

# Ultrasonic Doppler Velocimeter **DOP3010**



UDOP

The DOP3010 is a plug and play (USB),  
small and lightweight device

Its build-in digital ultrasonic synthesizer  
and its 10 channels multiplexer allow  
this instrument to cover almost any  
applications where high resolution and  
fast acquisition are requested .

Real time 2D/3D measurements can be  
performed in option.



# Overview

## A pulsed ultrasonic velocimeter

Like all other ultrasonic Doppler velocimeters manufactured by Signal Processing SA, the DOP3010 uses pulsed ultrasonic echo technique to measure velocity profiles. This instrument has been designed in order to fit almost all user's requests in terms of specifications and ease of use,

The DOP3010 can measure instantaneously different types of profiles, such as the Doppler energy profiles, the echo profiles, the spectral density (FFT) and many other data profiles in flowing liquids. It computes and displays in real time these data profiles based on the analysis of a user's specified number of gates placed along the ultrasonic beam.



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## The assisted mode

All the ultrasonic parameters (starting depth, number of gates, resolution...) and the processing conditions (PRF, TGC, number of emissions by profile ...) can be defined automatically or set by the user.

Based on very simple indications given by the user, such as the measurement depth along the ultrasonic beam and the maximum velocity to be measured, all the operating parameters are defined automatically. Tedious manual setting can therefore be avoided. Of course, advanced users can still fine-tune all these parameters or bypass this automatic mode.

The DOP3010 series also lets the user to set a quality factor of the measure, which defines an optimal trade-off between signal to noise ratio and sampling rate.

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## High resolution

The DOP3010 can emit any ultrasonic burst having a frequency in the range from 10.5 MHz to 450 kHz. The time between two adjacent measuring points can be as low as 166 ns and can be extended to 20  $\mu$ s. Moreover a profile can contain up to 1000 gates.

Associated to this performance, the DOP3010 includes a variable spatial resolution filter that allows to adapt the size of the sampling volume to the application and therefore improves the signal to noise ratio of the measurements.

The definition of the thickness of the sampling volumes are not only defined by the length of the ultrasonic burst, as it is some times mentioned, but also by the bandwidth of the instrument. To achieve an optimal resolution and a very good SNR ratio, the bandwidth of the DOP4000 has been fixed to 250 kHz.

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## A sensitive instrument

The sensitivity is a very important parameter because it influences the range of possible application of the instrument. A high sensitive instrument allows measurements in liquids containing few particles and/or in liquids having high attenuation coefficient. The sensitivity is defined as the minimum instantaneous power of the Doppler echoes from which Doppler information can be extracted.

Signal Processing made a lot of effort to offer very high sensitive instruments. This is why when many other instruments failed our ultrasonic velocimeters still deliver quality information.

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# The key features

## Digital Ultrasonic Synthesizer

The included digital ultrasonic synthesizer can generate any emitting frequencies between 0.45 MHz and 10.5 MHz. Associated to this performance, the DOP3010 includes a variable spatial resolution filter that allows to adapt the size of the sampling volume to the application and therefore improves the signal to noise ratio of the measurements.

## Sequential acquisition on 10 channels

The DOP3010 contains a multiplexer that allows to measure velocity profiles or other data issue from different probes one after the other. Up to 10 different transducers can be connected. During the acquisition process in multiplexer mode, the multiplexer switches from one channel to the other after the measurement of a user's defined number of data profiles. As all the 10 channels are totally independent, each channel can accept different probes and different set of parameters or settings, such as different emitting frequencies, PRF, number of channels, TGC, etc...

This 10 channels multiplexer increases the application field and the flexibility of the DOP3010.

## UDV 2D/3D capability (in option)

UDV 2D or 3D Ultrasonic Doppler Velocimetry measuring technique is a method that enables the measurement of two velocity components ( $V_x$  and  $V_z$ ) or three velocity components ( $V_x$ ,  $V_y$  and  $V_z$ ) simultaneously along a line. UDV 2D/3D has all the advantages of classical ultrasonic Doppler velocimetry, such as the capacity to realize measurements in non translucent liquids. One of the most interesting property of this technique compared to other techniques is that it can measure simultaneously more than one velocity component in real time. Only few tens of milliseconds are necessary to compute and display a complete 2D or 3D velocity field. This is not possible by means of use of the standard channels multiplexer.

The DOP4000 contains a special internal controller that manages the way the emitted burst is sent and the way the echoes are received from the 2 or 3 receivers.

Note that in order to be able to use this hardware an additional software package must be purchased and installed.

## A plug and play device

The DOP3000 series is connected to an external PC or a laptop through its built-in USB interface.



# DOP3010

## Specifications

### Ultrasonic emission

Frequency of emitted pulse	10.5 MHz to 450 kHz, step 1 kHz
Emitting power	3 levels, approximated instantaneous maximum power for setting: Low = 0.5W, Medium = 5 W, High = 35 W
Number of emitted cycles	from 2 to 32, step of 2 cycles
Pulse repetition frequency	from 0.1 Hz to 15'625 kHz (100'000 ms to 64 ms, step 1 ms)

### Reception

Number of gates	from 4 to 1000 gates, step of 1 gate
Position of first gate	movable by step of 1 gate, but not earlier than the end of the emitted burst
Amplification (TGC)	Uniform: -40 dB to +40dB, step 1 dB Slope mode: linear in dB custom mode: number of cells from 1 to 1000
Sensitivity	> -100 dBm

### Sampling volume

Lateral size	defined by the acoustical properties of the transducer
Longitudinal size	defined by the burst length and/or a user's selectable internal filter. Available values: 3.9, 2.9, 1.3, 1.1, 0.8, 0.7 mm (C=1500 m/s, defined 6 dB)
Display resolution	distance between the center of each sampling volume selectable from 0.166 to 20 $\mu$ s, step of 0.166 $\mu$ s.

### Environment

Host PC Operating system	Windows (starting from XP version)
Power supply	110 - 220 VAC, 50 - 60 Hz
Communication	USB 2, Connector type B
US interface	US probe In/Out, 10 BNC Receivers probe for UDV 2D/3D mode, 3 BNC Emission (max 80 Vpp) BNC Echo (max 0.7 Vpp, 50 ohm) BNC PRF, 100 ns pulse low level TTL for each emission
External trigger input	TTL level, pull up 330 ohm, BNC
Temperature	5 - 35 degrees
Sizes	235 x 155 x 69 mm
Weight	3 Kg

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### Ultrasonic processor

Doppler frequency	computation based on a correlation algorithm. 5 levels of the received Doppler energy may disable the computation Output value: signed byte format
Wall filter	IR high-pass filter 2nd order
Emissions per profile	from 8 to 512, any values minimum acquisition time per profile: about 2-3 ms
Filters on profiles	moving average: from 2 to 1000 profiles zero values included or rejected median: from 3 to 32 profiles
Velocity	variable positive and negative velocity range, movable origin. automatic computation of the projected velocity component along the flow axis
Compute and display	velocity profile, with or without histogram Doppler energy, with or without histogram echo profile, with or without histogram velocity profile with echo profile or Doppler energy velocity profile with v(t) of a selected gate power spectrum of one selected gated velocity profile and time-space velocity profile and flowrate
Cursor	4 available cursors in tracking mode (follow the displayed curve). Statistical values available (mean, standard deviation, minimum, maximum)
Additional tools	auto correction of the aliasing measurement of the ultrasonic field raw data acquisition (15'000 demodulated IQ values)

### Acquisition

External Trigger	manual or external signal (logic state) automatic record capability trigger delay: up to 32s, step of 1 ms
Data format	binary ASCII (only statistical values if desired)
Replay mode	replays a binary recorded measure
Acquisition mode	save the past (sizeable circular memory) record the futur
Internal memory size	from 1 to 64' 000 blocks each block containing from 1 to 65'536 profiles
Configuration parameters	9 saved configurations with description

### Multiplexer

Number of channels	10
Switching time	1 ms
Acquisition mode	sequential (channels measured one after the other)
Maximum switching rate	recommended 10 Hz
Contact resistance	0.2 ohm
Life expectancy	10 <sup>6</sup> cycles

<b>Options</b>	2D /3D software package
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