Brüel & Kjær

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Sound Intensity Measurements with LAN-XI

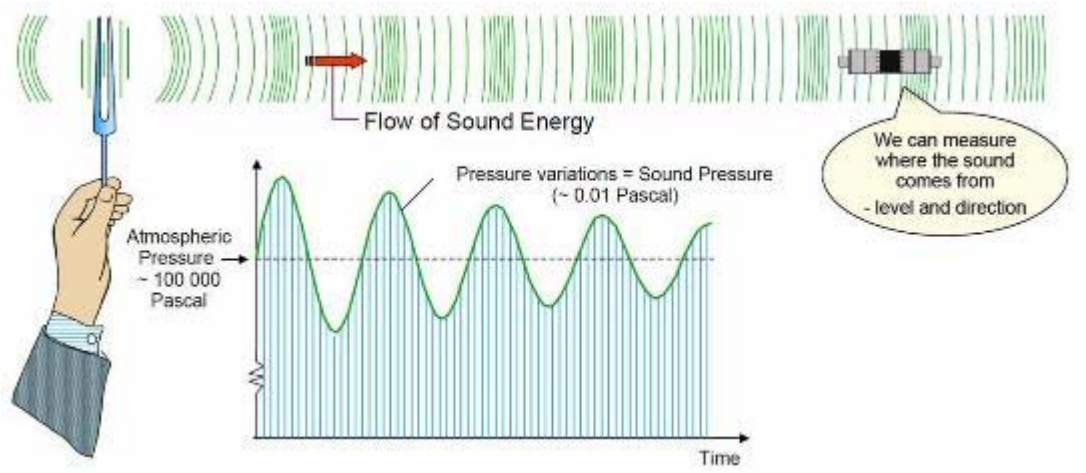
Sound intensity is a versatile tool to measure the magnitude and direction of the energy in a sound field. The measurement technique is used for a variety of applications such as the determination of sound power, sound absorption and sound transmission.

Sound intensity – The fundamentals

Sound intensity is defined as the rate of acoustic energy flow per unit area and is measured in W/m^2.

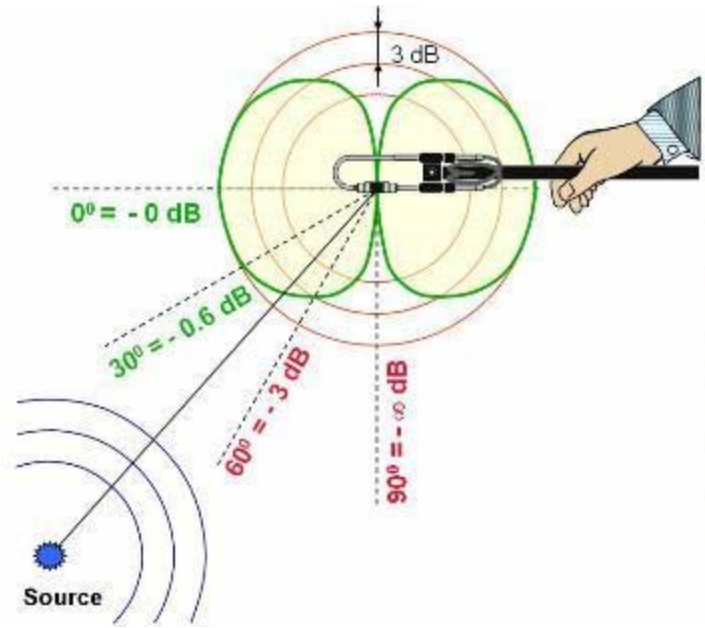
Acoustic energy is normally called **sound power** – measured in watts – and is defined as the rate at which airborne sound is radiated by a source. **sound pressure** – measured in pascals – is defined as the fluctuating pressure superimposed on the static pressure by the presence of sound.

Sound intensity is calculated from the product of the sound pressure and the particle velocity. While sound pressure can easily be measured directly, the particle velocity is usually determined by a finite difference approximation. This requires two phase-matched microphones in a face-to-face configuration as shown below.



Noise source location and quantification

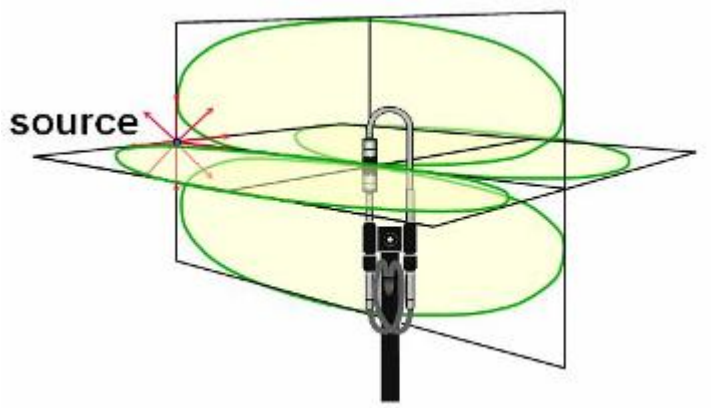
A sound intensity probe's sensitivity varies with the angle of incidence as shown in the diagram below. The probe has full sensitivity at 0 degree incident and, in theory, full damping at 90 degree incident.



0	cos 0	dB
0°	1	0
12°	0.98	- 0.1
27°	0.89	- 0.5
37°	0.79	- 1
60°	0.5	- 3
84°	0.1	-10
89°	0.01	- 20
90°	0	- ∞

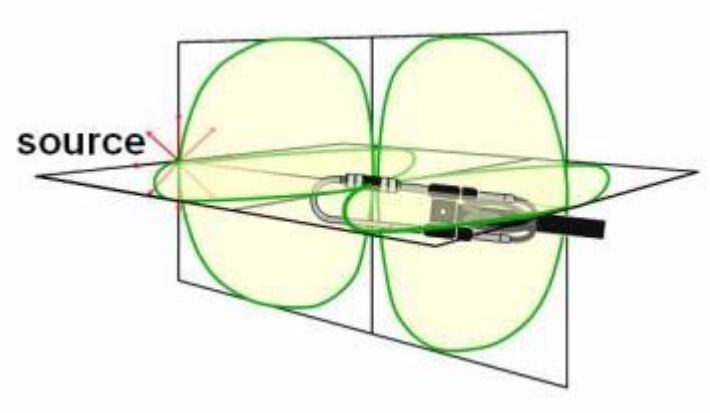
Locating a source

This sensitivity characteristic is quite useful when locating a source, as the location of the sound source is perpendicular to the probe when the measured sound intensity is minimum, as illustrated below.



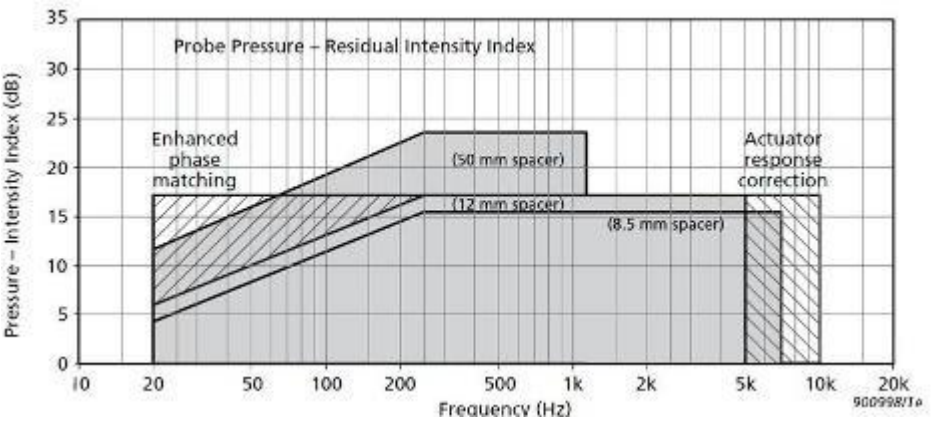
Measuring a source

To measure the sound intensity of the source, point the probe towards the source.



Frequency range

The useful free-field frequency range, according to IEC 1043 Class I for Sound Intensity Probe Kits using various microphone and spacer combinations, is from 1/3-octave centre frequencies of 50 Hz to 6.3 kHz. However, using the actuator response correction, the frequency response can be extended to 10 kHz using just the 12 mm spacer.

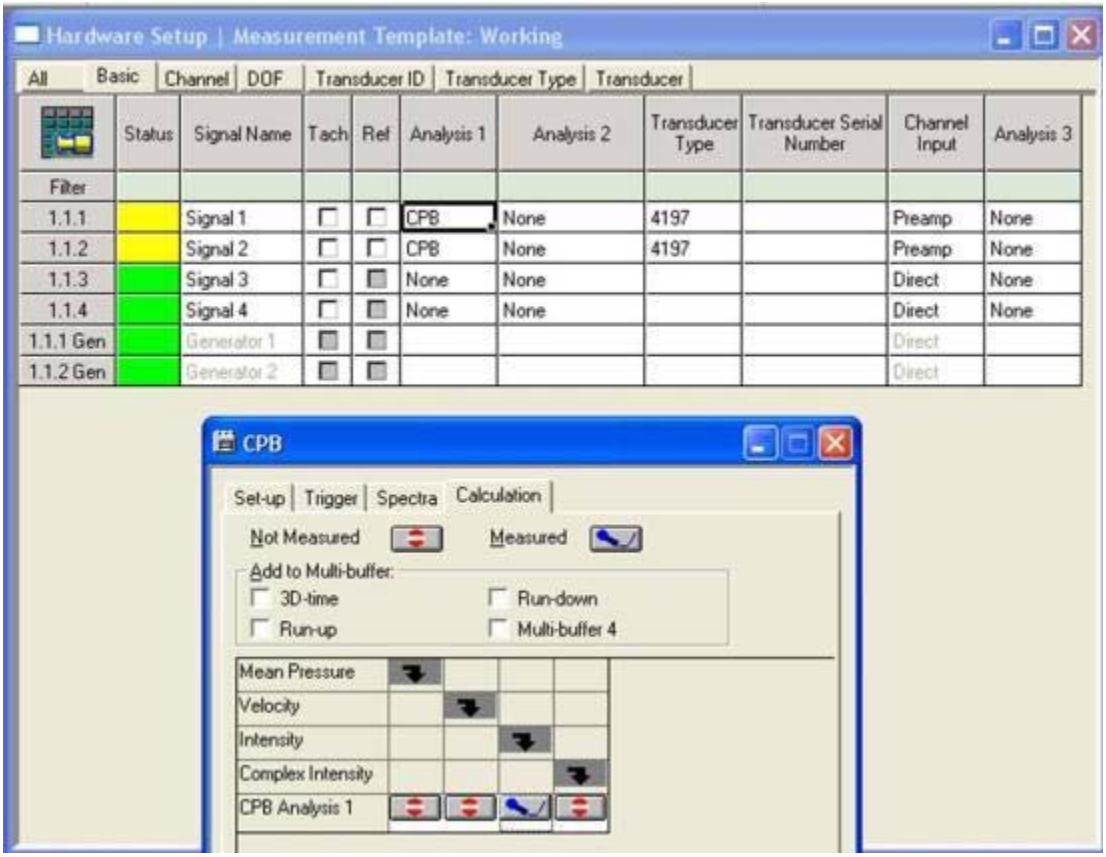


Specified frequency and Pressure-Residual Intensity Index ranges for the probe (Pressure-Residual Intensity Index = Pressure level - Intensity level (measured in a closed coupler)). Frequency axis is in 1/3-octave centre frequencies.

Setting up a simple sound intensity measurement with LAN-XI and PULSE

In this example, we use a LAN-XI module with a sound Intensity front panel UA-2104, a Sound Intensity Probe Kit Type 3599 and PULSE LabShop 7700 / 7771, as sound intensity is a part of the CPB Analyzer.

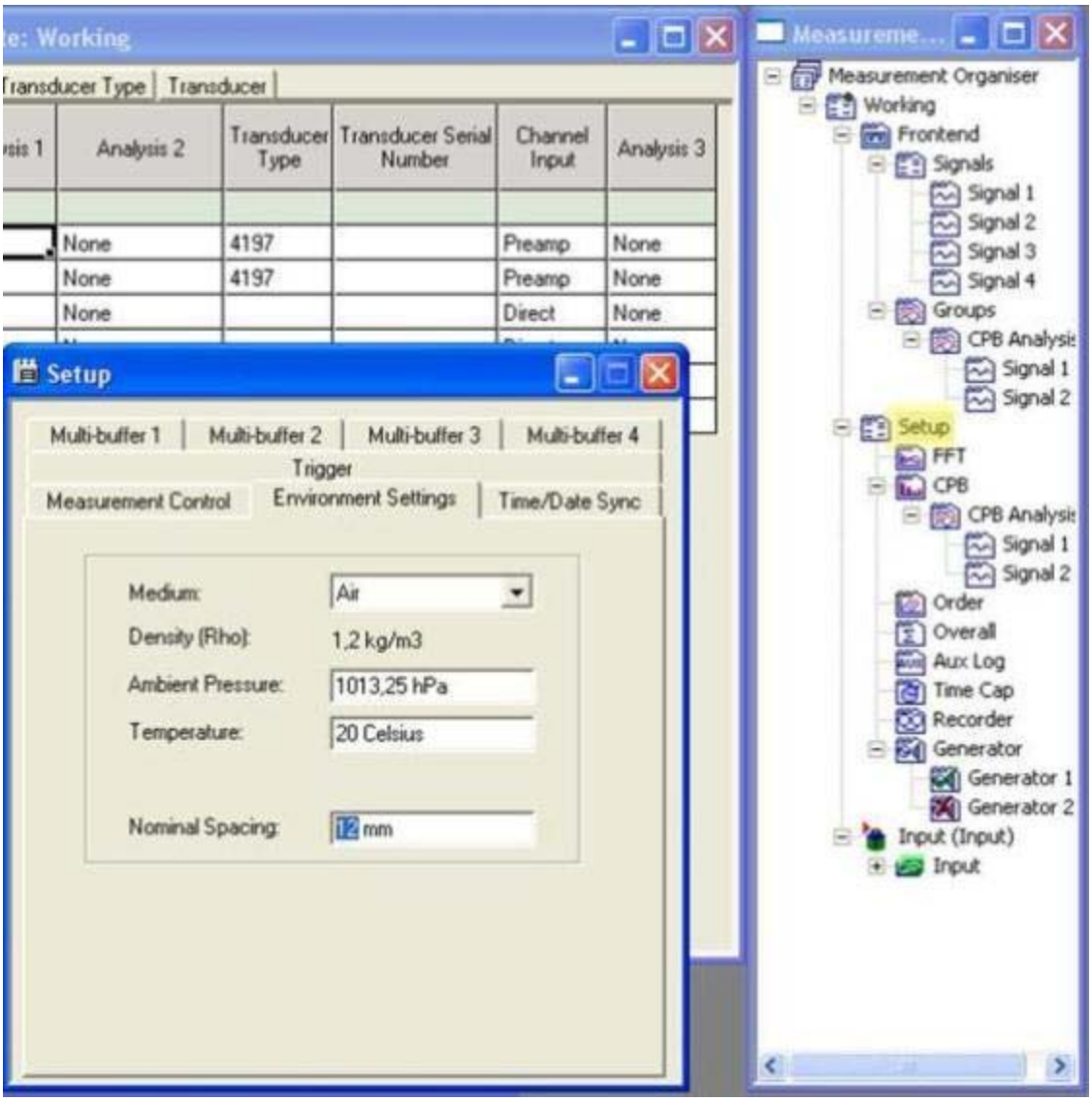
To set up a sound intensity measurement, first select the CPB Analyzer. Then select Calculation and Intensity in the properties of the CPB Analyzer, as shown below.

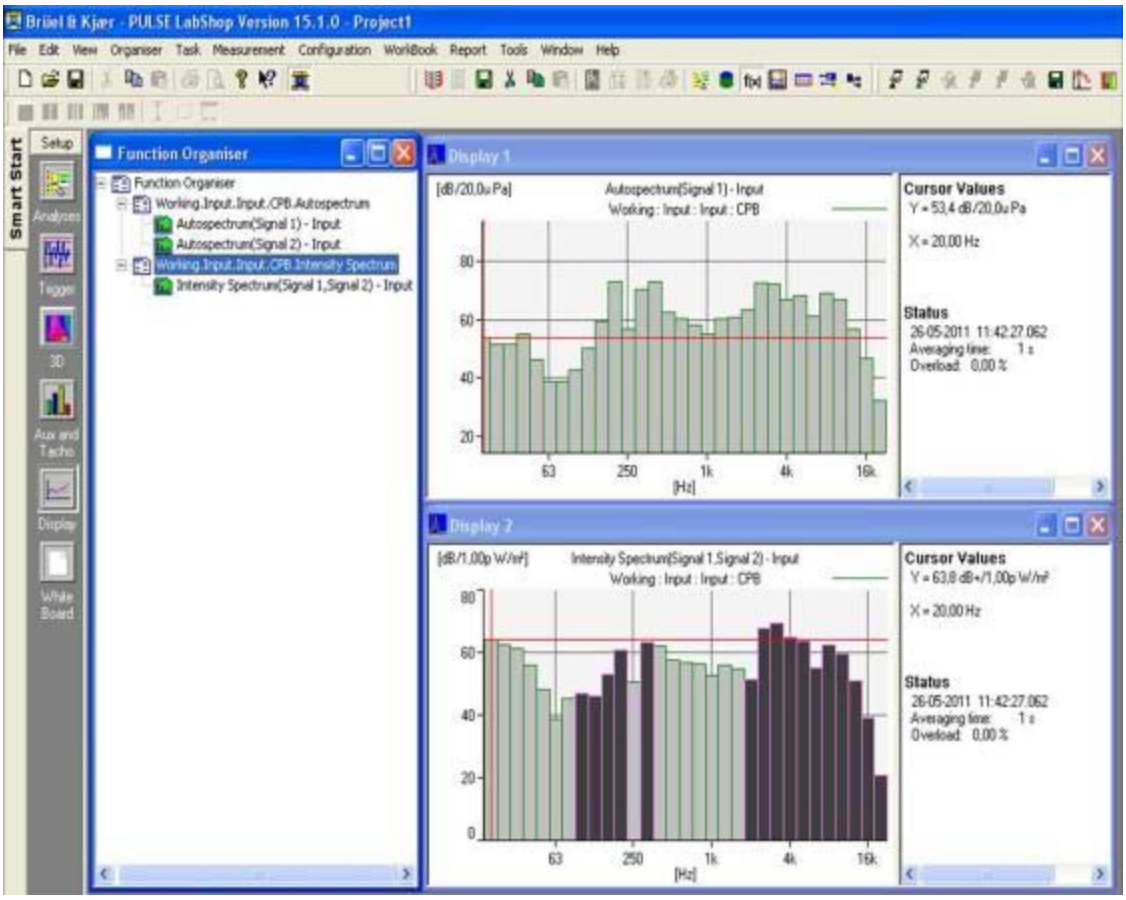


Please note that with the Transducer Type selected (here 4197), the Channels Input is automatically set to Preamp.

The correct parameter for the selected microphone spacer is set in Environment Settings (part of the properties of the Set-up in the measurement organiser).

Measurement start and stop can be controlled by the button on the remote control (Unit ZH 0632) or directly from LabShop. Positive and negative directions are shown on the both the Direction LED on the remote control unit and with two different colours in the LabShop display.


e: Working
Transducer Type
Transducer
sis 1
Analysis 2
Transducer Type
Transducer Serial Number
Channel Input
Analysis 3
None
4197
Preamp
None
None
4197
Preamp
None
None
Direct
None
Setup
Multi-buffer 1
Multi-buffer 2
Multi-buffer 3
Multi-buffer 4
Trigger
Measurement Control
Environment Settings
Time/Date Sync
Medium:
Air
Density (Rho):
1,2 kg/m3
Ambient Pressure:
1013,25 hPa
Temperature:
20 Celsius
Nominal Spacing:
12 mm
Measureme...
Measurement Organiser
Working
Frontend
Signals
Signal 1
Signal 2
Signal 3
Signal 4
Groups
CPB Analysis
Signal 1
Signal 2
Setup
FFT
CPB
CPB Analysis
Signal 1
Signal 2
Order
Overall
Aux Log
Time Cap
Recorder
Generator
Generator 1
Generator 2
Input (Input)
Input



When measurements are complete, save your project in order to make it easy to measure the sound intensity of a source the next time.