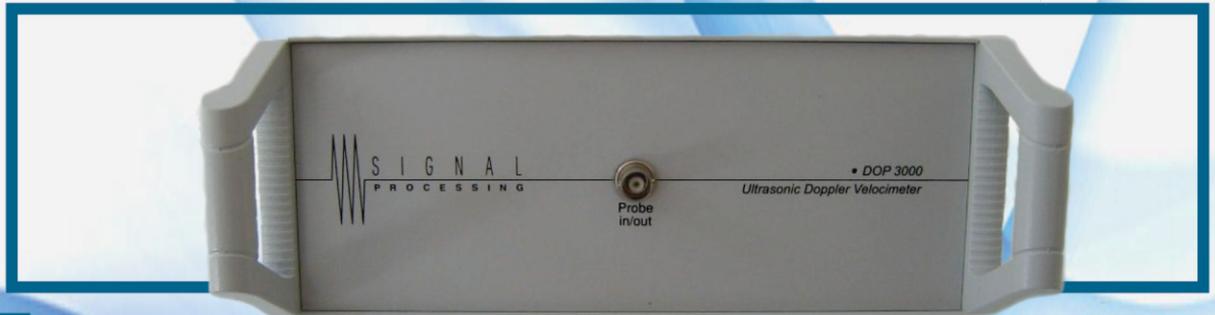


Ultrasonic Doppler Velocimeter **DOP3000**



UDOP

The DOP3000 has been designed to fit the user's request in terms of specifications and budget.

The DOP3000 is a single channel, modular instrument, which can be considered as a Budget base + upgrade software packages.



Overview

A pulsed ultrasonic velocimeter

Like all other ultrasonic Doppler velocimeters manufactured by Signal Processing SA, the DOP3000 uses pulsed ultrasonic echo technique to measure velocity profiles. This instrument has been designed to fit user's request in terms of specifications and ease of use and budget.

The DOP3000 is a modular instrument and can be considered as a Budget base + upgrades software packages.

Starting with a basic affordable instrument, it can evolve to become a powerful equipment capable of measuring in real time high resolution velocity profiles at a rate of just a few ms. Upgrades can be done simply by the user, step by step, by adding optional software packages.

In its basic version, the DOP3000 used a single emitting frequency, and can measure up to 1000 profiles. The instrument selects automatically one of the two available spatial resolutions in order to cover the selected depth with a maximum of 100 available gates. Two types of data profiles can be recorded, the velocity profile and the echo profile.

It is highly recommended to use UDOP simulation software when selecting software packages. In simulation mode, UDOP offers the possibility to select/unselect specific software packages. You will be therefore able to see the improvements due to the installation of the selected software packages.



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 DOP3000 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.

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.

A plug and play device

An external PC or a laptop controls the instrument through its built-in USB interface.

Additional software packages

Extended number of gates

Adding this package enables the user to change the number of gates in which the velocity is computed, and to place the gates anywhere in the measuring range. Therefore it is also possible to change the position of the first measuring gate, if for instance the velocities close to the transducer are not of interest or are simply not measurable (gates outside the flow region).

When the transducer has to be placed quite far away from the beginning of the volume to be investigated, using this package allows to remove irrelevant information from the gates where no flow exist, thus saving memory for the useful information.

The functioning parameters that can be tuned when this package is installed are the following:

Number of gates

Up to 1000 gates can be used and placed along the ultrasonic beam axis.

Starting depth

The starting depth defines the position of first measuring gates. It is the distance between the surface of the transducer and the first gate (defined in mm).

Extended resolution

The extended resolution package lets the user set the distance between two consecutive gates, as well as the size of these measuring gates. The basic DOP3000 automatically sets the resolution to fine mode or coarse mode depending on the maximal depth of measure selected. The present option package lets the user select any desired resolution (i.e. gate spacing) between 0.12 mm (166 ns) and 15 mm (20 μ s), as well as the length of these gates.

The functioning parameters that can be tuned when this package is installed are the following:

The resolution

The distance between the center of two adjacent gates. can be defined between 0.124 mm and 15 mm. (C=1500 m/s)

The thickness of the sampling volume

The thickness of the sampling volume is the distance, measured along the US beam, for which all the echoes issued from particles inside that range are combined together in order to give a single echo value. Its value is defined by both the burst duration and the electronic bandwidth of the receiver of the DOP3000. It covers the range from 0.8 to 4 mm (C=1500 m/s)

Burst length

Defined in number of cycles, between 2 and 32.

Maximum PRF value

The PRF value can be as low as 0.1 second, which allows the measurement of very low velocities.

Advanced compute

In its standard functioning mode, the DOP3000 computes and displays a velocity and/or the echo profile. This option package enables the instrument to show many more relevant measures that helps to characterize the liquid and its flow. Among them are the energy of the filtered echo, the velocity of a chosen gate as a function of time, the flow across a section of a pipe.

Moreover this software package improves the measurement by applying filters and also offers a powerful method to overcome in realtime the aliasing limitation

Additional features of this software package are:

Selectable number of emissions per profile

This allows to precisely adapt the acquisition rate and the quality of the measured profiles.



Additional software packages

Variable origin of the velocity scale

This allows to give more space to positive or negative velocities.

Realtime filters

A moving average filter or a median filter can be applied on any displayed profile in order to reduce the variance of the measurement.

Cursors on graph available

These cursors display the velocity and the depth values, and their statistical values

Auto correction of the aliasing

Two methods allow to perform a realtime the correction of the aliasing.

Variable Ultrasonic Frequency

The basic DOP3000 can only operate at one single ultrasonic frequency. Adding this package enables him to operate the DOP3000 at any ultrasonic frequency in the range of 0.45 MHz to 10.5 MHz, with an increment of 1 kHz.

Changing the ultrasonic emitting frequency will not only improve the spatial resolution but also enable to adapt the velocity scale to a desired value, as the Doppler frequency shift is directly linked to the emitting frequency. It also enables to adapt the ultrasonic beam to the application by using the best ultrasonic probe.

The functioning parameter that can be tuned when this package is installed is the following:

Ultrasonic emitting frequency

Advanced record

This software package enhances the built-in recording features of the DOP3000. It provides powerful editing and processing of the data to be recorded:

The functioning parameters that can be tuned when this package is installed is the following:

More profiles

Up to 64'000 profiles can be recorded.

Multiple blocks of data in file

Possibility to record more than just one set of profiles (block) per file.

Profile selection

Possibility to preview profiles stored in internal memory to accurately select the first and the last profile that must be contained in the saved file.

Update data file

Update in a single pass many UDOP binary data files to the latest software version.

Skip profile

Allow to extend the acquisition time to many hours.

Pre-record capability

Possibility to store events that happened a few seconds before the Record button was pushed.

Configuration parameters

9 different configurations can be saved.



Additional software packages

Variable Time Gain Control

This option lets the user manually set the TGC amplification. He can set a constant amplification gain, a slope amplification (which increases exponentially the gain as a function of the depth), or define gains in up to 1024 user-defined zones.

The functioning TGC modes that can be used when this package is installed are the following:

Automatic

An optimal TGC curve is automatically computed in order to avoid strong echoes or low energy gate problem.

Uniform

The amplification coefficients are the same for all gates.

Slope

The farther the gates are from the transducer, the more the echo signal is amplified according to an exponential slope. This slope is defined by two values, at the nearest and at farther depths.

Custom

The user can fine-tune the TGC in any gates or group of gates independently.

Advanced Trigger

The smart trigger capability of the instrument loaded with this package allows to synchronize the acquisition to any periodic or non periodic event.

When this package is installed, many trigger options can be set, such as:

Trig on external BNC low

The recording starts when the voltage on the BNC connector called Trigger falls to 0 V (CMOS).

Trig on external BNC high

The recording starts when the voltage on the BNC connector called Trigger gets to 5 V (CMOS).

Wait after trigger

Enables to set a delay between the trigger signal and the beginning of the recording.

Pre Trigger

Enables to record few profiles that happened before the trigger event.

Automatic recording capability

Allows to store automatically the measured profile and to repeat the acquisition by waiting for a new trigger event.

Sound speed

This package allows to measure the sound speed or sound velocity.

Ultrasonic Field Measurement

This software option enables the DOP3000 velocimeter to measure the ultrasonic field generated by a transducer connected to the probe in/out connector.

The software automatically computes and detects the intensity and position of an echo issued from a small sphere moved perpendicularly to the US beam axis. By repeating the measurements at different depths it is possible to determine the divergence of the US beam, and therefore to have a much precise knowledge of the shape of the sampling gates.



DOP3000

Specifications

Ultrasonic emission

Frequency of emitted pulse	<i>without package</i> "Variable frequency" Fixed, defined at purchase between 0.5, 1, 2, 4, 8 and 10 Mhz <i>with "Variable frequency" package installed</i> variable between 0.45 Mhz and 10.5 Mhz, set of 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	<i>without package</i> "Extended resolution" Fixed, 4 cycles <i>with "Extended resolution" installed</i> 2 to 32, step of 2 or 4 cycles
Pulse repetition frequency	<i>without package</i> "Extended resolution" selectable values between 10'000 μ s and 64 μ s step of 1 μ s <i>with "Extended resolution" installed</i> selectable values between 100'000 μ s and 64 μ s step of 1 μ s

Reception

Number of gates	<i>without package</i> "Extended number of gates" variable between 100 and 4, not user's selectable <i>with "Extended number of gates" installed</i> variable between 1000 and 4, step of 1 gates
Position of first gate	<i>without package</i> "Extended number of gates" fixed. Echo sampled after the end of the emitted burst <i>with "Extended number of gates" installed</i> movable by step of 1 mm but not earlier than the end of the emitted burst
Amplification (TGC)	amplification range from -40 to 40 dB <i>without package</i> "variable TGC" uniform or automatic computation <i>with "variable TGC" installed</i> uniform, slope mode exponential amplification between two defined depth values. custom mode user's defined values between -40dB and +40dB in cells: variable number (from 1 to 1024), size and position of the cells. automatic computation
Sensitivity	> -100 dBm

Sampling volume

Lateral size	defined by the acoustical properties of the transducer
Longitudinal size	<i>without package</i> "Extended resolution" defined by the burst length but not smaller than 1.1 mm. Not user's selectable <i>with "Extended resolution" installed</i> defined by the burst length 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 at -6dB)
Display resolution	<i>without package</i> "Extended resolution" 2 values as mentioned in the table below: US freq of 0.5 Mhz : Corse: 20 μ s Fine: 5 μ s US freq of 1 Mhz : Corse: 10 μ s Fine: 3 μ s US freq of 2 Mhz : Corse: 10 μ s Fine: 2 μ s US freq of 4 Mhz : Corse: 5 μ s Fine: 1 μ s US freq of 8 Mhz : Corse: 3 μ s Fine: 1 μ s US freq of 10 Mhz : Corse: 2 μ s Fine: 0.5 μ s <i>with "Extended resolution" installed</i> distance between the center of each sampling volume selectable between 0.166 and 20 μ s step of 0.166 μ s

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	<i>without package</i> "additional compute mode" automatically adjusted as a function of desired quality factor <i>with package</i> "additional compute mode" installed between 1024 and 8, any values
Acquisition time per profile	<i>minimum: about 2-3 ms</i>
Filters on profiles	<i>without package</i> "additional compute mode" none <i>with package</i> "additional compute mode" installed moving average: based on 2 to 32000 profiles zero values included or rejected median, based on 3 to 32 profiles
Velocity	<i>without package</i> "additional compute mode" bi-directional velocity scale (equal range) <i>with package</i> "additional compute mode" installed: variable positive and negative velocity range
Compute and display	<i>without package</i> "additional compute mode" velocity profile echo profile <i>with package</i> "additional compute mode" velocity profile echo profile velocity profile with echo profile velocity profile Doppler energy echo profile velocity profile with echo or energy profile velocity profile with v(t) of one selected gate power spectrum of one selected gated velocity and time space velocity profile with flowrate
Cursor	<i>without package</i> "additional compute mode" None <i>with package</i> "additional compute mode" installed 4 available cursors in tracking mode (follow the displayed curve). Statistical values available (Mean, standard deviation, minimum, maximum)

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DOP3000

Specifications

Acquisition

External Trigger	<i>without package "advanced Trigger"</i> None <i>with package "advanced Trigger" installed</i> by external signal, change in the logic state (TTL/CMOS level) automatic record capability Trigger delay from 0 ms 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 future.
Internal memory size	<i>without package "advanced Record"</i> 1000 profiles <i>with package "advanced Record" installed</i> 64'000 profiles, 65'536 blocks
Configuration parameters	<i>without package "advanced Record"</i> 1 saved configuration <i>with package "advanced Record" installed</i> 9 saved configurations with description
Additional tools	<i>with package "additional compute mode" installed</i> auto correction of the aliasing measurement of the ultrasonic field raw data acquisition (15'000 demodulated IQ values)

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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