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
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.

![Graph 1: Frequency Response](image1)

![Graph 2: Phase Response](image2)

![Graph 3: Max SPL](image3)

![Graph 4: 310 SB SPK](image4)

![Graph 5: Image](image5)

![Graph 6: Image](image6)

![Graph 7: Image](image7)

![Graph 8: Image](image8)

![Graph 9: Image](image9)

![Graph 10: Image](image10)
Oscillation behavior of the Neumann tweeter

Oscillation behavior of the Neumann midrange

Measurement of intermodulation distortion with

Vertical directivity with a slight constriction at the

Maximum SPL at a distance of 1 m, at maximum

On-axis phase response measured at a distance of

It could scarcely be better: On-axis frequency

ments. At the bottom is the averaged curve with EQ

the room correction was derived from the measure-

an EIA-426B spectrum multi-sine signal having a

transition point between the midrange and tweeter at

dropped by 6 dB relative to the center axis.

free of resonances.

At the transition from yellow to light green, the level

down modes, where particular zones of the
diaphragm form local oscillation pat-
begins to develop independent break-
d longer oscillates as a unit, but

tween 650 Hz and 2 kHz. Special attention

With sufficient amplifier power, here ensured by a 210 W peak for the

woofer, the desired sound pressure level

dated completely by Neumann itself, from the simu-

tation, 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 Neu-

mann 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 pat-

ters. Figures 8 and 9 show images of the midrange and tweeter domes obta-

ined 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 with-

out 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 wavegui-
de 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.

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The electronics of the KH 310 are all

found at the rear panel, which is manu-

factured 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 installati-
on, 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.

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 dB 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.