NEUMANN.BERLIN

KH 420

Active Studio Monitor

Operating Manual

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Contents

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Important safety instructions

1. Read these instructions.
2. Keep these instructions. Always include these instructions when passing the product on to third parties.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Only clean the product when it is not connected to the mains power supply. Clean only with a dry cloth.
7. Always ensure a free air flow around the cooling fins on the rear of the product. Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where it exits from the apparatus.
11. Only use attachments/accessories specified by the manufacturer.
12. Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.

13. Unplug this apparatus during lightning storms or when unused for long periods of time.
14. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, when the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
15. To completely disconnect this apparatus from the AC mains, disconnect the power supply cord plug from the AC receptacle.
16. WARNING: To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.
17. Do not expose this equipment to dripping or splashing and ensure that no objects filled with liquids, such as vases, are placed on the equipment.
18. The mains plug of the power supply cord shall remain readily accessible.

Installation

- Ensure that the room in which you use this product is wired in accordance with the local electrical code and checked by a qualified inspector.
- Only use the product indoors.
- Do not install the product in hot, humid, or excessively dusty locations, in direct sunlight or in locations where it is exposed to externally generated vibrations.
- Do not place burning objects (e.g. candles) on top of or near the product.
- If condensation has formed on the product, e.g. because it was moved from a cold environment to a warm one, allow the product to acclimatize to room temperature before using it.
- Do not overload wall outlets and extension cables as this may result in fire and electric shock.

Danger due to high sound pressure levels

WARNING
Danger of hearing damage due to sudden high sound pressure levels!

Audio signals that are present at switch-on of the product or that can be present during operation, can create sudden, very high sound pressure levels which can damage your hearing.

- ▶ Always lower the output level of the audio source before connecting it to the loudspeaker or starting it (pressing “play”).

DIM 1

If the DIM 1 accessory has been fitted:

- ▶ Always lower the output level of the audio source before switching to a different source (analog/digital) via the SIGNAL SELECT rotary switch ㉒ of the DIM 1 accessory.

This loudspeaker can be used for commercial purposes. Commercial use is subject to the rules and regulations of the trade association responsible. Neumann, as the manufacturer, is therefore obliged to expressly point out possible health risks arising from use. This loudspeaker is capable of producing sound pressure levels exceeding 85 dB(A) SPL. This is the sound pressure corresponding to the maximum permissible level which is by law (in some countries) allowed to affect your hearing for the duration of a working day (8 hours). It is used as a basis according to the specifications of industrial medicine. Higher sound pressure levels and/or longer durations can damage your hearing. At higher sound pressure levels, the duration must be shortened in order to prevent hearing damage. The following are signs that you have been subjected to excessive sound pressure levels for too long a time:

- You can hear ringing or whistling sounds in your ears.
- You have the impression (even for a short time only) that you can no longer hear high frequencies (temporary threshold shift).

Magnetic fields

WARNING
Interference due to magnetic fields!

This product generates a permanent magnetic field (> 1.5 mT) that can interfere with cardiac pacemakers and implanted defibrillators (ICDs).

- ▶ Always maintain a distance of at least 10 cm (4") between the loudspeaker and the cardiac pacemaker or implanted defibrillator.

Hazard warnings on the rear of the product

The label shown on the right is attached to the rear of the product.

The symbols on this label have the following meaning:

Presence of uninsulated dangerous voltage within the product’s enclosure that may be of sufficient magnitude to constitute a risk of fire or electric shock.

Never open the product or remove the grilles fitted to the product as there is a risk of electric shock. There are no user serviceable parts inside. Refer servicing to your Neumann service partner.

Read and follow the safety and operating instructions contained in the operating manual.

Intended use

Intended use of the product includes:

- having read this operating manual, especially the chapter “Important safety instructions”,
- using the product within the operating conditions and limitations described in this operating manual.

“Improper use” means using the product other than as described in this operating manual, or under operating conditions which differ from those described herein.

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The KH 420 studio monitor

Thank you for purchasing a Neumann studio monitor. The KH 420 features a Mathematically Modeled Dispersion™ Waveguide (MMD™), flexible acoustical controls, various input options and an extensive range of mounting hardware. This allows the loudspeaker to be used in diverse acoustical conditions, with any source equipment and in a wide variety of physical locations. The KH 420 represents the latest in acoustic and electronic simulation and measurement technologies to ensure the most accurate sound reproduction possible.

The KH 420 is designed for use as mid-field and main monitor. It can be used as a front loudspeaker in mid-sized and large multi-channel systems, or as a rear loudspeaker in larger multi-channel systems.

Package contents

1 KH 420
3 Mains cables (European, UK and US versions)
1 Operating manual
1 “Getting Started Quickly” supplement

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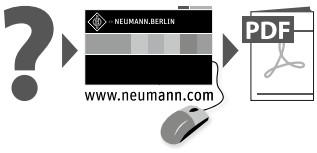
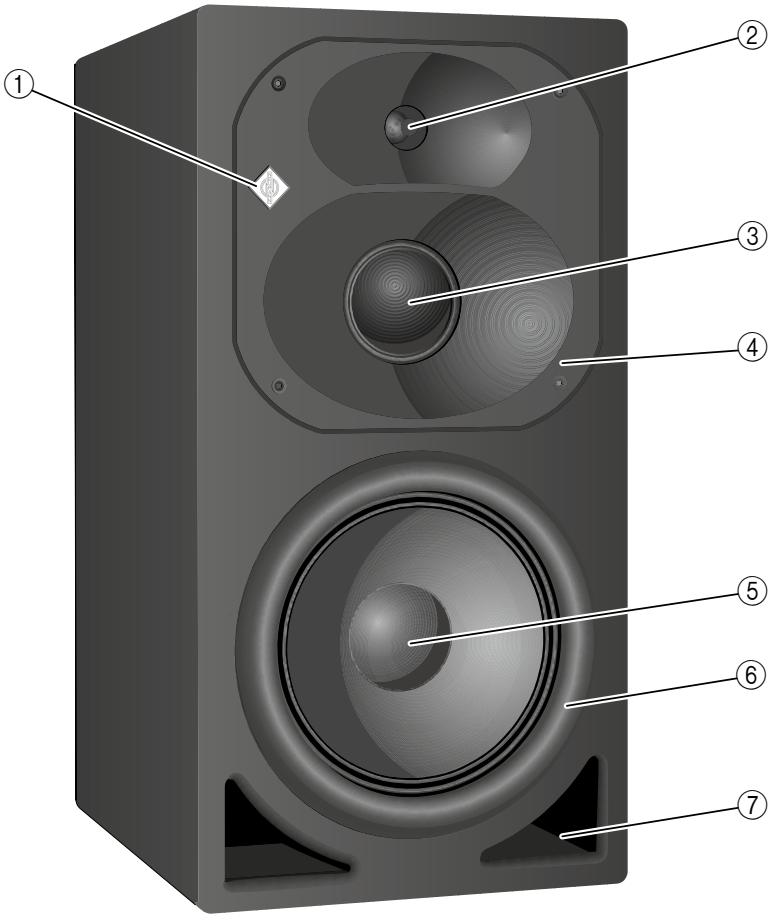
Note that imperial dimensions are approximate.



The current operating manual as well as the supplement “Getting Started Quickly” can also be downloaded from the “Downloads” area on the product page at www.neumann.com.

Product overview



① Neumann logo
- lights up white:
  loudspeaker is switched on and ready for operation
- flashes red:
  loudspeaker's protection system is active
  output level is reduced
  or, if the optional DIM 1 accessory is installed:
  A digital signal is selected via the SIGNAL SELECT rotary switch ㉒ but there is no valid digital signal connected
- lights up red:
  electronic's temperature is too high
  output level is reduced by 20 dB
  or
  input signal is constantly high
  output level is slightly reduced

② Treble driver
③ Midrange driver
④ Rotatable waveguide
⑤ Bass driver
⑥ Woofer ring*
⑦ Bass reflex ports

You can adjust the brightness of the Neumann logo. For more information, refer to page 22.

When installing a Remote Electronics Kit (REK4) the electronics panel and the cabinet that were originally shipped together should be connected together, otherwise the anechoic calibration is lost. To help with this during installation, the serial number shown on the electronics panel is also printed behind the woofer ring ⑥. To remove the woofer ring, carefully place your fingers on either side of the inside of the woofer ring, press outwards, and then pull towards you. To refit the woofer ring, align the pegs with the holes and gently push until the woofer ring is fully inserted.

⑧ Threaded inserts for mounting hardware
Remove inserted plastic plugs before attaching mounting hardware.

⑨ Accelerated Heat Tunneling™ cooling fins (AHT™)

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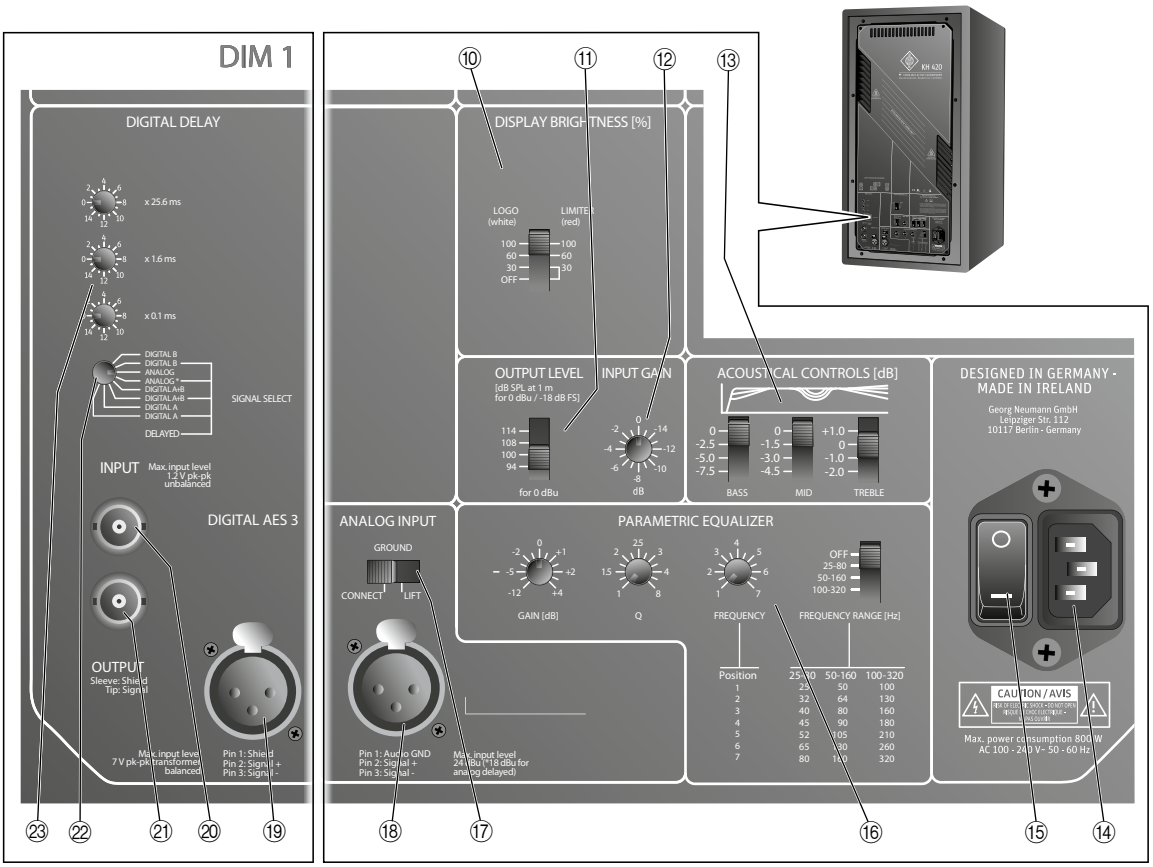

⑩ DISPLAY BRIGHTNESS switch
(Dims the Neumann logo)

⑪ OUTPUT LEVEL switch

⑫ INPUT GAIN control

⑬ ACOUSTICAL CONTROLS switches

⑭ IEC mains socket

⑮ On/off switch I/O

⑯ PARAMETRIC EQUALIZER controls
- PARAMETRIC EQUALIZER | GAIN [dB]
- PARAMETRIC EQUALIZER | Q
- PARAMETRIC EQUALIZER | FREQUENCY [Hz]
- PARAMETRIC EQUALIZER | FREQUENCY RANGE [Hz]

⑰ GROUND switch
(Connects/disconnects ground)

⑱ ANALOG INPUT socket (XLR)

DIM 1

⑲ AES3 INPUT socket (XLR)

⑳ AES3 INPUT socket (BNC)

㉑ AES3 OUTPUT socket (BNC)

㉒ SIGNAL SELECT rotary switch

㉓ DELAY rotary switches

DIM 1 is an optional accessory not included in the package contents of the KH 420. If the DIM 1 is not installed, the backplate's area marked with DIM 1 in the drawing above will be covered with a sticker.
Always have the DIM 1 installed by an authorized Neumann service partner.

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Installing and connecting the KH 420

CAUTION
Danger of injury and material damage due to tipping/dropping of the product!

If improperly mounted, the product and/or the mounting hardware (e.g. rack) can tip over or drop down.

- Always have the product mounted by a qualified specialist according to local, national and international regulations and standards.
- Use the mounting systems recommended by Neumann and always provide sufficient additional protection against tipping or dropping!

CAUTION
Damage to the product due to overheating!

If air cannot circulate properly around the cooling fins on the rear of the product, the amplifier(s) may overheat leading to premature activation of the thermal protection system which limits the maximum output level of the loudspeaker. In rare cases, damage to the product may also occur.

- Never cover the entrance and exit slots for the Accelerate Heat Tunneling™ cooling fins.
- Regularly clean the Accelerate Heat Tunneling™ cooling fins.
- When installing the product into tight spaces such as wall recesses, maintain an air gap of at least 5 cm (2") around the rear of the product and provide sufficient air circulation. If necessary, use forced-air cooling (e.g. when flush mounted in a wall), or use a REK 4 (remote electronics kit).

It is possible to remove the electronics panel and locate it remotely, using the REK 4 accessory and Cable Packs, CP nn.

For information on installation, please refer to the supplied “Getting Started Quickly” supplement. This will help you set up the loudspeakers in a way that will give you the best acoustic performance from the system.

For further information on setting up loudspeakers, please refer to the “Questions & Answers” section on the product page at www.neumann.com.

For more information on building systems using Neumann loudspeaker products, please refer to the “Product Selection Guide” at www.neumann.com

Preparing the loudspeakers

CAUTION
Risk of staining surfaces!

Some surfaces treated with varnish, polish or synthetics may suffer from stains when they come into contact with other synthetics. Despite a thorough testing of the synthetics used by us, we cannot rule out the possibility of staining.

- Do not place the KH 420 on delicate surfaces.

Rotating the MMD™ waveguide

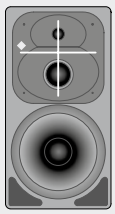
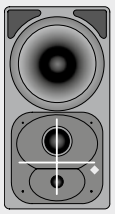
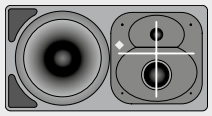
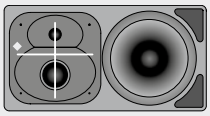
The MMD™ waveguide of the KH 420 is rotatable. Rotating the MMD™ waveguide allows you to place the bass driver either side of it. If the cabinet is positioned upside down, the MMD™ should also be upside down to maintain an optimum response in the bass-midrange crossover region. In all cabinet orientations, the acoustical axis should point towards the engineer’s listening position, or the center of the listening area, in both the horizontal and vertical planes – see the definition of the acoustical axis.

See the table below for rotation angles of the MMD™ waveguide depending on the mounting direction.

If you rotate your cabinet by …

0°	180°	90° clockwise	90° anticlockwise

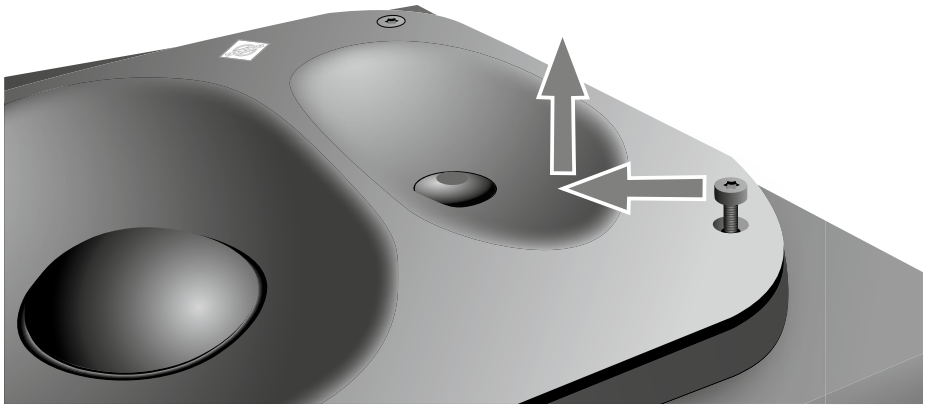
Your MMD™ waveguide should be rotated within the cabinet by …

0°	0°	90° anticlockwise	90° clockwise
			

 = Acoustical center

To rotate the MMD™, proceed as follows:

- ▶ Lay the loudspeaker cabinet on its back on a soft flat surface so the drivers are facing upwards. Ensure that none of the control knobs and switches on the back panel can be damaged by the surface.
- ▶ Undo the four bolts on the MMD™ waveguide using a T25 Torx head screwdriver.
- ▶ Carefully lift the MMD™ waveguide out of the cabinet avoiding scratches on the paintwork and damage to the sealing strip (pressing the screw to one side, as shown below, and pulling up can make this task easier):



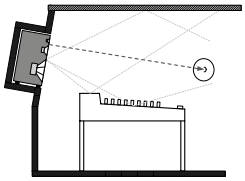
- ▶ Rotate the MMD™ waveguide to the new orientation (see table above) and position it back into the front panel cut-out. To avoid rattles, the driver cables are tightly sandwiched between the rear of the waveguide and the damping material.
- ▶ Ensure that the driver cables do not touch the edges of the cabinet.
- ▶ Tighten the four bolts on the MMD™ waveguide to a torque setting of 2 Nm (1.48 lbf-ft).
- ▶ Test the cabinet sealing by playing a reasonably loud (so you can feel some wind through the ports) 32 Hz sine wave. Then listen for any hissing sounds around the edge of the MMD™ waveguide and its drivers. If there is a hissing sound, the sealing has been compromised and should be repaired.

Once the waveguide has been rotated the logo will be incorrectly oriented:

- ▶ Carefully lever the logo out using a sharp knife.
- ▶ Reinsert the logo the correct way round.

Flush mounting the KH 420

The benefits of flush mounting are reduced cabinet edge diffraction (smoother midrange), increased bass driver loading (reduced bass distortion), and elimination of rear wall cancellations (flatter bass response).



A Remote Electronics Kit is highly recommended to avoid heat dissipation problems and allow easy adjustment of the controls.

- ▶ Have the flush mounting designed by an experienced acoustic engineer. The following instructions are addressed to this experienced acoustic engineer.
- ▶ Design the flush mounting wall's construction angles such that the loudspeaker's acoustical axis directly points horizontally and vertically towards the listening position or the centre of the listening area.
- ▶ Acoustically isolate the cabinet from the wall. This avoids transmission of vibrations to the flush wall.

To avoid midrange coloration:

- ▶ Do not put a "picture frame" around the edge of the cabinet that sticks out from the wall and front panel. Also avoid any other acoustical discontinuities near the cabinet.
- ▶ Compensate the acoustical loading using the recommended acoustical control settings shown in the "Adjusting the frequency response" section on page 17. A heavier wall provides more loading which should be compensated with more "bass" attenuation.

If the loudspeaker must be covered:

- ▶ Use a thin open weave cloth. Two layers of very thin material will improve opacity.

Preparing the room

- ▶ Arrange the loudspeaker setup symmetrically in the listening room.
- ▶ Arrange all acoustically relevant surfaces and objects symmetrically on either side of the listening axis of the room (left/right).
- ▶ Minimize the sound that is reflected back to the listening position by using angled surfaces and/or acoustical treatment.

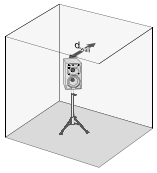
This product has been optimized for use in recording studios. In order to not affect the quality of reproduction, make sure that the product is used in an EMC (electromagnetically compatible) environment.

Positioning the loudspeaker

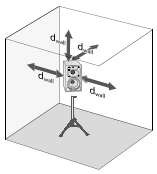
- ▶ Carry out the following steps very accurately, since the more accurate the physical arrangement of the loudspeakers in the room, the more accurate the reproduction will be at the listening position.

Distances

- ▶ Observe the recommended distances between the loudspeakers and your listening position (imperial dimensions are approximate):
  - Minimum: 1.25 m (4')
  - Recommended: 1.5–3.0 m (5'–9')
  - Maximum: 11.0 m (33')



- ▶ Avoid positioning the loudspeaker at a distance "d_{wall}" of 0.8 to 2 m (2' 6" to 6') from the wall behind the loudspeaker.



When positioning bass managed loudspeakers:

- ▶ Avoid a distance "d_{wall}" of 0.8 to 1 m (2' 6" to 3') from a solid wall behind the loudspeaker. Similarly, avoid these distances from solid side walls or a solid ceiling. Respecting these positioning limitations reduces the chances of dips and peaks in the low frequency response (comb filtering) caused by strong reflections.

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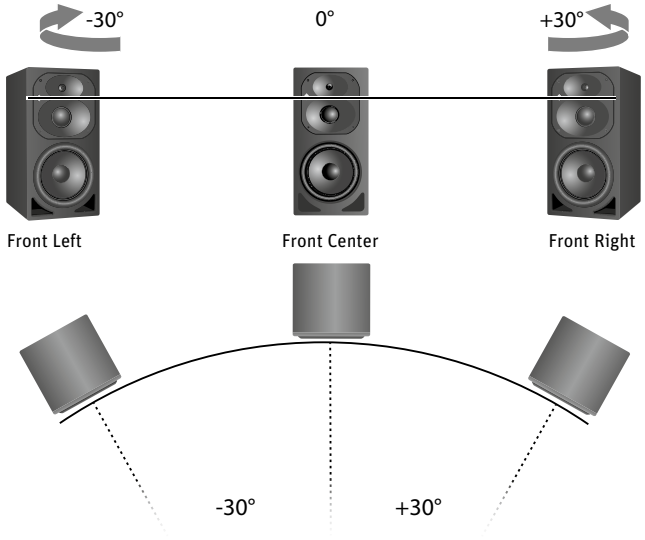
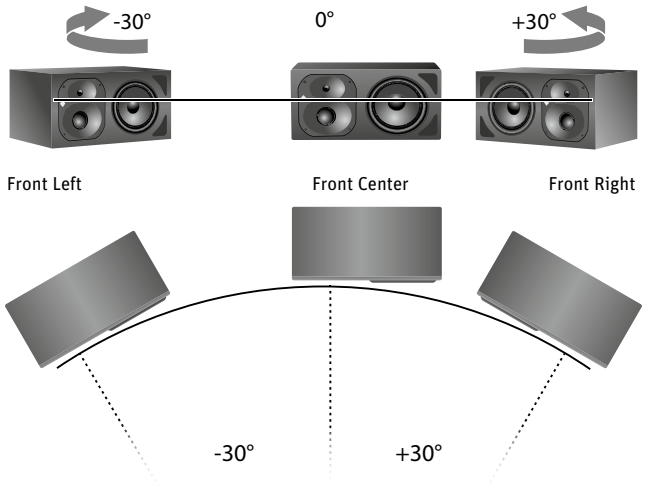
When positioning vertically oriented cabinets:



When positioning horizontally oriented cabinets:



Arranging the loudspeakers

- ▶ Copy the diagram “Installation angles” that can be found at the end of this operating manual.
- ▶ Place the diagram at the listening position or center of the listening area.
- ▶ Using a tape measure, place the loudspeakers at the same distance from the center of the diagram “Installation angles”. To ensure good imaging, do this at an accuracy of at least 1 cm ($^1/_2$").

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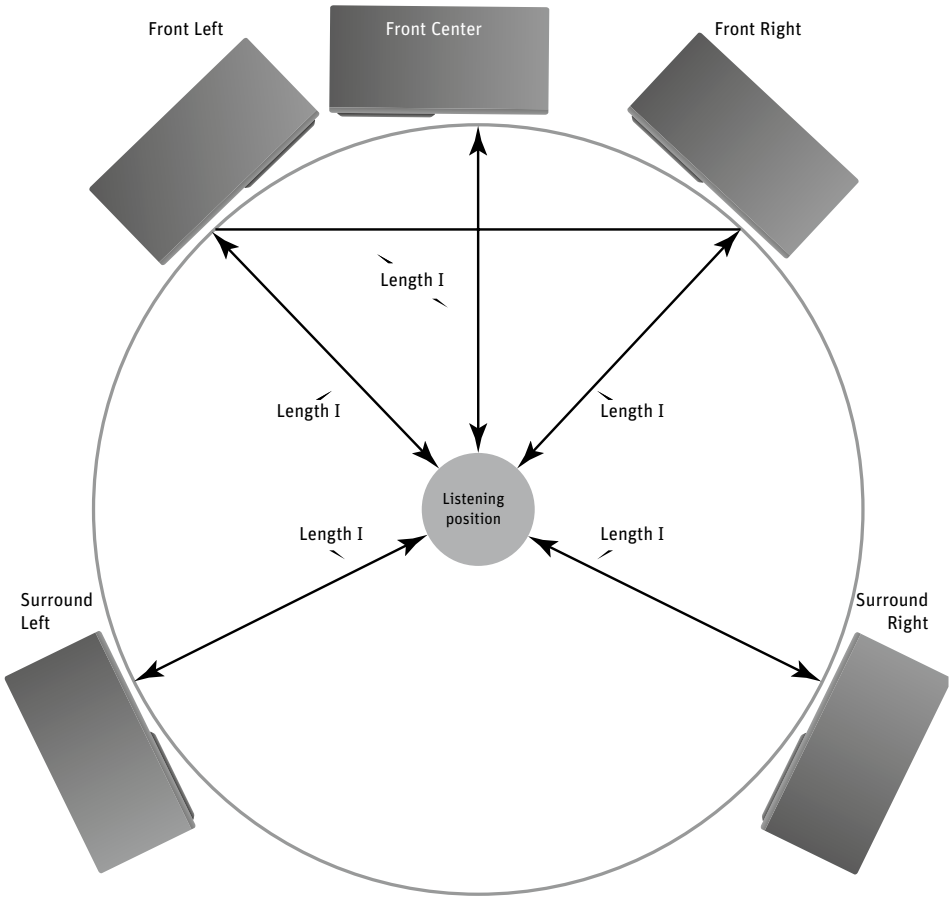
▶ Make sure that the distances are equal:



If the loudspeakers cannot be placed at the same distance from the listening position:

▶ Compensate for distance differences > 1 cm ($^1/_2$") by delaying closer loudspeakers by 30 µs/cm (76 µs/inch).

If you are using the DIM 1 accessory: DIM 1

▶ Use the DELAY rotary switches ㉓ to compensate for distance differences (see page 20).

The DELAY rotary switches ㉓ allow for corrections with a resolution of 3.44 cm (1 3/8"), any small remaining time-of-flight adjustment should be made by moving the loudspeaker cabinet.

▶ Check the location of the loudspeaker cabinet. This depends on the application:

- 2.0 systems (stereo): ±30°, plus optional subwoofer(s)
- 5.1 systems:
  ITU-R BS.775-1: 0°, ±30°, ±110° (±10°), plus optional subwoofer(s) (center, front left/right, surround left/right)
  ANSI/SMPTE 202M: 0°, ±22.5°, arrays to the surround left and to the surround right, plus optional subwoofer(s)
- 7.1 systems: 0°, ±30°, ±90°, ±150°, plus optional subwoofer(s) (center, front left/right, side left/right, back left/right)

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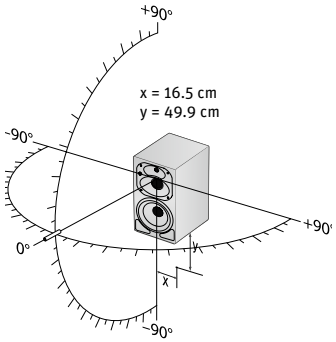
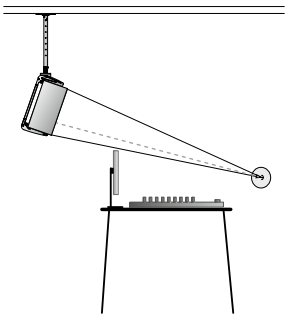


The acoustical axis of the KH 420 starts from the midpoint of the midrange and tweeter drivers.

- Always point the acoustical axis, in the horizontal and vertical planes, towards the listening position.

The acoustical axis is a line perpendicular to the loudspeaker's front panel along which the microphone was placed when tuning the loudspeaker's crossover during design. Pointing the acoustical axis, in the horizontal and vertical planes, towards the listening position or center of the monitoring area will give the best measured and perceived sound quality.



- Position the loudspeaker so that there is a direct line of sight from the listening position to the bass, midrange and tweeter drivers.

Connecting audio signals

- Always use good quality cables with the correct impedance and appropriate termination to avoid signal drop outs and to achieve the maximum cable lengths shown below:

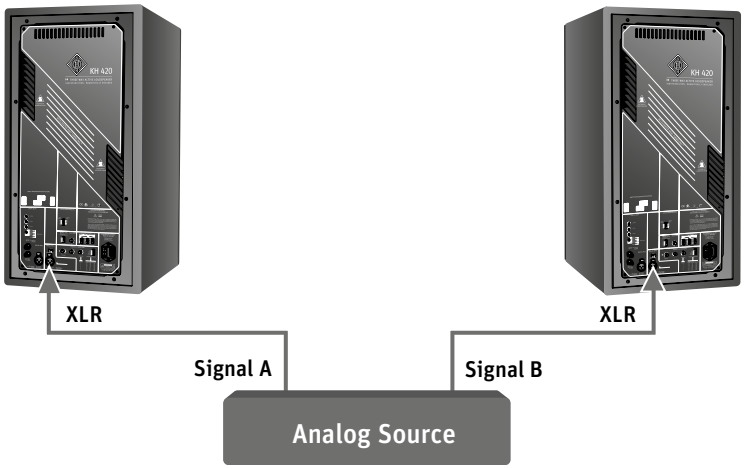
Signal (connector)	Impedance	Cable length	Connection method
Analog (RCA)	low	up to 10 m (30')	via an adapter (RCA-XLR) to the ANALOG INPUT socket (XLR) ⑱ (see page 14)
Analog (XLR)	low	up to 100 m (300')	directly to the ANALOG INPUT socket (XLR) ⑱ (see page 14)

Connecting analog signals

Digital signals can only be connected when the DIM 1 module is installed.

Connecting XLR cables

- Connect the left and right output of your analog audio source to the XLR input sockets of the respective loudspeaker.



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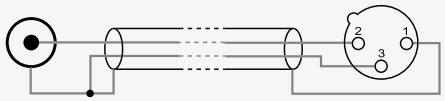
Connecting unbalanced cables

- Use an RCA-XLR adapter (not supplied) to connect unbalanced cables (e.g. RCA cables).
- Use the following wiring if you want to make your own RCA-XLR adapter:

Wiring	Pin	Signal
	1	Audio ground
	2	Signal +
	3	Signal –

If there is a humming sound from the loudspeaker, activate ground lift to disconnect pin 1 of the ANALOG INPUT socket (XLR) ⑱ from the loudspeaker's chassis ground.

Connecting digital signals to the KH 420 with the DIM 1 installed

DIM 1

- Always use good quality cables with the correct impedance and appropriate termination to avoid signal drop outs and to achieve the maximum cable lengths shown below:

Signal (connector)	Impedance	Cable length	Connection method
AES3 (BNC)	75 Ω	up to 100 m (300')	directly to the AES3 INPUT socket (BNC) ⑳ of the DIM 1
AES3 (XLR)	110 Ω	up to 100 m (300')	directly to the AES3 INPUT socket (XLR) ⑲ of the DIM 1
S/P-DIF (RCA)	75 Ω	up to 10 m (30')	via an adapter (RCA-BNC) to the AES3 INPUT socket (BNC) ⑳ **or** via an adapter (RCA-XLR) to the AES3 INPUT socket (XLR) ⑲ of the DIM 1

Connecting AES3 cables

- Connect the digital AES3 or S/P-DIF-output signal of your audio source to the AES3 INPUT socket ⑲ or ⑳ of the DIM 1. See figure below.

  The DIM 1 only supports non-encoded AES3 and S/P-DIF signals. Encoded signals such as MP3, DTS or Dolby Digital are not supported.

- Make an appropriate setting ("DIGITAL A" or "DIGITAL B") on the SIGNAL SELECT rotary switch ㉒. The setting depends on the signal channel order and the loudspeaker position.

  Only one cable is needed for uncompressed AES3 and S/P-DIF digital signals (single-wire mode). They contain two audio channels: "subframe A" and "subframe B". Usually, the audio channels are:

Subframe A	Subframe B
Left	Right
Center	LFE
Surround left	Surround right
Back left	Back right

A clock input is not required because loudspeakers are not audio sources and the converters are clocked to a very stable internally generated clock source.

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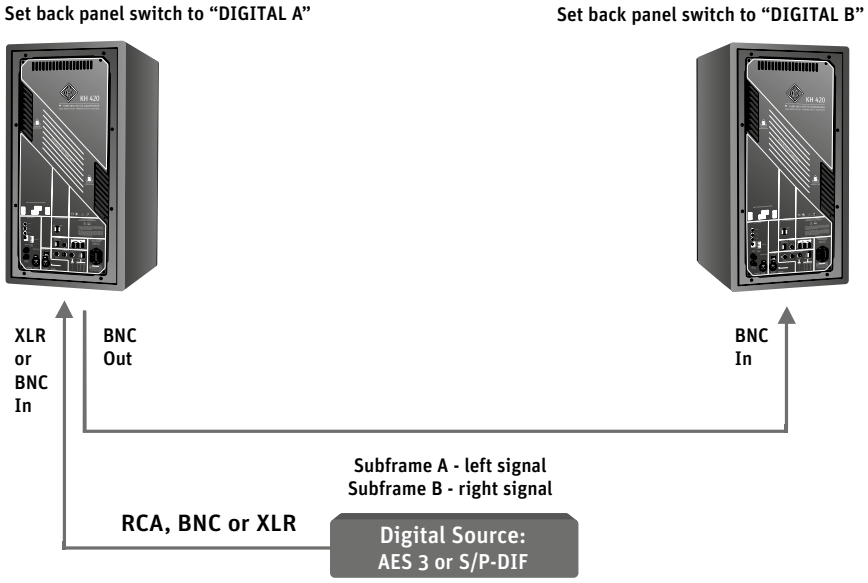
DIM 1

To connect an additional loudspeaker:

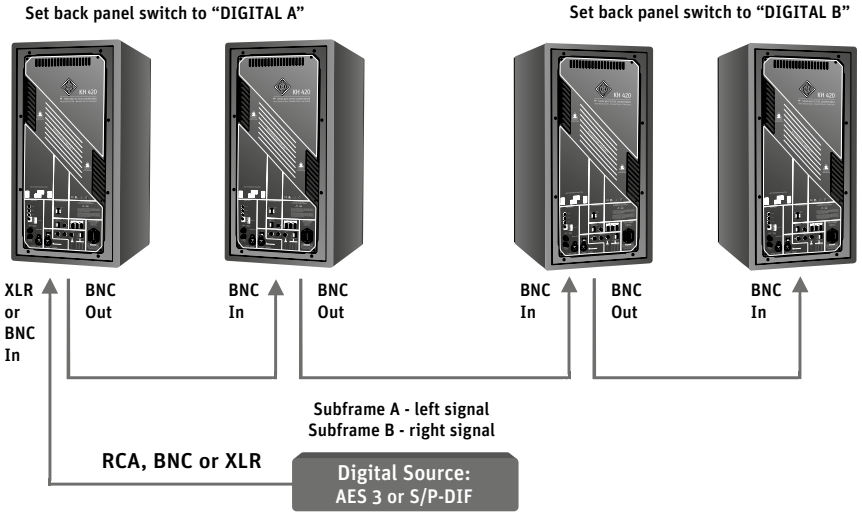
- Use the AES3 OUTPUT socket ㉑ of the DIM 1. See figure below.
- Make an appropriate setting (“DIGITAL A” or “DIGITAL B”) on the SIGNAL SELECT rotary switch ㉒.



Connecting multiple KH 420 loudspeakers together digitally via the DIM 1

- Use the AES3 INPUT ⑳ and OUTPUT socket (BNC) ㉑. T-pieces are not required (see figure below).
- Make an appropriate setting (“DIGITAL A” or “DIGITAL B”) on the SIGNAL SELECT rotary switch ㉒.

  End of the line external termination is not required as the AES3 INPUT socket (BNC) ⑳ already has an internal 75 Ω termination.



EN

DIM 1

Setting the SIGNAL SELECT rotary switch ㉒

▶ Select one of the following settings, depending on your needs:

Setting	Meaning
ANALOG	ANALOG INPUT socket (XLR) ⑱
DIGITAL A	Digital subframe A, AES3 INPUT socket (BNC) ⑳ or AES3 INPUT socket (XLR) ⑲
DIGITAL B	Digital subframe B, AES3 INPUT socket (BNC) ⑳ or AES3 INPUT socket (XLR) ⑲
DIGITAL A+B	Digital subframe A summed with digital subframe B and a 6 dB attenuation, AES3 INPUT socket (BNC) ⑳ or AES3 INPUT socket (XLR) ⑲

Each of these can be selected with and without delay added, so it is very quick to bypass the delay.

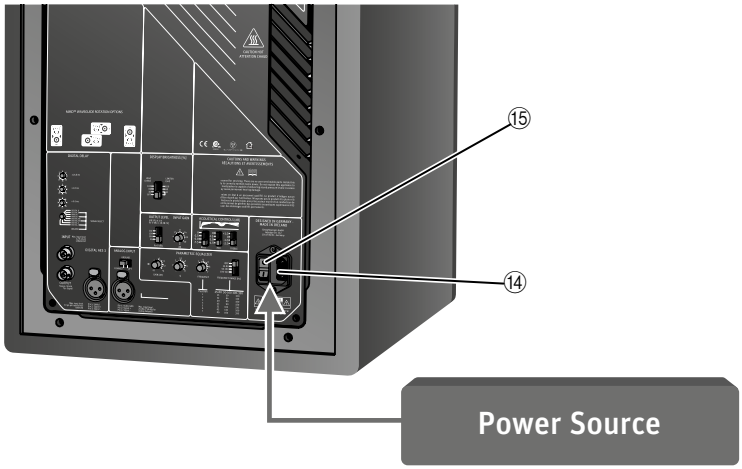
The digital output is a buffered copy of the digital input signal which can be used to feed the digital signal onto other loudspeakers or products. There is no digital output from the AES3 OUTPUT socket (BNC) ㉑ when an analog signal is connected to the ANALOG INPUT socket ⑱, therefore the DIM 1 cannot be used as an analog-to-digital converter. Delay is not added to the digital output, so any delay required on subsequent loudspeakers in the daisy chain should be made on those loudspeakers.

Connecting/disconnecting the KH 420 to/from the mains power supply

To connect the KH 420 to the mains power supply:

▶ Make sure that the on/off switch ⑮ is set to “O”.

▶ Connect the IEC connector of the supplied mains cable to the mains socket ⑭.



▶ Connect the mains plug of the mains cable to a suitable wall socket.

To disconnect the KH 420 from the mains power supply:

▶ Set the on/off switch ⑮ to “O”.

▶ Pull the mains plug out of the wall socket.

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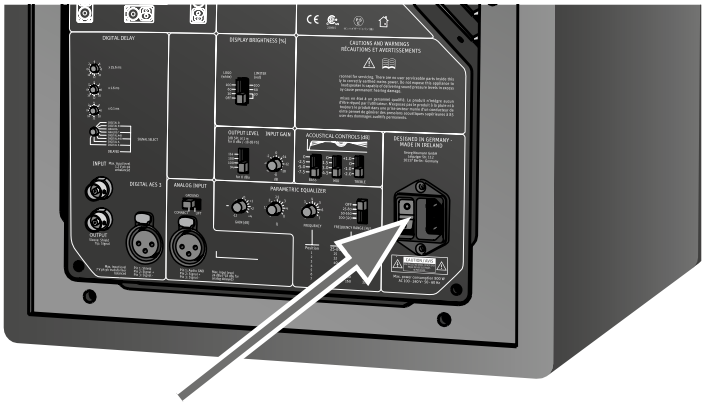
Configuring and using the KH 420

Switching the KH 420 on/off



▶ Set the on/off switch to:

- “I” to switch on the loudspeaker. The Neumann logo lights up, provided that it has not been switched off by means of the DISPLAY BRIGHTNESS switch ⑩ (see page 22).
- “O” to switch off the loudspeaker. The Neumann logo goes off.

There is an approximate five second delay before sound can be heard from the loudspeaker in order to avoid noises (pops) from preceding equipment switched on at the same time. Conversely, switching off the loudspeaker immediately mutes the audio.

Adjusting the frequency response

When all its acoustical controls are set to 0 dB, the KH 420 loudspeaker is designed to have a flat frequency response in anechoic conditions. When the loudspeaker is installed in your monitoring environment, the response changes. The same loudspeaker installed in different positions in the same room may require different acoustical control settings. In a symmetrical installation, left/right pairs (front or back) will probably have the same acoustical control settings.

▶ Before using your loudspeaker system for the first time, calibrate the frequency response of the loudspeakers in the room in order to obtain the desired response.

▶ Repeat the above step if you change the physical conditions in your studio.

▶ At your listening position, determine the frequency response of each loudspeaker.

▶ Use the ACOUSTICAL CONTROLS switches ⑬ to adjust the frequency response.

Recommended frequency responses measured at the listening position:

- Studio applications: flat
- Film applications: X-curve shape (see ANSI/SMPTE 202M)
- Home applications: subjective evaluation

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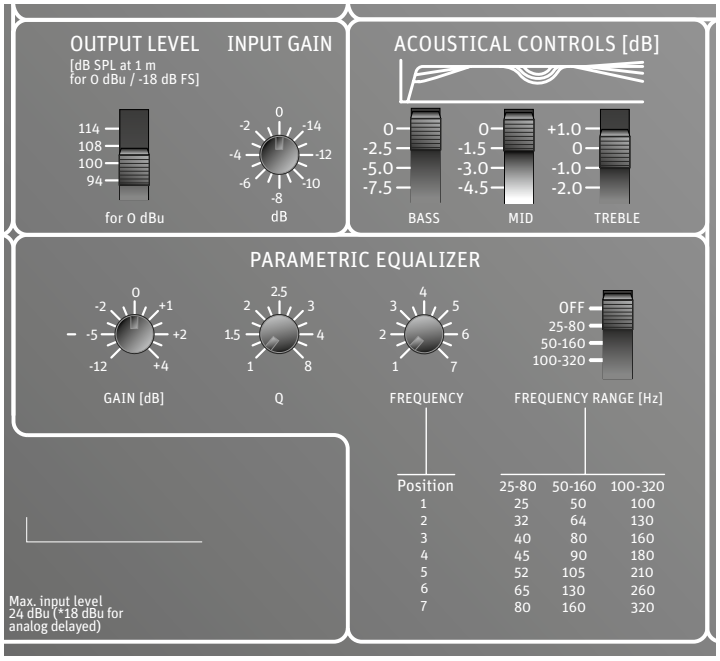
ACOUSTICAL CONTROLS switches ⑬	Function	Possible settings
Bass	Compensates for acoustical loading in the low frequency range due to nearby large solid boundaries (e.g. walls).	0, –2.5, –5, –7.5 dB
Mid	Compensates for a “harshness” in the sound quality experienced in some installations. The source of this is usually comb filtering due to desktop and/or ceiling reflections.	0, –1.5, –3, –4.5 dB
Treble	Compensates for insufficient or excessive high-frequency damping in the room.	+1, 0, –1, –2 dB
Parametric EQ	Compensates for low and low-mid frequency anomalies. Desktop loading typically causes a wide bump 2-6 dB high between 100 and 300 Hz. Reflections from nearby boundaries (walls, floor, ceiling) cause constructive and destructive interference. Strong room resonances are audible and should be reduced with the parametric EQ.	Gain: +4 to –12 dB Freq: Off, 25 to 80, 50 to 160, 100 to 320 Hz Q: 1 to 8



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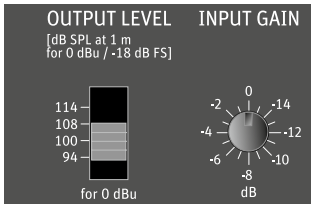
The following settings can be used as a starting point for further adjustment:

Loudspeaker position	ACOUSTICAL CONTROLS switches ⑬			PARAMETRIC EQUALIZER controls ⑯		
	Bass	Mid	Treble	Gain	Freq.	Q
In a corner	–7.5 dB	–	–	–3	200	4
Next to or flush mounted into an acoustically solid wall (e.g. brick, concrete)	–5.0 dB	–	–	–	–	–
Next to or flush mounted into an acoustically soft wall (e.g. gypsum)	–2.5 dB	–	–	–	–	–
Free standing in an untreated room	–2.5 dB	–1.5 dB	–1 dB	–	–	–
Free standing in a well-treated room	–	–	–	–	–	–
In a small room with strong side wall reflections	–5.0 dB	–	–	–	–	–
Near a small desktop or small reflecting surface*	–	–1.5 dB	–	–2	250	4
Near a large desktop or large reflecting surface*	–	–3.0 dB	–	–3	160	4

* Use these settings in addition to one of the top settings

It is recommended to use a properly setup acoustic measurement system when setting the acoustical controls. This is particularly true when setting the parametric equalizer.

Adjusting the acoustical level



- On your KH 420 loudspeakers, set the OUTPUT LEVEL switch ⑪ to the lowest possible value of 94 dB SPL and the INPUT GAIN control ⑫ to –15 dB.
- Play a broadband pink noise test signal that is set to –18 dBFS (Europe) or –20 dBFS (USA) on the mixing console's output level meters.
- Measure the sound pressure level at the listening position using a sound level meter with the following settings:
  - "C"-weighted
  - slow integration time
- Set the OUTPUT LEVEL switch ⑪ and the INPUT GAIN control ⑫ of your loudspeakers so that the desired acoustic level is obtained.

Recommended sound pressure levels:

Application	Sound pressure level
Film	85 dB(C)
Broadcast	79 to 83 dB(C)
Music	No defined reference levels

If the Neumann logo flashes red, the loudspeaker's protection system has been activated. To avoid this and achieve the desired output level, use larger loudspeakers or add a bass managed subwoofer to the system.

EN

Examples of sound pressure levels as a function of the input and output level of the KH 420:

Input signal [dBu]	0 (0.775 V)	0 (0.775 V)	+4 (1.23 V)	−20 (77.5 mV)
INPUT GAIN control ⑫ [dB]	0	−15	−4	−15
OUTPUT LEVEL switch ⑪ [dB SPL] at 1 m	100	100	94	114
Sound pressure level [dB SPL] at 1 m	100	85	94	79

Compensating for video delay (lip sync)

DIM 1

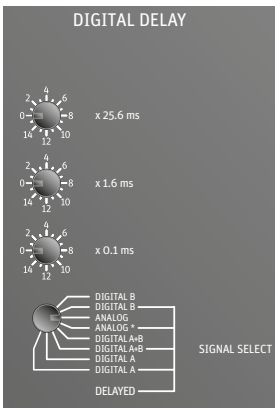
Signal processing in LCD, Plasma and LED screens, digital projectors with LCD or DLP chips, and video processors used in broadcast centers delays the video signal.

The delay is disturbing when audio leads video by more than 20 ms or lags by more than 40 ms.

To compensate for the video signal delay, the audio signal can be delayed by up to 409.5 ms, which is 10.2 frames at 40 ms/frame or 12.3 frames at 33 ms/frame. The same value should be used for all loudspeakers in the system.

Please consider the information on latency on page 21.

Compensating for listening distance differences (time-of-flight)



Loudspeakers placed at different distances suffer from time-of-flight differences which affects imaging. The delay resolution is small enough (0.1 ms) that the delay can be used for time-of-flight adjustment (3.44 cm or 1 3/8" steps).

To compensate for the time-of-flight delay, the audio signal of the KH 420 can be delayed by up to 409.5 ms, which is 140.87 m (462' 2"). Loudspeakers positioned closer to the listening position should be delayed to be the same as the furthest loudspeaker from the listening distance.

Example

Loudspeaker A listening distance: 1.50 m
Loudspeaker B listening distance: 1.65 m

Time-of-flight difference: 0.15 m

So loudspeaker A should be delayed by the time equivalent of 0.15 m which is 0.436 ms (0.15 m / 3.44 cm x 0.1 ms). The nearest setting of the DELAY rotary switches ㉓ is 0.4 ms, so set the 0.1 ms switch to position 4.

Please consider the information on latency on page 21.

If a video delay compensation has already been made, add the time-of-flight difference (here: 0.4 ms) to the setting already made.

EN

DIM 1

Example

Video delay compensation on loudspeaker A: 2 x 40 ms/frame
Desired time-of-flight compensation for loudspeaker A: 0.4 ms

Time-of-flight compensation: 80.4 ms

This delay value can be made with these switch settings: 3 x 25.6 ms, 2 x 1.6 ms, 4 x 0.1 ms.

The latency of the analog-to-digital and digital-to-analog converters should be taken into account when using the DELAY rotary switches ㉓ for time-of-flight compensation. For the digital-to-analog conversion (input signal via digital connector), the latency is dependent on the sample rate (values can be seen in the Specifications table on page 24). The analog-to-digital-to-analog conversion (input signal via analog connector) is fixed at 0.54 ms.

For time-of-flight compensation delay, calculate the desired delay value then subtract the appropriate latency depending on the input signal and sample rate, and then set the needed additional delay using the delay switches on the back panel.

Example:

Distance compensation for 1 m: 1 m / 344 m/s = 2.91 ms: 2.91 ms
Digital input signal, sample rate: 48 kHz, latency: 0.85 ms

2.06 ms

Delay settings:
0 x 25.6 ms, 1 x 1.6 ms, 5 x 0.1 ms
(equals 2.1 ms, which is the nearest value)

For video delay compensation, converter latency can be ignored as it is insignificant compared to long video signal delays.

To help with choosing a delay setting there is a set of lookup tables at the end of this operating manual. Also Neumann has made a delay calculator which is available at www.neumann.com.

Activating ground lift

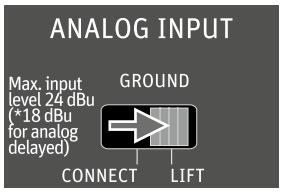
If there is humming or buzzing noise coming from the loudspeaker, first search for the cause of the noise:

▶ Disconnect all input and output signal cables from the loudspeaker.

If the noise goes away, it is probably coming from the audio source or source cabling.

It might be possible to eliminate the noise by disconnecting the ground from the input signals (activating ground lift).

To activate ground lift:



▶ Reconnect the signal cables and set the GROUND switch ⑰ to “LIFT”.
This internally disconnects pin 1 of the ANALOG INPUT socket (XLR) ⑱ from the loudspeaker’s chassis ground (see diagram “Pin assignment of the XLR socket” on page 14).

For safety reasons, the electronics chassis ground is always connected to the mains power earth pin.

EN

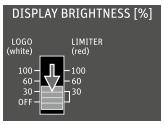
Adjusting the brightness of the Neumann logo

WARNING
Danger of hearing damage due to unexpected high sound pressure levels!

If the Neumann logo is switched off, it is not obvious whether the product is switched on or off. In this case, unexpected high sound pressure levels can cause hearing damage.

- ▶ Always set the audio sources connected to the loudspeaker to a low output level before they deliver an audio signal.
- ▶ If you switch off or dim the Neumann logo, mention this to everyone who works with this loudspeaker or the connected audio sources.

To dim or switch off the Neumann logo in low light level environments or when the loudspeaker is placed behind an acoustically transparent screen:



- ▶ Set the DISPLAY BRIGHTNESS switch ⑩ to:
  - “30 %”, “60 %” or “100 %” to adjust the Neumann logo to different brightness levels.
  - “OFF” to switch off the Neumann logo.

When the loudspeaker’s protection system is active or invalid digital signals are connected to the DIM 1 accessory, the color of the Neumann logo changes from white to red. The brightness of this red limiter indication corresponds to the setting of the DISPLAY BRIGHTNESS switch ⑩ (“30 %”, “60 %” or “100 %”). However, you cannot completely switch off the limiter indication, as it appears with a brightness of 30 % even if the DISPLAY BRIGHTNESS switch ⑩ is set to “OFF”.

Cleaning and maintaining the KH 420

CAUTION
Damage to the product caused by liquids!

Liquids entering the product can cause a short-circuit in the electronics and damage or even destroy the product.

- ▶ Keep all liquids away from the product!

- ▶ Before cleaning, disconnect the product from the mains power supply.
- ▶ Use a soft, dry, and lint-free cloth to clean the product. Do not use any solvents or cleaning agents.
- ▶ Never touch the driver diaphrams.
- ▶ Check the Accelerate Heat Tunneling™ cooling fins for any build-up of dust and fluff every six months.

The cooling fins can be cleaned without opening the electronics panel:

- ▶ Blow clean compressed air into the heatsink vents on the side of the electronics panel.

Troubleshooting

Problem	Cause	Solution
The Neumann logo is off, no sound is heard from the KH 420	The KH 420’s internal main fuse has blown.	Have the product checked by an authorized Neumann service partner.
The Neumann logo is off or not clearly visible, but sound is heard from the KH 420	The Neumann logo is switched off or dimmed.	Switch on the Neumann logo and switch off the dimming (see page 22) .
The Neumann logo is flashing red but there is no sound	A DIGITAL signal is selected on the SIGNAL SELECT rotary switch ㉒ but there is no valid audio signal connected to the digital input.	Connect a valid signal to the digital input, check the cabling, or set the SIGNAL SELECT rotary switch ㉒ to ANALOG.

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Problem	Cause	Solution
There is hum or buzz coming from the KH 420 when the audio cable is connected.	Bad cabling or ground loop in the installation.	Check all cabling to eliminate the cause of the problem, change from unbalanced to balanced cabling, or use the GROUND switch ⑰ (see page 21).

For further information, please refer to the “Questions & Answers” section on the product page at www.neumann.com

Specifications

Acoustics	
Free field frequency response	26 Hz to 22 kHz ±3 dB
Pass band free field frequency response	28 Hz to 20 kHz ±2 dB
Self-generated noise (INPUT GAIN set to 0 dB, OUTPUT LEVEL set to 100 dB SPL)	< 19 dB(A) at 10 cm
Total harmonic distortion < 0.5 % at 95 dB SPL at 1 m	> 120 Hz
Max. SPL in free space with a sine wave at 3 % THD at 1 m, calculated half-space	116.4 / 122.4 dB SPL (averaged between 100 Hz and 6 kHz)
Bass capability: Max. SPL in half space at 3 % THD at 1 m	109.9 dB SPL (averaged between 50 Hz and 100 Hz)
Max. short term SPL with IEC-weighted noise (IEC 60268-5) at 1 m, in typical listening conditions	109 dB(C) SPL
Max. short term SPL with music material at 2.3 m, in typical listening conditions (pair)	102 dB(C) SPL (full range) 109 dB(C) SPL (with subwoofer)
Max. long term SPL with pink noise at 2.3 m, in typical listening conditions (single / pair)	90 / 96 dB(C) SPL (full range) 90 / 96 dB(C) SPL (with subwoofer)
MMD™ waveguide nominal dispersion angle	110° x 80°
Electronics	
Woofer Class AB amplifier, continuous (peak) output power	295 W (330 W), THD and noise <0.1 % with deactivated limiter
Midrange Class AB amplifier, continuous (peak) output power	130 W (140 W), THD and noise <0.1 % with deactivated limiter
Tweeter Class AB amplifier, continuous (peak) output power	130 W (140 W), THD and noise <0.1 % with deactivated limiter
Controller design	analog, active
Crossover frequencies; crossover slope	570 Hz, 2.0 kHz; 24 dB/oct., 4th order
Acoustical controls	Bass (40 Hz): 0, –2.5, –5, –7.5 dB Mid (900 Hz): 0, –1.5, –3, –4.5 dB Treble (10 kHz): +1, 0, –1, –2 dB **Parametric equalizer** Gain: +4 to –12 dB Freq: Off, 25 to 80, 50 to 160, 100 to 320 Hz Q: 1 to 8
Protection circuitry	Excursion limiter: Low Peak limiter: Low Thermo limiter: Low, Mid, High Overheat protection: Amplifiers
Infrasonic filter frequency; slope	9 Hz; 18 dB/oct.

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Analog input	
Input type	XLR, electronically balanced
Impedance	14 kΩ
Input gain control (sensitivity)	0 dB to –15 dB
Output level control	94, 100, 108, 114 dB SPL
CMRR	> 56 dB, 100 Hz to 15 kHz
Maximum input level	24 dBu
Digital input (when optional DIM 1 accessory is fitted)	
Signal format XLR, BNC	AES3, S/P-DIF
Impedance XLR, balanced	110 Ω (input)
Impedance BNC, unbalanced	75 Ω (input and output)
Input switching	Analog/Digital A/Digital B/Digital A+B
Digital converter: resolution, design	16 … 24-bit
Digital converter: sampling rates [kHz]*	22.05, 24, 32, 44.1, 48, 64, 88.2, 96, 176.4, 192
Digital sensitivity	–18 dBFS = 100 dB SPL at 1 m
Dynamic range: A-D-A, D-A	> 116 dB(A), 123 dB(A)
THD+N: analog delayed, digital	< –104 dB, < –106 dB (typically)
Maximum delay: time / distance	409.5 ms / 140.87 m (462' 2")
Maximum delay: audio-video synchronization (lip sync)	10.2 at 40 ms/frame 12.3 at 33 ms/frame
Minimum delay resolution: time / distance	0.1 ms / 3.4 cm (1 3/8")
Latency D-A (with delay = 0 ms) **	1.84 ms at 22.05 kHz 1.70 ms at 24 kHz 1.28 ms at 32 kHz 0.93 ms at 44.1 kHz 0.86 ms at 48 kHz 0.64 ms at 64 kHz 0.47 ms at 88.2 kHz 0.43 ms at 96 kHz 0.24 ms at 176.4 kHz 0.22 ms at 192 kHz
Latency A-D-A (with delay = 0 ms)	0.54 ms
DELAY setting acknowledgement	Neumann logo “Red” 1 flash
Digital error /Loudspeaker’s protection system is active	Neumann logo “Red” continuous flashes

* These are the sample rates for which the delay setting value shown on the back panel is valid.

**Depending on the sample rate, this value should be added to the delay setting on the back panel to give the total delay.

Product properties	
Power consumption (idle)	60 W (+ 5 W when the DIM 1 is fitted)
Power consumption (full output AC)	800 W
Dimensions (H x W x D)	645 x 330 x 444 mm (25 $^{3}/_{8}$" x 13" x 17 $^{1}/_{2}$")
External volume	93 l
Weight	35.0 kg (77 lbs 3 oz) (+ 100 g (3 oz) when the DIM 1 is fitted)
Drivers bass, midrange, treble	magnetically shielded 250 mm (10"), 75 mm (3"), 25 mm (1")

EN

Threaded inserts for Neumann mounting hardware	Rear panel screws for attaching the LH 41 base plate or LH 42 ceiling system
Cabinet surface finish, Color	Painted wood and polyurethane, Anthracite (RAL 7021) or other RAL color Rear panel: black powdered coated steel
Operating conditions	
Ambient temperature	+10°C to +40°C (+50°F to +104°F)
Relative humidity	max. 90 % (non-condensing)
Power supply	100 to 240 V~, 50/60 Hz
Transport/storage conditions	
Ambient temperature	–25°C to +70°C (–13°F to +158°F)
Relative humidity	max. 90%
In compliance with	
Europe CE	EMC: EN 55103-1/-2 Safety: EN 60065
USA	EMC: 47 CFR 15 subpart B Safety: UL 60065
Canada	EMC: ICES-003; CAN ICES-3 (B)/NMB-3(B) Safety: CAN/CSA-C22.2 No. 60065

Acoustical measurements, block diagram and pin assignment

Additional technical data such as acoustical measurements, a block diagram of the KH 420 and the pin assignment of the XLR socket can be found at the end of this operating manual.

Accessories

Product	Description
CP	Cable Pack 2 m (CP 2), 5 m (CP 5), 10 m (CP 10), 15 m (CP 15), 20 m (CP 20), 25 m (CP 25), 30 m (CP 30)
DIM 1	Digital input module
FKH 420	Flight case for one KH 420
GKH 420	Metal grille
LH 28	Tripod stand adapter
LH 29	TV spigot (lighting stand adapter)
LH 36	Tilting adapter
LH 37	Subwoofer adapter
LH 41	Base plate
LH 42	Ceiling system
LH 43	Surface mounting plate
LH 45	Wall bracket
LH 46	Adjustable ceiling drop adapter
REK 4	Remote electronics kit

Manufacturer Declarations

Guarantee

For the current terms and conditions of the product guarantee, please visit www.neumann.com.

CE Declaration of Conformity

- RoHS (2011/65/EU)
- Low Voltage Directive (2014/35/EU)
- EMC Directive (2014/30/EU)

The declarations are available on the product page at www.neumann.com.

Certified by

Audio, Video and Similar Electronic Apparatus - Safety Requirements CAN/CSA-C22.2 No. 60065:03 and UL 60065-2007

Trademarks

Neumann® is a registered trademark of Georg Neumann GmbH. The following are trademarks of Georg Neumann GmbH:

- “Mathematically Modeled Dispersion” and “MMD”
- “Accelerated Heat Tunneling” and “AHT”

Other company, product, or service names mentioned in this operating manual may be the trademarks, service marks, or registered trademarks of their respective owners.

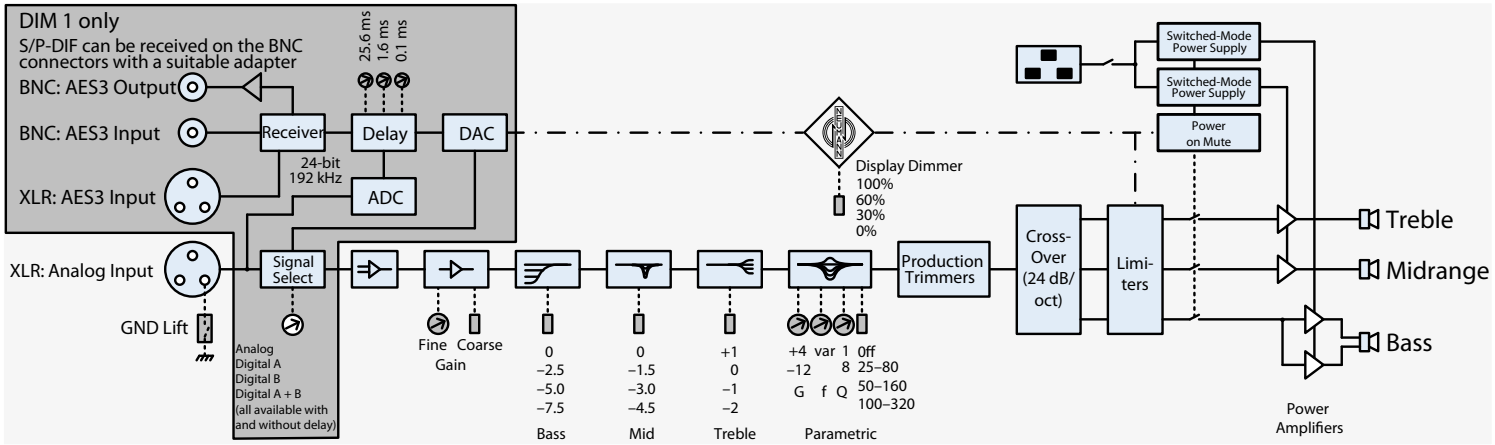
FCC

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This class B digital apparatus complies with the Canadian ICES-003.

Changes or modifications made to this equipment not expressly approved by Neumann may void the FCC authorization to operate this equipment.

System Block Diagram/System-Blockdiagramm/Synoptique Système/ Diagrama de Bloques del Sistema



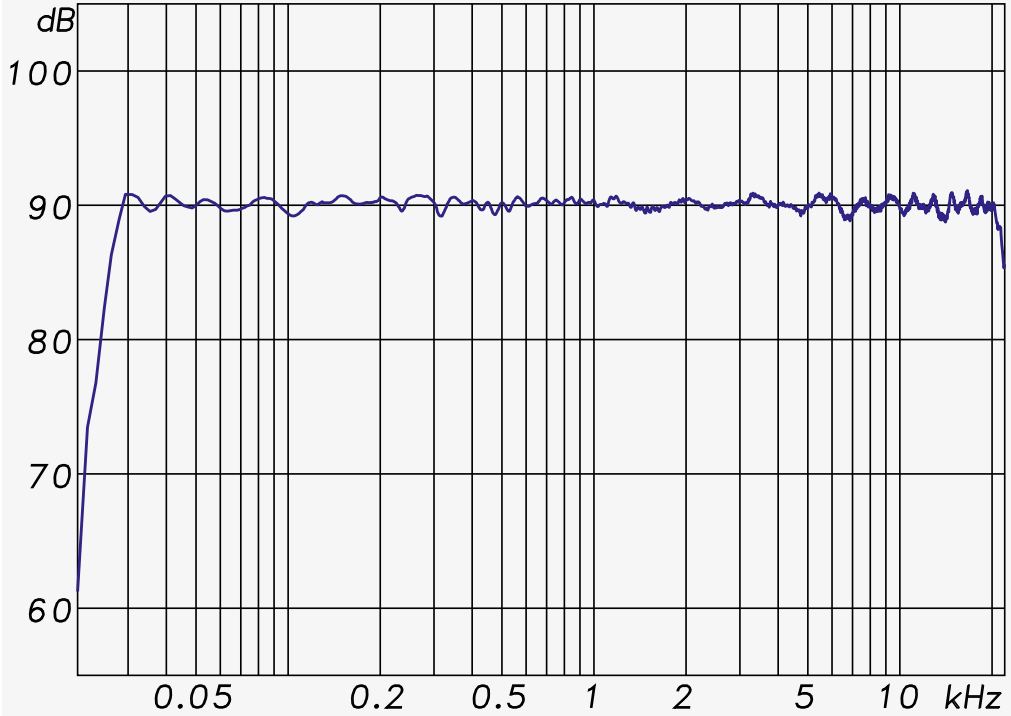
Pin assignment of the XLR socket/ Buchsenbelegung XLR/ Brochage de la prise XLR/ Asignación de la hembra XLR

1	Audio ground/Audio-Erdung/Masse audio/Toma de tierra de audio
2	Signal +/Signal +/Signal +/ Señal +
3	Signal –/Signal –/Signal –/ Señal –

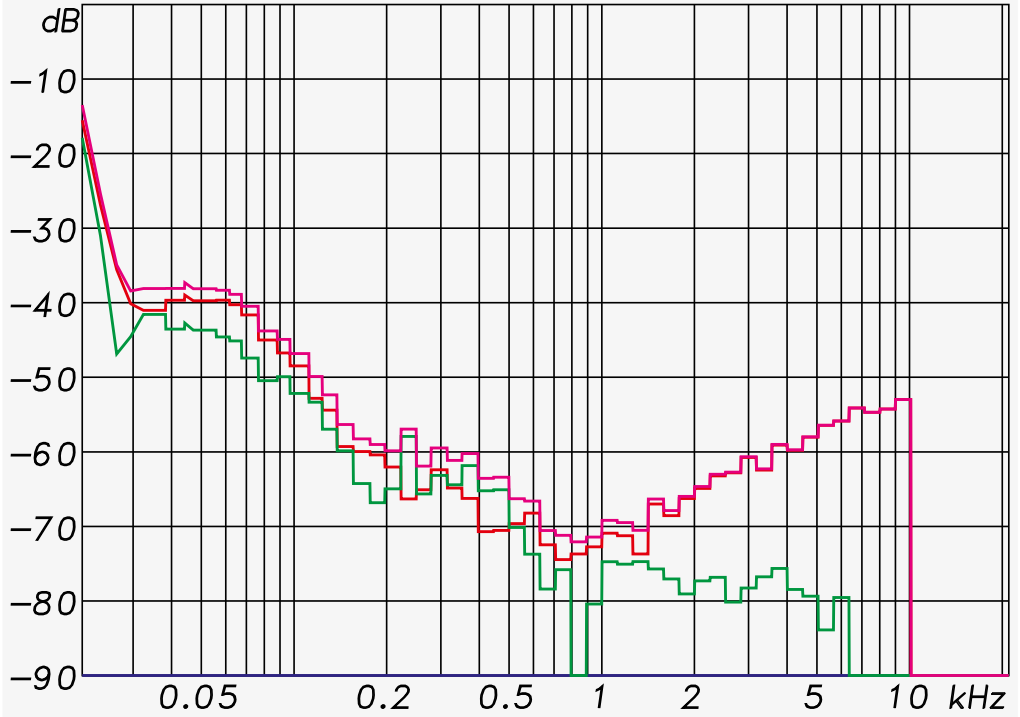
Acoustical Measurements/Akustische Messungen/Mesures acoustiques/Mediciones Acústicas

EN	Below are acoustical measurements conducted in anechoic conditions at 1 m.
DE	Die folgenden akustischen Messungen wurden unter reflexionsarmen Bedingungen bei 1 m Abstand durchgeführt.
FR	Vous trouverez ci après les courbes correspondant aux mesures acoustiques effectuées en chambre sourde, à une distance de 1 mètre du moniteur.
ES	Las siguientes mediciones acústicas se han realizado bajo condiciones de baja reflexión a una distancia de 1 m.

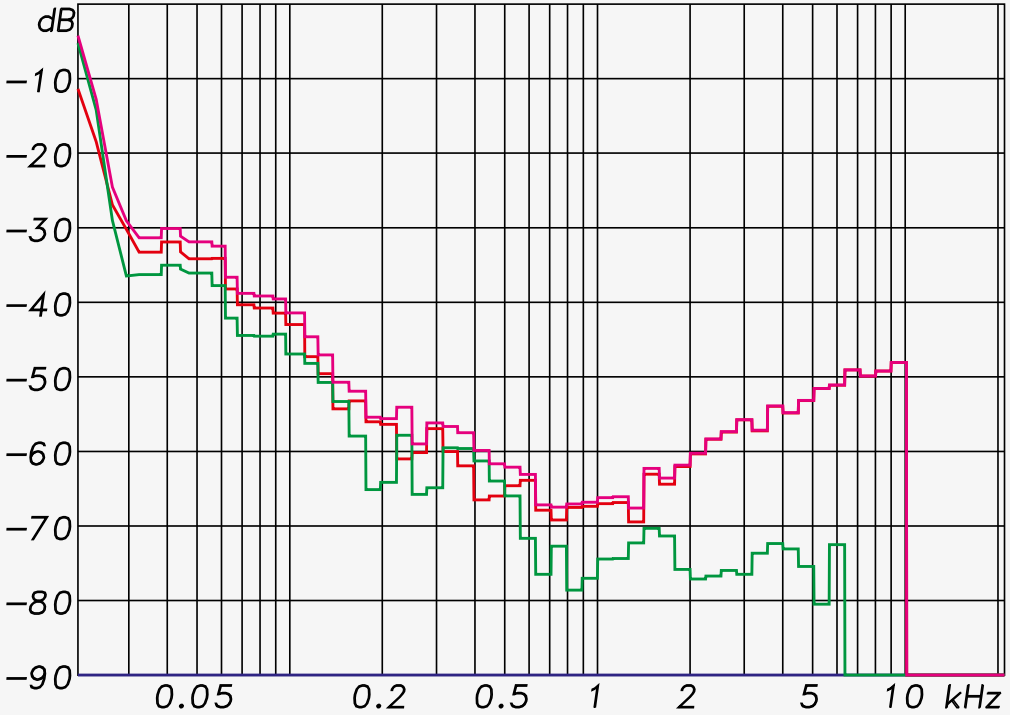
Free-Field Response | Freifeld-Frequenzgang | Réponse en champ libre | Respuesta en frecuencia en campo libre



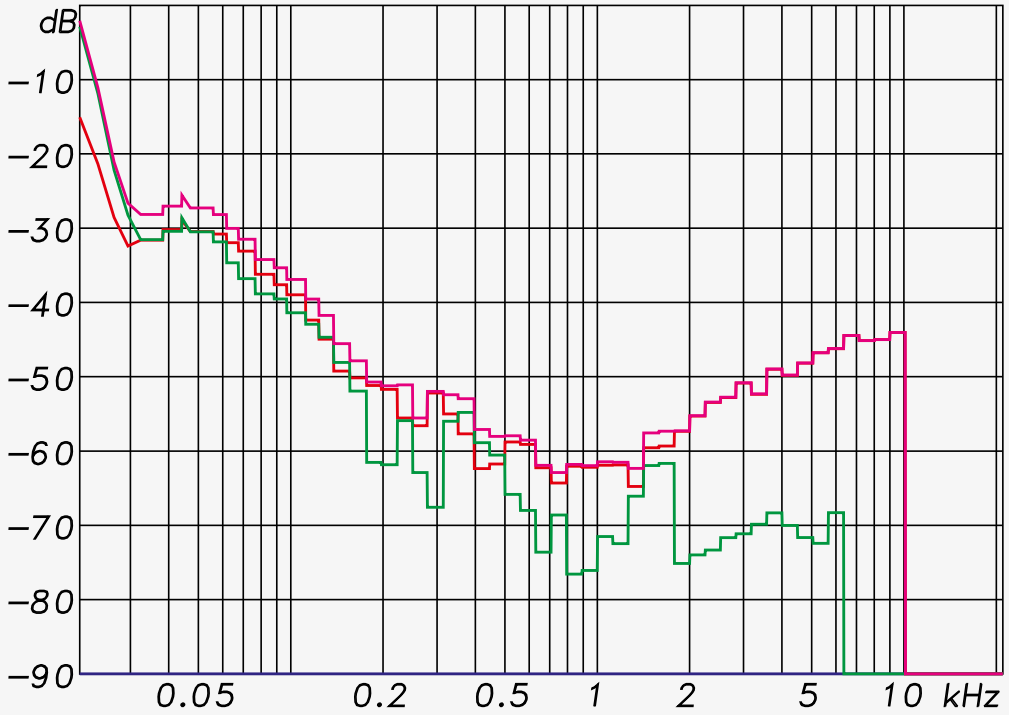
Harmonic Distortion at 90 dB SPL | Klirrfaktor bei 90 dB SPL Distorsion harmonique à 90 dB SPL | Distorsión armónica total a 90 dB SPL



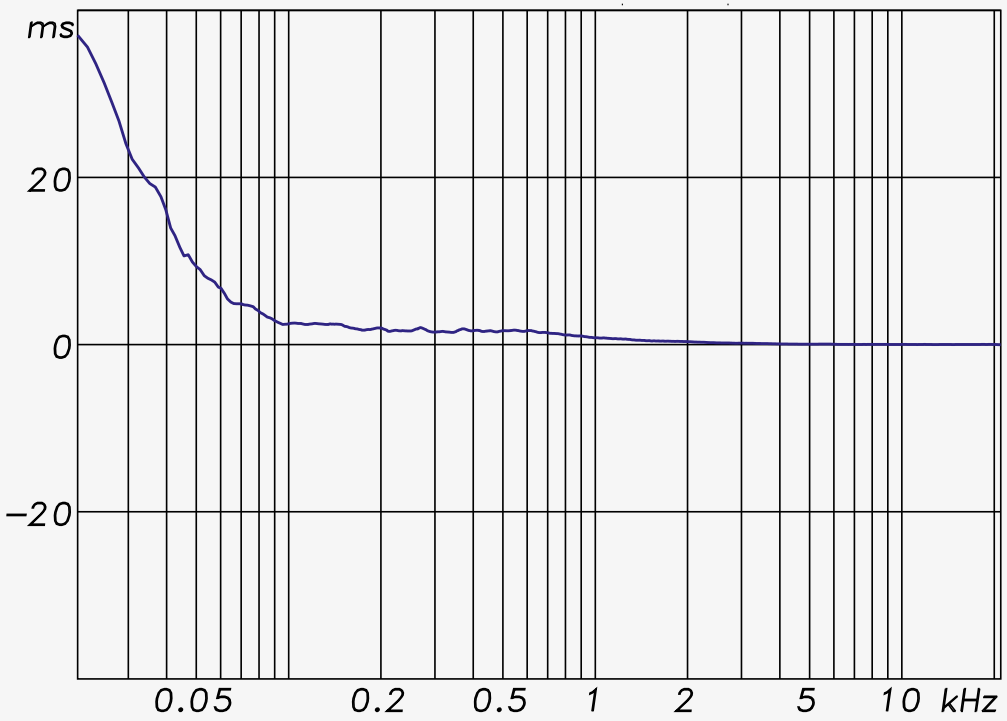
Harmonic Distortion at 95 dB SPL | Klirrfaktor bei 95 dB SPL Distorsion harmonique à 95 dB SPL | Distorsión armónica total a 95 dB SPL



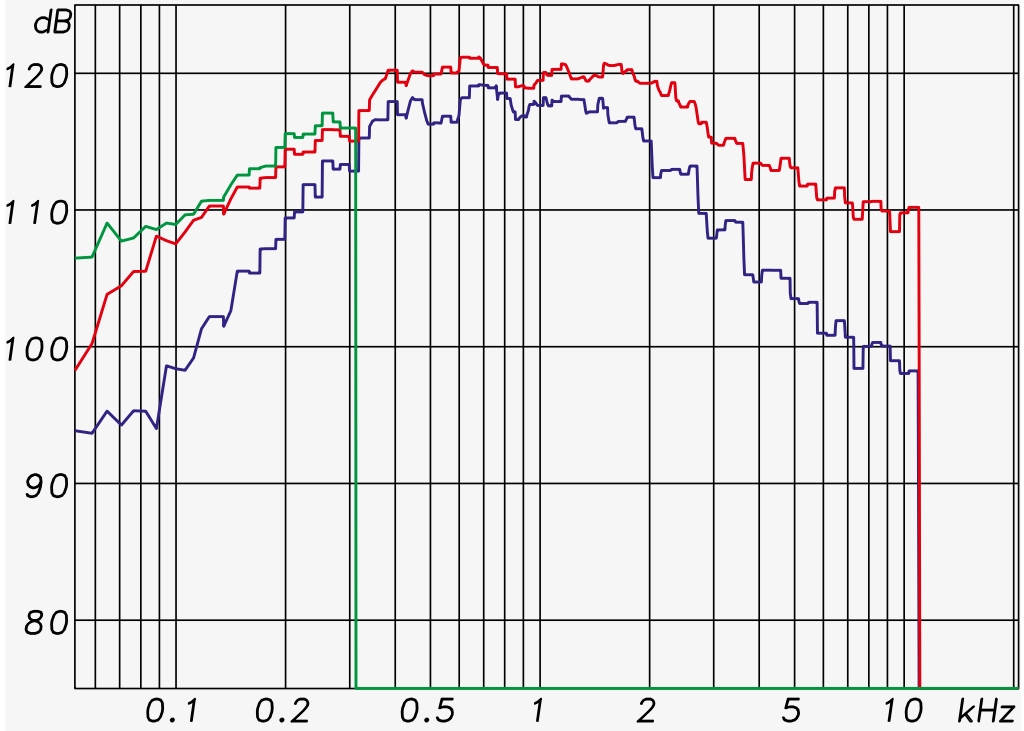
Harmonic Distortion at 100 dB SPL | Klirrfaktor bei 100 dB SPL | Distorsion harmonique à 100 dB SPL | Distorsión armónica total a 100 dB SPL



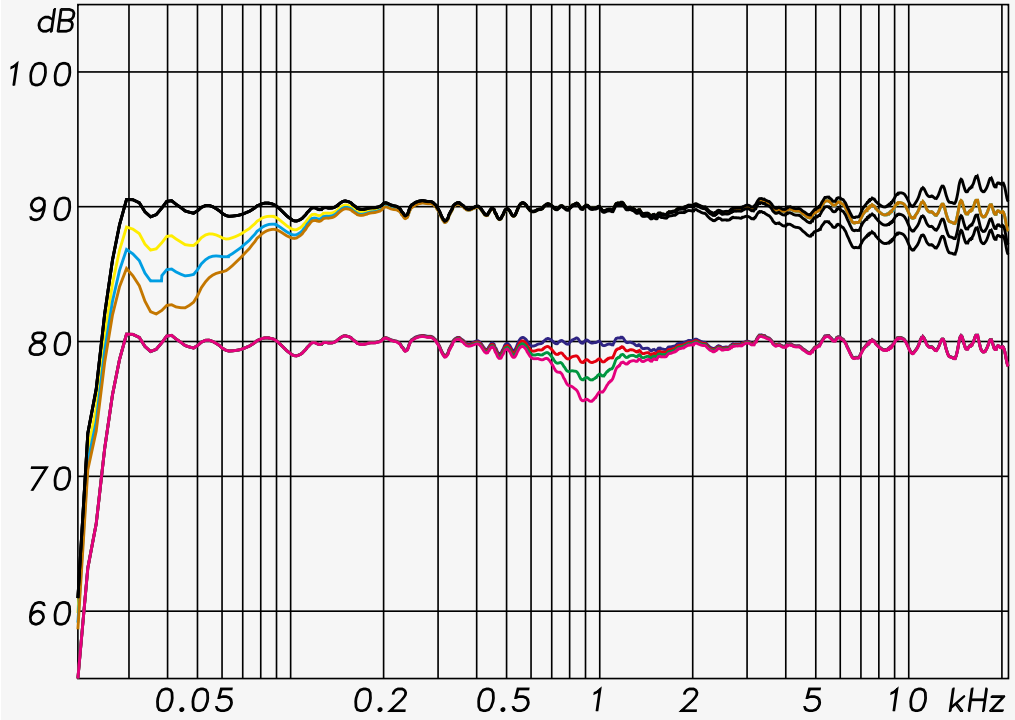
Group Delay | Gruppenlaufzeit
Temps de propagation de groupe | Retardo de grupo



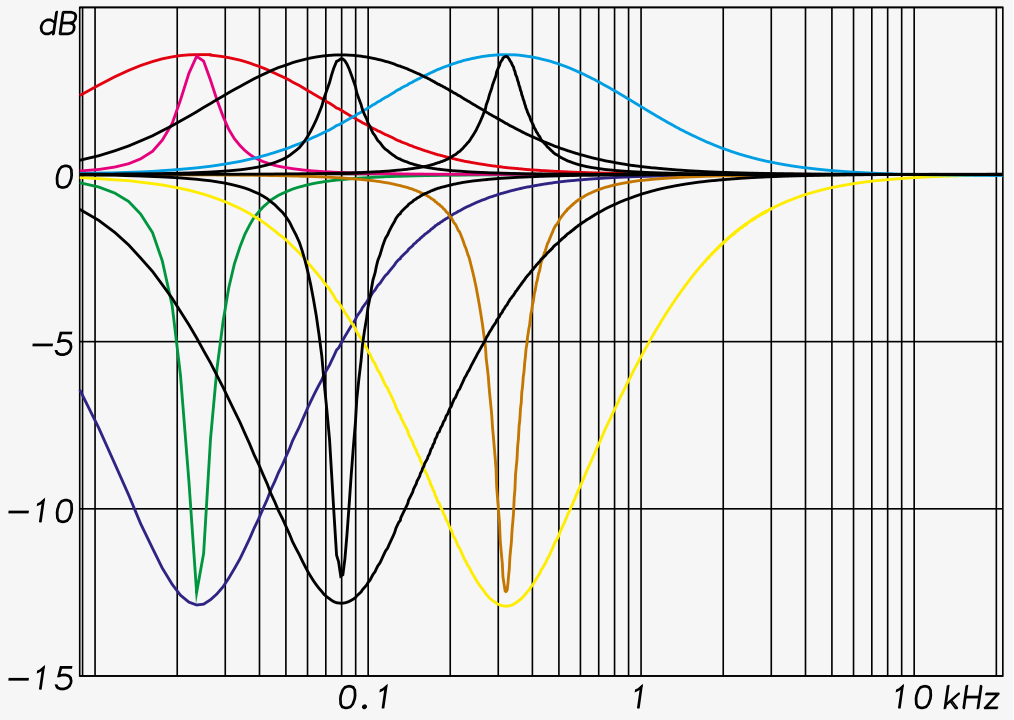
Maximum SPL at 1 m (1 %, 3 % and 10 %) | Maximaler SPL bei 1 m (1 %, 3 % und 10 %) | Niveau SPL maximal, à 1 m (1 %, 3 % et 10 %) | SPL máximo a 1 m (1 %, 3 % y 10 %)



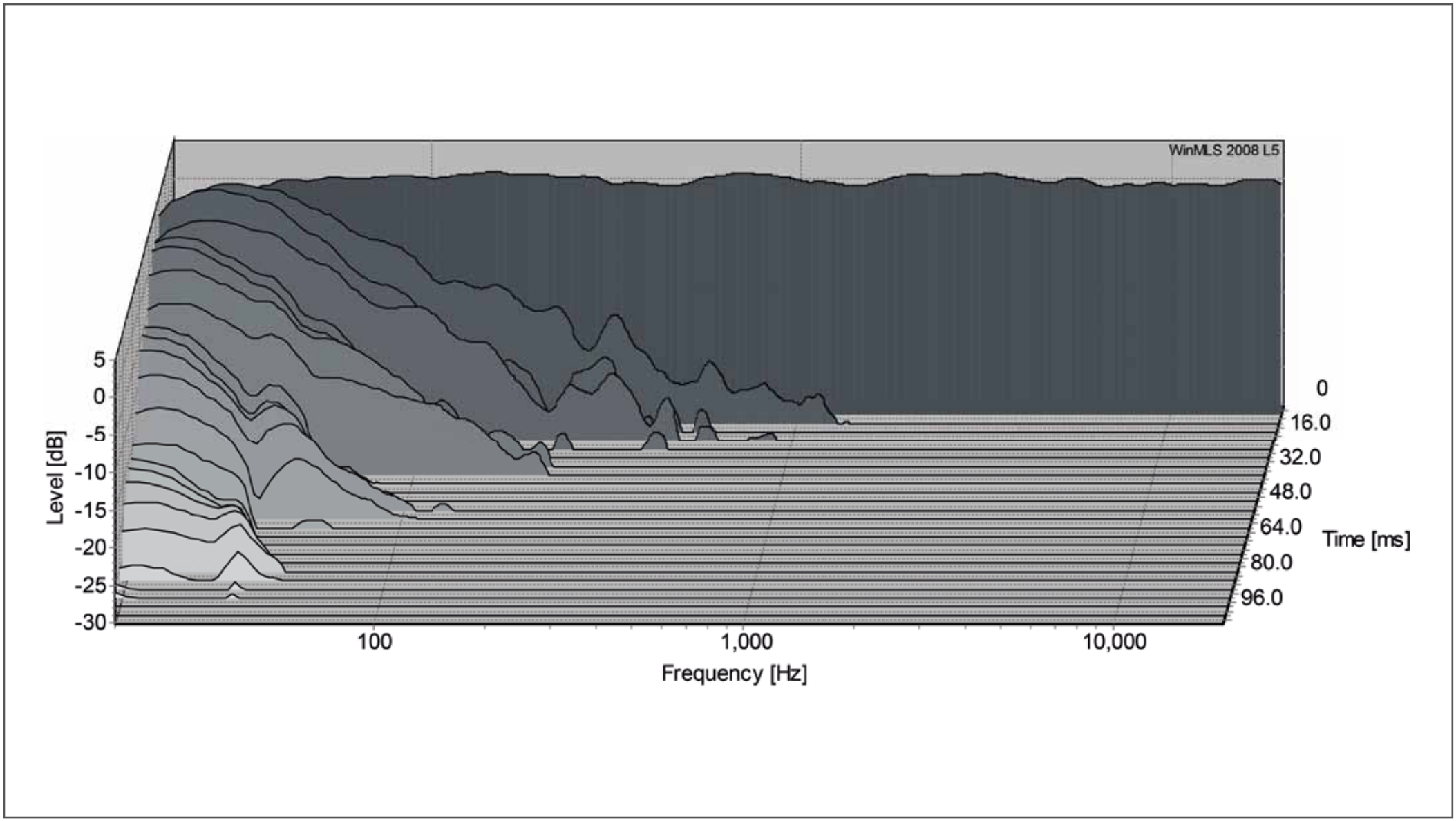
Acoustical Controls | Akustikregler | Effet des correcteurs de compensation acoustiques | Regulador acústico



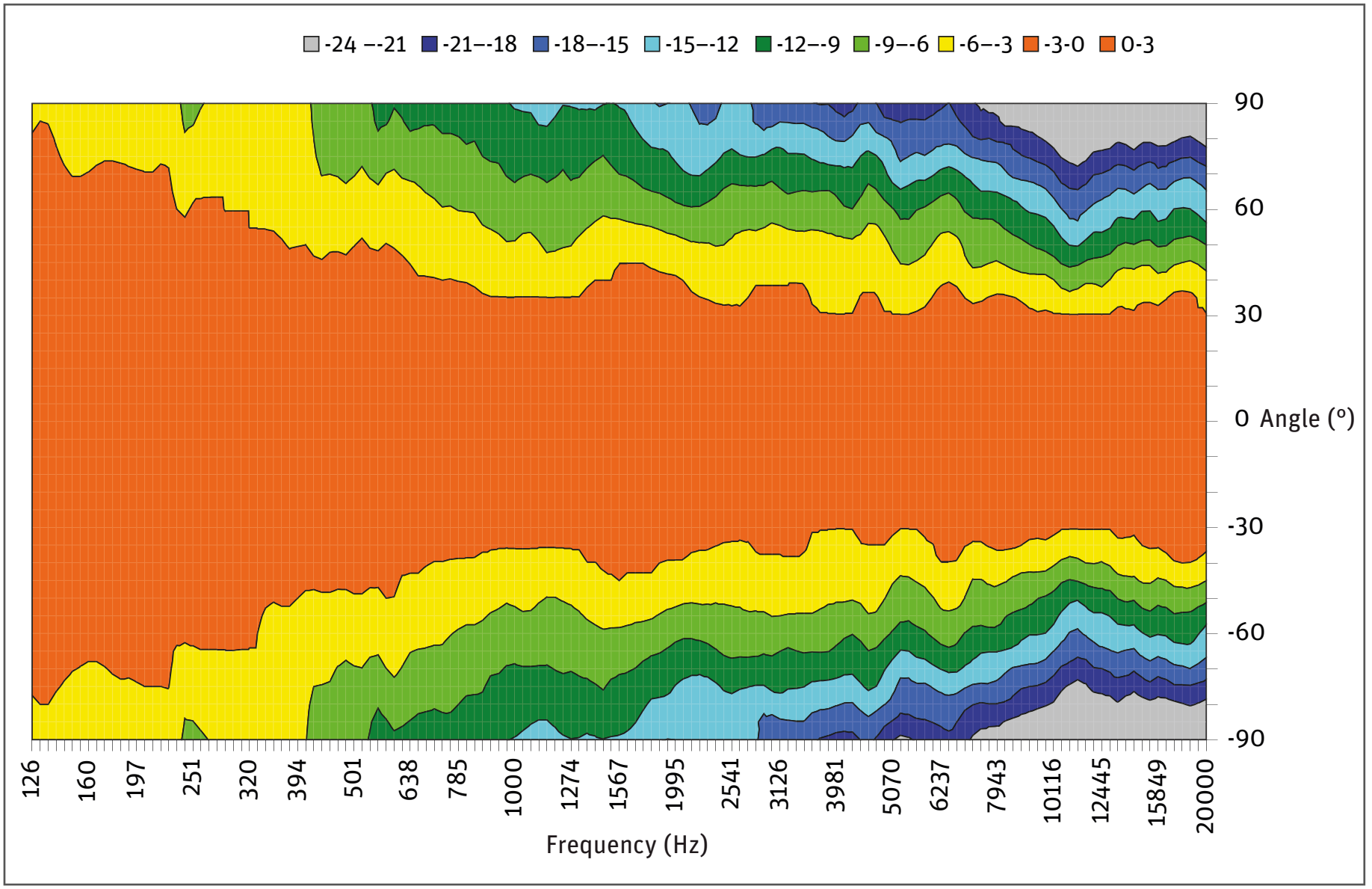
Parametric Equalizer | Parametrischer Equalizer Égaliseur paramétrique | Ecualizador paramétrico

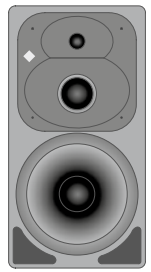


Cumulative Spectral Decay | Zerfallsspektrum | Décroissance spectrale cumulée | Caída espectral acumulada

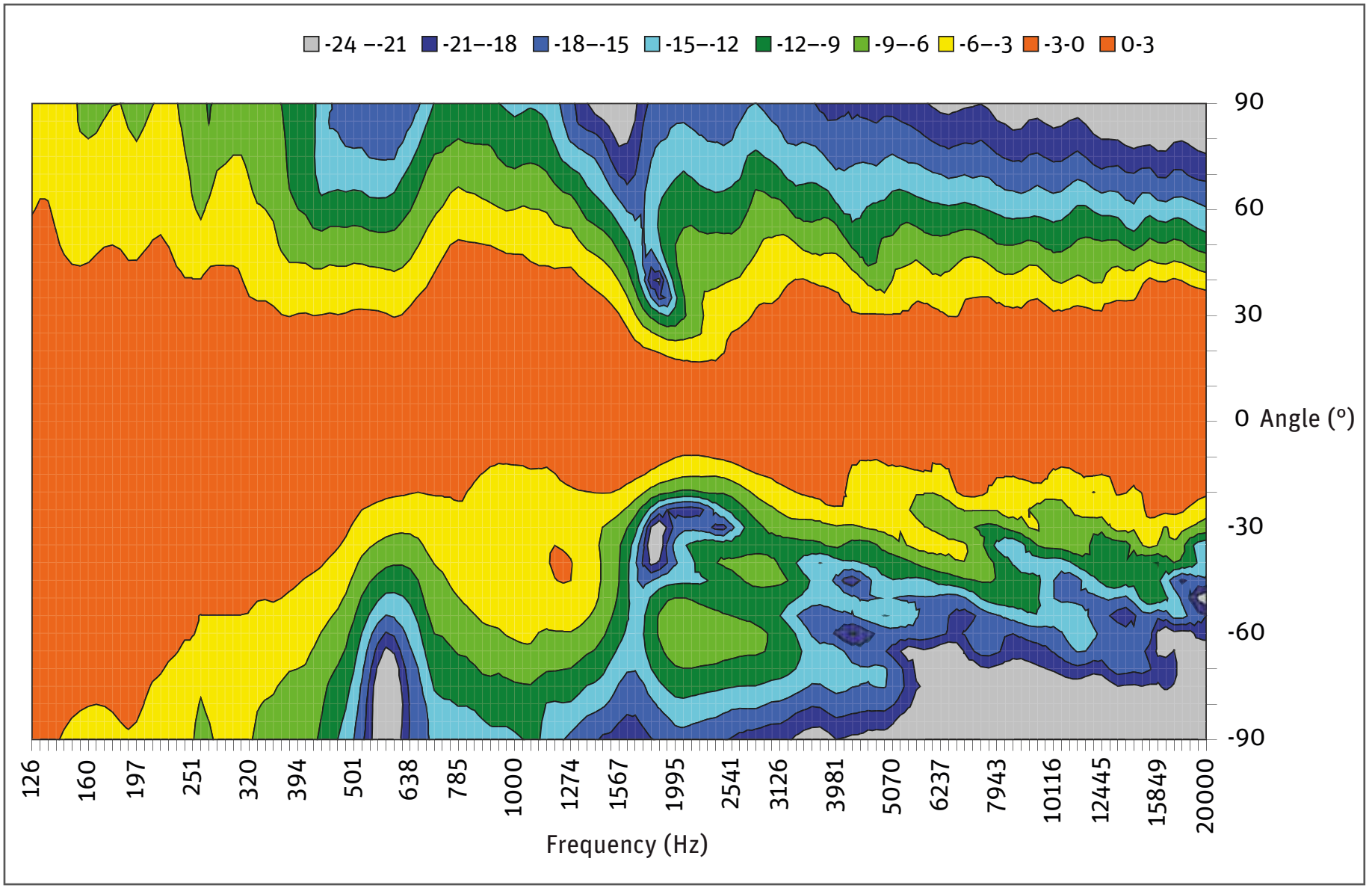


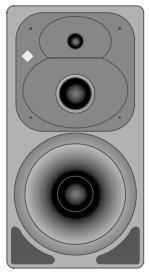
Horizontal Directivity Plot (Vertical Cabinet Orientation) | Horizontales Abstrahlverhalten (Vertikale Gehäuseausrichtung)
Directivité horizontale (Orientation verticale du coffret) | Directividad horizontal (Orientación vertical del gabinete)



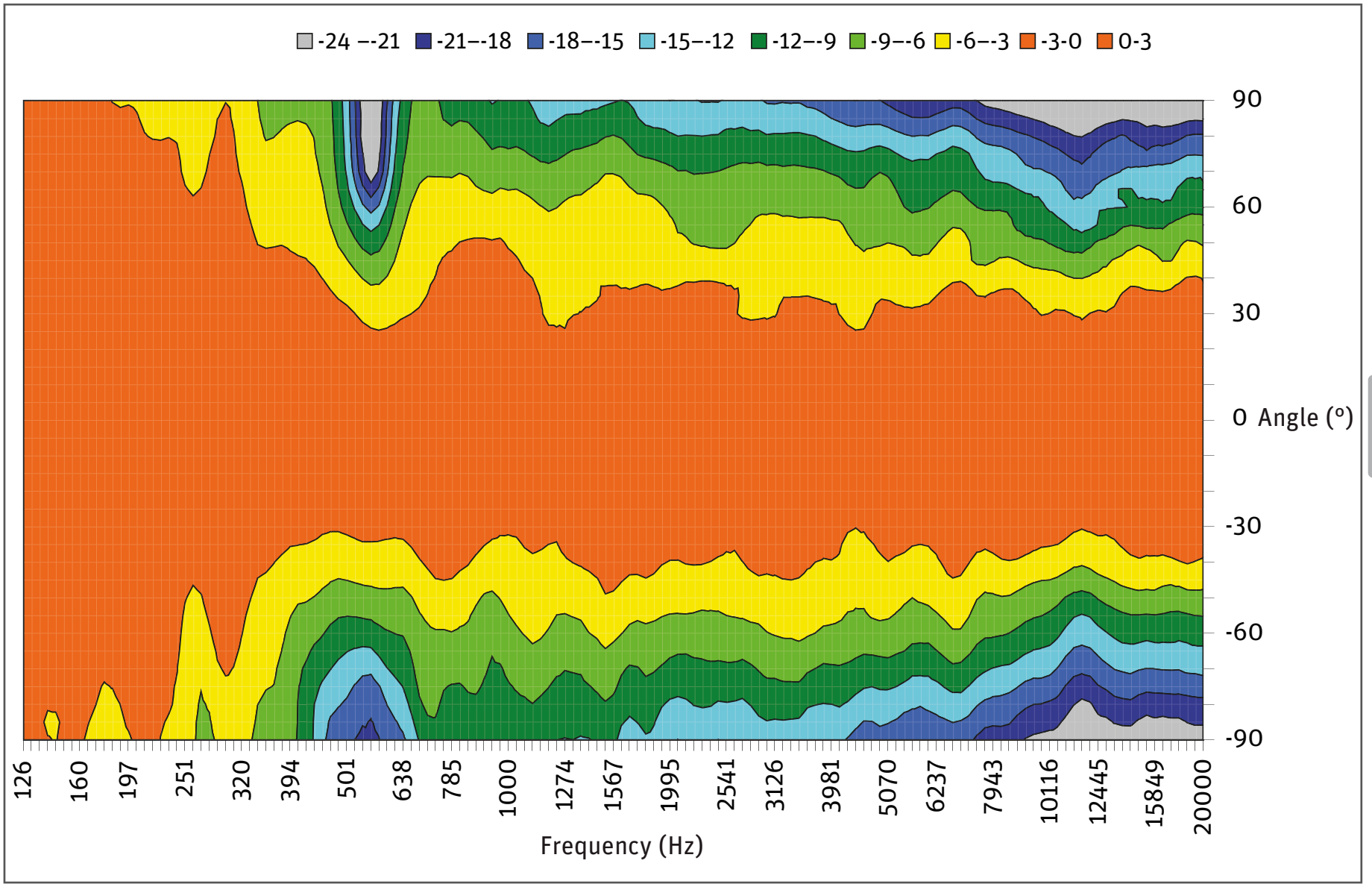


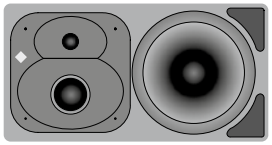
Vertical Directivity Plot (Vertical Cabinet Orientation) | Vertikales Abstrahlverhalten (Vertikale Gehäuseausrichtung)
Directivité verticale (Orientation verticale du coffret) | Directividad vertical (Orientación vertical del gabinete)



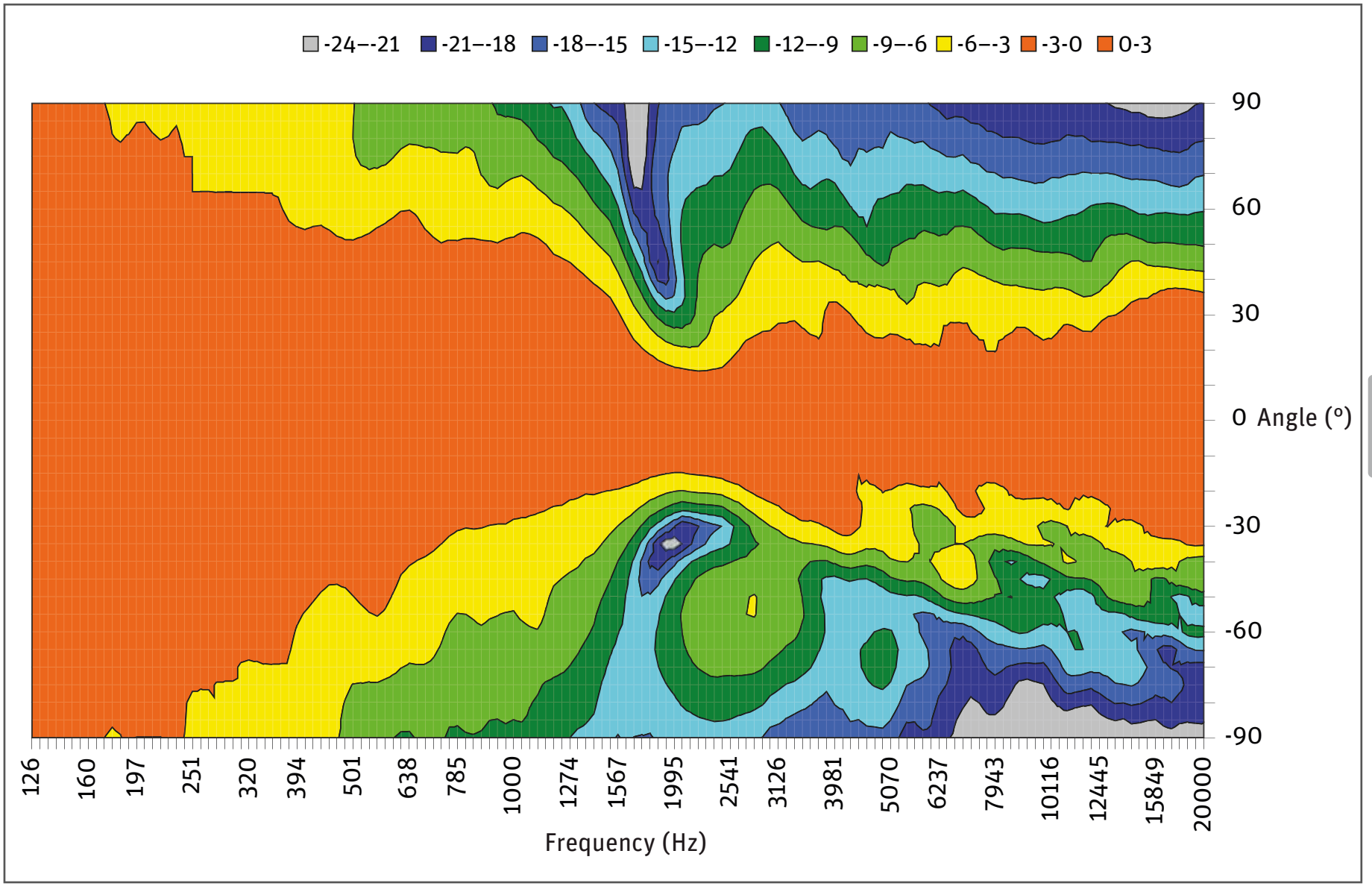


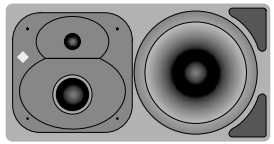
Horizontal Directivity Plot (Horizontal Cabinet Orientation) | Horizontales Abstrahlverhalten (Horizontale Gehäuseausrichtung)
Directivité horizontale (Orientation horizontale du coffret) | Directividad horizontal (Orientación horizontal del gabinete)



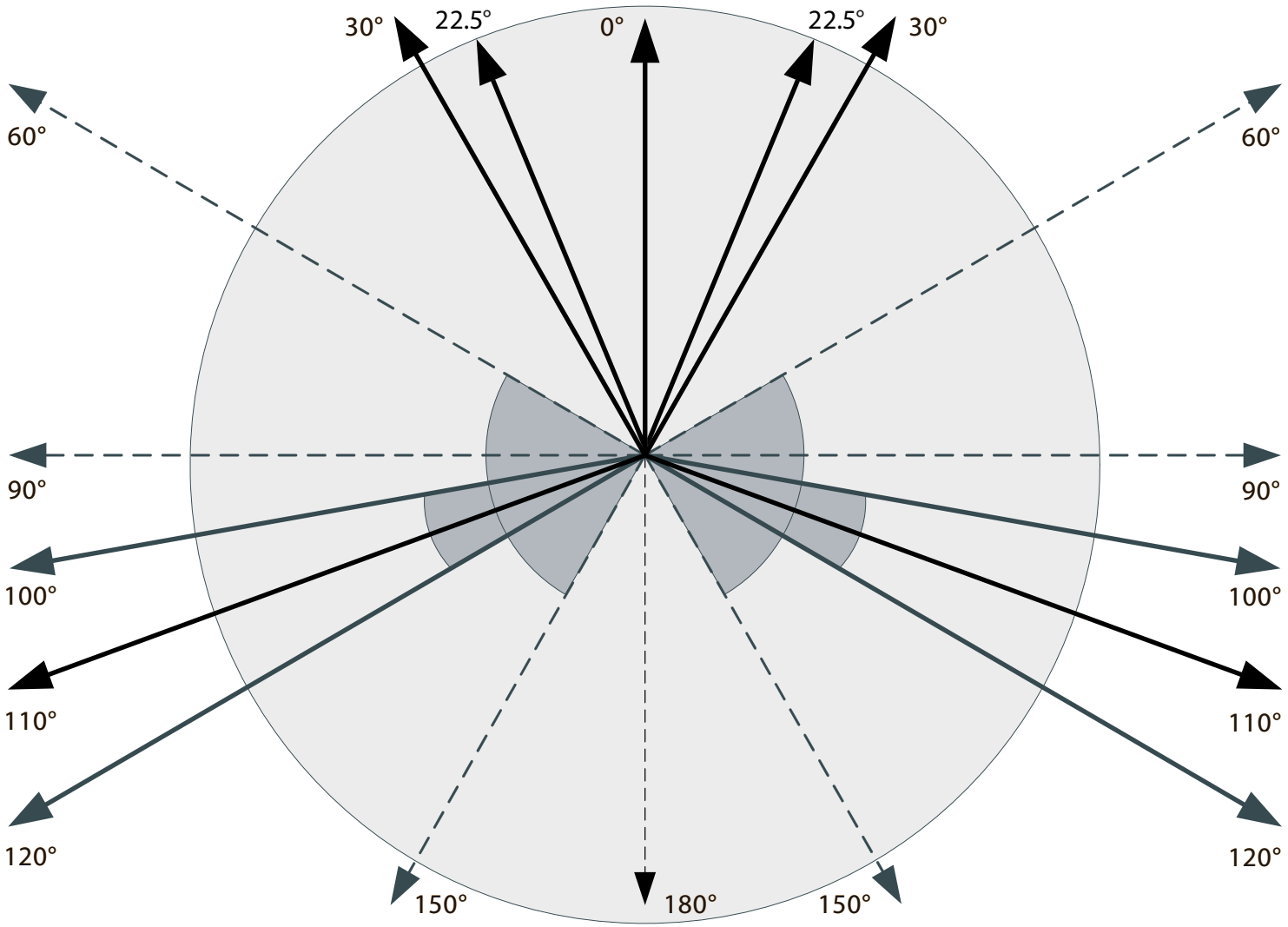


Vertical Directivity Plot (Horizontal Cabinet Orientation) | Vertikales Abstrahlverhalten (Horizontale Gehäuseausrichtung)
Directivité verticale (Orientation horizontale du coffret) | Directividad vertical (Orientación horizontal del gabinete)





Installation angles/Aufstellwinkel/Angles d'installation/Ángulos de colocación



Digital Delay Lookup Table/Digital Delay Lookup Table/ Digital Delay Lookup Table/Digital Delay Lookup Table

	Switch 1 (25.6 ms)						Switch 2 (1.6 ms)					
Position	Time [ms]	Distance [m]	Distance [Imperial]		Frames		Time [ms]	Distance [m]	Distance [Imperial]		Frames	
			[feet]	[inches]	50 Hz	60 Hz			[feet]	[inches]	50 Hz	60 Hz
0	0.0	0.000	0	0	0.0	0.0	0.0	0.000	0	0	0.0	0.0
1	25.6	8.806	28	11	0.6	0.8	1.6	0.550	1	10	0.0	0.0
2	51.2	17.613	57	9	1.3	1.5	3.2	1.101	3	7	0.1	0.1
3	76.8	26.419	86	8	1.9	2.3	4.8	1.651	5	5	0.1	0.1
4	102.4	35.226	115	7	2.6	3.1	6.4	2.202	7	3	0.2	0.2
5	128.0	44.032	144	6	3.2	3.8	8.0	2.752	9	0	0.2	0.2
6	153.6	52.838	173	4	3.8	4.6	9.6	3.302	10	10	0.2	0.3
7	179.2	61.645	202	3	4.5	5.4	11.2	3.853	12	8	0.3	0.3
8	204.8	70.451	231	2	5.1	6.1	12.8	4.403	14	5	0.3	0.4
9	230.4	79.258	260	0	5.8	6.9	14.4	4.954	16	3	0.4	0.4
10	256.0	88.064	288	11	6.4	7.7	16.0	5.504	18	1	0.4	0.5
11	281.6	96.870	317	10	7.0	8.4	17.6	6.054	19	10	0.4	0.5
12	307.2	105.677	346	9	7.7	9.2	19.2	6.605	21	8	0.5	0.6
13	332.8	114.483	375	7	8.3	10.0	20.8	7.155	23	6	0.5	0.6
14	358.4	123.290	404	6	9.0	10.8	22.4	7.706	25	3	0.6	0.7
15	384.0	132.096	433	5	9.6	11.5	24.0	8.256	27	1	0.6	0.7

Digital Delay Lookup Table/Digital Delay Lookup Table/ Digital Delay Lookup Table/Digital Delay Lookup Table

Switch 3 (0.1 ms)

Position	Time [ms]	Distance [m]	Distance [Imperial]		Frames	
			[feet]	[inches]	50 Hz	60 Hz
0	0.0	0.000	0	0	0.0	0.0
1	0.1	0.034	0	1	0.0	0.0
2	0.2	0.069	0	3	0.0	0.0
3	0.3	0.103	0	4	0.0	0.0
4	0.4	0.138	0	5	0.0	0.0
5	0.5	0.172	0	7	0.0	0.0
6	0.6	0.206	0	8	0.0	0.0
7	0.7	0.241	0	9	0.0	0.0
8	0.8	0.275	0	11	0.0	0.0
9	0.9	0.310	1	0	0.0	0.0
10	1.0	0.344	1	2	0.0	0.0
11	1.1	0.378	1	3	0.0	0.0
12	1.2	0.413	1	4	0.0	0.0
13	1.3	0.447	1	6	0.0	0.0
14	1.4	0.482	1	7	0.0	0.0
15	1.5	0.516	1	8	0.0	0.0