



Water



GWF



Ductus M

Stationary time of flight flow meter
for pressurized pipes DN > 3000

Your benefits

- Up to 8 acoustic measurement paths:
Exceptional accuracy, repeatability and linearity over the entire measurement range
- Multipath system offers installation flexibility:
Reliable results independent of installation conditions, only minimal straight runs necessary
- Variable integration methods:
Flexible choice of integration method, e.g. OWICS or Gauss-Jacobi, according to international standards
- Feedthrough and internal mount sensors:
Depending on whether pipe is accessible from the outside or completely buried
- Clamp-On option available:
Easy and non-intrusive mounting without process interruption guarantees minimal installation costs

Application

- Pressurized pipes 3000-15000 mm (118-590") in diameter
- Suitable for sites with difficult installation settings, e.g. pumps, short straight runs
- Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump turbines
- Combine two Ductus M systems for early stage leak detection
- Permanent flow monitoring for applications in clean water:
 - Hydropower plants
 - Turbine efficiency control
 - Leak detection
 - Reservoir monitoring

Features

- Wall-mounted transmitter, powder-coated sheet steel, IP65 (NEMA 4)
- Wetted sensors: Feedthrough or from the inside of the pipe
- Dry sensors: Clamp-On for easy installation, compliant with ISO12242
- Time of flight technology with digital signal processing
- Measurement in multiple planes with single or crossed paths
- Flow profile calculation in multipath systems, no on-site calibration needed
- Bi-directional measurement over the entire flow range
- Accuracy up to $\pm 0.5\%$ of measured flow value
- Measurement of low velocities down to 1.5 mm/s
- Microsoft Windows 10 operating system
- Configuration and parameter setup with integrated software package
- Internal data logger with selectable data and storage interval
- Interfaces: VGA, keyboard, mouse, 4x USB, 2x RJ-45 (Ethernet)
- Communication: RS-232, FTP, Modbus TCP (option)
- Power supply: 24 V DC

Options

- Feedthrough sensors if pipe can be dewatered for installation
- Internal mount sensors if pipe is accessible only from the inside
- Clamp-On sensors for non-intrusive flow measurement
- 1 to 8 acoustic measurement paths in one pipe or in multiple pipes (max. 4 paths in 2 pipes)

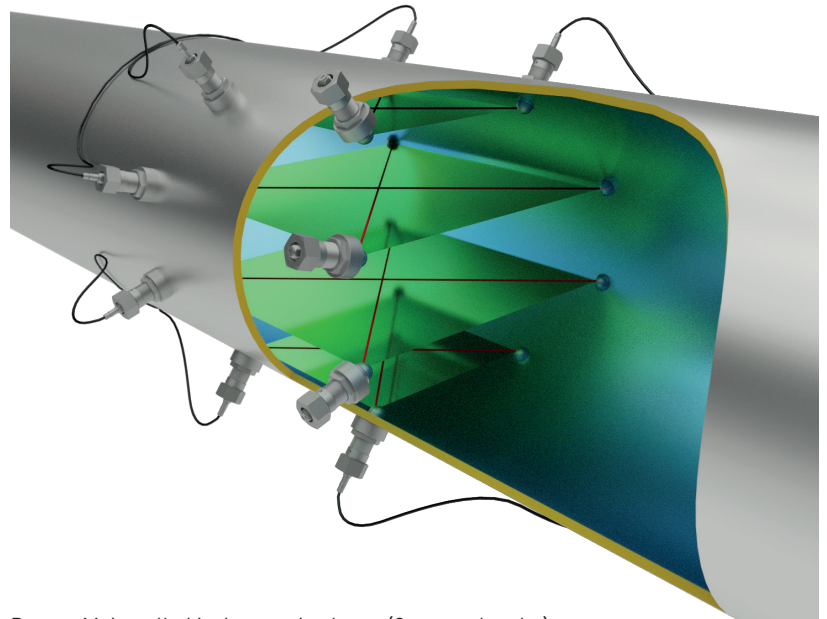
Product description

The Ductus M is a time of flight system designed to accurately measure water in big pipelines of a distribution network or in penstocks of a hydropower plant. The time of flight principle is ideal for bi-directional measurement as it provides precise evaluation of both upstream and downstream transit times. Ductus M increases your profitability with exceptional repeatability and linearity throughout the flow range.

In a multipath system such as Ductus M, the most exact measurement results can be achieved by considering several installation-specific parameters. These include the as-built dimensions of the conduit diameter and acoustic path lengths as well as the actual transducer locations and path angles. Using this information, the Ductus M system automatically calculates the as-built weighting factors (OWICS method) to integrate the flow. In this way, even transducers that are shifted from the theoretically optimal position have no negative influence on the measurement result. The Ductus M thus offers maximum installation flexibility compared to conventional systems.

Ductus M is a metering solution with up to 8 acoustic paths. In accordance with IEC 60041:1991 and ASME PTC 18:2011 and in combination with wetted transducers, the flow meter is suitable for field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines.

A further area of application is the detection of leaks, where at least two Ductus M systems are permanently installed. The GWF unique digital signal processing allows the detection of even the smallest time differences, i.e. even the smallest amounts are determined accurately.



Ductus M, installed in 4 acoustic planes (8 crossed paths)

Integration Methods

Ductus M performs a numerical integration of the total flow since only a limited number of averaged axial path velocities are available. The task of the numerical integration method is first to reconstruct the sampled area flow function through interpolation and second to integrate this reconstructed function as precisely as possible.

Different integration methods have been developed, from the well-known Gauss-Jacobi and Gauss-Legendre methods to new ones like OWICS. The newly introduced OWICS method is based on developed turbulent velocity profiles. OWICS allows to interpolate a non-ideal velocity distribution with a convex curvature. Ductus M offers flexible choice of the desired integration method depending on the specific on-site requirements.

Measuring principle

Ductus M is an ultrasonic flow meter which uses the time of flight measuring principle. An ultrasonic pulse is sent with and against flow direction between a pair of transducers. Since the propagation velocity of an acoustic wave and the flow velocity of the medium add vectorially, an acoustic pulse sent upstream travels at a lower absolute speed than a pulse sent downstream. By measuring the difference in travelling times of the pulses in the two directions, the average axial velocity of the fluid crossing the path is determined. Using specific integration methods, the total discharge can be calculated from the axial velocities.

Ductus M can measure in up to 8 acoustic paths, e.g. in 4 planes with two crossed paths each. The use of eight crossed acoustic paths compensates for most of the transverse velocity components that may originate from unfavorable conditions such as bends in the pipe. If these cross flows are not accounted for, they may cause significant inaccuracy in the measurements. An ultrasonic multipath system thus offers a significant advantage over other conventional flow measurement technologies.

The multi-path approach is accepted as the primary method for discharge measurement in circular, elliptical and rectangular cross-sections. Such a system removes the need for a time-consuming hydrometric calibration.

Component description

The Ductus M system is composed of a wall-mounted transmitter and several sensor options. For non-intrusive measurement, Clamp-On transducers are available. If the pipe can be dewatered for installation, feedthrough or internally mounted sensors are suitable options.

Transmitter



Wall-mounted transmitter

The Ductus M transmitter incorporates all the required algorithms and software to ensure measurement accuracy and repeatability.

The transmitter controls the measurements, calculates the flow rate and provides freely programmable current outputs, status alarms, frequency outputs and totalizer readings. The IP65 (NEMA 4X) powder-coated sheet steel housing features a 4 x 20 alphanumeric LCD.

Ductus M uses a Windows 10 operating system. Configuration and signal analysis can be done using the integrated software packages FlowVision DB and FlowVision SA. All configuration data as well as measured and calculated data are stored in the internal data logger.

By using TeamViewer or Ultra VNC software application you can remotely control the flow meter as if you were sitting right in front of it.

Clamp-On transducers



CO-L, Clamp-On sensor 200 kHz

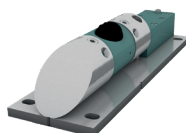
When combining the Ductus M with Clamp-On transducers, the flow measurement becomes non-intrusive. The transducers are installed with little technical effort and without process interruption on the pipeline.

Clamp-On transducers require no modification of the conduit or plant shutdown. Once the sensors have been installed, they can easily be removed from the mounting system, for example to renew the coupling paste. This prevents a shift of the installation position.

Wetted sensors



FT-L120 feedthrough sensor



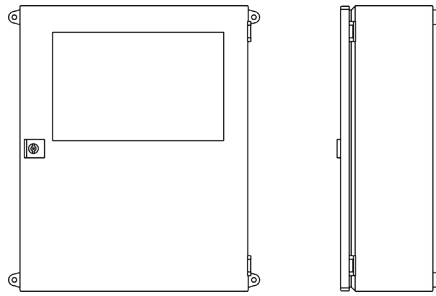
internal mount sensor TD-IM

Depending on your individual requirements, several options of wetted sensors are available. If the pipe is accessible from the outside, feedthrough sensors can be installed. Depending on the wall thickness, these can be screwed in directly with a thread. Welding nipples are used in addition for high pressure applications or insufficient wall thickness for threads.

If the pipe is accessible only from the inside, internally mounted sensors are a suitable option.

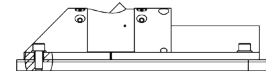
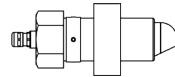
Technical data

Transmitter



Ductus M

Acoustic paths	1 to 8 (more upon request)
Number of pipes	up to 2
Range	0 to ± 20 m/s (bidirectional)
Accuracy	up to ± 0.5 % (8 paths)
Display	4 lines, 20 characters
Data logger	internal, user-selectable sampling interval
Interfaces	VGA (1024*768), PS/2 for external mouse, keyboard, 4x USB, 2x RJ-45
Communication	2 x RS-232, FTP, Modbus TCP (optional)
Inputs	max. 8 x 4-20 mA
Outputs	max. 4 x 4-20 mA, 4 x Relay, 2 x Pulse
Power supply	24 V DC, integrated battery backup (2 Ah)
Approval	IP65 (NEMA 4)
Enclosure	powder-coated sheet steel, wall mounted
Dimensions	500 mm x 400 mm x 176 mm (H x W x D)



Wetted sensors

FT-L120

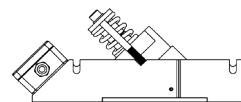
TD-IM

Frequency	120 kHz	200 kHz
Beam width	10° (-3 dB)	18° (-3 dB)
Configuration	IEC41 / ASME PTC 18	IEC41 / ASME PTC 18
Pipe diameter	0.3 m to 15 m	1.0 m to 10 m
Mounting	welding socket or thread	-
Pressure rate	60 bar *)	60 bar *)
Material	stainless steel	stainless steel / polyamide
Cable	twisted pair with shield	twisted pair with shield
Operating temperature	0 °C to 40 °C	0 °C to 40 °C
Dimensions	Ø 1 1/2", length: 186 mm	320 x 100 x 70 mm (L x W x H)
Installation	removal of the transducer for repair, replacement or cleaning by means of a special jacking tool.	from the inside

*) other ranges upon request

Clamp-On transducers

CO-L



Pipe diameter	0.4 m to 15 m (for < 3 m use Ductus S system)
Pipe wall thickness	up to 100 mm (steel, plastic, glass fiber)
Accuracy velocity	up to ± 0.5 % of reading
Frequency	200 kHz
Beam width	8° (-3 dB)
Material	stainless steel, polyamide
Operating temperature	-20 °C to 60 °C
Dimensions	270 x 115 x 100 mm (L x W x H)

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