



0 410

Active
Mid-Field Monitor

Operating Manual
0 410



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Introduction

Thank-you for purchasing a Klein + Hummel loudspeaker. A Mathematically Modeled Dispersion™ waveguide (MMD™), flexible acoustical controls, various input options and an extensive mounting hardware range allow the loudspeaker to be used in diverse acoustical conditions, with any source equipment and in a wide variety physical locations. The latest acoustical and electrical techniques and components have been used to ensure the most accurate sound reproduction possible. Klein + Hummel products are designed for longevity so we hope you enjoy many happy years of using this product.

Depending on the size, Klein + Hummel's three-way systems are designed for use as near field monitors through to large main control room monitors. They can be used in music, broadcast, and post production studios for tracking, mixing, and mastering. They may be positioned used free-standing or flush mounted into a wall, and can be mixed freely in multichannel systems.

Before reading the rest of this operating manual, review the safety and warnings section towards the back of this book. Note that imperial dimensions are approximate.

Package Contents

The shipping carton contains:

- This operating manual
- A production calibration certificate
- Product guarantee
- The loudspeaker
- Three mains power cables (Euro, UK, and USA)
- A trimmer and switch screwdriver

Signal cables are not included. Options and accessories are listed at the end of this operating manual.

Most Common Applications and Listening Distances

The minimum, recommended, and maximum listening distances are shown below, together with their most common application:

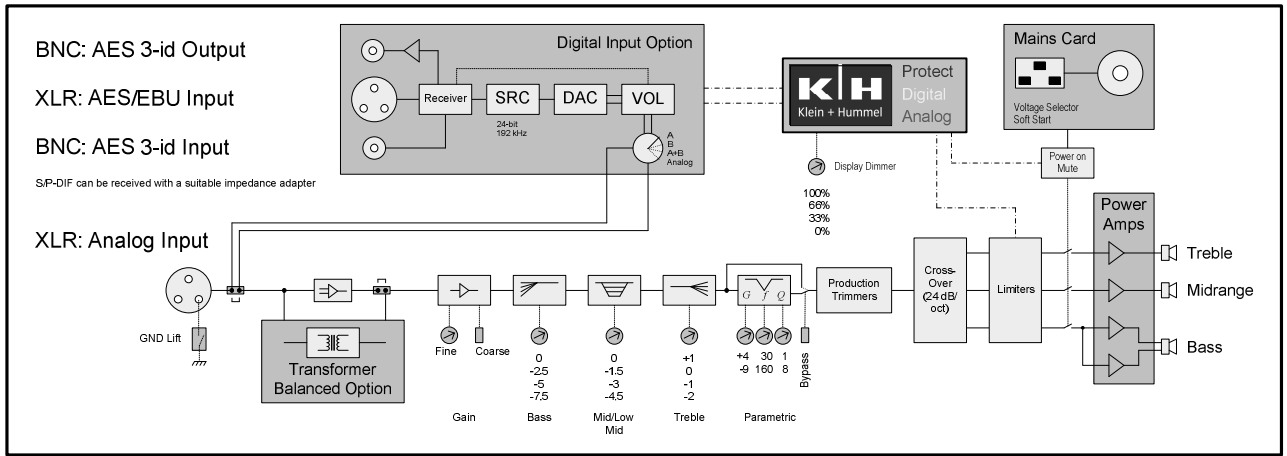
Product	Most Common Application	Distances		
		Minimum	Recommended	Maximum
O 410	Mid-field monitoring	1.5 m (5')	2.5 m (8)	8 m (24')

In multichannel systems, one should ideally use the same product for all main channels. However, as the rear channels often contain less bass and the signals are mixed at a lower level than the front channels, the rear loudspeakers can be smaller - table below for details. The center loudspeaker should always be of the same type as the left and right loudspeaker. The subwoofer should be sufficient to keep up with the main loudspeakers - see subwoofer operating manual for details.

Front	Ideal Rears	Smaller Rears	Subwoofer(s)
O 410	O 410	O 300, O 300 D	Refer to subwoofer operating manuals

System Block Diagram

Below is a three-way system block diagram.



Refer to the detailed product specifications section for information on the crossover frequencies, amplifier power, and driver types. In an O 410, the Low Mid / Mid control is a Mid control. As the digital option is user installable, there is no "D" version of the O 410.

Electronics Panel Picture



O 410 electronics panel

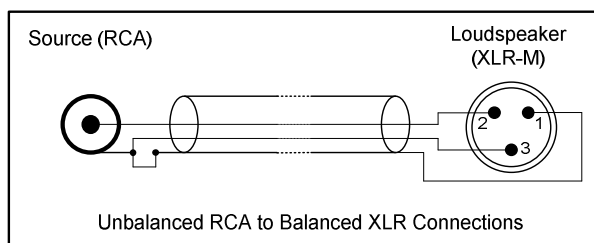
Input Stage

The **standard input stage** is a 14 k Ω electronically balanced type on a female XLR socket.

Pin	Signal
1	Audio Ground
2	Positive
3	Negative

If there is a humming or buzzing sound coming from the loudspeaker, first check it is not the loudspeaker by disconnection the input signal cables. If the noise goes away it is not the loudspeaker itself and so the noises must be coming from the cabling or the source. There are various ways to increase the loudspeaker's immunity from these external noises:

- Use **input ground lift switch** to disconnect the audio ground, on pin 1 of the analog XLR input, from the electronics' chassis ground. For safety reasons, the electronics chassis ground is always connected to the mains power earth pin.
- Fit an **optional transformer balanced input stage** to the loudspeaker. This is especially effective when combined with the ground lift switch.
- If unbalanced cables are used, they can be specially wired – see picture below. Disconnect the cable screen from the RCA sleeve if there are still humming or buzzing sounds, and/or use the ground lift switch on the loudspeaker.



In addition, it is possible to fit a **24-bit, 192 kHz digital input stage**. It has XLR and BNC inputs, and a BNC output, so it is possible to have analog and digital signals simultaneously connected; the selector switch is used to monitor the selected input.

Acoustical Controls

The acoustical controls are low-order analog filters designed to compensate for some of the acoustical issues commonly found in listening environments. There is either a Low Mid or Mid control depending on the loudspeaker model. The other controls are seen on all three-way systems.

Klein + Hummel loudspeakers are designed to have a flat pass band magnitude response in anechoic conditions when all the acoustical controls are set to 0 dB. When a loudspeaker is installed into a listening environment the response changes and thus should be corrected back to a flat response. It is therefore expected that the controls will need adjustment to improve the in-situ response of the loudspeaker. The acoustical controls' settings will depend on the loudspeaker's location and will probably be different for the same loudspeaker type installed in different locations in the same room. In a symmetrical installation, left/right pairs (front or back) will probably have the same acoustical settings. Suggested settings are shown after this description of the controls:

The **bass** control is used to compensate for the effect of loading due to nearby large solid boundaries such as walls. Four settings are available: 0, -2.5, -5, and -7.5 dB.

The **mid** control (0 410) is used to compensate for strong first order reflections (floor, ceiling, side walls), that may cause an aggressiveness in the midrange sound quality. A high mid-band reverberation time can also have this effect and thus be compensated. Four settings are available: 0, -1.5, -3, and -4.5 dB.

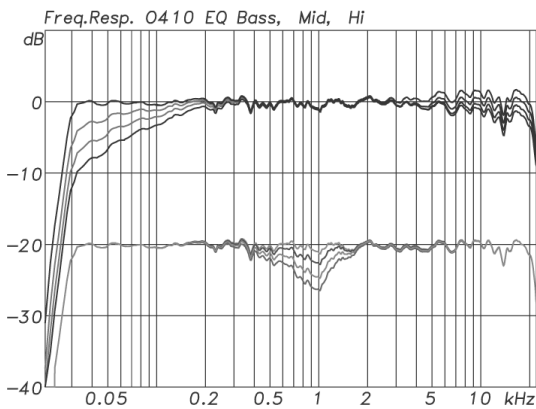
The **treble** control affects the treble driver output level and can be used to compensate for insufficient or excessive high frequency damping in the room. The treble control is often set to suit the listener's taste, although in well-controlled environments there should be little reason to adjust it away from 0 dB. Four settings are available: +1, 0, -1, and -2 dB.

The **parametric** equalizer is a single stage PEQ filter with gain (+4...-12 dB), frequency (20...200 Hz) and Q (1...8) controls designed to control nonlinearities seen below 200 Hz. These nonlinearities can come from boosts caused by constructive interference or strong room modes. It is possible to bypass the parametric equalizer using the bypass switch.

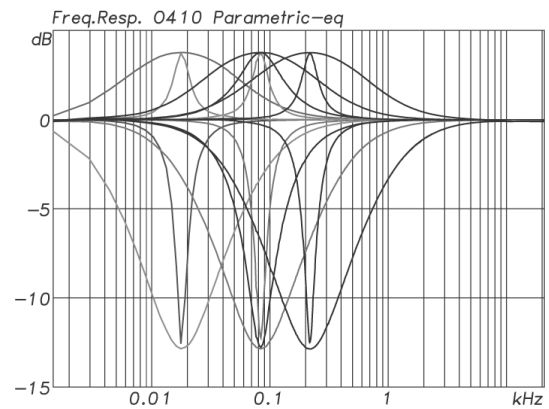
It is advised that an acoustical measurement system be used to set these controls in the most appropriate way for the loudspeaker's location. This is especially true of the parametric equalizer's controls. In the absence of appropriate equipment the following settings are recommended as a good starting point for further adjustment:

Acoustical Controls	Bass	Mid 0 410	Treble	Parametric
Loudspeaker Location				
In a corner	-7.5 dB	-	-	***
Next to or flush mounted in a solid wall	-5 dB	-	-	-
Next to or flush mounted in a soft wall	-2.5 dB	-	-	-
Free standing in an untreated room	-2.5 dB	-1.5 dB	-1 dB	***
Free standing in a well-treated room	-	-	-	-

*** This indicates that the parametric equalizer will probably need to be used. Its use will depend on the situation so no standard recommendation can be made here.



O 410 Bass, Midrange and Treble Acoustical Controls



O 410 Parametric EQ Acoustical Controls

Note: the parametric equalizer's response is not shown on the above graphs as it is freely adjustable within the stated parameter ranges.

The **input** and **output** controls consist of a finely graduated control called "**Input Gain**" and a coarse "**Output Level**" control. This allows the loudspeaker to be matched to a wide range of equipment outputs whilst maintaining the desired acoustical output. As with any other component in the audio chain, it is best to use the lowest gain for the application so as to minimize amplification of the preceding equipment's source noise. To check this, if the noise drops dramatically when the input cable is unplugged, the noise is coming from the source not the loudspeaker. The default setting is "0 dB" and "100 dB SPL at 1m". This gives an output level of 100 dB SPL at 1m when the input signal is 0 dBu (0.775 V). The most sensitive setting (most acoustical output for a given input voltage) is "6 dB" and "114 dB SPL at 1m", and the least sensitive setting is "-9 dB" and "100 dB SPL at 1m".

Input Sensitivity Rotary Switch [dB]	Acoustic output level [dB SPL] of the loudspeaker at 1m when input signal is 0 dBu	
	Output Level switch = "100 dB"	Output Level switch = "114 dB"
-9 dB	91	105
-8 dB	92	106
-7 dB	93	107
-6 dB	94	108
-5 dB	95	109
-4 dB	96	110
-3 dB	97	111
-2 dB	98	112
-1 dB	99	113
0 dB	100 (default)	114
1 dB	101	115
2 dB	102	116
3 dB	103	117
4 dB	104	118
5 dB	105	119
6 dB	106	120

Below are some examples of how to calculate the output level:

Input signal [dBu]	0 (0.775 V)	+4 (1.23 V)	+6 (1.55 V)	+16 (4.89 V)
Input gain setting [dB]	0	0	0	0
Output level setting [dB SPL]	100	100	100	100
Sound Output of Loudspeaker [dB SPL at 1m]	100	104	106	116

In Europe 0 dBu is -18 dBFS (EBU standard R68). In the US +4 dBu is -20 dBFS (SMPTE standard RP155). These dBu values should equate to 85 dB SPL at the listening position. It is typical in the broadcast industry to use a reference level of 79 dB SPL at the listening position. Near field loudspeakers can be as close as 1 m from the listening position, whereas loudspeakers in a Dolby certified movie mixing room should be at least 5 m from the listening position. In the examples below, it is assumed that the listener is inside the room radius and thus the sound field decays according to $20 \log_{10}(r)$, however this may not always be the case. Note that some additional attenuation at the source (-6 or -10 dB) is required for SPL calibrated near field listening, but this facility is always available in the console.

Input signal [dBu]	0 (0.775 V)	+4 (1.23 V)
Input level setting [dB]	-1	-5
Output level setting [dB SPL]	100	100
Listening distance [m] (dB change)	5 m (-14 dB)	5 m (-14 dB)
Loudspeaker Output Level [dB SPL]	85	85
Maximum input signal before clipping	17 dBu	17 dBu

The maximum input level that the input stage can accept is +19 dBu (approximately 6.9 V). To avoid clipping the input stage, increase the input level of the loudspeaker by up to 6 dB. The maximum acoustical output of the loudspeaker is limited by the protection system. In general, larger loudspeakers can play louder and for longer periods than smaller loudspeakers.

Other Controls

The **display dimmer** is used to attenuate the display when the loudspeaker is used in low light situations. The display can be completely turned off for use behind acoustically transparent screens. Four settings are available: 100, 66, 33, and 0 %.

The **power On/Off** switch turns the mains power completely on and off. There is a soft start function in the power supply to reduce the effect of turn-on transients on the power line, thereby avoiding blown fuses.

The **voltage selector** switches select between 230, 120, and 100 V. Set this appropriately BEFORE applying main power to the loudspeaker. An appropriate internal main fuse value is automatically selected. The applied mains power voltage should be within -15% and +10% of the selected value.

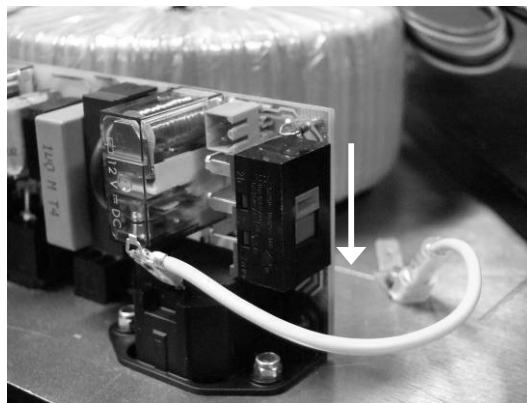
The **12 V trigger** is used to turn the loudspeaker on and off remotely without having to use the mains power switch. This may be useful in a large facility where the whole room is powered-up using a single switch. Equipment can be time-delayed using simple low-voltage circuitry so there is not a mains power surge, although there is already the soft start function to reduce this effect. Note that loudspeaker's electronics are fully powered on and off with this control, so the startup time is subject to the same on/off muting delays as if the loudspeaker had been turned off and on using the main power switch. There are two modes of operation, which are selected using an internal switch (see picture below):

Remote Power Mode	Switch Position	Function
"12 V TURNS OFF"	Away from backplate	Applying 12 V across the remote terminals turns OFF the loudspeaker Removing the 12 V from the remote terminals turns ON the loudspeaker
"12 V TURNS ON"	Towards backplate	Applying 12 V across the remote terminals turns ON the loudspeaker Removing the 12 V from the remote terminals turns OFF the loudspeaker

The factory default mode setting is "12 V TURNS OFF". In both modes and with either applied voltage levels at the terminals, switching the mains power switch to "OFF" will turn off the loudspeaker.

To change the remote power mode to "12V TURNS ON":

- Turn off the loudspeaker and disconnect the mains power and signal cables.
- Open the electronics panel (located in the cabinet or remote electronics kit).
- Locate the large switch on the mains power circuit board and move the switch towards the backplate.



- Close the electronics panel and reattach the mains power and signal cables.
- Power up the loudspeaker, apply 12V to the remote control terminals, and check that the appropriate lights are illuminated.

Crossover

Using 4th order filters, the crossover divides the input signal into three bands for reproduction by the appropriate sized driver. Time alignment ensures that the sound from each driver around the crossover frequencies is emitted at the same time. In addition to this an extensive protection system ensures that the loudspeaker is not damaged if a large signal is applied to the input. The red "PROTECT" lights up when the protection system is active. If this happens, reduce the input signal. If this happens regularly, use a larger loudspeaker with a higher SPL output, or add a subwoofer to handle the high-level low-frequency energy. The protection system consists of: thermal and peak limiters for the amplifiers, thermal modeling of the drivers, and an excursion limiter for the drivers.

The protection system is not a compressor, it is designed to protect the loudspeaker from damage, and the red light tells the user it is active. The protection cannot protect against sustained abuse of the loudspeaker, i.e. consistently playing the loudspeaker for long periods of time with the protect light on, so avoid this to ensure a long life from this product.

There are also production trimmers in the crossover section which are hidden from view to avoid "accidental" adjustment. These should only be adjusted by qualified personnel with specialized measurement equipment. If a

component critical for sound quality, e.g. bass driver, is changed, the loudspeaker should ideally be recalibrated in a Klein + Hummel Continental Service Center, i.e. one equipped with an anechoic chamber.

Amplifiers

Hybrid class AB amplifiers are used because, for full range loudspeakers, the overall performance is still better than any other solution. Harmonic and intermodulation distortions, and noise are all consistently low in well-designed class AB amplifiers. Heat dissipation is reduced by using class H techniques for each amplifier channel to seamlessly lower the amplifier power supply voltage when the input signal is low. Even so some space (5 cm, 2") is required around the electronics panel.

Accelerated Heat Tunneling™ (AHT™) is a technique designed to ensure equally effective cooling of the amplifiers, whether the cabinet is mounted vertically or horizontally. The "funnel effect" accelerates cool air into the lower heatsink aperture and expels heated air from the upper heatsink aperture. It is recommended that the amplifier heatsink is checked for any build-up of dust and fluff at least every six months. The heatsinks can be cleaned without having to open the electronics panel: simply blow clean compressed air into the vents on the side of the electronics panel and across the external heatsink. Failure to do this may limit maximum SPL output.

If the cabinet is flush mounted it is highly recommended that the electronics panel be mounted on a Remote Electronics Kit – see Accessories and Options section. Although no damage will result, insufficient cooling will cause the amplifier protection to activate prematurely thereby limiting the system's maximum output level.

Drivers

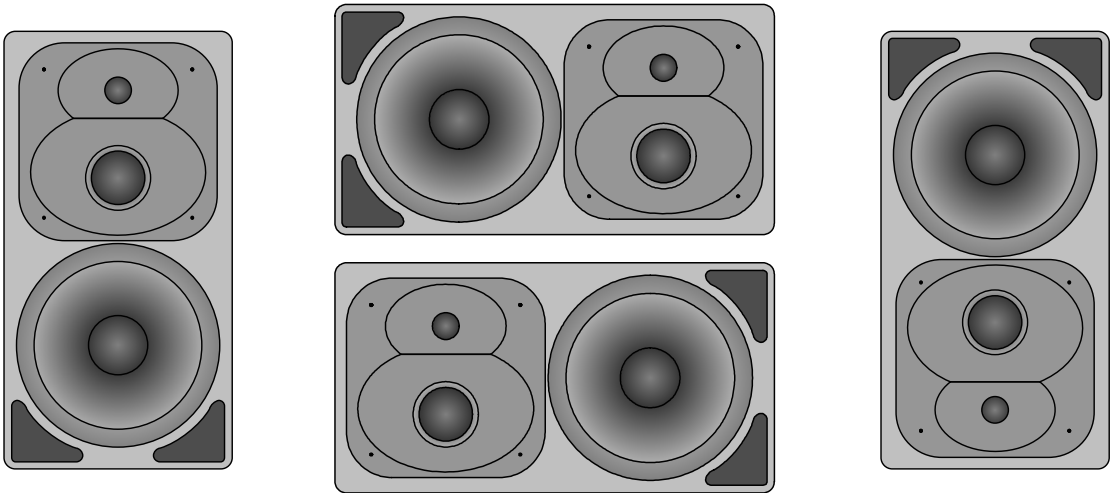
The drivers are the best available for their application. Long throw, efficient, low distortion drivers ensure a clean sound quality even at high replay levels. The bass driver is loaded by the internal volume of the cabinet. The mid and treble drivers have their own self-contained back cavities. All drivers are magnetically shielded for use next to CRT screens. The system's SPL output and the cabinet volume can be seen in the specifications section below.

O 410 Mathematically Modeled Dispersion™ Waveguide (MMD™)

The midrange and treble drivers are mounted into a Mathematically Modeled Dispersion™ waveguide (MMD™). The MMD™ is made from the same acoustically excellent material used in the O 300, LRIM™. It has been mathematically modeled and experimentally verified in an anechoic chamber to give optimum control of the directivity of the midrange and treble drivers. The benefits are increased driver loading, reduced edge diffraction and room reflections, a smoother power response and a wide useable listening area. The result is a reduced audio distortion and a corresponding sound quality improvement. The MMD™ has 80° x 60° dispersion and so, if the loudspeaker is horizontally mounted, must be rotated 90° in either direction from the position it which it was supplied. A rotated waveguide allows the bass driver to be placed either side of the MMD™. If the cabinet is positioned upside down, the MMD™ should also be upside down to maintain an optimum midrange-bass crossover region. As the display text is then upside-down, please contact K+H in Germany directly to get a replacement display sticker with upside-down text. 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 Cabinet section for a definition of the acoustical axis.

This is how to rotate the MMD™:

- Lay the loudspeaker cabinet on its back on a soft flat surface so the drivers are facing upwards.
- Undo the four Allen head bolts on the MMD™ using a T4 Allen head screwdriver.
- Carefully lift the MMD™ out of the cabinet, avoiding scratches on the paintwork and damage to the sealing strip.
- Reposition the MMD™ in the new orientation and centre it in the front panel cut-out.
- Tighten the four Allen head bolts on the MMD™ to a torque setting of 2.8 Nm (0.74 lbf-ft).
- Test the cabinet sealing by playing a reasonably loud (so you can feel some wind through the ports) sine wave with a frequency equal to the loudspeaker's -3 dB low frequency cut off (see specifications below). Then listen for any hissing sounds around the edge of MMD™ and its drivers. If there is a hissing sound, the sealing has been compromised and should be repaired.



Cabinet

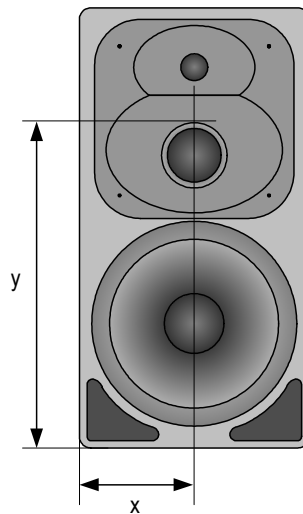
The wooden cabinet is painted using a standard RAL color. An appropriately colored pen can be used to touch up the paintwork if it is scratched during transport or use. The following RAL numbers correspond to K+H standard cabinet colors.

K+H Color Name	RAL Number
Anthracite	7021
Silver	9006

Combined with the cabinet volume, the ports load the bass driver to extend the low frequency response of the loudspeaker. The ports have a high capacity to move air without inducing turbulence and associated nonlinearities that degrade the sound quality.

The acoustical axis is a line normal 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 centre of the listening area will give the best measured and perceived sound quality. For three-way loudspeakers in the Klein + Hummel range, the acoustical axis is located on the mid-point of the midrange and tweeter drivers.

Product	x dimension	y dimension
O 410	16.5 cm (6 1/2")	51 cm (20 1/8")



O 410 Acoustical Axis

System Use

Klein + Hummel loudspeakers should only be used indoors and in these ambient conditions:

- +10° C to +40° C (+50° F to +104° F), <90% relative humidity, non-condensing

During transport or storage the ambient conditions can be:

- -25° C to +70° C (-13° F to 158° F), <90% relative humidity, non-condensing

Before connecting the mains power cable, ensure that the correct mains voltage is selected on the electronics panel (230, 120, or 100 V) and that the mains power switch is off. Next connect the input signal cable (analog, digital, or both as appropriate) and power up the loudspeaker. There will be a five second delay before sound can be heard from loudspeaker so as to avoid noises (pops) from preceding equipment turned on at the same time. Conversely, turning off the loudspeaker immediately mutes the audio. The K+H logo should light up together with either the green or yellow light to indicate an analog or digital signal. If there are no lights, check the mains power supply and the display dimmer (ensure it is not set to 0 %).

In a studio application, the loudspeakers should be placed according to the ITU-R BS.775-1 recommendations so there is consistency of reproduction when compared to other listening environments. For movie applications, ANSI/SMPTE 202M is the preferred standard for system setup. For home use, as materials are mixed in ITU style rooms, one should get as close as possible to this configuration to maximize replay authenticity.

Loudspeaker Name	ITU-R BS.775-1 Angle	ANSI/SMPTE 202M Angle
Left	-30°	-22.5°
Center	0°	0°
Right	30°	22.5°
Left Surround	-110°±10°	An array to the left
Right Surround	110°±10°	An array to the right

For two-channel stereo, ±30° should be used. There are currently no internationally agreed standards for 6.1 or 7.1 formats. However common practice is to use one or two loudspeakers in the centre back location of a 6.1 system. In a 7.1 system common practice is to place side loudspeakers at ±90° and to push the surround loudspeakers back to ±150°.

For the best stereo imaging the loudspeakers should be placed symmetrical in a symmetrical room where objects have been placed symmetrically. This ensures the same response from each loudspeaker at the listening position and thus good imaging. Sound reflected back to the listening position should also be minimized using surface angling or acoustical treatment. The acoustical axis point towards the listening position or centre of the listening area in both the horizontal and vertical planes.

The loudspeaker should be placed on a circle to ensure equal time of arrival of the audio from all loudspeakers. Failing this, appropriate electronic time delays should be added to compensate for time of flight differences.

If the loudspeaker is used free standing, good quality loudspeaker stands and suitable accessories (see Accessories and Options section) are recommended.

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 (smoother bass response). It is a good idea to employ an experienced acoustic engineer to design an effective flush mounting wall. Recommended acoustical control settings are shown in the Acoustical Controls section and a Remote Electronics Kit, shown in the Accessories and Options section, is highly recommended to avoid heat dissipation problems and allow easy adjustment of the controls. If the loudspeaker must be covered, use a thin open weave cloth. Two layers of very thin material will improve opacity.

Before trimming the levels, calibrate each loudspeaker's response:

- In studio applications, the response of each loudspeaker at the listening position should be flat.
- In movie applications, the response of each loudspeaker should be one of the X-curve shapes, depending on the size of the room (see ANSI/SMPTE 202M).
- In home applications, the response of each loudspeaker should be set for subjective audio quality. This is not necessarily a flat response, but generally, with time, a gently downward sloping response with increasing frequency is often preferred.

Absolute acoustic level calibration is achieved using a sound level meter set to 'C'-weighting and a "slow" integration time. Play a broadband pink noise test signal set to -18 dBFS (Europe) or -20 dBFS (USA) on the console meters and measure the sound pressure level at the listening position. Then adjust each channel's level (can also be adjusted on all loudspeakers for a specific channel) until the desired level is achieved:

Application	SPL
Movie	85 dB(C)
Broadcast	79 dB(C)
Music	Engineer's preference

For information on setting up a subwoofer with these main loudspeakers, please refer to the operating manual supplied with the subwoofer.

Technical Specifications

Acoustics

-3 dB free field frequency response	30 Hz ... 24 kHz, ± 3 dB
Pass band free field frequency response	32 Hz ... 20 kHz, ± 2 dB
Self-generated noise	≤ 25 dB(A) at 10 cm
Sine wave output with a THD < 0.5 % at 1 m distance	95 dB SPL (>100 Hz)
Max. SPL in half space at 3% THD	120.0 dB SPL
Averaged between	100 Hz and 6 kHz

Electronics

Woofer amplifier, cont.(peak) output power*	340 W (400 W)
Mid amplifier, cont. (peak) output power*	160 W (190 W)
Tweeter amplifier, cont.(peak) output power*	180 W (210 W)
Controller design	analog, active
Crossover Frequency	600 Hz/2.2 kHz
Crossover Slope (dB/oct.)	24
Equalization: Low cut	-
Bass	0, -2.5, -5, -7.5 dB
Mid	0, -1.5, -3, -4.5 dB
High	+1, 0, -1, -2 dB
Parametric Equalizer:	Bypassable
Gain	+4 ... -12 dB
Frequency	20 ... 200 Hz
Q	1 ... 8
Time of Flight adjustment delay	-
Protection circuitry	Limiter: low, mid, high
Infrasonic filter frequency; slope	15 Hz; 12 dB/oct.

Analog Input

Impedance, electrically balanced	XLR, 13 k Ω
Impedance, transformer balanced	XLR, 4.7 k Ω , optional
Input sensitivity	-8 dBu / +6 dBu
Attenuator	-9 ... +6 dB
CMRR	>60 dB @ 15 kHz

Digital Input/Output

Format XLR (Format BNC)	Optional AES/EBU (AES3id, S/P-DIF)
Impedance XLR, balanced	110 Ω
Impedance BNC, unbalanced	75 Ω (input and output)
Input switching	Analog/Digital A, B, Mono
Digital converter: resolution, design	16 ... 24-bit DAC, $\Delta\Sigma$
sampling rate	20 ... 216 kHz (SRC)

Displays and Mains Power

Displays and indicators: power on	K + H logo "red"
limit/clip	Red LED
display	Green (Analog signal), Yellow (Digital signal, error)
Mains power	230, 120, 100 V AC
Power consumption - Idle	36 VA
Power consumption - Full output AC	1300 VA

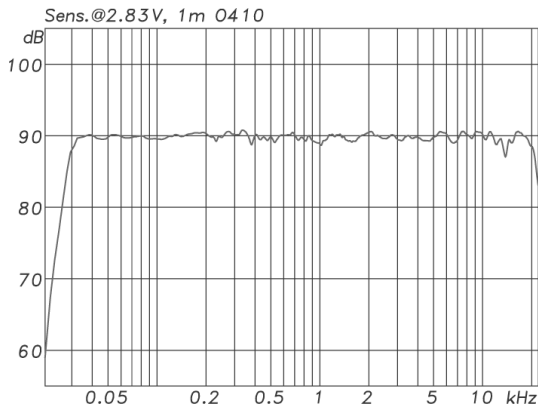
Mechanics

Height x width x depth, mm	645 x 330 x 444 mm
inches	25 ³ / ₈ " x 13" x 17 ¹ / ₂ "
Internal net volume	42 liters
Weight	36.0 kg (79.2 lb)
Drivers	Magnetically shielded
Woofer	10", 250 mm
Midrange	3", 76 mm
Tweeter	1", 25 mm
Mounting points	Threaded inserts on rear
Mounting hardware included	-
Cabinet surface finish	Painted
Color: standard	Anthracite or silver
Color: custom at extra cost	-
Baffle cover	Optional metal grille

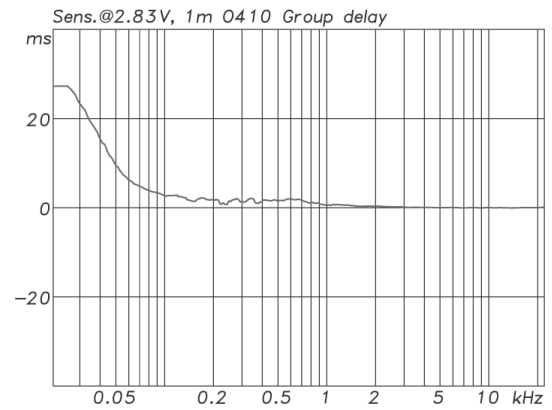
*THD+N < 0.1 % with limiter deactivated

Acoustical Measurements

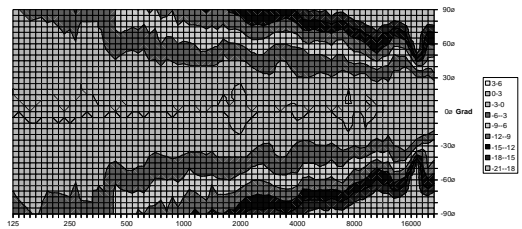
Below are acoustical measurements conducted in anechoic conditions at 1 m. Color versions of these graphs can be found on the appropriate product page of the klein-hummel.com web site.



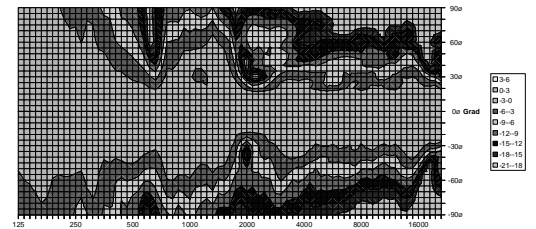
O 410 free-field response



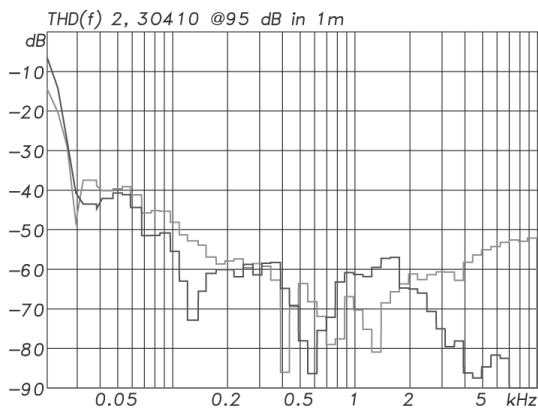
O 410 group delay



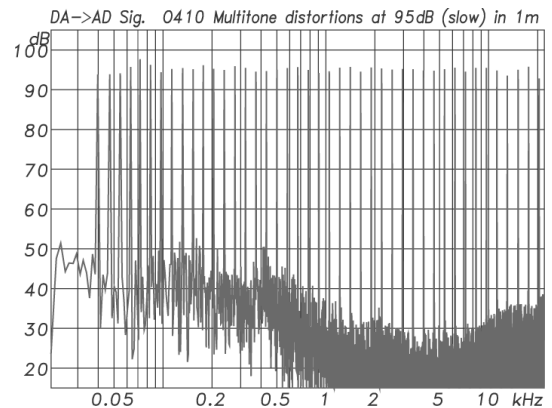
O 410 horizontal directivity plot



O 410 vertical directivity plot



O 410 harmonic distortion at 95 dB SPL



O 410 intermodulation distortion at 95 dB SPL

Accessories and Options

In this section is a description of the options and accessories that are available for the products covered in the operating manual. Note that options and accessories are fitted at the user's own risk and that safety and warning instructions should be observed.

Transformer balanced input module option (TIM 1)

This option changes the electronic balanced input into a transformer balanced input for increased noise immunity, especially when used in conjunction with the ground lift switch. The circuitry is based on a current transformation with a THD less than -100 dB @ 16 dBu input level, even down to 20 Hz. It can be used in conjunction with the digital input option when "Analog" is selected.

Digital input module option (DIM 1)

This option is a 16...24-bit, 20...216 kHz digital input stage that can accept AES3-2003 (commonly known as AES/EBU), AES3id-2001, and S/P-DIF (with a suitable impedance adapter or connector converter) signals. XLR and BNC connectors ensure good interconnectivity options. A buffered BNC output is provided for connecting additional loudspeakers to the same cable – a user supplied 75 Ω BNC terminated coaxial cable is required for this (same cable type as used for word clock signals). The BNC output provides an electronically buffered copy of the input data, but in AES3id format. The BNC input stage has an internal 75 Ω termination so T-pieces and terminators are not required. A four-way switch allows selection of:

- "Analog" input (electronic, or transformer if it is fitted)
- Digital subframe "A"
- Digital subframe "B"
- Digital subframes A and B simultaneously "M" (mono). Note: output level is automatically attenuated by 6 dB to avoid clipping and have the same loudness as a single channel reproduction (A or B).

It is possible to have an analog and a digital cable simultaneously connected to the loudspeaker. The input selector switch is used to monitor the selected input. Only one of the digital inputs (XLR or BNC) should be connected at a time. A clock input is not required because loudspeakers are not audio sources and the clock signal is locally regenerated from data contained in the bit stream.

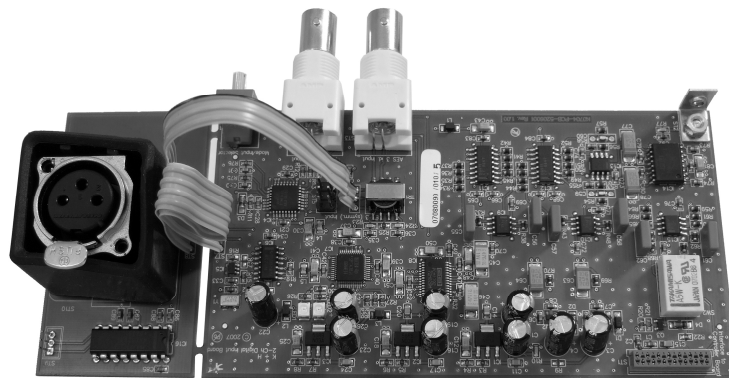
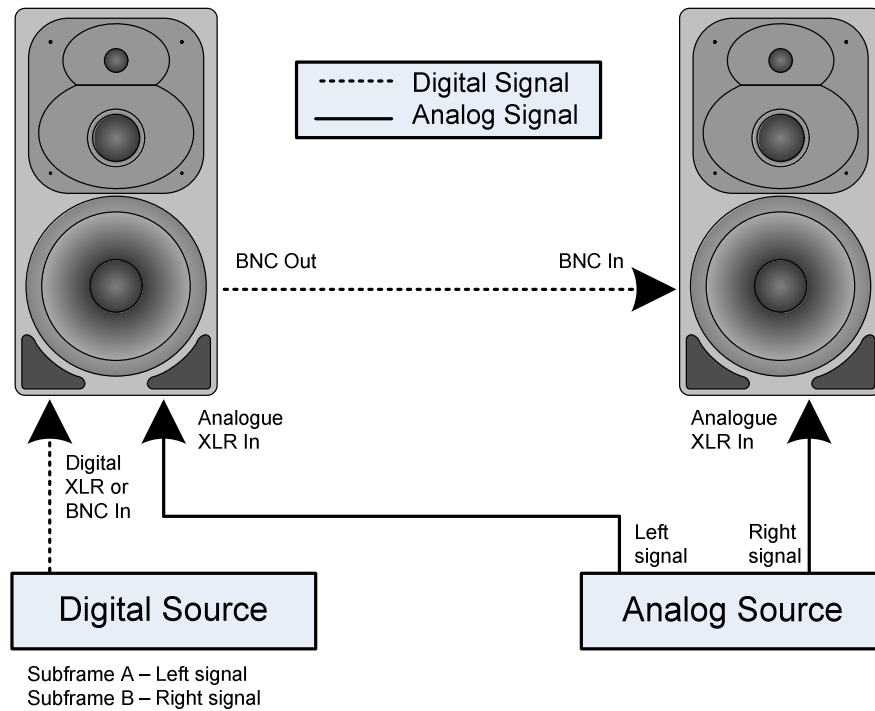
User-bit volume control (IEC 60958-1) is supported so that the source can directly control the output level of the loudspeaker whilst using digital signals normalized to full scale. The digital volume control occurs in the analog domain, thereby offering full bit resolution and improved reproduction at low replay levels. The source must also support this standard for it to work – see information provided by the manufacturer of the source to see how it has been implemented.

De-emphasis is supported on 32, 44.1, and 48 kHz sample rates.

An interconnection example is shown below. To listen to the analog source, set both loudspeakers to "Analog". To listen to the digital source, set the left loudspeaker to "A" and the right loudspeaker to "B" (note the signal routing in the source).

If the analog input is selected (Analog), the green light on the MMD™ display illuminates. If the digital input is selected (A, B, or M), the yellow light on the MMD™ display illuminates. The yellow light does not illuminate if there is no valid word clock on either digital input (note: the green light will also be off in this state as a digital input has been selected). If there is an error in the digital signal, the yellow light will flash. If this happens check the cables and connectors, and the source equipment. If there are no lights on, check that mains power is applied and that the display dimmer switch is not set to 0%. Always use good quality cables with the correct impedance to achieve these maximum cable lengths:

Format (Connector)	Impedance	Cable Length
S/P-DIF (RCA)	75 Ω	up to 10 m (30')
AES3 (XLR)	110 Ω	up to 100 m (300')
AES3id (BNC)	75 Ω	up to 1000 m (3000')



Warning: The digital input option’s BNC connectors protrude from the rear panel. If the O 410 cabinet is placed on a flat hard surface with the drivers facing upwards, the circuit board will be damaged. Find a soft surface, such as bubble wrap, packing foam, or a folded blanket, or angle the cabinet slightly to avoid applying pressure to the BNC connectors.

Remote electronics kit option (REK 1)

This is a hardware kit to allow the electronics panel to be located up to 30 m (90’) away from the loudspeaker cabinet. The benefits enjoyed when loudspeakers are flush mounted are: lack of heat dissipation problems, easy adjustment of the controls, and easier electronics servicing. An 8-pole Speakon terminated cable carries the driver signals and a CAT-5 cable carries the display signals. Additional space is not required behind the cabinet as the connectors face downwards when installed. The connections are as follows (note: “Bass 2” is not used when there is only one bass driver in the cabinet):

Drivers	Speakon Pins	Display	RJ-45 Pins
Bass 1-/+	1 -/+	K+H Logo -/+	1 & 2
Bass 2-/+	2 -/+	Red -/+	3 & 4
Midrange -/+	3 -/+	Yellow -/+	5 & 6
Treble -/+	4 -/+	Green -/+	7 & 8

The cabinet’s serial number is printed under the bass ring – pull it gently by hand to remove it – so it is visible when the cabinet is flush mounted. This number should be matched to the serial number printed on the remote located electronics panel.

Cable pack (CP nn)

A CAT-5 and 8-core driver cable of length 2, 5, 10, 15, 20, 25, and 30 m (6', 15', 30', 45', 60', 75', and 90') are available from Klein + Hummel (Cable Pack 2, 5, 10, 15, 20, 25, or 30), or industry standard cables may be sourced from a third party. The Klein + Hummel cables use flame retardant materials and high-quality metal connectors (Neutrik EtherCon NE8MC and Neutrik Speakon NLT8FX). The conductor specification is shown in the table below:

Length	Wire Gauge
<=20 m (60')	2.5 mm ² (14 AWG)
>20 m (60')	4 mm ² (12 AWG)

Mounting hardware (LH nn)

A collection of hardware for mounting the loudspeaker:

- LH 28 **Tripod stand adapter** – used to fit the loudspeaker onto a standard 1.4" tube tripod stand (external fit with screw thread).
- LH 29 **TV spigot adapter** – used to fit the loudspeaker onto a standard TV spigot used in broadcast studios (internal fit).
- LH 36 **Tilting adapter** – used to add a tilting function to a tripod stand or TV spigot.
- LH 37 **Tripod stand adapter** – used to fit the loudspeaker into a standard 35 mm (1.4") flange fitting.
- LH 41 **Base plate** – used to fit the loudspeaker onto a tripod stand. Adding an LH 36 gives a tilting function.
- LH 42 **Ceiling system (Vertical)** – used to suspend the loudspeaker from a ceiling when the cabinet is oriented vertically. The maximum angle is 30°, selectable in 2.5° increments.
- LH 43 **Surface mounting plate** – used to mount the LH 42 onto a flat surface such as a ceiling.
- LH 44 **Ceiling system (Horizontal)** – used to suspend the loudspeaker from a ceiling when the cabinet is oriented horizontally. The maximum angle is 30°, selectable in 2.5° increments.
- LH 45 **Wall mount 'L' bracket** – used to suspend the loudspeaker from a ceiling when the cabinet is oriented horizontally. The maximum angle is 30°, selectable in 2.5° increments.



LH 28 – Tripod stand adapter



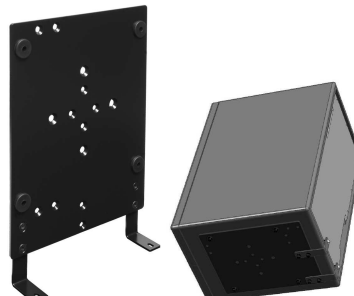
LH 29 – TV spigot adapter



LH 36 – Tilting adapter



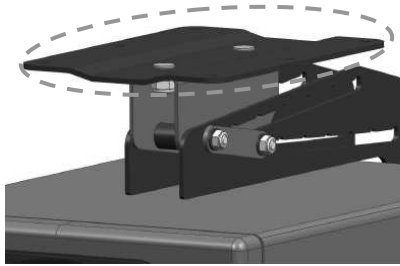
LH 37 – Tripod flange adapter



LH 41 – Base plate



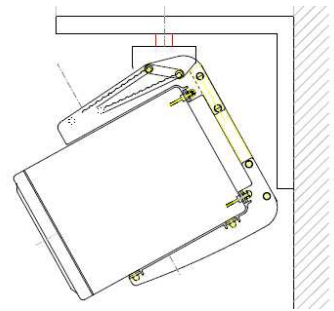
LH 42 – Ceiling system (Vertical)



LH 43 – Surface mounting plate



LH 44 – Ceiling system (Horizontal)



LH 45 – Wall mount 'L' bracket

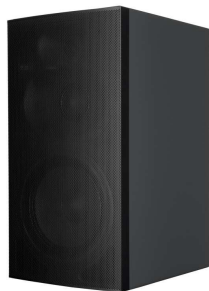
Suitable combinations of the above hardware are:

Location of Loudspeaker	Hardware Combinations
Flush Mounted	REK 1 and CP <i>nn</i> for electronics
On a Floor Stand (tripod, TV spigot, or with a 5/8" thread)	LH 41 + LH 28 LH 41 + LH 36 + LH 28 LH 41 + LH 29 LH 41 + LH 36 + LH 29
On a Subwoofer (fitted with a flange)	LH 41 + LH 37 LH 41 + LH 36 + LH 37
On a Wall	LH 42 + LH 45 LH 44 + LH 45
Off a Ceiling	LH 42 LH 42 + LH 43 LH 44 LH 44 + LH 43
Off a Lighting or Truss Bar	LH 42 + LH 29 LH 44 + LH 29

Detailed mechanical drawings of these accessories can be found on line at www.klein-hummel.com.

Metal grille (GO 410)

A metal grille (pictured below) can be attached to the front of the loudspeaker to protect the drivers. It simply clips into the grooves on the long sides of the cabinet. It is damped to avoid rattles and has been designed for acoustic transparency. The grille is available in black and silver.



Flight case (FO 410)

As the original packing is primarily designed to get the loudspeaker from the factory to the end user, it is highly recommended that a flight case (pictured above) is used if the loudspeaker is regularly moved between locations. One O 410 can be packed in each flight case.

Safety and Warnings

In addition to specific warnings throughout this document, please observe these additional general instructions. The term "loudspeaker" includes the case when the electronics of an active loudspeaker is installed into a Remote Electronics Kit, or when it is still located in the back of the cabinet.



This symbol means that a high voltage is to found nearby. Take appropriate precautions to avoid electric shocks.



This symbol means that hot parts of the product may be found nearby. Take appropriate precautions to avoid burns.

General

- Keep these instructions in a safe place for future reference.
- Failure to follow the safety and warning instructions contained in this document voids the warranty.
- This product should be used for the intention for which it was designed and as described in this document.

Environment

- 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.
- A correctly earthed mains power connection should always be used.
- If access to the interior electronics is required, disconnect it from the mains power and allow electrical energy storage devices, such as capacitors and transformers, to discharge.
- Other electronic products may generate sufficient heat to require ventilation.
- Do not block or cover heatsinks, fans, or vents.
- Unless otherwise stated, this product is designed to be used indoors only.
- Do not expose this product to water, any other liquids, moisture, or naked flames.
- Do not install this product into hot, humid, or excessively dusty locations, or into direct sunlight.
- Avoid installing this product into locations where it will experience externally generated vibrations or heat (e.g. radiators).
- If the product is moved from a cold environment into a warm one (such as from a vehicle into a building), it is possible that condensation will form. Please allow the product sufficient time for acclimatization to room temperature before using.
- Wherever an amplifier is located, a free flow of air should be maintained by leaving a gap of at least 5 cm (2") around it. A flush mounted cabinet with the electronics panel still installed should be well-ventilated to avoid heat build-up and possible risk of fire.

Use

- The equipment should be mounted by a suitably qualified professional in accordance with local, national, and international regulations and standards.
- Falling equipment can damage itself, people, and other objects, so do not place this unit on any unstable platform, cart, trolley, stand, table, or mounting hardware.
- Do not use accessories and options with this product that are not approved by Klein + Hummel.
- Mounting hardware must be attached to the appropriate hardware and attachment points rated and intended for such use.
- Ensure that the operating voltage of this product matches that of the local mains voltage.
- Use the power cable that came with this product as this has been manufactured to international safety standards. If it has been damaged obtain a similarly certified and specified mains power cable.
- This product should be unplugged from the mains power and the signal sources if is not to be used for an extended period of time, or during lightening storms.
- The power switch on this product should be set to off before applying mains power via the mains power cable.
- Some parts of this product, particularly power amplifier components, can become hot to the touch. Do not touch these parts until they have cooled down.
- Never touch the loudspeaker's drivers.
- Loudspeakers are often capable of producing a sound pressure level in excess of 85 dB. This may cause permanent hearing damage so user caution is recommended. Noise exposure is a function of SPL and time, so observe local regulations when listening at high levels for a long time. Hearing protection may be required.

Servicing

- Repairs, maintenance, or other servicing of this product when its interior compartment is exposed should only be performed by Klein + Hummel authorized service engineers familiar with the equipment and risks involved in handling electronics.
- Servicing may be required in the event of exposure to unfavorable environmental conditions, such as liquids, excessive heat, or a lightning strike.
- Amplifier outputs may carry high voltages so take appropriate precautions, for example, connect the cables before powering up.
- When replacing a fuse, ensure that a brand new fuse is used. It must be exactly the same type, value, and voltage as the original, as stated in the product's technical specifications or on the circuit board.

Maintenance and Servicing

- There are no user serviceable parts inside the standard version of this product. Repairs should only be undertaken by Klein + Hummel certified service engineer.
- Options and accessories are fitted at the user's own risk.
- Products may be cleaned using a non-abrasive cloth lightly dampened with water. Disconnect the mains power cable when cleaning to avoid risk of electric shock. Do not use alcohol-based cleaners.
- The electronics should only be opened by non-"Klein + Hummel certified service engineer" for the installation of user installable options as described in the product's operating manual. The mains power cable should be disconnected whenever the electronics panel is opened.
- If the main fuse blows, the product should be checked by a Klein + Hummel certified service engineer.

Guarantee

This product comes with a guarantee, a copy of which is enclosed with this product.

Recycling

Attention to product quality in the design phase ensures, firstly, that products have a long life and that, secondly, all parts of a product may be reused or recycled at the end of that life. An extensive product servicing network ensures that products can be repaired in the event of the premature failure of a part, or as a way to prolong the life of a product that would otherwise be considered a candidate for landfill. Eventually there comes a time when a product is considered beyond repair (for economic reasons or lack of parts), so the parts must be disposed of in a suitable manner. The disposal should conform to local environmental regulations and be conducted in an authorized recycling facility.

Loudspeakers and electronic products consist of some or all of these components:

Item	Material	Recycling Instructions
Loudspeaker Cabinets	Wood (MDF), steel, aluminum, polyurethane or a combination	Separate materials then recycle
Drivers	Aluminum, copper, paper and plastics	Separate materials then recycle
Damping Materials	Sheep wool	Compost
Electronics Panel	Aluminum	Remove electronics and recycle
Electronics	Various	Recycle in an approved recycling facility
Remote Electronics Kits	Steel and some electronics	Separate materials then recycle
Cables and Connectors	Metals and/or plastic	Reuse or recycle
Packing Material	Cardboard, wood and/or plastics	Separate materials then recycle
User Manuals and Sales Literature	Paper and cardboard	Recycle

EC Declaration of Conformity

This equipment is in compliance with the essential requirements and other relevant provisions of Directives 89/336/EC and 73/23/EC. The declaration is available on the internet site at www.klein-hummel.com. Before putting the device into operation, please observe any respective country-specific regulations.

For loudspeakers fitted with digital inputs: Compliance to FCC Rules

This device complies with part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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

Changes or modifications to this equipment not expressly approved by Klein + Hummel may void the FCC authorization to operate this equipment.

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- "Low Resonance Integral Molding" and "LRIM"
- "Mathematically Modeled Dispersion" and "MMD"
- "Accelerated Heat Tunneling" and "AHT"

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Klein + Hummel reserve the right to change product specifications without notice. Exceptions and omissions excluded.

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