Sound & Recording
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Test: Neumann KH 310

Near-field monitor

With the KH 120, the traditional microphone manufacturer Neumann succeeded in making a brilliant debut in the near-field studio monitor market segment. Within a short time the small monitor was at the top of the sales charts – justifiably so, due to the sound characteristics and the unbeatably good price/performance ratio. This was ample reason to be curious about how the new 3-way system would fare in our measurement and testing studio.

Neumann KH 310

3-Way High-End Monitor Tested & Measured

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THE FREQUENCY RESPONSE IS ONE OF THE BEST EVER MEASURED IN OUR TESTING LABORATORY.

+++	Measurements
+++	Sound quality
++	Possible applications
+++	Workmanship and value
+++	Price/performance ratio

Manufacturer/Model Manufacturer/Sales Neumann / Sennheiser
MSRP per pair: 3,994 euros www.neumann.com

With the KH 310, Neumann Berlin is now presenting the second newly developed monitor since the takeover of the Klein+Hummel brand under the Neumann label. The KH 310 is a compact 3-way system for near-field and mid-field applications, which is also well-suited for use as a surround monitor in larger studios. In contrast to the approach of many other manufacturers, the external appearance continues to be very inconspicuous, and has scarcely changed in comparison to the previous model O 300. However, when examined closely, the KH 310 is revealed as a completely newly developed system with many technical fine points. Only the concept remains unchanged: 3-way with a sealed housing, with the external shape and dimensions of the housing remaining the same. All of the drivers, the entire electronics and the driver waveguides are newly developed.

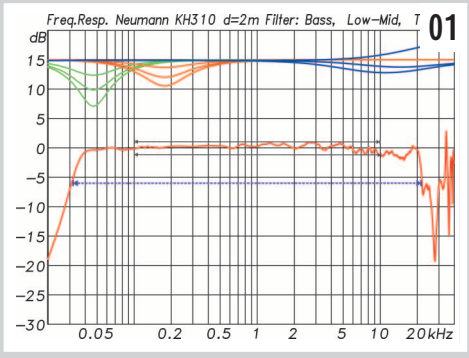
EXTERNALS

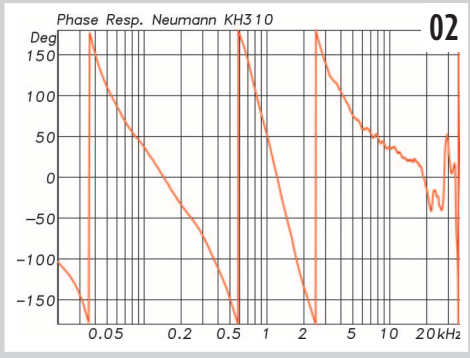
The KH 310 now continues the concept of the O 98 (1982-1998), O 198 (1998-2000) and O 300 (1999-2013) into the fourth generation. Thanks to its closely arranged loudspeakers and the resulting small front surface area, the application possibilities of the compact 3-way system include use as a large near-field monitor, or as a main or surround loudspeaker. Due to its low height, the KH 310 hinders neither the acoustics of main monitors located behind it, nor the view through the control room window.

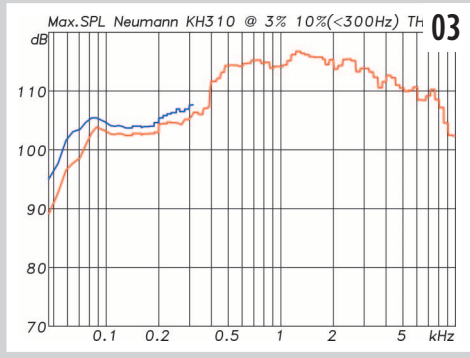
The midrange and tweeter are favorably situated one above the other. For the woofer positioned to one side, the "side-by-side" arrangement is less problematic, because the crossover at 650 Hz occurs at such a long wavelength that the distance between the drivers no longer has an adverse effect.

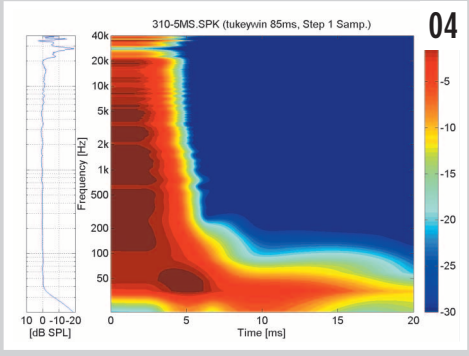
Particularly for compact monitors, sealed housings are rather rare. The reason for this is the greater level stability of bass reflex designs, which exhibit higher sensitivity at low frequencies, thanks to the support of the bass reflex resonator. However, such designs have two disadvantages. Not only does the frequency response below the resonance tuning frequency of the housing diminish twice as sharply (24 dB/oct.) as that of a sealed housing (12 dB/oct.), but also the phase shifts, of 360° instead of 180° through the high-pass function, are twice as great. This means that apart from the achievable bass level, a

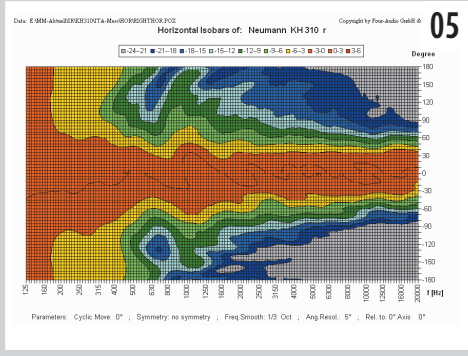
The following measurements of frequency response, directivity and distortion values come from the measurement laboratory, with anechoic conditions. The class 1 measurement chamber permits measurement distances of up to 8 m, and provides free-field conditions for the range of 100 Hz upward. All measurements are performed via a B&K 1/4" 4939 measurement microphone with a 96 kHz sampling rate and 24 bit resolution, with the aid of the Monkey Forest audio measuring system. Measurements below 100 Hz are performed as combined near-field/far-field measurements.

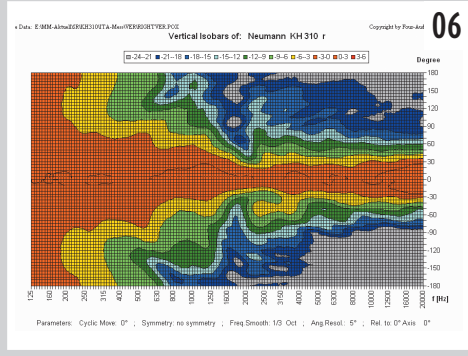


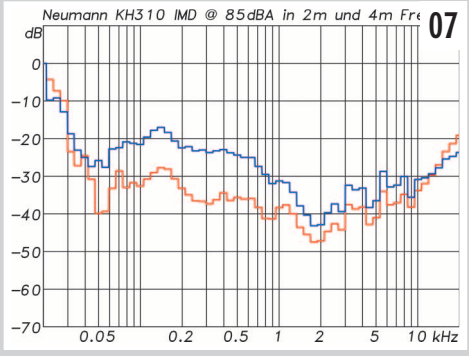


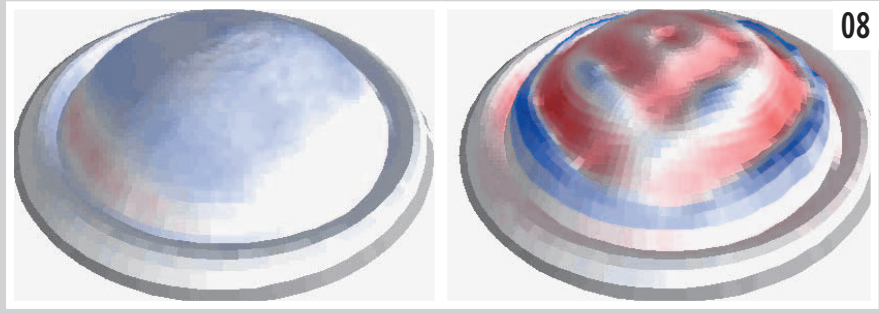


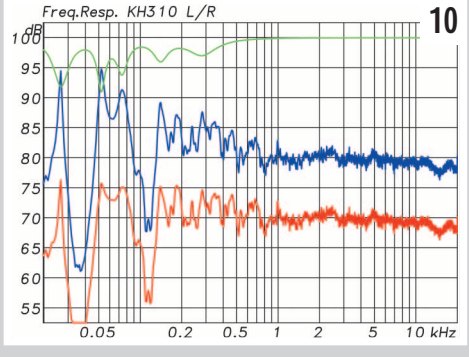


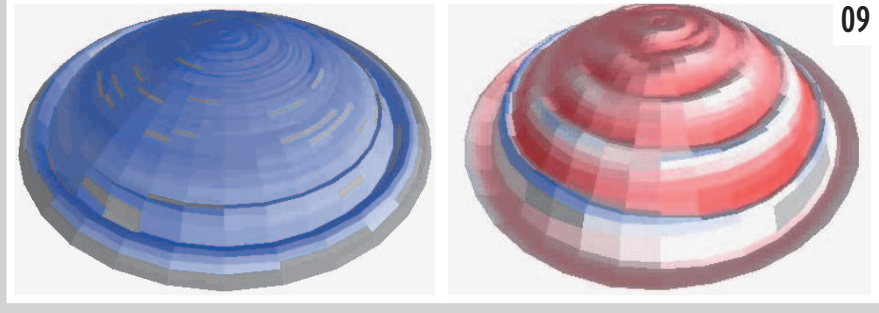












01 It could scarcely be better: On-axis frequency response measured at a distance of 2 m. At the top are the filter curves for the treble, low-mid and bass filters (blue, orange and green, respectively). The two gray lines indicate the frequency range from 100 Hz to 10 kHz, for the evaluation of ripples. The curve (violet line) extends from 30 Hz to 22 kHz (-6 dB), with an almost vanishingly small ripple of only 2.2 dB (maximum to minimum).

02 On-axis phase response measured at a distance of 2 m. At the crossover frequencies of 650 Hz and 2 kHz in each case there is a 360° phase rotation. At the lower end of the transmission range there is another rotation of 270° due to the electronic 1st order high-pass filter and the acoustic 2nd order high-pass filter (sealed housing).

03 Maximum SPL at a distance of 1 m, at maximum 3% distortion (red curve), and maximum 10% distortion (blue curve) for the bass range up to 300 Hz. Below 100 Hz the woofer averages 104 dB, and between 100 Hz and 10 kHz the average maximum SPL appears as 111.7 dB. There are no weak points at all in the form of sharp drops in the Max. SPL curve.

04 Spectrogram of the KH 310, with perfect decay free of resonances.

05 Horizontal directivity represented by isobars. At the transition from yellow to light green, the level dropped by 6 dB relative to the center axis.

06 Vertical directivity with a slight constriction at the transition point between the midrange and tweeter at 2 kHz.

07 Measurement of intermodulation distortion with an EIA-426B spectrum multi-sine signal having a 12 dB crest factor, for 85 dBA Leq at distances of 2 m (red curve) and 4 m (blue curve). Here the red curve for measurement at a distance of 2 m likewise provides optimal values, with distortion considerably below -30 dB (3%). If the level is increased by 6 dB (85 dBA at 4 m), the intermodulation distortion in the range of the woofer below 600 Hz then increases by approximately 10 dB, but still remains below -20 dB (10%).

08 Oscillation behavior of the Neumann midrange dome at 2 kHz (left), compared to that of a dome of similar size of another manufacturer (right).

09 Oscillation behavior of the Neumann tweeter dome at 15 kHz (left), compared to that of a dome of similar size of another manufacturer (right).

10 Averaged frequency response measurement for each of 30 positions of the left and right loudspeaker around the listening position (blue). Below 150 Hz, the room modes are clearly evident. An EQ (green) for the room correction was derived from the measurements. At the bottom is the averaged curve with EQ (red).

sealed housing is in fact a better choice. The bass level is precisely what makes a bass reflex housing indispensable as a rule, especially for small monitors, since even at low frequencies a certain minimum level is essential for listening under usual level conditions. However, with an 8" woofer, the size of the KH 310 is such that even without the support of a resonator a high level can be achieved, which is thus primarily dependent upon the capabilities of the driver.

This design was developed completely by Neumann itself, from the simulation, to all of the series of measurements, to the tools. Special attention has been paid to the large linear excursion. With sufficient amplifier power, here ensured by a 210 W peak for the woofer, the desired sound pressure level can thus also be attained with a sealed housing. Even the two domes have been developed completely by Neumann and, like the woofer, are manufactured exclusively for Neumann as OEM parts.

Above a certain frequency, a dome no longer oscillates as a unit, but begins to develop independent break-up modes, where particular zones of the diaphragm form local oscillation patterns. Figures 8 and 9 show images of the midrange and tweeter domes obtained via laser interferometer scanning. Here the differences can be clearly seen. For the tweeter, the goal is to shift the break-up modes as much as possible to the range above 20 kHz. For the large 3" midrange diaphragm of course this is not possible, but here it is also not required, since the midrange is driven only up to 2 kHz, where it operates without any problem, as shown in Figure 8.

The large midrange dome, like the tweeter, is equipped with a waveguide, which controls the directivity and also provides for an increase in sensitivity, thus combining two advantages. For the midrange, due to the compact arrangement at the front, the waveguide is of necessity rather small. The gain in sensitivity is therefore also somewhat secondary. Nevertheless the curves, as well as the bulge around the woofer, result in less reflection interference for the other drivers.

NEUMANN KH 310 PROFILE

Frequency range: 30 Hz - 22 kHz (-6 dB)
Ripple: 2.2 dB (100 Hz - 10 kHz)
Horizontal opening angle:
112° (-6 dB isobar 1 kHz - 10 kHz)
Horizontal standard deviation:
19° (-6 dB isobar 1 kHz - 10 kHz)
Vertical opening angle:
82° (-6 dB isobar 1 kHz - 10 kHz)
Vertical standard deviation:
24° (-6 dB isobar 1 kHz - 10 kHz)
Max. SPL:
111.7 dB (3% THD 100 Hz - 10 kHz)
Bass capability:
104 dB (10% THD 50 - 100 Hz)
Max. SPL at 1 m (free-field) with EIA-426B signal at full-scale level:
102.4 dBA Leq and 116 dB peak
Pair deviation:
0.45 dB (max. value 100 Hz - 10 kHz)
Noise level (A-weighted): 16.5 dBA (distance 10 cm)
Dimensions: 383 x 253 x 292 mm (WxHxD)
Weight: 13 kg

ELECTRONICS

The electronics of the KH 310 are all found at the rear panel, which is manufactured in one piece from a section of continuously cast aluminum. Inside are the circuit boards for the power supply, the amplifiers and the filters. The number of cables is kept to a minimum, with the result that the entire installation, even with cables, makes an orderly, tidy impression. For the power supply, a modern HF switched-mode power supply was selected. The amplifiers are integrated class AB circuits with 150/70/70 W continuous and 210/90/90 W peak output power. Crossover is effected by 4th order filters (24 dB/oct.) at 650 Hz and 2 kHz.

In addition to the usual exterior photos taken in the test laboratory, details and the interior of the monitor were also brought to light via the camera. Opening the rear panel reveals the complex electronics. In the background the housing made of MDF can be seen, with many covered cables.

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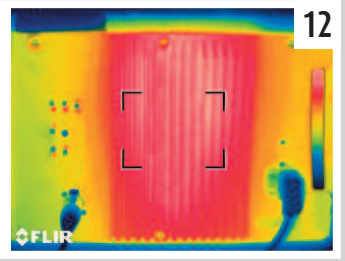

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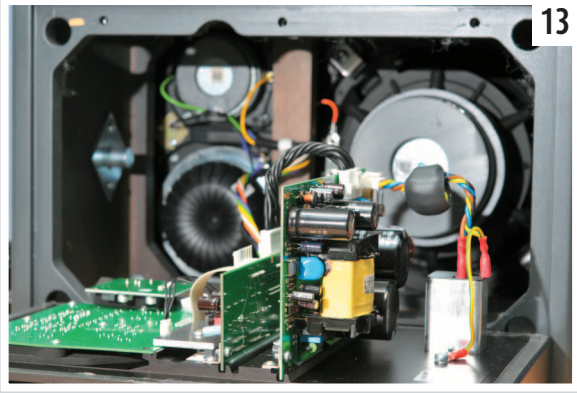
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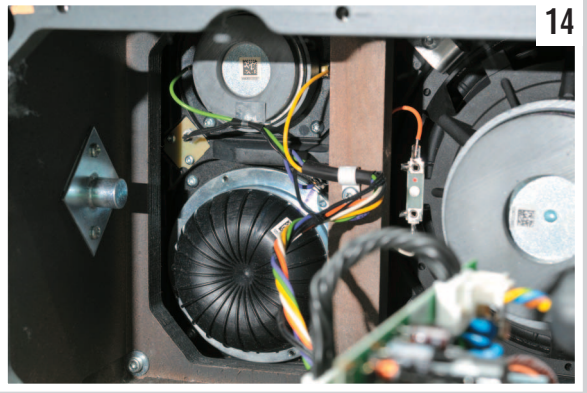
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11 Perfectionism is also apparent from the back, with a rear panel made of a section of continuously cast aluminum. All of the switches are well-arranged and clearly labeled.

12 Nothing is left to chance. Thermogram of the rear panel, demonstrating a uniform distribution of heat over the heat sink.

13 The electronics inside the rear panel, with a switched-mode power supply and four amplifier integrated circuits on the aluminum section.

14 The three drivers seen from the rear. The woofer and tweeter are equipped with ferrite magnets, including compensation magnets. The midrange is provided with a neodymium magnet.

At Neumann nothing is left to chance. For users, this can be seen in various aspects, e.g. very practically in the instructions, which truly deserve the name, or – not so immediately apparent, but nevertheless important – in the heat dissipation via the rear panel. Developer Markus Wolff illustrated this with a thermogram (Fig. 12) of the rear panel of the KH 310; the temperature distribution shows the uniform heating of the heat sink, with no hotspots that could be dangerous for the components. At the same time, the temperature of all of the control areas is considerably lower.

The limiters have also been developed with great attention to detail. There is an independent thermo limiter for each driver, with a long time constant, as well as peak and excursion limiters for the woofer. As soon as one of the limiters is active, the Neumann logo on the front of the monitor flashes red.

All of the controls are found on the rear panel, in the form of reliable sliding switches. Once one is familiar with the function of the switches, the settings can be quickly recognized by reaching behind the monitor. In the "Acoustical Controls" area there are filters for the bass, low-mid and treble, each with four settings. The effect of the filters is demonstrated by the green, orange and blue curves in Figure 1. An additional switch marked "Output Level" has the four settings 94, 100, 108 and 114 dB, for the sound pressure level reached with an input voltage of 0 dBu at a distance of 1 m. Beside it is a trimmer, in case intermediate settings are desired. There are also controls for the brightness of the logo on the front of the monitor, and for the ground lift.

LISTENING TEST

The listening test took place under well-known conditions, and also involved several other loudspeakers, which were all installed and tested in sequence. As expected, the KH 310 proved to be completely neutral and comprehensive. Nothing was lacking, at either the lower or upper end. At a listening distance of 2.5 m, even with difficult material, the impression that the KH 310 had reached its limits never arose. This is probably one of the most obvious advances achieved in comparison to the previous model O 300. The differences with regard to the other systems tested in the same session were clearly identifiable, in favor of the KH 310.

Nevertheless, the results were genuinely interesting in terms of many details often noticeable only at the second hearing, e.g. the depth differentiation of sources in the recording. Although with other loudspeakers these lay more or less in the plane of the loudspeaker, the KH 310 succeeded in reproducing clear depth differentiation. Over time one thus detected various other details that had not previously been heard. However, despite all the precision of the reproduction, this was never at the expense of enjoyment or the reproduction dynamics, and this held true independently of the type of music material being monitored.

MEASUREMENTS

In the fine tradition of the earlier monitors, for the KH 310 one expects excellent measurement results that require no discussion. The frequency response (Fig. 1) is one of the best ever measured in our testing laboratory. Above 20 kHz the curve then drops sharply, since this is the range of the tweeter dome diaphragm resonance, the excitation of which is to be avoided. This is effectively suppressed via a special circuit design for the tweeter control.

Basically, one could be of the opinion that in fact no more signal components are to be expected here. Nevertheless, if such components occur, e.g. in the case of 96 kHz recordings, then a strong excitation of the diaphragm resonance via intermodulation distortions would be perceptible even in the audible frequency range, and this is precisely what is to be avoided.

In the spectrogram shown in Figure 4, the KH 310 proves to be extremely impressive. The decay behavior is perfect in every respect. The promise shown by the special woofer design and by the oscillation behavior illustrated in the images of the two domes has thus been fulfilled.

In terms of the maximum SPL and the intermodulation distortion, illustrated in Figures 3 and 7 respectively, here too the KH 310 exhibits excellent results. For the midrange and tweeter the values increase only minimally, demonstrating one of the advantages of the 3-way system. If the woofer receives strong inputs and large excursions are generated, the accompanying intermodulation distortions are restricted to a small, uncritical frequency range in comparison to the situation with a 2-way system.

If the KH 310 is operated close to the level where the limiter takes effect, then at a distance of 1 m, an average level LAeq of 102.4 dBA and a peak level LZpk of 116 dB are achieved. All of the data were measured for an individual speaker.

With regard to directivity, the KH 310 has two advantages which come into play. One is the extensive tweeter waveguide, and the other is the 3-way principle, where the midrange does not have to be reproduced by the large woofer diaphragm. In large areas, the relationship of the “diaphragm diameter to wavelength transmitted” thus has a more favorable ratio than is the case with a 2-way system. The horizontal isobars in Figure 5 appear correspondingly uniform, with an average opening angle of 112° and a deviation of only 19°. The vertical isobars are naturally somewhat poorer, but still very good. Here the average opening angle is 82° and the deviation is 24°. The smaller vertical dispersion angle here is intended to reduce reflection interference from the ceiling and work surfaces.

Two additional measurements should be mentioned. The noise level of 16.5 dBA at a distance of 10 cm is at an exceedingly low level, which is imperceptible at normal listening distances, and the pair deviation of only 0.45 dB is extremely low.

CONCLUSION

As a near- to mid-field monitor, the KH 310 r from Neumann displays the same almost obsessive perfectionism which is already familiar from the KH 120. The workmanship, measurements, and listening impression are all completely convincing throughout, all of which has been accomplished without the use of any exotic concepts, transformers or the like. With straightforward engineering skill, here a highly professional tool of the highest quality has been created.

Anyone who now thinks that this may all be fine and good, but certainly sounds boring and will not provide any listening pleasure, is greatly mistaken. A listening trial at Neumann Berlin or a dealer can quickly dispel this impression. Possibly one may then be 4,000 euros poorer, however with the good feeling of having made a safe and worthwhile investment. ■