Microflown Technologies
Charting sound fields

Datasheet

USP Mini

UM

Microflown Technologies
Tivolilaan 205
6824 BV Arnhem
The Netherlands

Phone : +31 880 010 811
Fax : +31 880 010 810
Mail : info@microflown.com
Web : www.microflown.com

USP MINI (UM)

Pressure and 3D particle velocity in one single probe

The miniaturized version of the USP regular.

USP mini is the smallest version of the USP regular. This ultra-miniature three dimensional sound probe is mainly designed for array applications and it is capable of measuring sound pressure and particle velocity in three orthogonal directions. Therefore it also gives information about the elevation: 3D sound intensity and sound power can be easily measured.

USP mini probes combined with the new MFPA-4 electronics provide a full solution for high accuracy pressure, particle velocity, intensity and sound power measurements over the whole frequency range (20 Hz - 10 kHz).

I. UM SENSORS

THE VELOCITY SENSOR

The particle velocity sensor is a platinum based MEMS. The Microflown™ consists of two tiny wires which are kept heated at a constant temperature of 200 ^{o}C degrees. Motion of the air surrounding the sensor produces a temperature shift. This temperature difference is proportional to the resistance of the wires, providing a broadband (0.1 Hz to at least 10 KHz) and linear signal proportional to the particle velocity. By combining three of those in the orthogonal axes it is possible to obtain particle velocity information in three dimensions.

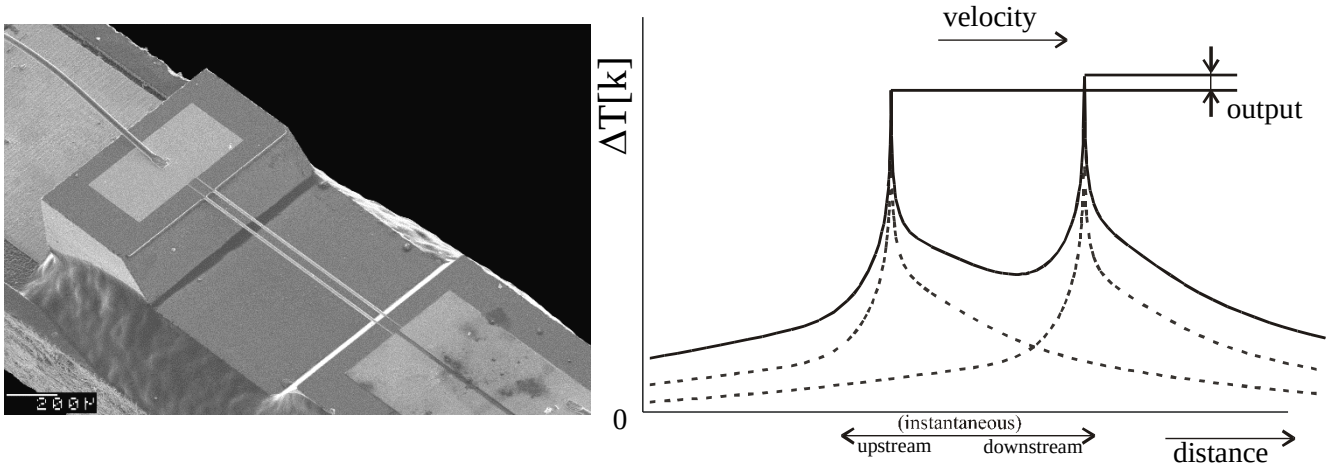

Figure 1. Sensor principle

THE PRESSURE SENSOR

The pressure microphone integrated in the probe is a FG-23329-D65.

The combination of one pressure sensor and three particle velocity sensors enables the direct measurement of 3D sound intensity, sound power and acoustic impedance.

II. CHARACTERISTICS TABLE

Parameter	Value	Unit/ note
Physical		
Connector	Integrated cable	
Diameter	½	inch
Length	40	mm
Weight	13.4	g
Probe Environmental Parameters		
Operative temperature range	-25 to 85	°C
Sensitivity variation due to temperature	<0.067	dB/K
Sensitivity variation due to humidity (20-90%)	0.06	dB/ %RH
Sensitivity variation due to pressure (1-0.82 bar)	<0.5	dB
Measurement range Pressure sensor		
Maximum level range	110	dB [SPL ref: 20 e-5 Pa]
Frequency response	20 – 10.000	Hz
Nominal sensitivity	70	mV/Pa @ 1kHz
Measurement uncertainty ±1 dB	60 – 7.000	Hz
Measurement uncertainty ±3 dB	20 – 10.000	Hz
Measurement range Velocity sensor		
Maximum level range	135	dB [PVL ref: 50 nm/s]
Frequency response	0.1 – 10.000	Hz
X orientation		
Nominal sensitivity	14.2	V/(m/s) @ 250Hz
Measurement uncertainty ±1 dB	40 – 8.000	Hz
Measurement uncertainty ±3 dB	20 – 10.000	Hz

Y orientation		
Nominal sensitivity	14.3	V/(m/s) @ 250Hz
Measurement uncertainty ±1 dB	40 – 8.000	Hz
Measurement uncertainty ±3 dB	20 – 10.000	Hz
Z orientation		
Nominal sensitivity	13.5	V/(m/s) @ 250Hz
Measurement uncertainty ±10 dB	40 – 8.000	Hz
Measurement uncertainty ±3 dB	20 – 10.000	kHz

III. SYSTEM CHARACTERISTICS

DYNAMIC RANGE

The dynamic range of the measurement chain formed by the USP mini probe (consisting of three particle velocity sensor and one pressure sensor) and the MFPA-4 is described by the following graph:

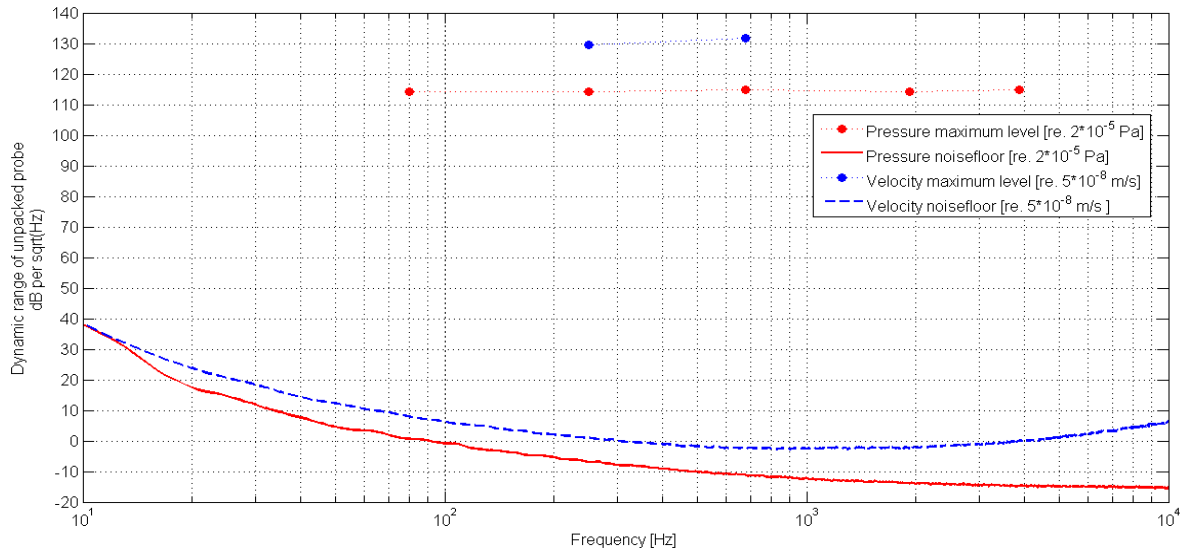

Figure 2. USP mini and MFPA-4 dynamic range

RESPONSE MODEL

The magnitude and phase response for every probe is calibrated, modeled and compiled in the calibration report.

Below is an example of the response of both sound pressure and particle velocity sensors.

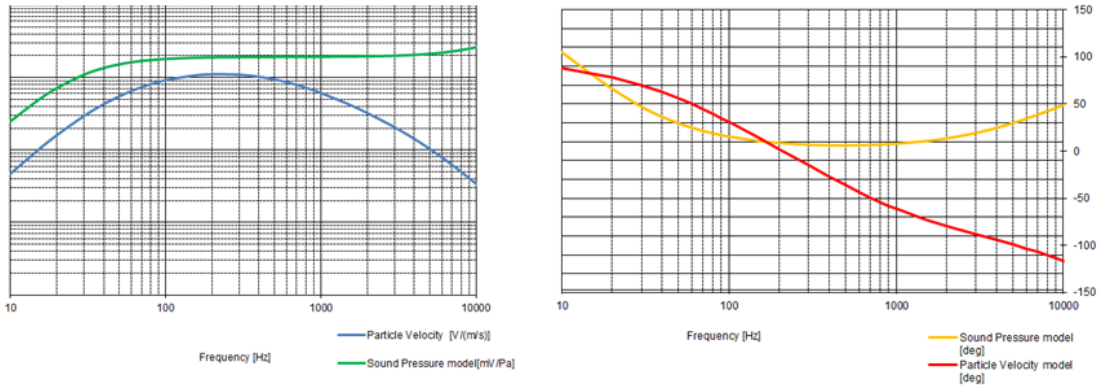

Figure 3. Typical USP mini model

To correct for the particle velocity sensor behavior, the model of the inverse response needs to be applied in order to obtain a flat response across the whole usable frequency range.

- Frequency response: Signal [Volts] / Su or Sp
- Phase response: Signal [Volts] - ϕu or ϕp

- VELOCITY SENSOR MODEL:

$$Su\left[\frac{V}{m/s}\right] = \frac{S_u@250\,Hz\left[\frac{V}{m/s}\right]}{\sqrt{1+\frac{f_{c1u}^2}{f^2}}\sqrt{1+\frac{f^2}{f_{c2u}^2}}\sqrt{1+\frac{f^2}{f_{c3u}^2}}\sqrt{1+\frac{f_{c4u}^2}{f^2}}}$$

$$\varphi_u[deg] = arctan\frac{C_{1u}}{f} - arctan\frac{f}{C_{2u}} - arctan\frac{f}{C_{3uf}} + \arctan\frac{C_{4u}}{f}$$

- PRESSURE SENSOR MODEL:

$$Sp\left[\frac{mV}{Pa}\right] = Sp@1KHz\frac{\sqrt{1+\frac{f^2}{f_{c3p}^2}}}{\sqrt{1+\frac{f_{c1p}^2}{f^2}}\sqrt{1+\frac{f_{c2p}^2}{f^2}}}$$

$$\varphi_p[deg] = \arctan\frac{C_{1fp}}{f} + arctan\frac{C_{2fp}}{f} + arctan\frac{f}{C_{3fp}}$$

DIRECTIVITY

- VELOCITY SENSOR:

The polar pattern of the Particle Velocity sensor has a figure of eight response (green in figure 4).

- PRESSURE SENSOR:

The polar pattern of the Sound Pressure sensor has an omnidirectional response as shown by the red line in figure 4.

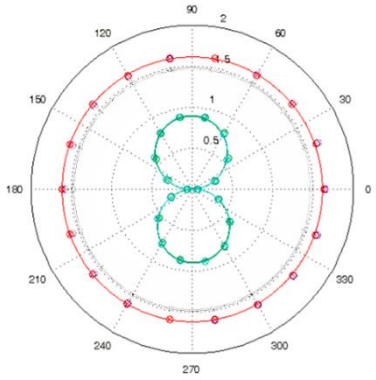

Figure 4: USP mini polar pattern

DC-FLOW

The maximum level of DC-flow that the U sensor in the USP mini probe can withstand is consistent with 1m/s wind speed.

RECALIBRATION

The PU sensors require a qualified calibration every 2 years.

IV. USAGE AND PRECAUTIONS

- Do not submerge the electronics in water as this will lead to permanent damage.
- Only use the 7 pin to 7 pin Lemo cable supplied with the kit. Any modifications to this cable or the use of cables of a different brand or type may result in permanent damage to the probe or the signal conditioner.
- The USP mini probe must be powered via a Microflown™ signal conditioner, the new MFPA series or the prior MFSC/ Router. Do not power the sensor with any other device; this might cause permanent damage to the system.
- Access exposure to dust/dirt particles could damage the Microflown™ sensor.

V. TECHNICAL SUPPORT

For any problem or doubt with your equipment, please contact Microflown™ Technologies Customer service:

- Mail: cs@microflown.com
- Skype: cs.microflown
- Telephone: +31(0) 88 001 08 11 Monday to Friday, from 9:00 to 17:00 (UTC+1).

VI. WARRANTY POLICY, REPAIRS AND REPLACEMENTS

WARRANTY AND REPLACEMENT OR SUBSTITUTION

During the first two years (24 months) the seller offers a warranty on all its products, except for trading items and third party manufactured items. The seller warrants that all products will be free from defects in materials and workmanship for this period of two years. During this two year period, the seller will repair or replace defect products free of charge. Products damaged by accident, abuse, misuse, natural disaster or by any unauthorized disassembly, repair or modification are not covered by this warranty. The incurred transportation costs of returning the products to seller will be borne by the buyer. The logistical cost for returning the products back to the buyer will be borne by the seller. Several products come with a "VOID if seal is broken" sticker, the warranty is void at all times when this sticker is broken.

GRACE PERIOD (YEAR 3 AND 4)

During the third and fourth year the seller offers a grace period. In the grace period the products purchased at an earlier date can be replaced by completely new state of the art products of the same scope of the original purchase. This applies only for the products known as standard probes and signal conditioners. In the first year of the grace period, (year 3) customers have an option to replace their products for 25 % of the actual ex works end-user price. The full freight and packaging charges apply.

In the second year of the grace period, (year4) customers have an option to replace their products for 50 % of the actual ex works end-user price. The full freight and packaging charges apply.

The new products are accompanied by a new warranty. Both the two years warranty and grace period become applicable again from the date of invoice.

REPAIRS OUTSIDE WARRANTY POLICY

Replaced/repaired parts come with a six month warranty under the same conditions as the two year warranty.