



# KUDO™

THE INCREDIBLE INNOVATION OF  
**WAVEFRONT  
SCULPTURE  
TECHNOLOGY®**

## L-ACOUSTICS PROFESSIONAL SOUND SYSTEM

L-ACOUSTICS® KUDO is a new generation of line source array offering far more flexibility and possibilities than any other line array to date. KUDO marks a significant evolution in L-ACOUSTICS pioneering Wavefront Sculpture Technology® (WST) since WST can now be performed in both vertical and horizontal planes simultaneously.

Two patented DOSC waveguides are incorporated in KUDO, allowing WST to be performed either vertically or horizontally. In parallel, coverage pattern adjustment is available in the perpendicular plane using patent-pending K-Louver technology. Mechanically-adjustable K-Louvers provide directivity control for the mid/high section and allow KUDO to be reconfigured with four different coverage pattern settings.

KUDO combines the functions of a variable-curvature vertical line source array (like V-DOSC®) and a constant-curvature horizontal line source array (like ARCS®). When used as a vertical line source array, inter-enclosure angles are 0-10° at 1° resolution and the horizontal directivity can be configured as: 50° (symmetric); 110° (symmetric); 25° x 55° (asymmetric) or 55° x 25° (asymmetric). Within the same array, individual enclosures can be configured with different horizontal directivity depending on the shape, width and reverberation properties of the venue, making KUDO extremely flexible with respect to audience geometry matching.

When installed horizontally as a constant curvature line source array, 10° inter-enclosure angles are employed and the horizontal coverage is 10° x N (where N is the number of enclosures). Vertical directivity can then be configured as: 50° (symmetric); 110° (symmetric); 25° x 55° (asymmetric - up) or 55° x 25° (asymmetric - down).

Given the choice of 4 directivity settings and 2 orientation possibilities, KUDO provides the performance equivalent of 8 different loudspeakers. Having such unprecedented flexibility in a high-power, medium format system makes KUDO truly unique.

### APPLICATIONS

L-ACOUSTICS KUDO is primarily intended for end users such as regional sound companies for touring or corporate applications and for high-performance permanent installation in theatres, concert halls, houses of worship, sports facilities, clubs, congress centres, hotel ballrooms, theme parks or arenas. As a full range 3-way system, KUDO can be used for corporate, classical or theatrical sound reinforcement without subwoofers due to its exceptional low end performance. For touring applications, the addition of SB118 or SB218 subwoofers is recommended.

A complete turnkey system is available consisting of KUDO enclosures, dedicated rigging, SB118 or SB218 subwoofers, OEM factory presets for approved digital signal processors, turnkey power amplifier racks and associated loudspeaker plus signal distribution panelling and cables. All elements of the KUDO system have been selected for their quality and durability and there is a strong emphasis placed on complementary technical support and training.



- ▶ **Vertical line source array (inter-enclosure angles up to 10°) with adjustable horizontal coverage**
- ▶ **Active 3-way enclosure (2 x 12" LF, 4 x 5" MF, 2 x 1" HF)**
- ▶ **Vertical or horizontal WST-based line source design**
- ▶ **Adjustable polar pattern (50° or 110° symmetric) (25°/55° or 55°/25° asymmetric)**
- ▶ **Modular horizontal line source array (10° per enclosure) with adjustable vertical coverage**
- ▶ **Designed for high performance fixed installation and touring**
- ▶ **Ergonomic, captive rigging system**

### SPECIFICATIONS

L-ACOUSTICS specifications are based on measurement procedures which produce unbiased results and allow for realistic performance prediction and simulations. Some of these specifications will appear very conservative when compared with other manufacturer's specifications. All measurements are conducted under free field conditions and scaled to a 1 m reference distance unless otherwise indicated.

#### Frequency Response

Frequency response	50 - 18k Hz (± 3 dB)	(3WX preset)
Usable bandwidth	40 - 20k Hz (- 10 dB)	

#### Sensitivity<sup>1</sup>

LF	96 dB SPL	50 - 300 Hz
MF	102 dB SPL	300 - 2k Hz
HF	115 dB SPL	2 - 18 kHz

#### Power Rating<sup>2</sup>

	Power Rating <sup>2</sup>		Amplification	Impedance
	(Long Term)	(Recommended)	(Recommended)	(Nominal)
LF	2x 60 Wrms	2x 450 Wrms	2x 1800 Wpeak	2x 8 ohms
MF	50 Wrms	315 Wrms	1250 Wpeak	8 ohms
HF	24 Wrms	75 Wrms	300 Wpeak	8 ohms

#### Nominal Coverage (vertical WST line source) (-6dB)<sup>3</sup>

Horizontal	symmetrical	50° or 110° (+0° - 10°)
	asymmetrical	25°/55° or 55°/25°
Vertical	defined by the array	0°-10° inter-enclosure angles at 1° resolution

#### System Output<sup>4</sup>

	Continuous SPL (flat array)	Continuous SPL (maximum curvature array)
One enclosure	130 dB	130 dB
Two enclosures	136 dB	133 dB 20° vertical coverage
Four enclosures	142 dB	135 dB 40° vertical coverage

#### Components

LF	2 x 12" weather-resistant loudspeakers (4" voice coil, bass-reflex loaded)
MF	4 x 5" weather-resistant loudspeakers
HF	2 x 1" compression drivers mounted on patented DOSC waveguide module

<sup>1</sup> Sensitivity is the average SPL measured over the component's rated bandwidth (50° K-Louver setting)

<sup>2</sup> Power rating displays the long term RMS power handling capacity using pink noise with a 10 dB crest factor over the component's rated bandwidth

<sup>3</sup> Directivity is averaged over the 1-10 kHz range

<sup>4</sup> System Output gives the unweighted SPL output of the system referenced to 1 m, including preset equalization and band leveling adjustment as measured under freefield conditions using the 3WX preset and 50° K-Louver setting

#### Enclosure

- Width 876 mm 34.5 in
- Height 356 mm 14 in
- Depth 689 mm 27.1 in
- Weight (net) 87 kg 191.4 lbs
- Shipping Weight 90 kg 198 lbs
- Shipping Dims 390 x 730 x 920 mm 15.35 x 28.74 x 36.22 in
- Connectors : 2x Neutrik Speakon NL8
- Material : 15 mm, 30 mm Baltic birch plywood
- Finish : Maroon-gray™
- Grill : Black epoxy perforated steel with acoustically transparent, technically-advanced grille cloth
- Rigging : Integrated flying hardware and handles

#### Additional Equipment

- OEM factory presets for approved digital processors
- L-ACOUSTICS SB118, SB218 subwoofers
- L-ACOUSTICS LA24a or LA48a power amplifier

## ARCHITECT SPECIFICATIONS

The enclosure shall be an active, 3-way loudspeaker containing two direct radiating, bass reflex-loaded 12-inch low frequency transducers, four 5-inch midrange frequency transducers mounted in a V-shaped configuration and two 1" exit compression drivers coupled to individual waveguides. As a full range system, frequency response shall be 50 Hz to 18 kHz with less than  $\pm 3$  dB variation and the usable bandwidth shall be 40 Hz to 20 kHz (-10 dB).

Individual waveguides employed in the loudspeaker shall generate a flat, isophasic wavefront for the high frequency section. When arrayed horizontally or vertically, multiple loudspeakers shall function according to the principles of Wavefront Sculpture Technology whereby the separation between acoustic centers of individual sound sources shall be less than the size of half the wavelength at the highest frequency of their operating bandwidth or the sum of the individual areas of the isophasic radiating elements shall be greater than 80 percent of the target radiating area and the radiated wavefront of individual enclosures shall have less than 5 mm variation with respect to a flat wavefront.

Components shall be configured in a coplanar symmetric arrangement and provide modular coverage angles (-6 dB points) of 50 degrees (symmetric); 110 degrees (symmetric); 25/55 degrees (asymmetric); or 55/25 degrees (asymmetric) independent of the number of arrayed elements.

Crossover points shall be 300 Hz between low and midrange sections and 2 kHz between midrange and high sections with 24 dB per octave Linkwitz-Riley characteristics. Long term power handling shall be 2 x 450 Wrms, 315 Wrms and 75 Wrms for low, midrange and high sections, respectively. Low frequency transducers shall be powered individually at a nominal 8-ohm impedance, midrange frequency transducers shall be connected in series/parallel at a nominal 8-ohm impedance and high frequency transducers shall be connected in parallel at a nominal 8-ohm impedance. Connection to the loudspeaker shall be made via two parallel 8-pin Neutrik NL8 Speakon connectors.

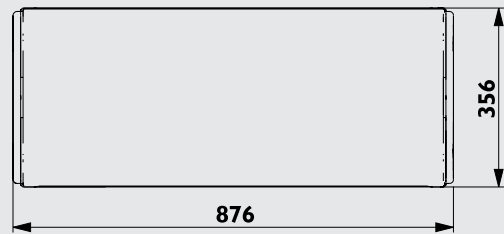
The enclosure shall have a truncated trapezoidal shape with trapezoidal angles of 5 degrees top and bottom. Dimensions shall be 87.6 cm (34.5-in) wide, 35.6 cm (14-in) high, 68.9 cm (27.1-in) deep and the enclosure weight shall be 87 kg (191.4 lbs). Cabinet construction shall consist of 15 mm (0.59-in), 30 mm (1.18-in) Baltic birch plywood with internal steel bracing and joints that are sealed, screwed and rabbeted. The finish shall be maroon-gray, high-resilient paint. The front of the enclosure shall be protected by a black powder-coated, 1.5 mm (0.06 in) thick steel grill that is covered with acoustically-transparent, highly-resistant, technically-advanced grille cloth.

Loudspeaker enclosures shall be installed vertically or horizontally using dedicated rigging bumpers. The enclosure shall have a captive rigging system with two rotating arms mounted internally on both sides that allow up to 21 enclosures to be assembled in a vertical column with variable angles between enclosures up to a maximum of 10 degrees at 1 degree angular resolution.

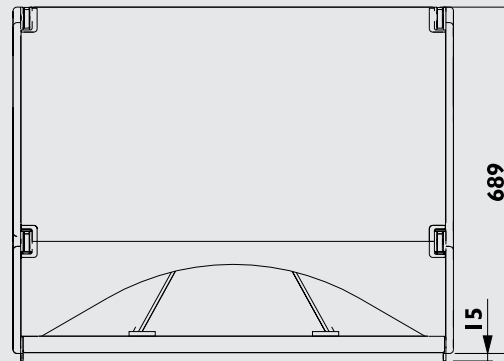
The loudspeaker shall be used with an approved digital processor with OEM factory presets for active 3-way or 4-way operation in conjunction with additional subwoofer enclosures.

The loudspeaker system shall be the L-ACOUSTICS KUDO.

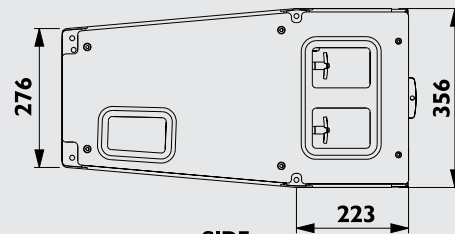
The subwoofer system shall be the L-ACOUSTICS SB118 or SB218.



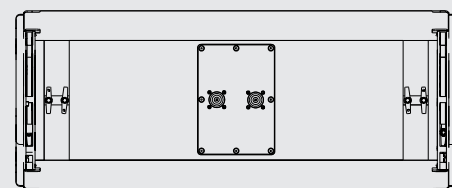
FRONT



TOP



SIDE



REAR

SCALE 1:15

(Dimensions in mm)

## ACCESSORIES

<b>K-COVx2</b>	2x protective covers for KUDO enclosures (recommended for touring)
<b>K-PLA</b>	Removable front dolly with castors (recommended for touring)
<b>K-BUMP</b>	Rigging / stacking bumper for installing KUDO vertically
<b>K-LIFT</b>	Rigging bumper for installing KUDO horizontally
<b>PADO2K</b>	Amplifier patch panel for 2x L-ACOUSTICS LA power amplifiers
<b>RK122K</b>	Power amplifier rack including PADO2K panel, suitable for 2x L-ACOUSTICS LA amplifiers, (powers 3 KUDO enclosures)
<b>RK124K</b>	Power amplifier rack including 2x PADO2K panels, suitable for 4x L-ACOUSTICS LA amplifiers, (powers 6 KUDO enclosures)

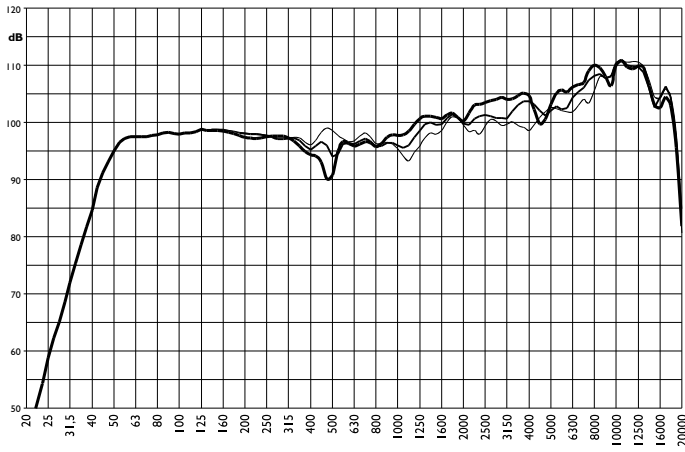
<b>DOS.7</b>	8 conductor loudspeaker cable, 0.7m length (Speakon NL8 connectors)
<b>DOS10</b>	8 conductor loudspeaker cable, 10 m length (Speakon NL8 connectors)
<b>DOS25</b>	8 conductor loudspeaker cable, 25 m length (Speakon NL8 connectors)
<b>DOSFILL</b>	Adapter cable, male barrel CA-COM8 to Speakon NL8 (for use with DO7 or DO25 cables)
<b>CO6</b>	Control Output panel for standalone amplifier rack configurations
<b>DOM2</b>	6 pair signal modulation cable, 2 m length
<b>DOM30</b>	6 pair signal modulation cable, 30 m length
<b>DOMP</b>	male/male adapter for use with DOM2, DOM30
<b>DOMM</b>	link breakout 6 pair breakout to male XLR
<b>DOMF</b>	link breakout 6 pair breakout to female XLR



# KUDO™

PERFORMANCE  
DATA

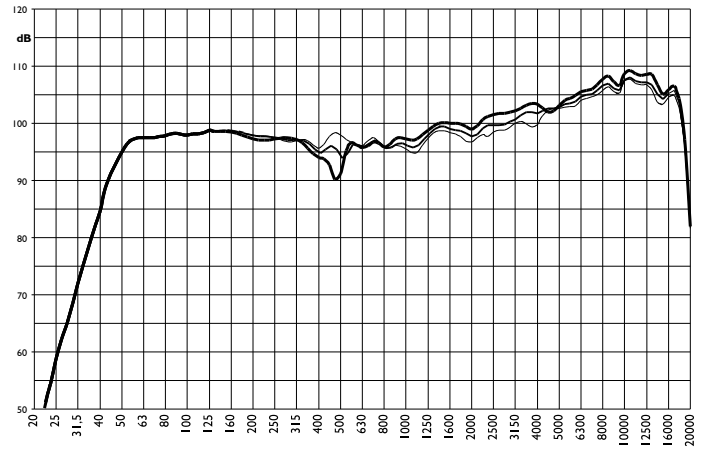
## ON AXIS FREQUENCY RESPONSE



with 3WX preset

- 110° K-Louver setting
- 25°/55° or 55°/25° K-Louver setting
- 50° K-Louver setting

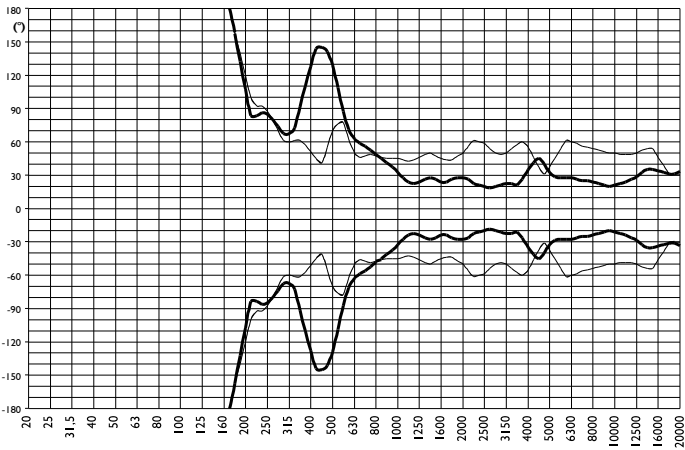
## AVERAGED FREQUENCY RESPONSE



averaged over 40° horizontal angle with 3WX preset (vertical mode)

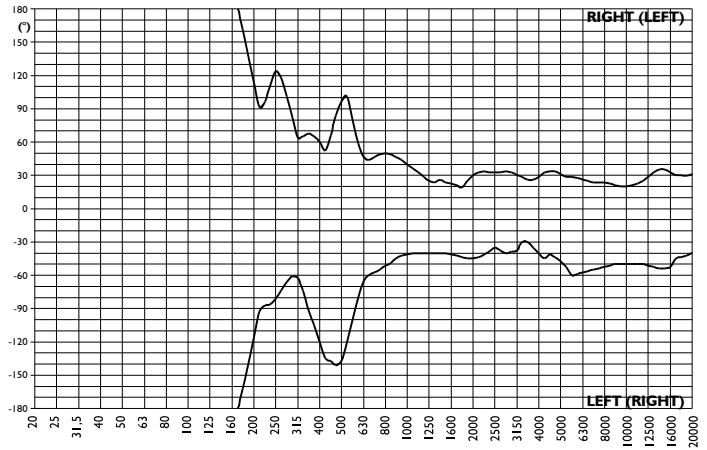
- 110° K-Louver setting
- 25°/55° or 55°/25° K-Louver setting
- 50° K-Louver setting

## BEAMWIDTH (-6dB)



- 110° K-Louver setting
- 50° K-Louver setting

## BEAMWIDTH (-6dB)



- 55°/25° K-Louver setting Asymmetric - LEFT  
(25°/55° K-Louver setting Asymmetric - RIGHT)



# WAVEFRONT SCULPTURE TECHNOLOGY®

The first task of sound engineers and audio consultants is to design sound reinforcement systems for a predefined audience area. Performance expectations in terms of clarity, coherence, sound pressure level (SPL) and coverage consistency have progressively increased over the years while at the same time the size of the audience has grown, inevitably leading to an increase in the number of loudspeakers.

In the past, conventional horn-loaded trapezoidal loudspeakers were typically assembled in fan-shaped arrays according to the nominal horizontal coverage angle of each enclosure in an attempt to reduce coverage overlap that causes destructive interference. With this type of arrangement, the optimum clarity available in one direction could only be provided by the individual enclosure facing in this direction. Attempts at "flattening the array" to achieve greater throw and higher SPLs resulted in severe interference in an uncontrolled way, affecting coverage, pattern control, intelligibility and overall sound quality. Even when arrayed according to specification (always an "optimum" compromise since the polar response of individual horns varies with frequency), the sound waves radiated by individual horn-loaded loudspeakers do not couple coherently thus the conventional system approach is fundamentally flawed. Furthermore, the chaotic sound fields created by interfering sound sources waste acoustic energy, thus requiring more power than a single, coherent source would in order to achieve the same SPL.

As an illustration of this principle, imagine throwing some pebbles into a pool of water. If one pebble is thrown into the water, circular waves will expand concentrically from the point where it entered. If a handful of pebbles are thrown into the water, we observe the equivalent of a chaotic wavefield. If we throw in a single larger stone, having total size and weight equal to the handful of pebbles, then we again see circular waves as for the case of the single pebble - only now with a much larger amplitude.

## A Single Sound Source From Many Speakers

The initial specification for the Wavefront Sculpture Technology® (WST) research and development program was the design of a single acoustic source that is completely modular and adjustable while providing a totally coherent, predictable wavefield. In 1988, an early L-ACOUSTICS system called "Incremental" proved the project's feasibility. Based on this experimental concept, Professor Marcel Urban and Dr. Christian Heil began theoretical research and presented their findings at the 92nd AES Convention in Vienna in 1992 (Preprint #3269). The theory that was developed defines the acoustic coupling conditions for successfully arraying individual sound sources - including wavelength, the shape of each source, their surface areas

and their relative separation.

Briefly, the coupling conditions can be summarized as follows:

An assembly of individual sound sources arrayed following a regular step distance on a planar or curved continuous surface is equivalent to a single sound source having the same dimensions as the total assembly if one or both of the following two conditions are fulfilled :

1) Frequency: The step distance (distance between the acoustic centers of individual sources) is smaller than half the wavelength over the operating bandwidth.

2) Shape: The wavefronts generated by individual sources are planar and together fill at least 80 percent of the total radiating surface area.

Additional conditions were published in the Audio Engineering Society journal paper "Wavefront Sculpture Technology", JAES Vol. 51, No. 10, October 2003. The first two WST conditions were re-derived (based on an intuitive approach using Fresnel analysis) and in addition it was shown that:

3) Deviation from the ideal, target wavefront (flat or curved) must be less than a quarter wavelength at the highest operating frequency (this corresponds to less than 5 mm curvature at 16 kHz)

4) For curved arrays, enclosure tilt angles should vary in inverse proportion to the listener distance (geometrically this is equivalent to shaping variable curvature arrays to provide equal spacing of individual enclosure impacts on the audience listening plane)

5) Limits exist concerning the size of each enclosure, the minimum allowed listener distance and the relative angles that are allowed between enclosures.

L-ACOUSTICS defines the practical implications of these conditions as Wavefront Sculpture Technology. The first WST condition dictates the design constraints for achieving single sound source performance at lower frequencies. By loading high-frequency compression drivers with the L-ACOUSTICS "DOSC" waveguide it is possible to meet the second WST condition at higher frequencies. Since WST conditions are satisfied over the entire audio bandwidth, the sound engineer or designer is provided with a "single" loudspeaker with well-defined coverage and wavefront shape, thus allowing the geometrical distribution of energy to be precisely installed to match the geometry of the audience seating area.

L-ACOUSTICS KUDO™, ARCS®, dV-DOSC and V-DOSC® are true line source arrays. KUDO, dV-DOSC and V-DOSC are designed for large audiences and long-throw applications while ARCS is suitable for medium-throw needs. All use the heart of Wavefront Sculpture Technology - the patented DOSC Waveguide - to achieve remarkable results.



Specifications subject to change without notice

Specs KUDO 0305

[www.l-acoustics.com](http://www.l-acoustics.com)

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