Neumann KH 150

Active Monitors

The latest model in Neumann's celebrated KH series sets a new standard for nearfield monitoring.

PHIL WARD

Neumann's range of active monitors, from the diminutive KH 80 to the much more substantial KH 420, have long been admired by *Sound On Sound* reviewers and readers alike. But there has always been a gap in the Neumann range between the compact two-way KH 120 and the significantly larger three-way KH 310. It's a gap that I suspect has long frustrated those aspiring Neumann monitor owners for whom the KH 120 doesn't quite meet bandwidth and volume level needs, and the KH 310 doesn't fall within budget. That gap has now been filled by the subject of this review: the KH 150.

You can't really mistake a Neumann monitor for any other brand, and the KH 150 follows the established industrial design style closely. In fact, without something to provide scale in photographs, it's not easy at first glance to tell the difference between the KH 150 and the smaller KH 120. Under the skin, however the KH 150 is significantly more advanced technically, and offers an even more ambitious level of electro-acoustic performance.

The Drivers

The KH 150 is a relatively compact two-way monitor of comfortable nearfield monitoring dimensions, and it combines a nominally 165mm bass/midrange driver with an elliptical-waveguide-loaded 25mm tweeter. The enclosure design incorporates softened edges and a smoothly integrated waveguide that will help minimise the response aberrations that can be caused by diffraction from sharp edges. The enclosure is constructed from composite polycarbonate front and rear mouldings with a wooden carcass, and finished with a textured paint. Dark grey and white options are available. In the context of multi-channel monitoring environments, mounting facilities are becoming a significant issue, and the KH 150 enclosure usefully incorporates M6 threaded inserts on its rear panel for this purpose.

As well as the two colour options, the KH 150 is also available with two different sets of connection facilities. The standard KH 150 offers just conventional balanced analogue and S/PDIF digital inputs, while the KH 150 AES67 offers AoIP (Audio over Internet Protocol) network connectivity compatible with AES67-compliant protocols such as Ravenna and Dante.

Downstream of its inputs, and following 48kHz/24bit A-D conversion (for the analogue inputs), the KH 150 incorporates amplification rated at 145 Watts for the bass/mid driver and 100 Watts for the tweeter. The 48kHz internal sampling rate might sound limiting in today's world, but Neumann explain that this is a choice driven by tweeter performance. All tweeter diaphragms reach a frequency where they will enter a resonant break-up mode and even if, as is said to be the case with the KH 150 tweeter, the break-up frequency is above audibility, break-up intermodulation distortion effects can appear in the audible band. So it's beneficial, say Neumann, not to drive tweeters to break-up frequencies above audibility, and that means there's little point in an internal sampling rate that would enable audio bandwidth to extend much above the high-frequency limit of human hearing.

The KH 150 uses a new and patent-pending amplifier technology that, say Neumann, "combines superior audio performance with the energy efficiency of Class-D". Further research established that the amp topology incorporates some novel techniques that take driver impedance into account within the feedback strategy. Fundamentally, the KH 150 amplifier technology takes advantage of the fact that the architecture of active speakers enables the driver and amplifier system to be engineered and optimised holistically, rather than as disconnected entities.

DSP

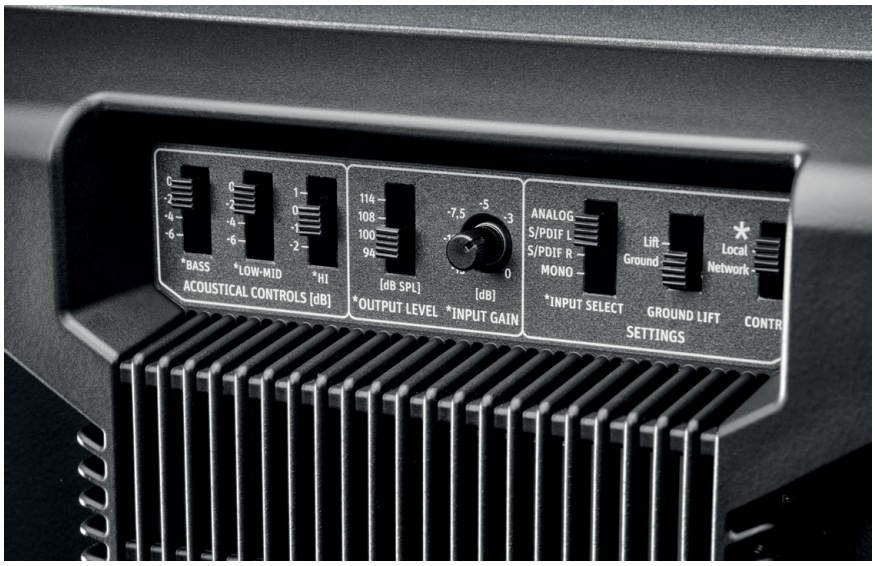
Perhaps of more immediate interest to users is what's between the monitor's inputs and its amplifiers, and that's a whole load of DSP power aimed at optimising both the KH 150's inherent

electro-acoustic performance and its integration with listening-room acoustics. One example of the former is a bass/mid driver limiting function that kicks in to stop diaphragm displacement exceeding ±12mm. This means, say Neumann, that overall bass/mid driver distortion is reduced because the usual need to engineer non-linear mechanical limiting into the driver suspension is avoided. The DSP handles fine adjustment of individual driver responses to ensure no more than ±0.8dB divergence between any two monitors, and it also facilitates the KH 150's fourth-order crossover filter slopes and wide-band phase correction. The latter ensures, say Neumann, that the KH 150's phase response remains within ±45 degrees between 105Hz and 16kHz.

So the KH 150 is very much a monitor of the DSP age and while, as I'll describe further down, there's much also to write about in its traditional electro-acoustics, it wouldn't be half the monitor it is without those audio digits getting processed.

When it comes to user-accessible elements of the KH 150's DSP, there are effectively two modes of operation. The first is local control, in which the KH 150 operates as a conventional active monitor with a variety of rear-panel switches adjusting input selection, ground lift, local or network control, input sensitivity and gain, and three EQ bands. The EQ offers 0dB to -4dB of low-frequency adjustment, 0dB to -6dB of low midrange adjustment (centred around above 200Hz), and +1dB to -2dB of high-frequency adjustment. However, the KH 150 is also fully integrated with Neumann's MA 1 monitor alignment technology, and the second mode of operation sees MA 1 deployed to enable both TCP/IP network-based monitor configuration and measurement-driven room optimisation.

The MA 1 package comprises an individually calibrated measurement microphone and a Mac/Windows-compatible analysis and control application. The measurement microphone, as might be expected from Neumann, exudes a sense of engineered precision, and the app looks suitably professional and inspires confidence. The app is also intuitive in use and demands very little in terms of time and effort. What it does demand, however, is that, while the optimisation process is underway, the monitors are connected to the same TCP/IP network as the computer to be used. In most cases this will be the DAW computer,



In local control mode, the KH 150 operates as a conventional active monitor, with rear-panel switches offering control of the input, ground lift, input sensitivity, gain, and three-band EQ.

but it doesn't need to be, because once the optimisation process is complete, the optimisation data is uploaded to the monitors so they can be disconnected from the network. If you subsequently need to run the monitors in un-optimised mode, a flick of the KH 150 rear panel Network/Local switch will do the trick. Having mentioned a few paragraphs back that the KH 150s bracket mounting facilities suit the monitor for use in multi-channel systems, that's not yet the case for MA 1, which at present is stereo-only. I imagine a multi-channel version is on the way.

As with conceptually similar products such as Sonarworks, ARC, Trinnov, Dirac and Genelec GLM, the calibration process relies of a series of monitor measurements, seven sine-wave sweeps in this case, captured using the measurement mic in a variety of positions, focused on the primarily listening position. MA 1 derives from the measurements the characteristic acoustic signature of the environment, along with how the monitors interact with it, and from that analysis constructs equalisation data that aims to optimise the in-room listening position performance. Interestingly, MA 1 doesn't simply aim for a 'flat' response, but creates a target curve that its algorithms propose will best suit the specific monitors and room.

I've included a couple of MA 1 screenshots that illustrate the process. Screen 1 shows an MA 1 composite measured response of the pair of KH 150s in my room, and Screen 2 shows the result of the optimisation. You'll see at the bottom of the screens that MA 1 also provides the facility for EQ modifications through 10 (two shelf and eight parametric) user-accessible filter stages, so if you want to tweak the optimised MA 1 response and upload that to the monitors you're perfectly able to do so.

Now, you might expect that, in optimising the performance of a stereo pair of monitors, MA 1 would display the pre- and post-optimisation data for the two monitors individually, but it doesn't: it displays a summed response curve. MA 1 works like this because although it analyses and generates optimisation data for each monitor individually, it needs to take into account that if the optimisation data for each monitor is significantly different, the resulting stereo image quality will suffer. This is because it is direct sound reaching the listener's ears that is primarily the source of stereo image information, and the fundamental *modus operandi* of MA »

Neumann KH 150
€3300

PROS
- Remarkable bandwidth and volume level from a compact monitor.
- Utterly neutral and uncoloured tonal balance.
- Brilliant stereo imaging and mix clarity.

CONS
- MA 1 is stereo-only at present.

SUMMARY
The KH 150 and MA 1 is a fabulous example of what can be achieved with the best of advanced electro-acoustics and DSP. It comes with the sound of a standard being raised.

Screen 1: The combined in-room response of a pair of KH 150 monitors, as measured by the MA 1 software.

» 1 (and the other conceptually similar systems I've mentioned) is to equalise the direct sound with the optimisation data in order that, when room effects are 'printed' on it, the resulting composite is tonally optimal. But if each of a stereo pair of monitors were to need significantly different equalisation because, for example, they were positioned in acoustically different environments, the stereo imaging could be compromised. It's for this reason also that the user EQ offered by MA 1 can only be applied to the summed system response. If users were able to equalise the two monitors of a stereo pair individually, stereo imaging would again be at risk.

Crossing Over

I mentioned the monitor's fourth-order crossover filter slopes a few paragraphs up. The crossover frequency is at 1700Hz, and that's not far short of an octave lower than is more traditionally found in similarly configured two-way monitors. The low crossover frequency is made possible by the sensitivity gains that result from the tweeter waveguide enabling its usable bandwidth to be extended downward. That in turn also enables better directivity matching between the two drivers around the crossover frequency than is typically found when crossover frequencies are higher and tweeters are used 'naked'. A similar technique can be found on, for example, the Amphion range of monitors.

The KH 150 tweeter is a 25mm dome unit that's closely related to the drivers found in other Neumann monitors. It benefits from Neumann's proprietary Mathematically Modelled Waveguide and Extreme Linear Force Factor technologies, and incorporates what Neumann describe as an "alloy fabric dome", in an apparently deliberate move to be unspecific about the actual material. The KH 150 bass/mid driver is a newly developed unit that Neumann say was specifically engineered to offer a significant improvement in distortion, low-frequency bandwidth and maximum level. In particular, the driver's motor system is designed to offer extreme linearity and low distortion over extended diaphragm displacement. By way of illustration, a typical off-the shelf 165mm bass/mid driver will offer between ±6mm and ±8mm of linear diaphragm travel. The KH 150 driver, say Neumann, offers ±12mm. This was achieved through intense FEA modelling of the magnet system and diaphragm suspension components, and the use of a variable voice-coil winding profile technique. The latter is particularly unusual. Forward of the voice coil and magnet system, the KH 150 bass/mid driver employs a paper diaphragm and dust cap, paired with a rubber roll surround. The relatively low crossover frequency will help with bass/mid diaphragm design and optimisation, because it makes the diaphragm break-up characteristics and surround termination characteristics a little less critical. Even so, Neumann say that the particular demands placed on the surround by the driver's very high linear displacement make its optimisation extremely complex.

Screen 2: The MA 1-corrected response.

Finally on the bass/mid driver, its custom-designed die-cast aluminium chassis forms a structural element of the enclosure front panel — recovering the structural panel weakness that results from the big hole the driver demands.

Pass The Port

Beneath and either side of the KH 150 bass/mid driver are a couple of reflex port

exits. They are triangular in form and flared to help retain laminar airflow to as high a volume level as possible. The KH 150 reflex tuning frequency is at a relatively low 42Hz, and the length of port required to achieve that means the ports tubes internally bend upward inside the cabinet. Neumann development engineers say that much time, effort and simulation work was carried out on the ports to ensure both laminar airflow and minimal organ-pipe resonance effects.

Considering the reflex loading and bass/mid driver together, the resulting low-frequency bandwidth specification is -3dB at 39Hz, with a maximum low-frequency (50Hz to 100Hz) level for 3% total harmonic distortion of 107.5dB. These are impressive numbers for a relatively small nearfield monitor, and to add some context, the equivalent specifications for the much larger Neumann KH 310, with its 210mm bass driver, are 34Hz and 106.8dB respectively. The KH 310 offers 5Hz extra bandwidth, but is actually 0.7dB shy of the KH 150 in terms of maximum level.

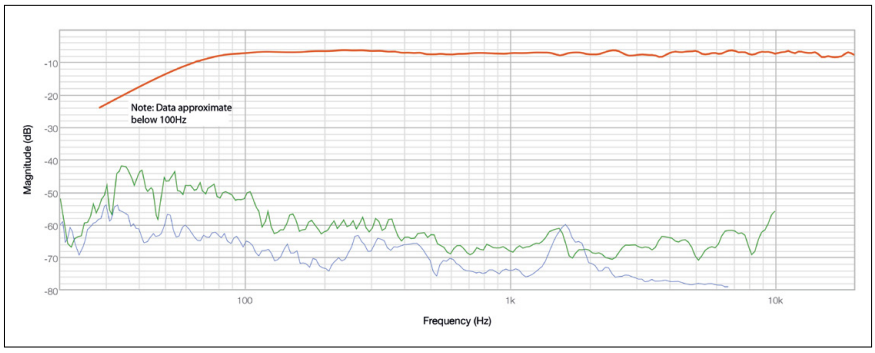


Diagram 1: The KH 150's measured on-axis frequency response (red trace), and second- and third-harmonic distortion levels (green and blue, respectively).

One related area where the KH 150 and KH 310 fundamentally differ, however, is in their low-frequency time-domain performance. The KH 310, due to its closed-box loading technique, demonstrates low-frequency group delay (think of group delay as frequency-dependent latency) of just 12ms at 40Hz, whereas the KH 150's group delay reaches 27ms at a similar frequency. As I've written on quite a few occasions in the past, there's much debate on the significance of low-frequency group delay and many, including me, believe it to be potentially audible. However, the situation is far less black and white than raw specification numbers might suggest, and all sorts of other factors play a role in the subjective low-frequency character of monitors, the choices monitor designers make, and the needs of monitor manufacturers to make products that work across different professional sectors. There's also a lot more to subjective »

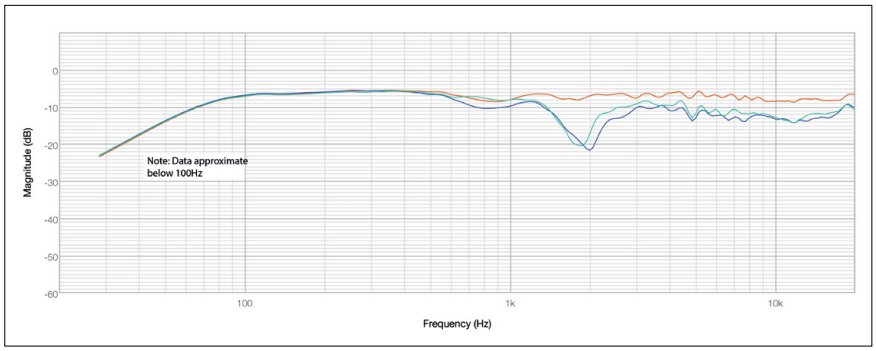


Diagram 2: The KH 150's frequency response measured on-axis (red trace), and 30 degrees above and below (blue and green, respectively).

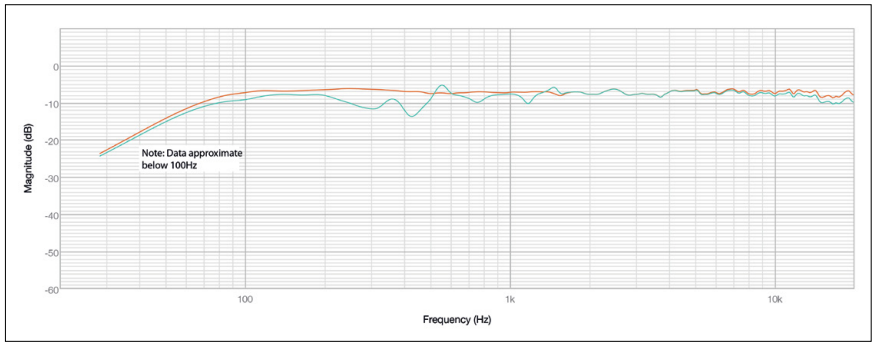


Diagram 3: The axial frequency response (red), overlaid with the MA 1's equalised response, as measured in the free field.

» low-frequency performance than group delay: for example, low distortion and high volume levels at low frequencies, especially when driver and enclosure size is limited, are generally easier to achieve with reflex loading. And while group delay defines how promptly a monitor is able to 'accelerate', it says nothing about what happens when it needs to stop (that's all to do with port and driver Q).

Port dynamics are also of vital significance in defining how well a reflex-loaded monitor is able to play bass. Poorly designed ports that become non-linear and compress at relatively low volume levels, or demonstrate organ-pipe resonances that result in the radiation of significant midrange energy, can give ported monitors a worse name than perhaps they deserve. Considering the low-frequency bandwidth and maximum level requirements defined by the very broad range of potential roles it needs to satisfy, I'm sure Neumann had little option but to choose reflex loading with the KH 150s. The issue then, as with any other aspect of monitor design, was to find the combined set of engineering parameters that result in optimal performance. And speaking of performance, as is traditional, I took a KH 150 along to my big measuring space (a church, now you've asked) and fired up FuzzMeasure to investigate a few elements of objective performance, and this is what I found...

Taking Measurements

Diagram 1 illustrates the KH 150 frequency response and harmonic distortion (second and third harmonics). Sound pressure level was 90dB (at 1m) and the data is accurate down to around 100Hz. The measuring mic was 1.5m away and positioned on an axis midway between the bass/mid driver and tweeter. The resulting KH 150 frequency response is probably the flattest I've ever measured on a commercially available speaker and, while I'm not one to get too excited about a single response curve (monitors are much more than a single axial frequency response curve), I will admit to a mild double take and a quiet "wow!" (I was in a church, remember) when the curve appeared on the laptop screen. On the particular axis I measured, the frequency response is flat to within ±1dB from 100Hz to 20kHz. The distortion performance revealed in Diagram 1 is similarly notable. The second harmonic is typically at -50 to -55 dB, and the third harmonic is typically another 5 to 10 dB lower. For context, -50dB equates to 0.3% and -60dB equates to 0.1% distortion, so these are seriously impressive figures.

Diagram 2 illustrates the KH 150's vertical dispersion at 30° off-axis upwards and downwards. As expected there's a crossover interference dip where the path lengths from the two drivers go out of phase, but it's over quickly and is remarkably symmetrical up and down. This suggests extremely well-managed driver integration through the crossover region. The off-axis curves also reveal a gentle reduction in tweeter level without any sudden discontinuities.

Diagram 3 illustrates the same axial response of Diagram 1 overlaid with the result of MA 1 optimisation in my room. This shows how MA 1 changes the frequency response of the KH 150 once it has the room optimisation data uploaded. Finally, Diagram 4 illustrates in-room measurements of the pair of KH 150s with and without room optimisation engaged. Along with the illustrated measurements, I made some others, to check horizontal dispersion and to look for port organ-pipe resonances, for example. The KH 150 threw up nothing of concern.

Listening Tests

So a little tyre-kicking analysis of the KH 150 suggests an extremely well-engineered monitor that packs a lot of electro-acoustic and DSP expertise into a conveniently dimensioned and, in high-performance monitor terms, relatively affordable package. But what does the

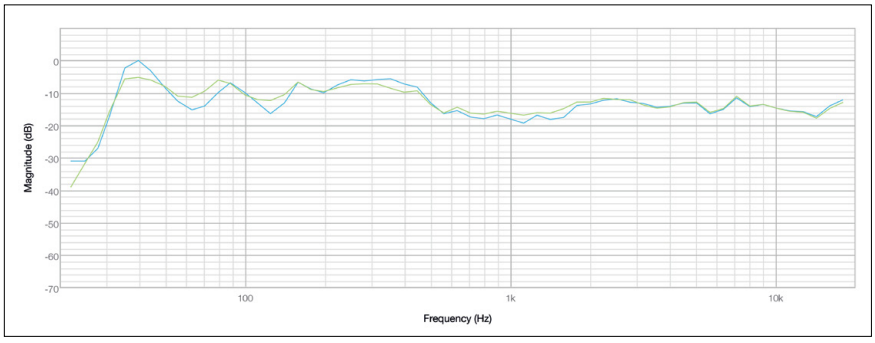


Diagram 4: The KH 150's in-room response before and after MA 1 optimisation (blue and green traces).

ALTERNATIVES

I've given the KH 150 and MA 1 a very positive review, but of course there are other very fine monitors in its price range. The **PS1 A17M**, the **Genelec 8350A**, the **Focal ST6 Solo 6** and the **Dynaudio Core 7** are four such examples.

KH 150 sound like? As a confirmed admirer of Neumann's existing monitors I had high hopes for the KH 150 and MA 1, and I wasn't disappointed. I've left myself not very many words to describe my subjective thoughts, but in some respects that's fine, because there's not actually much to say other than that the KH 150 and MA 1 is as near to flawless as I've heard compact nearfield monitoring get.

I began with the KH 150 working in local mode without the benefit of MA 1 room optimisation, and the rear-panel low-frequency EQ switch at -2dB, to suit my room. From the start, the flatness of the KH 150's frequency response, its well-managed dispersion, and its very low distortion, wide bandwidth and serious volume level capabilities combine to create a powerfully analytic monitoring tool. The KH 150 is deeply insightful through the entire audio band with stereo imaging that's rock solid, as much mix clarity as you could ever want to hear, and a tonal character that's authentic, trustworthy and apparently unchanging whatever the volume level. KH 150 bass is unfeasibly extended considering the monitor's relatively compact dimensions, yet it sounds dynamic and dependable with great subjective pitch and dynamic accuracy. I would never have guessed its 27ms group delay.

Adding the MA 1 to the KH 150 mix, for me, wasn't a massive game-changer, not least because the game is already so good, but it did sharpen the stereo imaging still further, help reveal yet more mix detail and significantly reduce the tonal balance and coloration of room effects. The benefits of MA 1 will always be somewhat context-dependent, so in an acoustically more challenging installation it will likely enable the qualities of the KH 150 to shine though when otherwise they might struggle to. Having said that, considering the relatively modest cost of adding the MA 1 kit to a pair of KH 150s, you'd be crazy not to employ it, and certainly, once I'd configured MA 1, I didn't go back to using the KH 150s without its optimisation engaged.

But along with performing the nearfield role all but faultlessly, there's more to the KH 150 and MA 1, because on the right material I also found listening to be hugely rewarding. If truth be known, I pretty quickly stopped listening analytically to try and get a handle on such things as coloration and tonal balance, because they were so clearly on point, and started listening just for the simple fun of discovering new insights into material I thought I knew intimately. For example, there's a bass part in Joe Jackson's 'You Can't Get What You Want' from the *Body And Soul* album that I simply hadn't noticed before, and I've been listening to that track since the mid-1980s. Monitors that enable that kind of revelation are few and far between, so the KH 150 joins a very select bunch. ///

£ KH 150 €3300, KH 150 AES67 €3790. Prices are per pair, including VAT.
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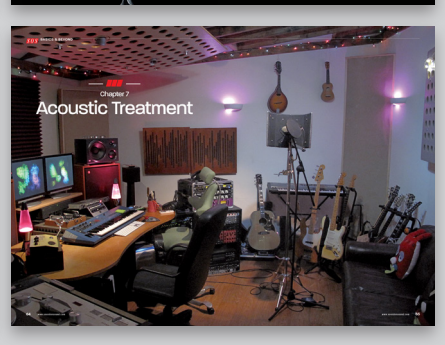

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