with a very constant continuous narrowing of the opening angle. The behaviour is equivalent to a rectangular window with a length of about 455 mm, which starts to build a sidelobe with a level 12 dB below the main lobe at 0° from 750 Hz upwards.



Pict.16: Vertical isobarics of the QR36 with a very similar behaviour compared to the QR18, but with the window having twice the length and the focussing and the sidelobe starting earlier. Apart from the main direction and the sidelobe the QR36 is behaving absolutely perfect since the ribbon-tweeter works as an almost perfect line-source. An error of +/-3.5° comes up in the representation of the opening angle with the size of the source of 1 m at a measuring distance of 8 m.

1.7 ohms, so the user does not have to be concerned with such issues.

The behaviour of QR18 and QR36 with a controller is shown in pictures 5 and 9. The controller card in the amp is obviously designed for several cascaded QRs. In the case of an individual cabinet the frequency response is flattened and filtered with a high pass, but there is still a rise with the higher frequencies, which can be adjusted with simple high- or low-shelving filters depending on the length of the system. A possible example for a single cabinet is shown in the blue curves. In pictures 7 and 8 or 11 and 12 respectively the spectrograms of the QRs measured with EASERA are shown with and without additional filters. The absolutely perfect behaviour of the ribbon-tweeter, which shows a perfect decay without any resonances up to 20 kHz, stands out independently of the filters. In the low range things are almost as good. There is just a minimal resonance at 400 Hz in the spectrogram, probably caused by a cabinet resonance. In both spectrograms with filtering we can not only observe the level matching, but also a delay in the focal point

of energy in the bass sector caused by the additional electronic high pass filtering. In the delay time graphs this characteristic can be observed as an increasing delay towards the lower frequencies.

## Maximum levels

For the measurements of maximum levels both speakers were used with the ALC4 power amplifier offering maximum power of 1,720 W for the QR18 and 2,250 W for the QR36. Pictures 6 and 10 show the SPL-levels reached this way with 1%, 3% and 10% THD. Aside from the ribbon-tweeter it is already astonishing that the three 6.5“ woofers in the QR18 already approach a level of 124 dB above 150 Hz. The QR36 adds another 6 dB to this and is good for an impressive value of 130 dB above 150 Hz. The very similar curves for THD of 3% and 10% also show that the limiting factor was more on the side of the amplifier power then with the loudspeakers. Above 1 kHz the ribbon-tweeter is brought into play, which reaches up to 135 dB as a single unit in the QR18 and breaks the 140 dB line in the dual configuration in the QR36.

There are no weak points in the whole curve and the peak level achievable could possibly be another 6 dB higher. In the HF range above 1 kHz the RBN1801 therefore is setting new benchmarks beyond the usual compression drivers. Interesting as well is the upper end of the measured frequency range, where 120 dB at only 1% distortion can be reached with a RBN1801. On first impression of the graphs the impression might arise that the HF section of the Q-series could be slightly oversized compared to the LF-section. While this might apply for a single cabinet, it is put in perspective when several QRs are cascaded. In this case the lows rise 6 dB in level per each doubling, while the high frequencies only have a bigger expansion of the wave front. Both effects complement each other, making the QRs the ideal tool for long ranges in acoustically complicated surroundings.

## Directivity

For this type of speaker two completely different characteristics have to be evaluated in directivity measurements and graphs. In the horizontal plane the QRs act as „normal“ speakers with a spherical wave front which can be tested with a turntable setup and shown correctly for all distances with polar diagrams or isobaric graphs. Meaning that if I measure –6 dB at an opening of 90° at a distance of 4 m this also applies at distance of 2 m or of 20 m. These deductions are allowed since we are always in a sector where sound waves spread in a spherical wave front seen for this plane. This does not apply to the vertical plane though, since there the near field is expanded and we are initially dealing with a cylindrical wave in a broad area. This can only roughly be described in a typical isobaric curve – which happens in the form that in an ideal case a more focused pattern is seen at rising frequencies.

The horizontal directivity of the QRs is shown first in pictures 13 and 14. An almost constant directivity of 90° is reached in the range of the ribbon-tweeter through the addition of the horn. Thanks to the sharp filtering only minimal interferences are seen in the crossover region and these just occur in a 1/3 octave wide band. Below 1 kHz the opening angle widens strongly thanks to the small 6.5“ membranes and reaches almost 180°. So far this is typical for the horizontal plane which can also be affected by ordering an optional 120° horn for the ribbon-tweeter.

In the vertical plane the QRs should act as a line source as good as possible without the rise of unwanted side lobes or other unwanted effects. The criteria for this are fulfilled by the QRs with a distance of up to half of the wavelength for the spectrum up to 1000Hz between the single sources. Above this the ribbon-tweeter takes over which projects a perfectly planar wave because of its construction principle. When multiple ribbons are combined, the total line-up reaches 94% coverage of the frontal height, creating an almost ideal base.

This is reflected in the results of the vertical directivity plots. In pictures 15 and 16 increasingly “sharpening” isobarics are seen. The wave front does not even break up at the highest frequencies. Beyond the main lobe of 0° there are only two side lobes, which are not caused by the placement of the sources, but by the length. A homogenously radiating line source is equivalent to a rectangular “window”. As is known from the theory of signal processing, all windows inevitably generate side lobes, an effect even more pronounced with rectangular windows. And this is the case here. The first side lobe is about 13 dB below the main lobe at 0° and travels from its start at 500 Hz and 90° to the inside with rising frequencies until it vanishes at 4 kHz in the main lobe. As we know from theory, additional side lobes follow this, but their level is 20 dB or more below the main lobe and can not be seen in the isobaric graph.

A 3D chart with increased level scale makes these side lobes visible. From the viewpoint of acoustics they are irrelevant though, since their levels are at least 20 dB below the levels on the main lobe direction. The diagram shown above therefore only serves as a demonstration of the phenomenon of side lobes with rectangular windows.

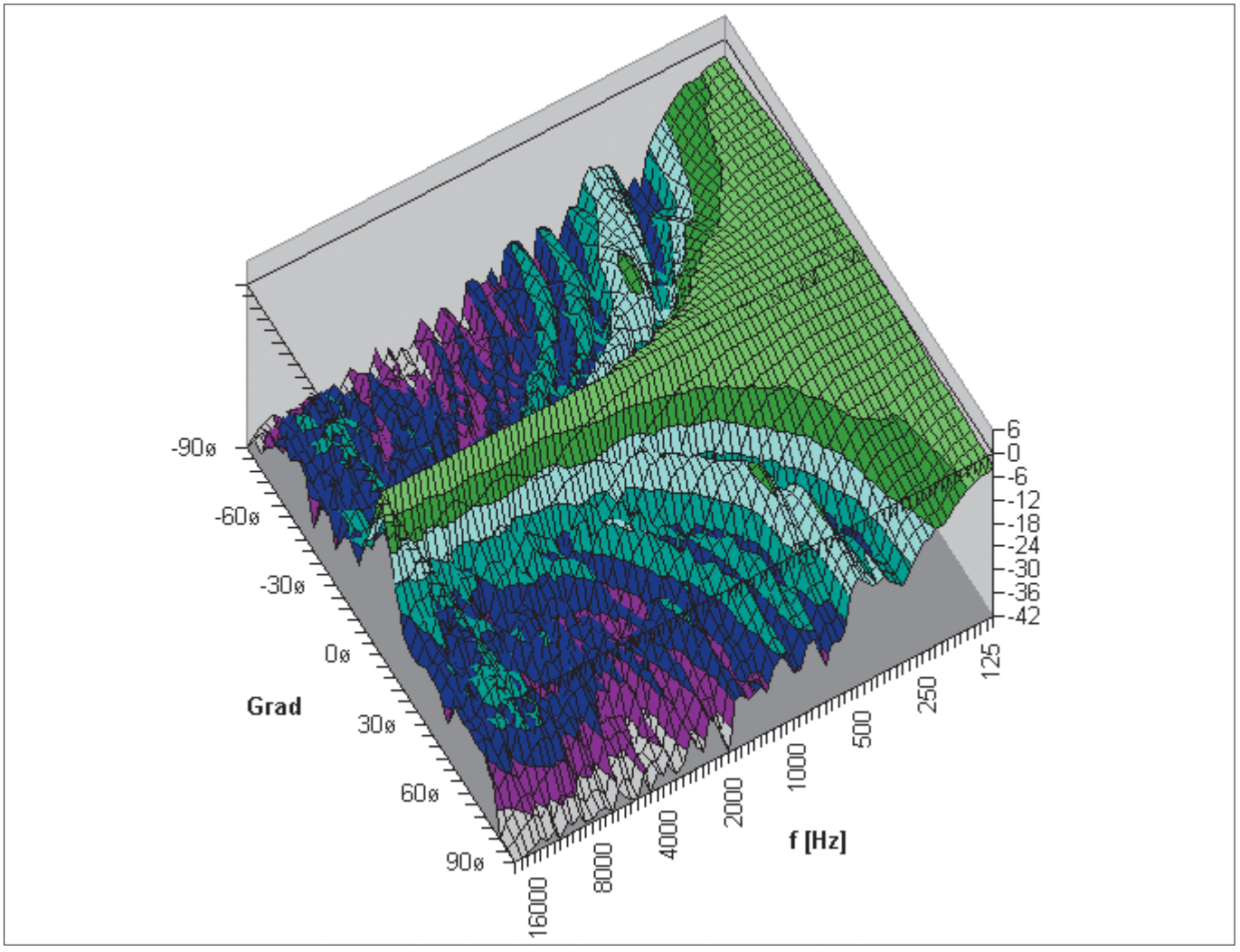
To sum it up – the directivity of the QRs can therefore be described as a perfect line source in the vertical plane and as a clean 90° system in the horizontal plane. The decisive element for the successful use of such a speaker is the right alignment and matching of the required length. In contrast to conventional line-arrays curving or intensity shading are impossible though with this type of loudspeaker.

## Listening test

One unit each of QR18 and QR36 was available for the listening test and were used with the power amp ALC4 and the already mentioned EQ settings. The listening tests started with speech signals, which were reproduced incredibly direct and clean by the QRs. There were absolutely no colourations and no trace of obtrusiveness even at high levels. In short: perfect!

With musical signals and the normal settings there was a surprisingly voluminous bass, which we even reduced a bit with the EQ. There was nothing to criticize with the tone and the QRs were completely convincing with the highly transparent and pleasant reproduction over the complete frequency spectrum. The detailed highs, which kept their quality in any situation and at every level, were totally seductive. In this aspect the ribbon-tweeter proved to be clearly superior to conventional compression drivers.

The performance in the bass range was surprisingly good as well, something hardly expected in the light of the small drivers. The lab tests had already implied – and it was confirmed by the listening impressions – that the woofers are able to cleanly and powerfully reproduce the bass, as long as no real deep sub is expected. For this case suitable subwoofers, which can also be matched via the controller amps, are available from Alcons.




## ALCONS AUDIO

The Dutch manufacturer of speakers and electronics Alcons Audio is based on a team of experienced staff with an average of more then 15 years of experience in the field of professional audio technology. The team around Tom Back has managed to develop an impressive range of products within a short time – including speakers for tour business, cinema-sound and the traditional fixed installation market. In addition there are power amplifiers and controllers. Within the R&D department of Alcons Audio Philip de Haan is in charge of the loudspeakers and Jeroen Fortanier leads the electronics including digital signal processing.

## Conclusion

The Q-series with the models QR18 and QR36 by Alcons Audio offers an unusual solution for many demanding and complicated sound reinforcement tasks. The core of the

Q-series is the powerful RBN1801 ribbon-tweeter, self-designed and –manufactured by Alcons Audio, which outperforms all compression drivers with its absolutely outstanding qualities. The RBN1801 delivers highest sound levels up into the 140 dB range at very low distortion and delivers a perfectly coherent cylindrical wave as well. Building on this the Q-series is designed as a scalable line source for flown lengths of up to 10m. The RBN is extremely well complemented by the 6.5“ drivers mounted in a line, which handle the frequency range up to 1 kHz in matching quality.

For those who can not really be convinced by technical data and lab test results it is suggested to check them out in a listening test, which is where they can really show their strength. Highest levels over the total frequency bandwidth combined with the highest audio quality does not have to be a contradiction, as the QRs prove impressively.

In addition there is the special qualification for acoustically difficult surroundings, which can be overcome as far as possible by the perfectly clean directivity without disturbing side lobes. The ALC controller amps offered with the QRs are optimally matched to the speakers and offer a high degree of operational reliability with their exactly matched limiters.

**Prices in €:**

| | |
|---|---|
| QR18 | Euro 2990 |
| QM18 "fill" | Euro 1490 |
| QR36 | Euro 5490 |
| QM36 "fill" | Euro 2490 |
| ALC4 | Euro 3890 |
| Controller Module | Euro 189 |

**Text and measurements: Anselm Goertz**
**Fotos: archive**
**Translation: Alex Merck**