WELES WA301

3D PU Sound Intensity Probe

KEY FEATURES:

- Direct measurement of sound pressure and triaxial particle velocity
- Omnidirectional pressure sensor

Weles Acoustics WA301 is a general purpose 3D sound intensity probe which relies on direct measurement of sound pressure and triaxial particle velocity. Nearly full acoustic bandwidth can be analyzed from just one measurement - no spacers required.

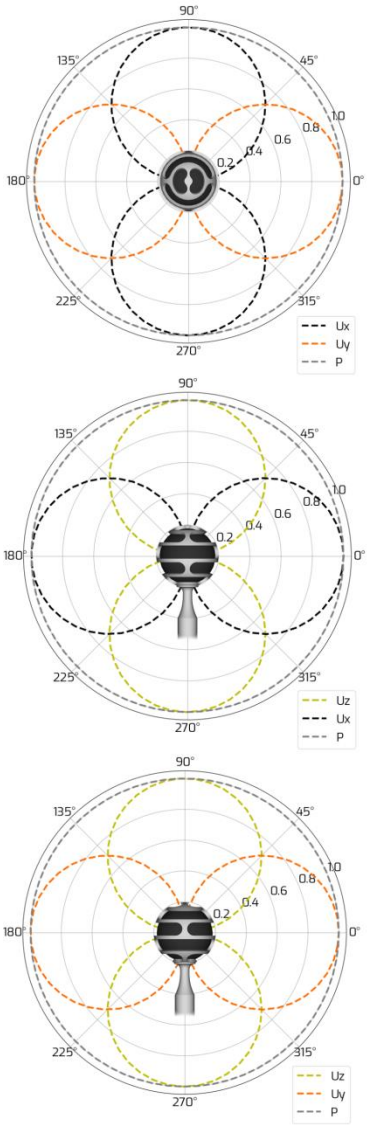
WELES ACOUSTICS SP. Z O.O.
PRZEMYSŁOWA 13, 44-200, RYBNIK, POLAND

KEY APPLICATIONS:

- Near field and Far field sound source localization and ranking – highest performance and accuracy is achieved with particle velocity measurements
- 3D Particle velocity mapping
- 3D Sound intensity mapping
- Sound power measurement
- Sound pressure measurement
- 3D Sound field visualization

TECHNOLOGY:

Sound intensity is defined as the product of sound pressure and particle velocity. The WA301 sound intensity probe consists of four acoustic transducers: sound pressure microphone and three orthogonally positioned Weles particle velocity sensors. Each particle velocity sensor is responsible for measurements in a different axis – X, Y and Z respectively. Since the particle velocity and sound pressure are measured directly, the three-dimensional sound intensity vector can be determined in the entire frequency range covered by WA301 probe. No standards yet exist for measuring 3D sound intensity with PU probes.



Weles Acoustics designs and manufactures particle velocity transducers. Particle velocity is a physical quantity that together with sound pressure fully characterizes any sound field. Intrinsic characteristics of particle velocity physics coupled with distinctive features of the Weles sensor make it a unique tool for sound source localization. Working principle of the particle velocity sensor is similar to a hot wire anemometer. The sensor consists of several thin platinum strings. These strings are heated to a near incandescent temperature. Passing sound waves alter the temperature, and in turn the electrical resistance of the heated strings. The resulting voltage difference is proportional to the acoustic particle velocity.

The Weles particle velocity sensor is directional. Its polar pattern resembles a figure-of-eight. It is a bi-directional transducer. Thanks to this trait, each particle velocity sensor can be employed to measure the particle velocity in one axial direction. The sensing elements of the WA301 3D PU probe are enclosed in a spherical housing. The diameter of the sphere is 4 cm. The spherical housing is engineered to provide maximum acoustic transparency within the probes operating frequency range. Furthermore, the spherical shape ensures that the housing itself does not alter the measured sound field. All sensing elements of the WA301 PU probe are positioned at the center of the sphere and occupy a volume approximately 0.216 cm^3.

DESIGN:

The casing of WA301 3D sound intensity probe is built out of high quality stainless steel. The head of the probe was engineered to provide maximum acoustic transparency while maintaining protection for all sensing elements from particles of dust, sand or oil. The robust and durable spherical housing encloses 3D printed mechanical sound amplifiers that are built around the Weles particle velocity sensors and the microphone.

The mechanical amplifiers are designed to increase the signal-to-noise ratio of the velocity transducer. All sensing elements of the WA301 PU probe are positioned at the center of the spherical housing. Thanks to this unique architecture, sound intensity is measured almost exactly at the same point. The distance separating all sensing elements is smaller than 6mm making the WA301 a very compact and capable solution. Additional layer of protection for the sensing elements is realized by a foam insert which fills the inside of the WA301 spherical housing. The purpose of the foam insert, apart from protecting from particle ingress, is to decrease the impact of DC airflow on particle velocity measurements.

WA301 probe is built, assembled and tested by Weles Acoustics. Each probe is calibrated and mechanically tested to withstand minor shocks and excessive vibration – This PU sound intensity probe is built to endure. See specification for details.

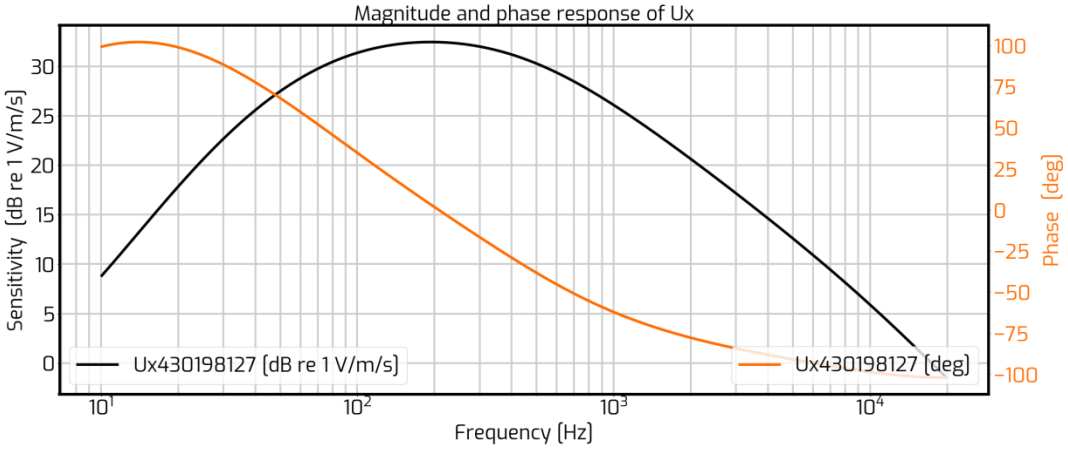
Each WA301 probe is delivered with a Weles BOX. Connection between the probe and the BOX is established with a 7-pin LEMO cable. The Weles BOX is designed to provide power to all sensing elements built into the probe. Furthermore, the Weles BOX acts as an interface between any data acquisition system that is meant to process analog signals provided by the probe. For WA301 probe, four signals are provided over four BNC connectors: one sound pressure signal and three particle velocity signals (one signal for each axis X,Y and Z). The Weles BOX does not act as a pre-amplifier for the transducers inside the probe. Transducer pre-amplifiers are integrated inside the probe housing.

SPECIFICATIONS:

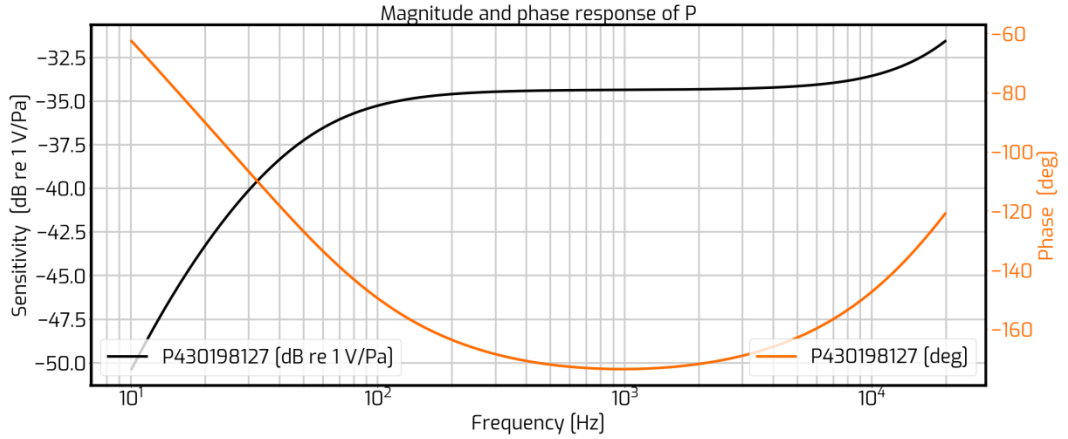
Parameter	Particle Velocity X, Y and Z axis	Sound Pressure	Sound Intensity X, Y and Z axis
Frequency range (±2 dB)	20 Hz to 10 kHz	20 Hz to 10 kHz	20 Hz to 10 kHz
Total self-noise (20 Hz – 10 kHz)	46 dB (A)	30 dB (A)	46 dB (A)
Dynamic range upper limit (<3% THD)	136 dB SVL	136 dB SPL	136 dB SIL
Output Voltage Swing	10 Vpp	10 Vpp	-
Temperature range, operation	-20 to 85 °C	-20 to 85 °C	-20 to 85 °C
Temperature range, storage	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C
Temperature coef. @250 Hz	-0.0517 dB/°C	-0.0235 dB/°C	-0.0517 dB/°C
Static pressure coef. @250 Hz	<0.5 dB/kPa	<0.5 dB/kPa	<0.5 dB/kPa
Humidity coef. @250 Hz	0.06 dB/%RH	0.05 dB/%RH	0.06 dB/%RH
Maximum DC airflow	1.5 m/s		
Connector type	Lemo 7p EGG-1B-307		
Weight	78g (WA301 Probe)/365g (Weles BOX WA301)		
Dimensions	153.4/12.7/40mm Length/Tube diameter/Sphere diameter		
CE/RoHS compliant	Yes/Yes		

Weles Acoustics reserves the right to change specifications without notice.

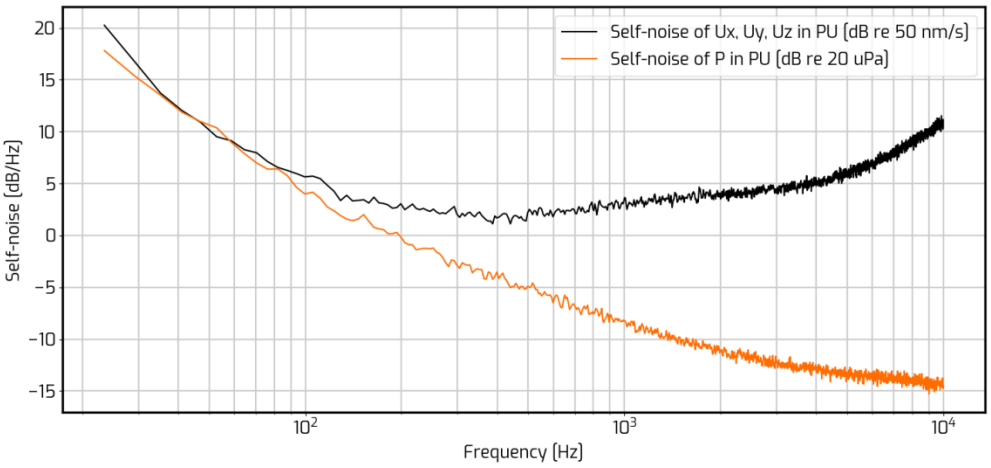
TYPICAL FREQUENCY RESPONSE – PARTICLE VELOCITY SENSOR:



TYPICAL FREQUENCY RESPONSE – SOUND PRESSURE MICROPHONE:



TYPICAL SELF-NOISE – SOUND PRESSURE MICROPHONE/PARTICLE VELOCITY SENSOR:



CALIBRATION:

Calibration of the WA301 probe is carried out in a two-step process. The first calibration step is carried out in a stainless steel standing wave tube. The WA301 PU intensity probe is positioned in the middle of the tube while a reference microphone is fixed at the rigid end of the tube. The ratio between particle velocity (u) and reference sound pressure (p_{ref}) is determined. Direct comparison of measured u/p_{ref} ratio with the known theoretical value of the same ratio, allows obtaining the amplitude calibration curve for any given frequency (within the tubes limits). The same technique is employed to establish the amplitude calibration curve of the sound pressure (p) transducer. Phase mismatch between p and u sensors is determined, by measuring the transfer function between u and p, The reference sound pressure is not used in this case. The same technique is employed to calibrate each of the three particle velocity sensors. The standing wave tube calibration determines the low frequency and phase response of each transducer in the WA301 PU probe.

The second calibration step allows obtaining the mid-high frequency and phase response of each transducer in the WA301 PU probe. Calibration measurements are carried out in a semi-anechoic room, relying on a Piston on a sphere setup. Data acquired in both calibration steps is combined to obtain a broadband characterization of all four transducers in the WA301 PU probe.

Calibration techniques employed and perfected at Weles Acoustics ensure a precise and reliable measurement of 3D particle velocity, sound pressure and 3D sound intensity. All particle velocity sensors and microphones are calibrated in a controlled laboratory environment. Each probe manufactured at Weles Acoustics is delivered with an individual traceable calibration certificate. State of the art equipment is used to complete the calibration process and ensure a high quality product. We recommend to recalibrate the probe every year at Weles Acoustics headquarters.

WARRANTY AND QUALITY ASSURANCE:

Sound intensity probes manufactured at Weles Acoustics are built from high quality materials carefully picked during the probes' design stage. The WA301 is covered by a 2 year warranty period. The warranty period covers any and all equipment failures not caused by negligent use, or purposeful mishandling. The warranty does not cover damages caused by using a third party power supply or third party cable that connects the WA301 probe with Weles BOX.

All probes manufactured by Weles Acoustics can be covered by Weles Quality Assurance Program. As a member of this program, any service needs of your probe will be handled by skilled and dedicated Weles Acoustics staff. We will take care of recalibrating your probe at annual intervals and make any necessary repairs should they be required. This service will be rendered as long as you wish to remain a member of the program. For more information please contact us at info@weles-acoustics.com.

SERVICE:

WA301 Sound Intensity probe is fully serviceable. Nearly any component of the system can be replaced, repaired or recalibrated. All maintenance and repair tasks are carried out at Weles Acoustics headquarters in Poland. Cost estimates for repairs are provided on a case by case basis. For members of the Weles Quality Assurance Program all service needs are covered at a fixed annual cost.

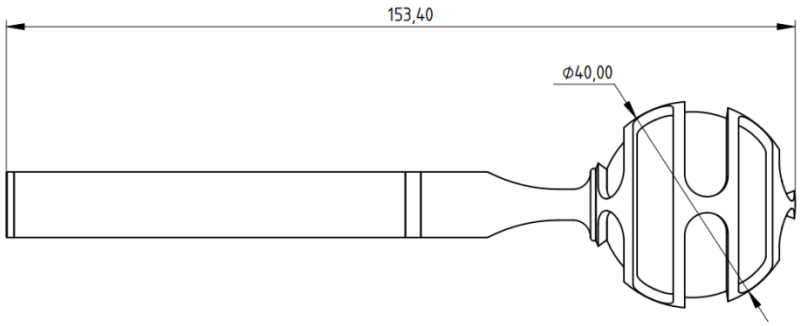
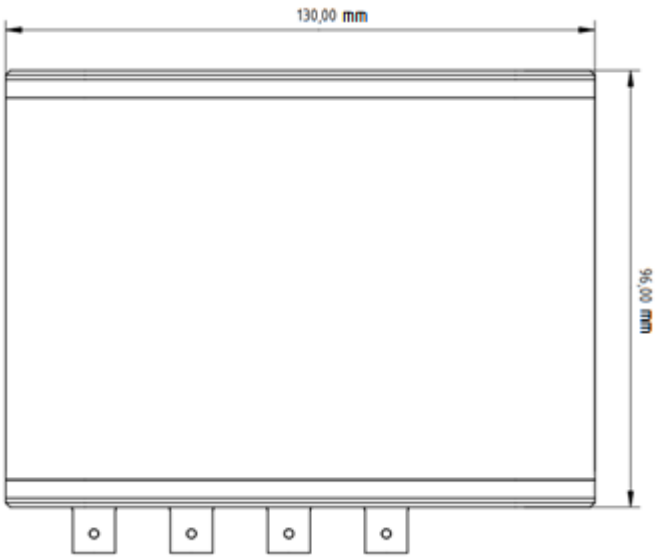
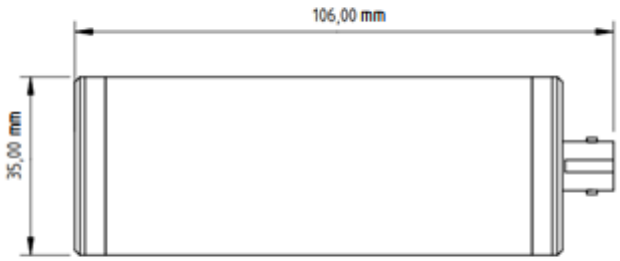
SYSTEM COMPONENTS:

The WA301 PU Sound Intensity probe comprises the following items:

- WA301 3D Sound Intensity probe
- Weles BOX WA301
- 7 pin male LEMO to 7 pin male LEMO cable
- 5V Power supply
- Protective case
- Calibration certificate

DIMENSIONS:

WA301 3D Sound Intensity probe:



Weles BOX WA301: