

Support of Microflow probes in Test.Lab Rev. 10A

Summary

P-u probes allow measurement of sound intensity over a large frequency range. LMS Test.Lab Sound Intensity Testing supports Microflow PU probes, both the 1D and 3D USP probes. Visualization of 3D sound intensity on geometry, combined with traditional colored planes and overlaying pictures supported in Test.Lab from Rev. 10A.

Pressure – Particle Velocity probes



Sound intensity can be measured with very good accuracy with another kind of probe, the so-called PU probe, standing for Pressure-Particle Velocity probe, sometimes also called p-v probe. Microflow PU probes are a new generation of reduced combinations of pressure and particle velocity sensors, allowing the calculation of the sound intensity in its most simple form, i.e. $\vec{I} = p\vec{u}$.

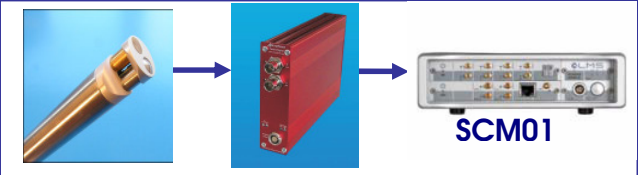
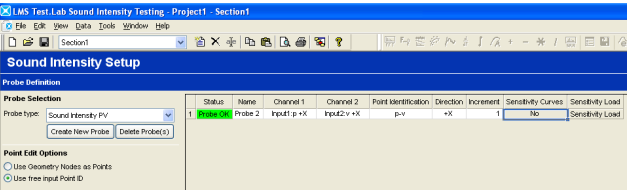
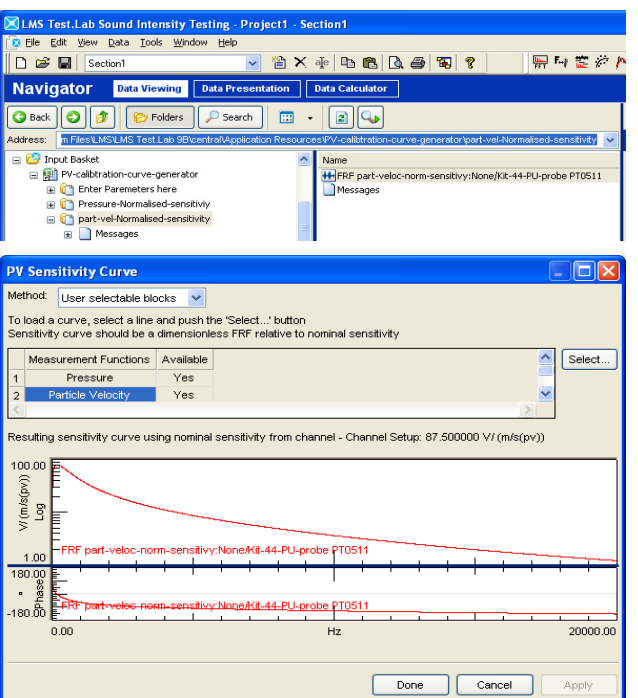
The advantage of the Microflow PU probes is that they are small (the PU mini is in total about 4cm high, and 1.5cm of diameter), with both miniature sensors included in a single frame, and with easy connections.

Moreover, compared to common classical pressure-pressure probes, the PU probes allow measurement of the sound intensity over a single, large frequency range, from 20Hz to 10kHz, or depending on the model even up to 20kHz.

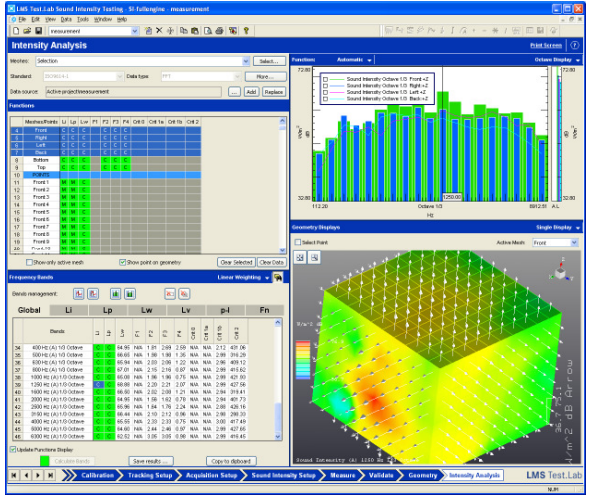
Unlike the pp-probe, the PU probe is not susceptible to the pressure/intensity index, allowing measurements in non-anechoic conditions.

Setup & usage in Test.Lab

The support of standard PU probes was already supported in Test.Lab 9A in the LMS Test.Lab Sound Intensity Testing application, which was released Dec. 2008.

<p>1. The PU probe is connected by lemo to a signal conditioner from Microflow, which delivers a pressure and a particle velocity output, as can be seen in the figure.</p> <p>In Test.Lab, the user defines these 2 signals in the Channel Setup.</p>	 <table border="1" data-bbox="803 745 1437 819"> <thead> <tr> <th>PhysicalChannel</th> <th>OnOff</th> <th>Dir</th> <th>InputMode</th> <th>P.S.</th> <th>Prob</th> <th>Quantity</th> <th>SI Unit</th> <th>Sens.</th> <th>Range</th> <th>Range Int</th> <th>Range EU</th> </tr> </thead> <tbody> <tr> <td>Tach01</td> <td><input type="checkbox"/></td> <td>None</td> <td>Voltage DC</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>24</td> <td>Linear</td> <td></td> </tr> <tr> <td>Tach02</td> <td><input type="checkbox"/></td> <td>None</td> <td>Voltage DC</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>24</td> <td>Linear</td> <td></td> </tr> <tr> <td>Input1</td> <td><input checked="" type="checkbox"/></td> <td>None</td> <td>Voltage AC</td> <td></td> <td></td> <td>Pressure</td> <td>mV</td> <td>64.40000</td> <td>mV/Pa</td> <td>12</td> <td>Linear</td> <td>100.335 Pa</td> </tr> <tr> <td>Input2</td> <td><input checked="" type="checkbox"/></td> <td>None</td> <td>Voltage AC</td> <td></td> <td></td> <td>Particle Velocity</td> <td>V</td> <td>87.5</td> <td>V/(m/s)</td> <td>12</td> <td>Linear</td> <td>0.13743 (m/s)</td> </tr> </tbody> </table>	PhysicalChannel	OnOff	Dir	InputMode	P.S.	Prob	Quantity	SI Unit	Sens.	Range	Range Int	Range EU	Tach01	<input type="checkbox"/>	None	Voltage DC						24	Linear		Tach02	<input type="checkbox"/>	None	Voltage DC						24	Linear		Input1	<input checked="" type="checkbox"/>	None	Voltage AC			Pressure	mV	64.40000	mV/Pa	12	Linear	100.335 Pa	Input2	<input checked="" type="checkbox"/>	None	Voltage AC			Particle Velocity	V	87.5	V/(m/s)	12	Linear	0.13743 (m/s)
PhysicalChannel	OnOff	Dir	InputMode	P.S.	Prob	Quantity	SI Unit	Sens.	Range	Range Int	Range EU																																																				
Tach01	<input type="checkbox"/>	None	Voltage DC						24	Linear																																																					
Tach02	<input type="checkbox"/>	None	Voltage DC						24	Linear																																																					
Input1	<input checked="" type="checkbox"/>	None	Voltage AC			Pressure	mV	64.40000	mV/Pa	12	Linear	100.335 Pa																																																			
Input2	<input checked="" type="checkbox"/>	None	Voltage AC			Particle Velocity	V	87.5	V/(m/s)	12	Linear	0.13743 (m/s)																																																			
<p>2. Next, the Sound Intensity Setup worksheet allows the definition of the probe to be used. The channels in the previous step are reused.</p>																																																															
<p>3. Since the Microflow PU probes are not completely linear, specific amplitude and phase corrections for both the pressure and the particle velocity can be found in a calibration document. These calibration values will translate in a sensitivity curve that is generated in an Excel file, and can be accessed directly in Test.Lab, using the Excel Data Driver.</p> <p>This sensitivity curve has to be selected in the probe definition for both the pressure and the particle velocity sensor.</p>	 <table border="1" data-bbox="803 1417 1437 1501"> <thead> <tr> <th>Measurement Functions</th> <th>Available</th> </tr> </thead> <tbody> <tr> <td>1 Pressure</td> <td>Yes</td> </tr> <tr> <td>2 Particle Velocity</td> <td>Yes</td> </tr> </tbody> </table> <p>Resulting sensitivity curve using nominal sensitivity from channel - Channel Setup: 87.500000 V/(m(s(pv)))</p>	Measurement Functions	Available	1 Pressure	Yes	2 Particle Velocity	Yes																																																								
Measurement Functions	Available																																																														
1 Pressure	Yes																																																														
2 Particle Velocity	Yes																																																														

4. The Sound Intensity measurements & analysis can now be started.



P-U probes with 3D partial velocity measurement



The Microflow technology for PU probes also allows to measure particle velocity in 3 orthogonal directions, thereby allowing 3D sound intensity measurements.

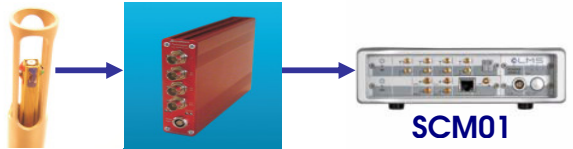
These 3D probes are called USP (Ultimate Sound Probe), and come in three different sizes.

Setup & usage in Test.Lab

USP probes are supported already since Test.Lab 9A in the LMS Test.Lab Sound Intensity Testing application, which was released Dec. 2008.

1. The USP probe is connected by lemo to a signal conditioner from Microflow, which delivers a pressure and 3 particle velocity outputs, as can be seen in the figure.

In Test.Lab, the user defines 1 pressure and 3 particle velocity signals.

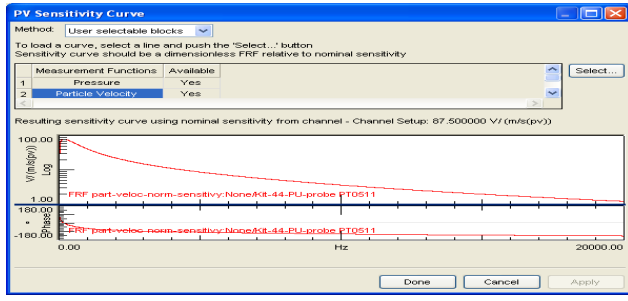


Channel Setup									
Status: Verification OK									
	PhysicalChannelId	On/Off	Group	Point	Dr.	InputMode	P.Sig.	Polar.V	Quantity
1	Tacho1	<input type="checkbox"/>	Tacho	Tacho1	None	Voltage DC			
2	Tacho2	<input type="checkbox"/>	Tacho	Tacho2	None	Voltage DC			
4	Input1	<input checked="" type="checkbox"/>	Acoustic	Pressure	None	Voltage AC			Pressure
3	Input2	<input checked="" type="checkbox"/>	Acoustic	PV1	+X	Voltage AC			Particle/Velocly
5	Input3	<input checked="" type="checkbox"/>	Acoustic	PV2	+Y	Voltage AC			Particle/Velocly
6	Input4	<input checked="" type="checkbox"/>	Acoustic	PV3	+Z	Voltage AC			Particle/Velocly
7	Input5	<input type="checkbox"/>	Acoustic	Distanc	None	1 A Resistor			MicroStrain

2. Next, the Sound Intensity Setup worksheet allows the definition of the USP probe to be used. The channels in the previous step are reused. 3 probes are actually defined, all with the same pressure.

Reference curves are selected for each direction of the 3D probe.

Status	Name	Channel 1	Channel 2	Point Identification	Direction
Probe OK	Probe 1	Input1:Pressure S	Input2:PV1 +X	pv1	+X
Probe OK	Probe 2	Input1:Pressure S	Input3:PV2 +Y	pv2	+Y
Probe OK	Probe 3	Input1:Pressure S	Input4:PV3 +Z	pv3	+Z

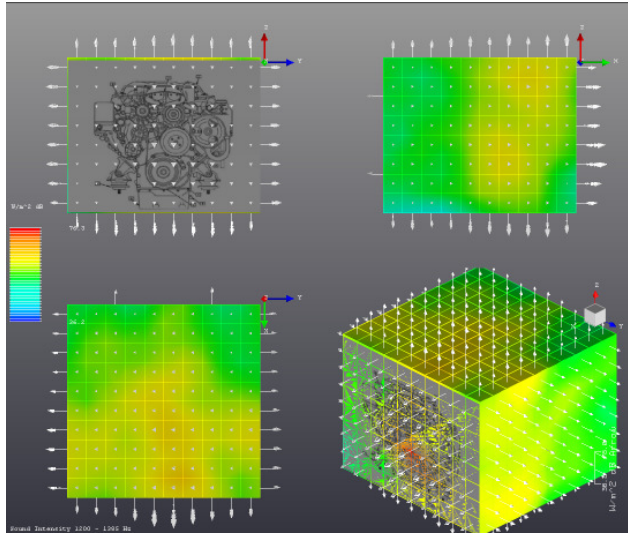


The screenshot shows the 'PV Sensitivity Curve' dialog box. It includes a table of measurement functions:

Measurement Functions	Available
Pressure	Yes
Particle Velocity	Yes

The plot below shows the resulting sensitivity curve for 'None#81-44-PV-probe PT0511' on a log-log scale. The y-axis is 'W/m² Log' ranging from 1.00 to 100.00, and the x-axis is 'Hz' ranging from 0.00 to 20000.00. The curve shows a decreasing trend with frequency.

3. The measurement will then proceed as normal, but the visualization is done in 3D, as vectors on a geometry, thereby expressing the flow of the acoustical energy. Full geometry and display capabilities of Test.Lab available, such as Active Pictures, and quad displays on the right. Also includes the possibility to add a picture onto the geometry for easy and straightforward interpretation of the data.



The screenshot displays a 3D visualization of acoustical energy flow. It features a central 3D model of a mechanical part with a grid of vector arrows representing the flow direction and magnitude. A color scale on the left indicates intensity levels from blue (low) to red (high). The visualization is presented in a quad view, showing the model from multiple perspectives (top, side, and 3D perspective).