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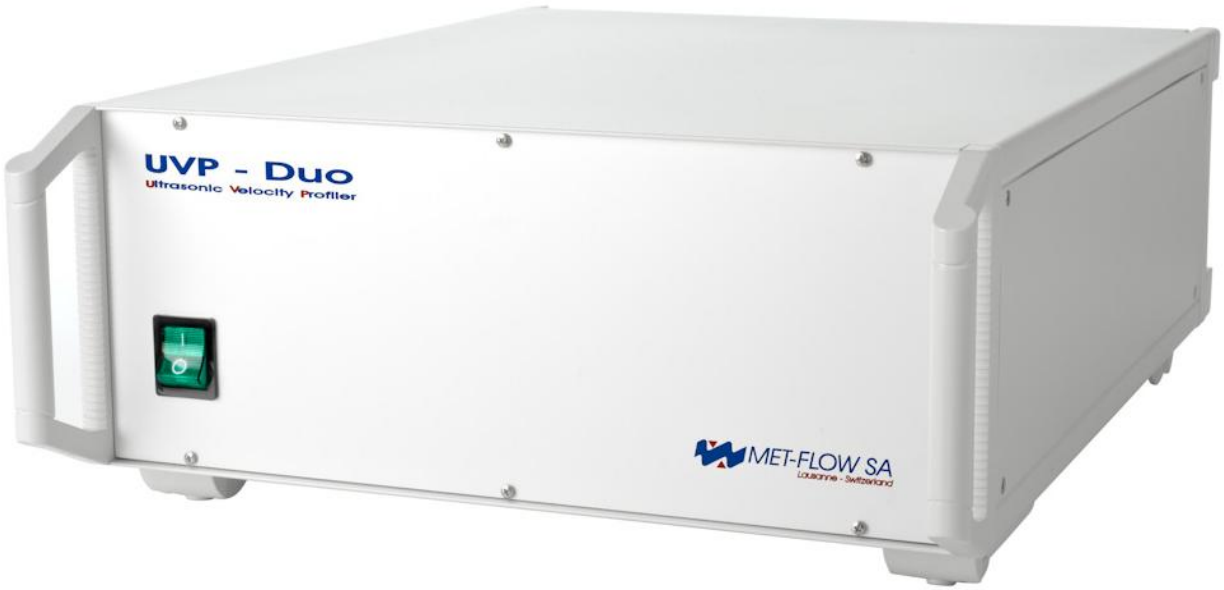
UVP-DUO Monitor

FOR FLEXIBLE VELOCITY PROFILING



UVP-DUO-MX rear panel

Main features of UVP-DUO

- Remote controlled from host computer through LAN
- Five selectable frequencies for wide application range
- Signal quality on-line display
- Measurement window from 2 to 2'048 channels
- Turbulent statistics, histograms, correlations, power spectra
- Integrated 2D flow field mapping with up to 20 transducers
- Compact, sturdy and lightweight design

Met-Flow SA – Lausanne – Switzerland

What UVP-DUO does for you

- Measuring of velocity profiles in almost **any liquid, either transparent or opaque**: water, slurry, oil, food, liquid metal and more.
- Velocity profile measured and displayed in **real time**, so you can directly optimise the flow, or use UVP-DUO Monitor measurement as an on-line feedback for **technological processes**.
- From time sequences of profile: **possibility to compute turbulence statistics**, spatial correlation, power spectrum, histograms, and other relevant data.
- **High flexibility** of UVP-DUO Monitor for various measuring situations: velocity profiles from 2 to 2'048 measured points allowing large velocity and distance ranges.
- **UVP ActiveX Library** including functions to program a custom-designed acquisition software. Access to demodulated echo possible. Compatible with Matlab®, Labview® and many more.

Integrated multiplexer

A single transducer can measure velocity profiles in liquids along a single line. Since measurement and its evaluation is very fast, UVP-DUO-MX (with integrated multiplexer) can scan through 20 transducers quasi simultaneously and still allow sufficient resolution for most flow measurements.

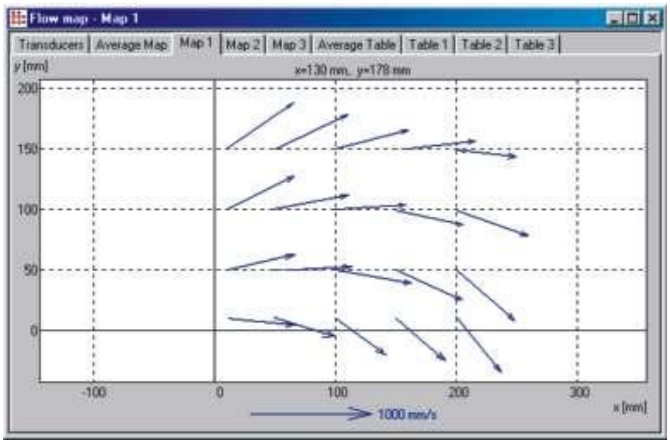
Each transducer is connected to a single BNC connector at the rear panel of UVP-DUO-MX (see above picture).

Integrated flow mapping function

Arranging several transducers in a grid array crossing each measuring lines allow the use of a special 2D flow mapping function.

The latter calculates a 2D velocity vector at each crossing point from respective projections on the transducers measuring lines. Thus using up to 20 transducers a 2D field integrating up to 100 velocity vectors can be determined.

3D measurement is also possible using the same principle with a third velocity component.
For more details on flow mapping, please refer to our *Software* flyer.



Example of 2D flow field

Who uses UVP-DUO

Researchers and scientists working in both academy and industry, interested in accurate velocity profiling, use UVP-DUO.

They are typically found in the following research fields :

- Environmental hydraulics: sediment, river, wave, waste water flows
- Hydraulics engineering: construction, transportation
- Processes: food, cosmetics, paper, oil, mining, chemistry, etc.. industries
- Liquid metals: metallurgy, earth science, chemical reactor, etc.
- Fundamental fluid mechanic: turbulence, magnetic flows, convection, etc.

Typical measurement limits

Sound Velocity C [m/s] **1'480**

Frequency	Spatial resolution	P_{max}	V_{range}		Sampling rate	
			maximum	resolution	time	rate
[MHz]	[mm]	[mm]	[mm/s]	[mm/s]	[msec]	[Hz]
0.5	5.92	3'000	365.1	1.43	129.7	7.7
		21	51'930	202.9	0.9	1'097
1	2.96	3'000	182.5	0.71	129.7	7.7
		11	51'034	199.4	0.5	2'155
2	1.48	3'000	91.3	0.36	129.7	7.7
		6	49'333	192.7	0.2	4'167
4	0.74	3'000	45.6	0.18	129.7	7.7
		3	46'250	180.7	0.1	7'813
8	0.37	3'000	22.8	0.09	129.7	7.7
		1.7	40'988	160.1	0.1	13'847

Spatial resolution: corresponds to "channel width", here calculated for a 4 cycles emitted pulse in water.
P_{max}: called maximum depth, is the maximum reachable distance which actually set pulse repetition frequency and thus measurable velocity range.
Maximum V_{range}: is the maximum velocity range the method can detect for a given pulse repetition frequency (or P_{max}).
When velocity is measured as "signed" velocity range becomes $[-V_{range}/2;+V_{range}/2]$.

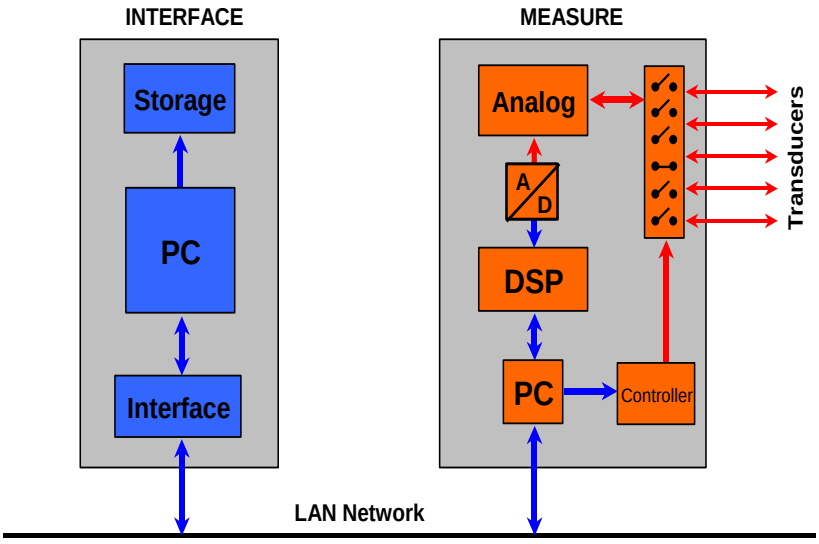
Sampling rate: is calculated for 32 repetitions of pulse emission in water. For sampling time lower than 10 m/sec an additional time of 1 m/sec should be added for processing time. For higher sampling time it can be ignored.

The Architecture

The measuring and user interface parts (PC) of UVP-DUO are physically separated featuring a more compact UVP measurement unit which can be placed close to the measurement location, while the PC part can easily be adapted or upgraded to user's requirements and technological evolution.

Communication between both parts uses a standard **Fast Ethernet network**, thus requiring no specific dedicated device while being able to use any existing LAN.

A **fast DSP** (digital signal processor) is implemented within the acquisition part, combined with a special buffer system and fast A/D converters. The latter allows fast processing of large data sets, permitting the handling of large velocity profiles at high sampling rates.



UVP-DUO internal architecture

Software

For a detailed description of the UVP-DUO Version 3 acquisition and review software, please refer to the *Software* flyer.

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Technical specifications

Emitting frequency	0.5, 1, 2, 4, 8 MHz
Emitting voltage on transducer	30, 60, 90, 150 Vpp (indicative values)
Emitted cycles per pulse (1)	2 to 32 cycles, by step of 1
Pulse repetition frequency (2)	244 Hz to 443'114 Hz
Number of channels	Selectable from 2 to 2'048 channels
Receiving amplification	Exponential, time-dependent, for compensation of distance attenuation
Space resolution - longitudinal (3)	Minimum 0,19 mm (emitted frequency dependent)
Space resolution - lateral (4)	Defined by used transducer
Channel distance	Variable, from 0,37 mm in water (medium-dependent)
Velocity range resolution	1/256 of velocity range (1 LSB)
Raw echo acquisition	Same spatial, temporal and range resolutions as velocity
Repetition rate (emissions per profile)	8 to 2'048, step of 1
Acquisition time per profile (5)	Variable, minimum 1 m/sec
Doppler shift detection algorithm	Time domain
Triggering	External signal (TTL) or keyboard
Time delay between profiles	0 to 65'000 m/sec
Recording capacity	Up to host computer hard disk capacity
Configuration parameters saving	Unlimited number of configuration files can be saved
Measurement signals	5 transducer connectors (UVP-DUO SX) or 20 transducer connectors (UVP-DUO MX)
Interface signals	Raw echo (max 0,7 V) output, pulse repetition frequency output, window start gate output, trigger input, remote connector, service connector
Remote control interface	Ethernet 100 Base-T (RJ-45 remote connector)
Remote computer operating system	Windows 98 / SE / ME / NT 4 / 2000 / XP / Vista / 7
Display	External display - up to host remote computer characteristics
Power supply	Selectable 110/220 V, 50/60 Hz
Size of instrument casing / weight	340 x 130 x 400 mm / 9.3 kg
Operating conditions	Temperature 0-40°C, storage –20-60°C, relative humidity 30-80%, non-condensing
Packaging	Sturdy transport case on wheels

(1) Increasing number of emitted cycles improves signal quality but decreases longitudinal resolution.
(2) Maximum pulse repetition frequency is limited by maximum measurable depth, i.e. by time of flight of ultrasonic signal to a distant point and back to transducer.
(3) The least number of waves in a pulse is two. Longitudinal space resolution depends on ultrasonic frequency (wavelength) and also on the performances of transducer used. Met-Flow transducers are very accurate and therefore converge to the theoretical resolution limit.
(4) For ultrasonic beam divergence values see the *UVP Transducers* flyer.
(5) Acquisition time depends on the ultrasound time of flight to the maximum depth point and back, and on the repetition rate.

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