SOUND & RECORDING

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5/22

NEUMANN KH 150

Special edition of Sound & Recording 5-2022

Manufacturer/Sales

Neumann/Sennheiser Sales

Price list/street price per pair

3,300 euros/approx. 3,150 euros

Internet

www.neumann.com

Our rating

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

Neumann KH 150 profile

Frequency range:
36 Hz – 20.6 kHz (–6 dB)
Ripple: 1.2 dB (100 Hz – 10 kHz)
Hor. dispersion angle:
80 degrees (–6 dB isobar 1 kHz – 10 kHz)
Ver. dispersion angle:
60 degrees (–6 dB isobar 1 kHz – 10 kHz)
Max. SPL:
108.8 dB (3% THD 100 Hz – 10 kHz)
Bass capability:
101 dB (10% THD 70 – 120 Hz)
Maximum level in 1 m (free field) with EIA-426B **signal at full output:**
98.2 dB Leq and 110.4 dB Lpk
Pair deviation:
0.2 dB (max. value 100 Hz – 10 kHz)
Noise level (A-weighted): 19.8 dBA (10 cm)
Dimensions: 225 × 345 × 273 mm (W×H×D)
Weight: 8 kg

NEUMANN KH 150

TWO-WAY NEAR-FIELD MONITOR WITH DSP SYSTEM

Like other monitor models in the KH series from Berlin-based Neumann that have appeared over the last few years, the recently introduced KH 150, which is positioned between the KH 120 and KH 310, comes equipped with cutting-edge DSP technology. In terms of performance, the KH 150 is closer to the KH 310, but with quite a number of fundamental differences.

Text and measurements: **Anselm Goertz** Photos: **archive**

While the KH 310 is a three-way system with a sealed housing and a small waveguide for the tweeter, the KH 150 is a two-way bass reflex system with a very large waveguide for the tweeter. Thus, despite their similar data, both monitors therefore have their own uses and can therefore fulfill users' wishes in their own respective ways. The KH 150 is a typical-size near-field monitor for listening distances of 2 to 3 m, which can thus be used for stereo listening or as a surround-loudspeaker in multi-channel systems.

The middle section of the KH 150 is made of wood, finished with a plastic composite material on the front and back, and all its edges are carefully rounded. The monitor is available both in Neumann's familiar anthracite color and in white, with looks that make a solid, yet unspectacular and serious impression. Its rich choice of accessories includes various stand adapters, mounting plates and mounting brackets that can be used to install or hang the KH 150 in any conceivable position. Alternatively, the KH 150 is also available in a version with AES67 multi-channel digital network audio.

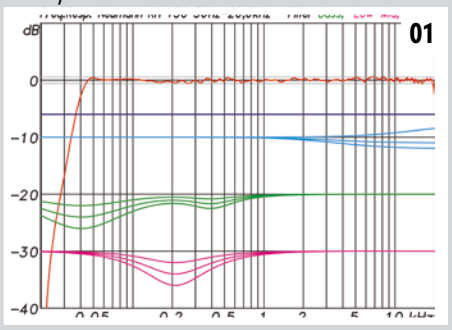
Almost all the components of the KH 150 were newly developed, except for the tweeter. The 1" dome with aluminum fabric diaphragm is the tried and tested model used in every other monitor in the KH series. The dome radiates the sound over a very large waveguide that produces uniform dispersion in both planes with an opening angle (-6 dB) of 80×60 degrees for the whole frequency range above the x-over frequency of 1.7 kHz.

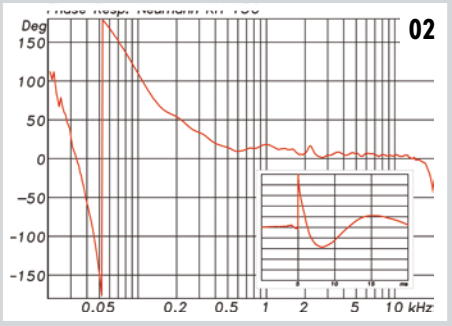
The KH 150's 6.5" bass driver was produced with the manufacturer in a lengthy development process that included all the tools required for production. The large ports are located in the corners at the front, underneath the woofer, which allows the monitor to be placed or installed near the wall. Inside, the bass reflex ports extend at an angle of 90° up to roughly the center of the housing to minimize the number of enclosure modes coupled to the outside via the ports. Longitudinal resonances in the ports, which are optimized in terms of flow, are effectively suppressed through additional measures.

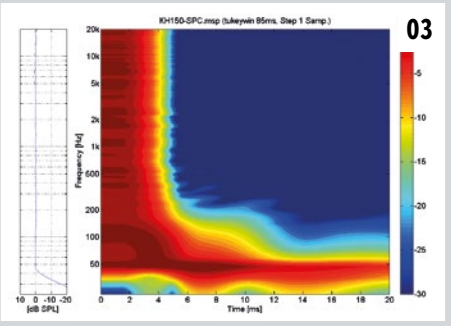
The KH 150's electronics are located at the rear of the interior of the housing and can partly be seen through the ventilation slots. In addition to the DSP, there are two class D power amplifiers with 145 W and 100 W of power that are also completely new in-house developments. Crossover between tweeter and woofer is done by a 4th order filter with phase correction (24 dB/Oct) at 1.7 kHz. The latency caused by the FIR filtering is just 2 ms. All the electronics, including all connectors and switches, are located on a large board, which means there are no plugs and cables inside the cabinet except for the cables to the drivers and the Neumann logo on the front. Just for the network connection, there is a sandwich board that houses either the Ethernet connection for control over the network or the optionally available redundant AES67 socket for audio over IP.

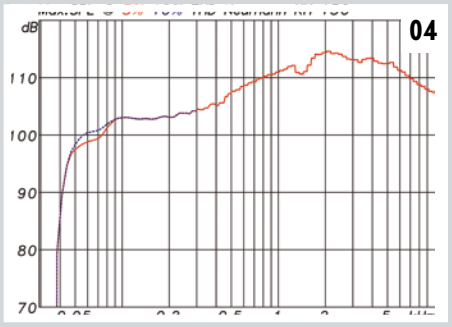
All the control elements are located on the rear in the form of easy-to-operate slide switches that reliably

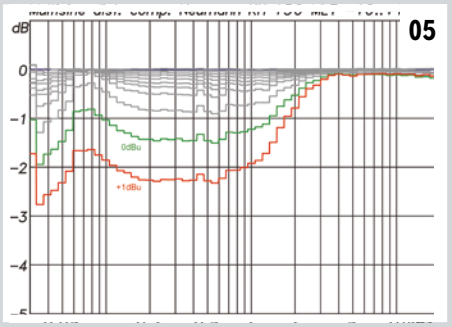
The following measurements of frequency response, dispersion and distortion values were obtained in the measurement laboratory under anechoic conditions. The class 1 measurement chamber permits measuring distances of up to 8 m, and provides free-field conditions for 100 Hz and above. Except for the noise level measurement, all measurements are taken using a G.R.A.S. 1/4" 46BF measurement microphone at a 96 kHz sampling rate and 24-bit resolution and with the WinMF audio measurement system. Measurements below 100 Hz are performed as combined near-field/far-field measurements. A G.R.A.S. 1/2" 40AF measurement microphone with high sensitivity and low self-noise is used for the noise level measurement.

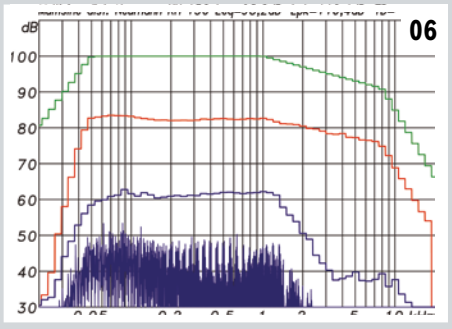


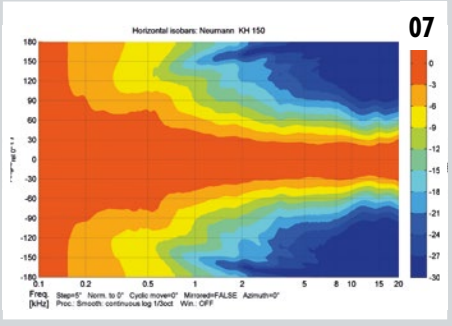


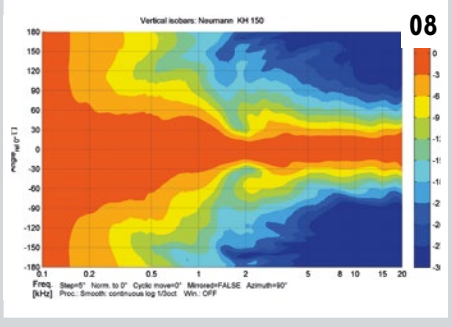


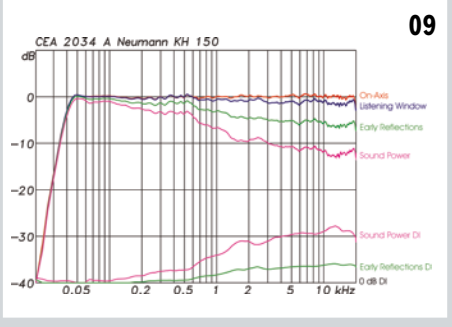












01 On-axis frequency response measured at a distance of 4 m. The lower and upper corner frequencies (–6 dB) are 36 Hz and 20.6 kHz. The ripple is very low at ±0.6 dB. In the lower part of the graphic, you can find the filter curves for the bass (green), low-mid (purple) and high (blue) settings.

02 Phase response of the KH 150 with a linear-phase response from approx. 300 Hz and above. The small image shows the corresponding step response.

03 Spectrogram of the KH 150 with perfect decay.

04 Maximum level at a distance of 1 m, at maximum 3% distortion (red curve) and at maximum 10% distortion (<300 Hz) (blue curve)

05 Power compression measured with a multi-tone signal with EIA-426B spectrum, starting at an average level Leq of 89.3 dB. Using this reference measurement as a basis, the input level was increased in 1 dB increments up to +11 dB, where the compression by the limiter exceeds the 2 dB limit value (red curve). The graph from figure 06 was derived from the measurement to the green curve.

06 Measurement of total distortion (harmonic and intermodulation) with a multi-tone signal with EIA-426B spectrum and 12 dB crest factor for a maximum power compression of 2 dB or a maximum distortion of –20 dB. Based on 1 m in a free field, a level of 98.2 dB is reached as Leq and 110.4 dB as Lpk.

07 Isobar display showing the horizontal dispersion. At the crossover point from orange to yellow, the level has fallen by 6 dB relative to the center axis. The average opening angle (–6 dB) is around 80°.

08 Isobar display showing the vertical dispersion; the average opening angle (-6 dB) is about 60°. The slight constriction at 1.7 kHz is caused by the crossover from the woofer to the tweeter at this point, where angle-dependent interference occurs in the vertical plane.

09 KH 150 spinorama graph. The upper red curve shows the established frequency response on the axis, the blue curve shows the average response in the typical angular range around the listening position, the green curve shows the average response in the angular range of the early reflection and the pink curve shows the average response over the entire envelope surface of the loudspeaker.

click into place. For adjustment to the location, there are three filters for bass, low-mid and high. The effect of the filters is shown in figure 01. A further switch with the designation “Output Level” includes the four positions 94, 100, 108 and 114 dB for the sound pressure, which is reached at 0 dBu input voltage at a distance of 1 m. There is also a potentiometer with an adjustment range of 0 to –15 dB, if values in between are desired. There are three more switches for selecting the input (Analog, S/PDIF Ch1, Ch2 or Mono, or AES67 for the KH 150 AES67), for the ground lift and for selecting the monitor settings locally at the box or via the network. More details about these features and the automatic calibration feature with the MA 1 software will follow later in a separate article.

The measurement values are intended to show the results of the high costs and effort involved in the development of the KH 150 in practice. In typical Neumann fashion, the measured “on-axis” frequency response from figure 01 is ideal. The lower and upper corner frequencies (-6 dB) are at 36 Hz and 20.6 kHz. The ripple in passband is very small ±0.6 dB. The same is true of the pair deviation, which was only 0.2 dB for the two test specimens. Generally speaking, there is usually no pair matching or the like at Neumann, but rather each monitor can be paired with any other of the same model. The phase response (Fig.02) is almost linear-phase above 300 Hz. In this case, the phase shifts that are present are compensated by a short FIR filter. The spectrogram from figure 03 also presents a perfect picture of the KH 150. Resonances are nowhere to be seen here. However, a perfect frequency response alone does not guarantee a good overall result. Only in combination with controlled uniform dispersion will the desired neutral listening impression be created at the listening point and in its surroundings.

Figures 07 and 08 show the directivity of the KH 150 for the horizontal and vertical plane with very smooth isobar lines. The –6 dB dispersion is very practical with 80°×60°, which ensures there is sufficient room for movement in the horizontal and reflections from the working surface are minimized efficiently. The spinorama graph from figure 09 also shows a practically ideal curve for both the “listening window” and the “early reflection”, with a level reduced by about 6 dB but a curve that is otherwise parallel to the “on-axis” frequency response. The same applies to the “sound power” level, which means there is no sound coloration due to reflection in the surroundings of the loudspeakers or the space as a whole. Detailed information about the interpretation of the spinorama graphs can be found in the 2018 third edition of the highly recommended book “Sound Reproduction” by Floyd E. Toole.

The maximum level that a monitor can reach is primarily determined by the drivers and the available amplifier power. For the drivers, the natural limitation is based on the one hand on the maximal excursion of the diaphragm, which is particularly true for woofers, and by the thermal load capacity of the voice coil. With that in mind, all the relevant states are monitored in the KH 150’s DSP system and, if necessary, limited through the use of limiters. Specifically, these limiters include power amplifier clip limiters for both paths, thermo limiters for the drivers, an excursion limiter for the woofer and another limiter that prevents the power supply from overloading. To test the effectiveness of the protective circuits, Neumann tests the monitors at maximum power during development in a 1000-hour test with a wide variety of signals.

At this point, the objection may well be raised that there is no way that such a tightly controlled loudspeaker could still sound good; however, this impression perhaps originates from analog times, where limiters were created with VCAs that could create problems in the signal path. Limiters created at a digital level, on

Rear view of the KH 150. The power supply connections and the analog input with XLR jack are located in the lower part of the rear panel, in the ducts at the side of the cooling section.

Internal view with the rear open

the other hand, ensure that they only affect the signal when activated, and do not do so otherwise. Sound interference by the limiters can therefore be ruled out as long as they do not have to intervene. In the latter event, the effects of the limiters are less disruptive than hard distortion or even damage to the drivers in any case.

To detect when one of the limiters is active, the KH 150 indicates too high peaks by flashing red (peak limiter) or a continuously illuminated red Neumann logo on the front if the thermo limiter is active.

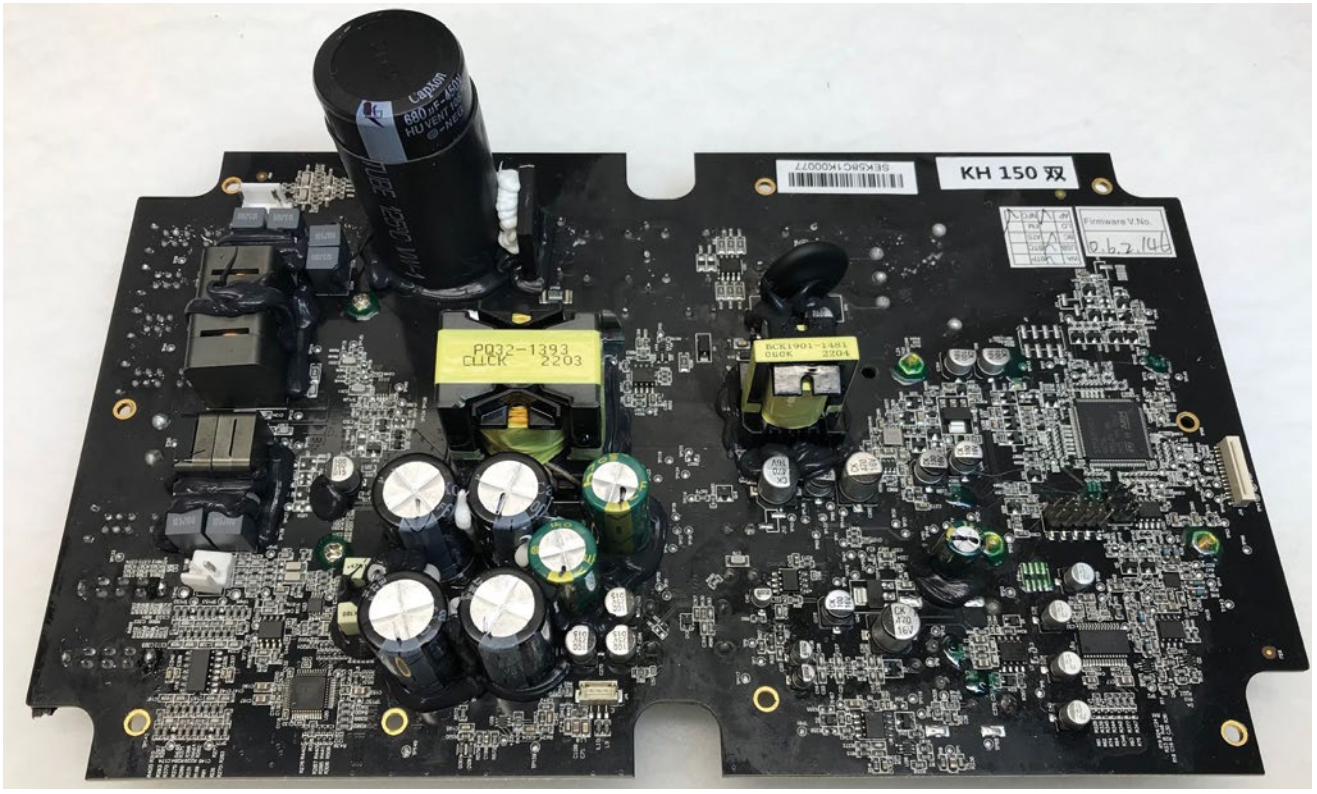
The sinusoidal burst measurement (figure 04) for the KH 150 delivers values ranging from 103 dB at low frequencies, rising to 114 dB in the working range of the tweeter. As expected, the tweeter has more headroom than the woofer in this combination. There are no weak points in this measurement. The curves run very uniformly without any local breaks. The multi-tone measurement from figures 05 and 06 provides slightly more detail. The criteria for the maximum level in this measurement are a maximum of –20 dB of total distortion (THD+IMD) and no more than 2 dB of compression in several adjacent frequency bands compared to a measurement in the linear small signal range. The curves in figure 05 show that the limiting factor at the KH 150 is primarily caused by the limiter for the low-frequency path. Figure 06 was derived from the measurement to the green curve. Although the distortion is still below the –20 dB limit value at –22 dB, the limiter does not allow any further level increase, as can clearly be seen from the red curve in figure 05, which is moved down by 1 dB in parallel in the frequency range of the woofer. During the multi-tone measurement, the KH 150 reaches an average level Leq of 98.2 dB and a peak level Lpk of 110.4 dB. All level values relate to a distance of 1 m in free field and full space.

The listening test was set up in anechoic conditions, as has been customary lately. The actual listening room is still being used as a video studio and is therefore temporarily unsuitable for listening tests. However, the video technology will have to be cleared away for a few days by the time that the "MA 1 - Automatic Monitor Alignment" software is to be tested together with the KH 150 and a KH 750 at the latest.

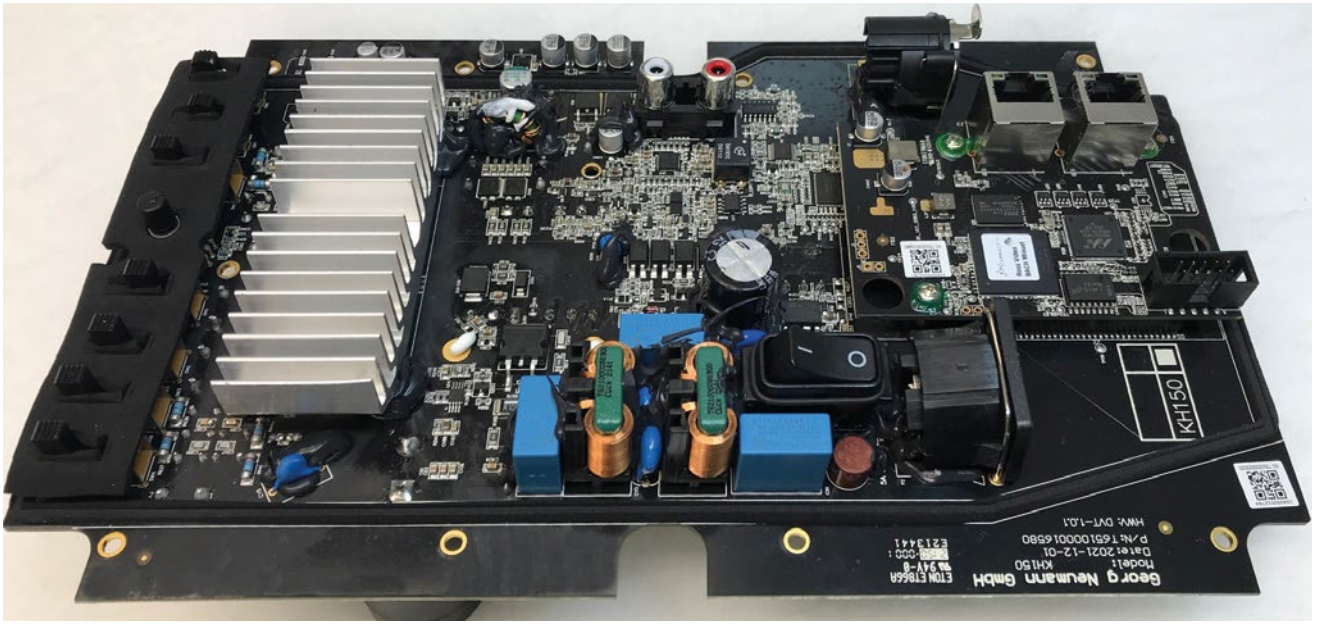
The known correlation between comprehensively good measurement values and a correspondingly good listening impression manifested itself during the listening trial. To be able to establish this correlation, however, it is always necessary to consider all the measurement results and not only selective individual measurements. The frequency and phase response, the dispersion in the form of isobars and the distortion values/the measurements at the achievable maximum level have to be considered and evaluated.

The KH 150 managed to leave a near perfect impression. Neutrality, depth of field and sharpness, SPL capability and lack of distortion – it was all there and painted a very harmonious picture overall. Surprisingly, the depth and the SPL capability of the bass response were particularly noticeable and, if you did not see the loudspeaker, would suggest much larger monitors.

Conclusion: With the KH 150, Neumann is adding a medium-sized model that can be used either as a classic nearfield monitor, in surround systems or, together with subwoofers, as the main loudspeaker to its KH range with studio monitors. There is barely any other way to say it: the depth and level of development per-



fection are typical of Neumann and meet the highest of standards, which is reflected in both the measurement results and the listening impression. The equipment with analog and digital inputs (including the optional AES67), connectivity options, the MA-1 system for room adjustment (consisting of a measurement microphone and software) that is available as an accessory and the wide range of application and assembly tools reinforce the outstanding overall impression it makes. Fortunately, this impression is not marred by the price, which with a list price including VAT of 3,300 euros for the pair is very agreeable. When you compare the price to the features and capabilities of the KH 150, it really is worth it in the true sense of the word. ←



Front and back of PCB with KH 150 electronics