

deltawave

Ultrasonic multimeter for fluids

- Flow measurement
- Flow profile determination
- Turbidity measurement

deltawave

made by systec



Clever messen!
systec
CONTROLS



deltawave flow measurement, flow profile determination, turbidity measurement in fluids

deltawave is the first ultrasonic multimeter that can acquire, apart from the flow, the flow profile and turbidity or solid load, as well as the mean medium temperature and changes in the medium composition.

deltawave measures everywhere: in filled pipes, in partially filled pipes, open canals, channels and rivers.

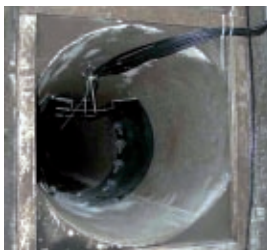
deltawave also works under extreme conditions, maintenance-free, calibration-free and reliably. The measurement system monitors itself continuously and the multi-canal property ensures redundant safety.

With a deltaxwave measurement transducer, you can realize up to eight different measurement points.

deltawave is in use in a variety of different industrial plants:

Water and drainage water applications

Special advantages: Maintenance-free, deposits of biomass and dirt on the sensorics have no effect on the measurement quality. IDM-accuracy in the partially filled cross-section area or open channel! No culverts required. Back-ups and back flows are reliably acquired and measured. With the turbidity monitoring, for example, the function of after-purification can be monitored.



- Purification plants of industry and community economy

Applications are, for example

- Monitoring of purification plant inflow and outflow according to the (German) self-monitoring regulation (EkVO)
- Control of rain trapping ponds
- Feeding of parallel ponds
- Monitoring the after-purification

- Drain water associations and city works

Acquisition of the exact discharge quantities for internal accounting purposes

- Recognition of false water quantities
- Checking and acquisition of the canal hydrology

deltawave

Really versatile, always accurate and can be deployed anywhere

Thermal and hydro power stations

Special advantages: IDM-accuracies in pressurized pipes with little construction effort. Reliable quantity acquisition in the inflow of river power stations, turbine acceptance measurements.

Exact, mean temperature measurement of the medium. Installing and dismantling possible under operating conditions. Exact calculation of discharge costs with government agencies.

• Thermal power stations

Here, deltaxwave reliably carries out

- the monitoring of tapped and recycled cooling water quantities for accounting purposes
Kühlwassermengen zu Abrechnungszwecken
- Energy balancing to avoid impermissible flow heating
- Exact determination of the mean water temperature, even in case of temperature skeins
- Optimization of the pump performance

• Storage power stations and pumped storage power stations

- Turbine and pump monitoring
- Optimization of the turbine efficiency
- Turbine acceptance according to international standards
- Checking the required water quantities
- Pipe rupture monitoring

• River power stations

- Efficiency optimization and vane control
- Monitoring of environment protection requirements

General advantages:

- Flow measurement independent of medium viscosity
- Suitable for electrically non-conducting media
- Practically no pressure loss
- Retrospective installation without pipe interruption is possible
- Maintenance-free



Water resources policy, environment protection and hydrography

Particular advantages: Continuous discharge measurement, high accuracy, freedom from maintenance, acquisition of flooding events without „rapid deployment troops“, gigantic data store, all communications interfaces (RS232, LAN, USB), acquisition of speed profiles.

- Tidal wave forecasting
- Monitoring the compliance with environment protection requirements, for example, of hydro-power stations
- Discharge monitoring, e.g. of purification plants
- Navigability monitoring



Intelligent evaluation

Running time methods with hitherto-unachieved resolution for flow measurement

The electronics of deltaxwave measures the running time difference of the ultrasonic signals running in and against the direction of flow with unbelievable precision.

The evaluation technology developed by systec Controls has a resolution of up to < 30 psec.

That is the reason that deltaxwave measures even the smallest flow speeds reliably. And because the runtime measurement is a purely digital time measurement, the electronics works in a drift-free and maintenance-free manner.

Correlation process for measurement under the most difficult conditions

Ultrasonic signals are disturbed by a large number of influencing quantities; this includes EMC radiation, gas or solid impurity loading, machine noise etc. In order to be able to reliably find the ultrasonic signals again in this „ambient noise“, in the case of the traditional ultrasonic devices, the signal amplitude must be a multiple of the noise. For deltaxwave, systec Controls has developed a new kind of evaluation method, which finds the ultrasonic signals even if the amplitude of the noise is a multiple of the signal amplitude. The benefits for the deltaxwave user are the reliable and stable measurement data even under extremely unfavorable conditions.

The traditional standard damping (green line) in comparison to the new Smart damp. The grey points are the measured value quantities to which the dampings react.

At t = 50 seconds, for example, there is a measured value jump that Smart Damp follows far faster than the standard damping.

In the range from 50 to 150 seconds, the measured value changes continuously (scatter). As the diagram shows, Smart damp damps just as well as the standard damping, but follows measured value jumps significantly faster, which ultimately results in a higher regulation quality.

Innovative pulse Doppler process for determining the flow profile

When the flow of open channels is to be measured, major constructions are often required. Either filled pipes are generated through expensive procedures, and there, for example, IDMs are deployed, or precisely defined cross-sections, for example, Venturis are built, to acquire the flow through a level measurement. This is expensive, often inaccurate and in addition, brings the danger of overflowing.

For flow profile determination, deltaxwave sends impulse packets into the fluid.

The pulses are reflected on the mobile gas bubbles or particles.

Owing to the motion of the particles, the frequency of the ultrasonic signal changes according to the Doppler principle.

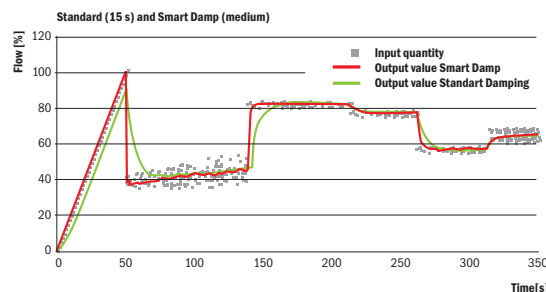
Thus, the frequency displacement is a measure of the particle speed or the medium speed.

Since, in addition, the time till the echo is received is measured, the position of the particles can also be determined.

By the use of several ultrasonic paths on different measurement levels, deltaxwave determines a high-resolution spatial image of the flow profile.

Expensive construction measures like culverts, long inflow paths etc. become superfluous.

- Up to 16 (!) measurement paths make possible far more accurate measurements than was the case so far
- The flow profile is acquired in a far better manner than in the case of point-based systems or systems working in only one line, because: In traditional systems, changes in the flow profile owing to back-ups or alternating levels result in extreme measurement errors
- Detection of even the smallest (return) flows



Determination of the turbidity as a „side effect“

The deltaxwave process -for which a patent claim has been filed - for locally resolved particle concentration measurement, uses the energy of the echoes from the medium. This changes with the particle concentration. As with the pulse-echo process, here too, the time of arrival of the echo is determined, which allows an exact localization of the particles. The result: deltaxwave can determine, locally resolved, the particle concentration or the mean value of the particle density in a large cross-section area. This particle monitoring is, for example, of interest for the monitoring of after-purification basins or for protecting pumps or turbines.

The particular advantages:

- No disturbance from external light or discoloration of particles carried along in the (drain) water as is the case with turbidity photometers
- There is no lens to be cleaned; deltaxwave works without any maintenance.
- Acquisition of the particles across the entire cross-section area (and not only at points). The measurement shows – differently from the normal optical instruments – the spatial distribution of the particles. This makes a more reliable measurement statement possible.

Smartdamp - reacts immediately and is damped as well

The problem in the case of normal damping of the first order is well-known: Nicely smoothed measured values „cost“ a slow reaction of the measuring instrument with jerky measured value changes.

The smoothed measured values are required for stable regulation; the real-time jump response cannot be dispensed with. Therefore, for the user, with most measuring instruments, there only remains a compromise between moderate regulation quality and a just about adequate reaction to jerky changes in measured values.

Here, the new damping strategy developed by systec Controls, „Smartdamp“ gives a big advantage: Smartdamp quickly follows the measured value in case of sudden jumps, but reliably damps small measured value variations, to ensure a high control quality of the downstream control elements.

Maintenance-free, no culverts, no long approach paths

High-Tech Ultrasonic transducer

Hohe Signalausbeute

deltawave ultrasonic transducers provide an excellent signal exploitation. Piezo, the housing, gluing and casting materials were optimized for the highest transmission of the sound energy. Therefore, the integration of the ultrasonic signals in the fluid takes place with the best possible signal exploitation. As compared to other ultrasonic transducers and clamp-on-systems, a significantly more stable signal is achieved owing to the high signal exploitation. This also makes possible the measurement of media that are bad conductors of sound or under high solid and gas loading, – and that at path lengths of more than 100 m.

The assembly plate has a standard impact protection, which protects the transducer reliably from damage by driven material.



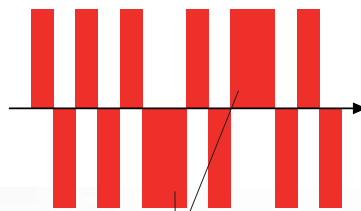
Fast reaction to encoded transmission signals

To exclude the possibility of wrong measurements with certainty, deltaxwave transmits coded transmission signals – similar to Morse code.

The digital signal processor then searches in the received signal for the transmitted Morse code. If a deviating signal is found, the signal is rejected. As a result, mis-measurements caused by noise are practically eliminated. This becomes possible thanks to the extremely powerful ultrasonic transducers, which can cleanly convert such coded transmission signals into ultrasonic signals.

Short response and reverberation times

Fast response and reverberation of the ultrasonic transducer has a number of advantages: The maximum signal amplitude is quickly available, hence the signal is more easily recognizable. In pulse-echo operation, a short reverberation time ensures short block distances, i.e. even echoes that originate close to the transducer can also be heard, since the reverberation is sufficiently damped. An ingenious structural shape and special casting materials make this advantageous transducer behavior possible.



180° phase change, as a result, the signal is recognized even with high noise.

Powerful hardware architecture

Multiboard concept

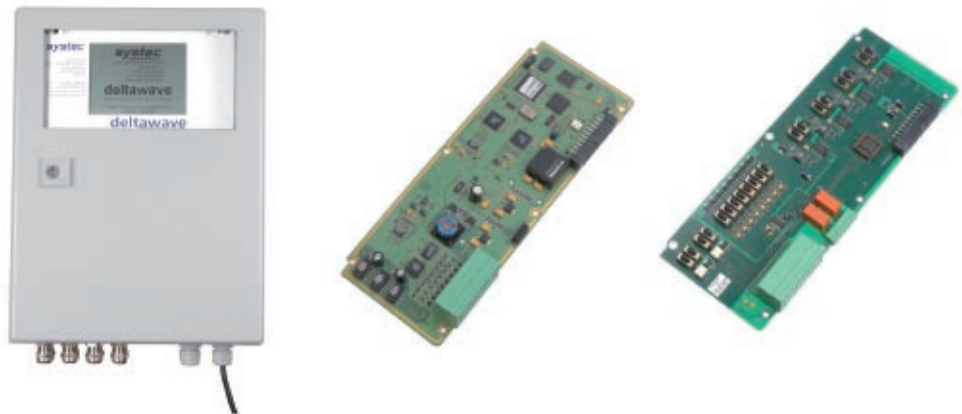
The deltaxwave measurement transducer consists of a main computer, which makes it possible for the user to individually configure measurement cards. Plug&Play applies here purposefully for all extension cards: Open the housing, insert the new measurement card, close the housing, use the new measurement card.

The main computer recognizes new measurement cards automatically and immediately makes the hardware available, without any further steps being required.

Since all the measurement cards have their own processors, the system performance is always assured, regardless of whether 4, 8, 12 or 16 ultrasonic paths are used.

The powerful 64-bit Linux main computer merely assigns their tasks to the measurement cards and the respective cards then fulfill their measurement function fully independently. Thus, depending on the configuration, the individual measurement path is measured up to more than 100 times per second. This ensures not only the measurement performance, but also a high degree of redundancy and system stability. All the boards are equipped with a separate self-monitoring system.

Developed in modular concept, adaptable,



Description	deltawave measurement transducer Ultrasonic multimeter for measurement of the flow, of the turbidity and the flow speed distribution	deltawave ultrasonic board Multi-frequency DSP ultrasonic board	deltawave I/O-board Input and output board
Technical Data	Number of measurement cards: 1 to 4 Supply: 90-230 V AC (24 V DC upon request) System of protection: IP65, - optional Eexd Display: Touchscreen, Grafics, 320x240 points, LED background lit Interfaces: USB, RS232, LAN Processor: 64 Bit RISK Operating system: Embedded Linux Dimensions (b x h x t): 300 x 400 x 210 mm Weight: approx. 6 kg Installation: Wall mounting, M8/M10 Number of independent measurement points: 1-8	Measurement principles: Running time difference, pulse Doppler, Impulse energy Number of ultrasonic transducers: 8 Number of paths: 4 Ultrasonic boards per measuring transducer: 1 to 4 (1 to 16 measurement paths) Number of measurement points: 1 to 4 Frequency range: 0.2-2 MHz Path lengths: 0.1 to 150 m Measurement range: -20..20 m/s Resolution: <0,001 m/s Number of measurements: up to 100/s (path length dependent) The I/O board works autonomously with its own processor.	Eingänge 4..20 mA: 8 counts, external or own supply Outputs 4..20 mA: 4 counts, External or own supply Outputs digital: 2 counts, open collector, external or self-supplied (24 VDC) Relay: 2 counts, basic/NO/NC I/O boards per measurement transducer: 1 or 2 External or own supply is defined via a switch on the I/O Board The I/O board works autonomously with its own processor.
Permissions	CE, Exd	CE, Eexm	CE

Autonomous individual components, highest failure safety



deltawave 1.0 MHz Ultrasonic transducer For internal assembly	deltawave 0.5 MHz Ultrasonic transducer For internal assembly	deltawave 0.2 MHz Ultrasonic transducer for internal assembly	deltawave quicklock For pipe assembly from the outside, optionally under operating conditions
<p>Frequency: 1 MHz</p> <p>Path lengths: 0.1..10 m</p> <p>Path angle: 15..75° (45° Std.)</p> <p>Temperature range: -40..80°C</p> <p>Pressure range: max. 10 baü</p> <p>Material (coming in contact with the medium): PVC / PU / V4A (others upon request)</p> <p>Cable length: 10 – 150 m</p> <p>Cable type: RG 58</p> <p>By default, the sensor is supplied with a wall mounting, other mounting systems upon request</p>	<p>Frequency: 0.5 MHz</p> <p>Path lengths: 0.5..40 m</p> <p>Path angle: 15..75° (45° Std.)</p> <p>Temperature range: -40..80°C</p> <p>Pressure range: max. 3 bar overpressure</p> <p>Material (coming in contact with the medium): PVC / PU / V4A (others upon request)</p> <p>Cable length: 10 – 150m</p> <p>Cable type: RG 58</p> <p>By default, the sensor is supplied with a wall mounting, other mounting systems upon request</p>	<p>Frequency: 0.2 MHz</p> <p>Path lengths: 3..150 m</p> <p>Path angle: freely selectable</p> <p>Temperature range: -40..80°C</p> <p>Pressure range: max. 2 bar overpressure</p> <p>Material (coming in contact with the medium): PVC / PU / V4A (others upon request)</p> <p>Cable length: 30 – 300 m</p> <p>Cable type: RG 58</p> <p>The sensor mounting is specifically projected and manufactured depending on the application.</p>	<p>Frequency: 1 MHz</p> <p>Path lengths: 0.1..10 m</p> <p>Path angle: 15..75° (45° Std.)</p> <p>Temperature range: -40..80°C</p> <p>Pressure range: PN 6/16/40/100</p> <p>Material (coming in contact with the medium): PVC / V4A (others upon request)</p> <p>Cable length: 10 – 150 m</p> <p>Cable type: RG 58</p> <p>The sensor can be supplied in different structural shapes. Installing and dismantling under operating pressure possible as an option (Quicklock version)</p>
Ex m	Ex m		

Proven measurement processes, simple installation



Basis of calculation

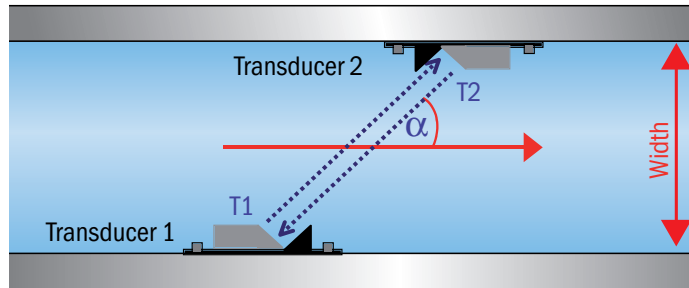
The determination of the flow speed is based on the ultrasonic running time method:

Two ultrasonic transducers emit, at an angle α (15 - 75°), sound waves into the medium. Such a transducer pair together forms an acoustic path.

The sound waves emitted by transducers located upstream are accelerated by the flow; the sound waves emitted by the transducers located downstream get delayed. The running time difference (T2-T1) between the two is a direct measure of the mean flow speed across the path length. From this, if the geometry is known, the flow can be calculated.

deltawave acquires the difference in running times with an extremely high resolution.

As a result, extremely large measurement ranges of 1:10,000 (0.002..20 m/s) and excellent path accuracies (from 0.1%) can be realized. The calculation of the through flow or discharge is conformant to international standards.



High accuracy through multi-path measurement

Even with just a single acoustic path, under ideal conditions, a reproducible and reliable determination of the flow is possible. The flow conditions in large pipes and in open or partially filled channels are, however, very complex. Short inflow paths, changing levels, back-ups, channel roughness, wind and waves are only some of the many interfering quantities in the case of such measurements.

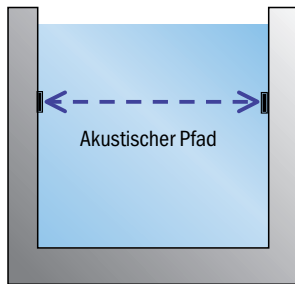
In order to achieve, under such difficult conditions, good through-flow or discharge accuracies, a multiple path measurement is necessary. By installing crossed transducer pairs, high accuracies are realized even with extremely short inflow paths (e.g. immediately after curves, after valves or pipe narrowing). The following table provides an overview of what accuracy can be achieved with which delatwave equipment:


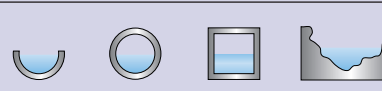
Installation options

Regardless of whether there is a rectangular cross-section involved, or partially or fully filled pipes or naturally running water, the location of the measurement point considerably influences the measurement result.

On the basis of the isometric view or drawing of the application, system Controls recommends the best possible installation location and specifies the expected accuracy free of cost. If desired, and for reimbursement of the small charges that will be incurred, the customer advisor of system Controls responsible for the respective location can also take over the measurement recording on-site.

The structural shape as well as the mounting of the transducer is matched individually to the measurement environment.



Inflow path	Accuracies					
	> 10D			< 5D		
Paths / Crosswise measurements	2	4	6	2x2	4x2	6x2
 filled pipes and filled rectangular cross-sections	1.5-2 %	0.5-1 %	0.50%	1.5-2 %	0.5-1 %	0.50%
 open channels partially filled pipes, running water	3-4 %	2-3%	1-2%	3-4%	2-3%	1-2%

Installation in open channels

The transducers can be installed directly on the surface of the channel or on special mounting rails, which make it possible to pull them under operational conditions. Connecting a level measurement device (4..20 mA) makes possible correct discharge calculation under alternating level values.



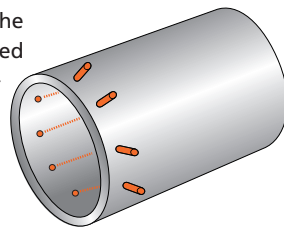
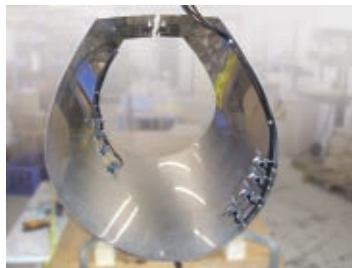
Installation in piping

In filled pipes, the transducers are either introduced into the inside of the tube through welding sockets or installed internally, e.g. by means of a clamping ring.

The cables are led out here via special sealing packing.

Welding sockets in the Quicklock construction can be installed in ongoing operation at operating pressures up to 100 bar and – if necessary at all – maintained.

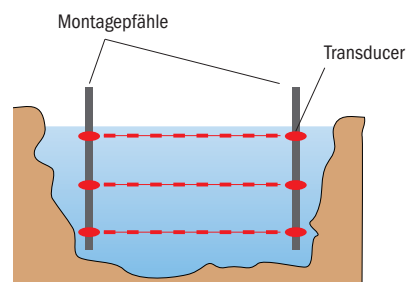
In the case of partially filled pipes, the measurement system is only enhanced by one more level measuring instrument.



Installation examples for natural running waters on bridges and dams

Installation is possible on bridges and dams as well as at a distance from the banks.

In channels in the case of which the banks are not uniform in cross-section or covered by vegetation, according to international standards, it is also permitted to mount the transducers on stakes that must be inserted at a certain distance from the banks. In particular, when the ratio between „not measured“ and „measured“ flow is low, the correction (calibration) to be carried out is also less and the generated measurement inaccuracies are within tolerance.



Adapting to the flow channel, systec Controls, in cooperation with the measurement point operator, develops customized and easy-to-assemble fastenings.

Self-explanatory, convenient, safe and can be monitored over the Internet

Parameterization

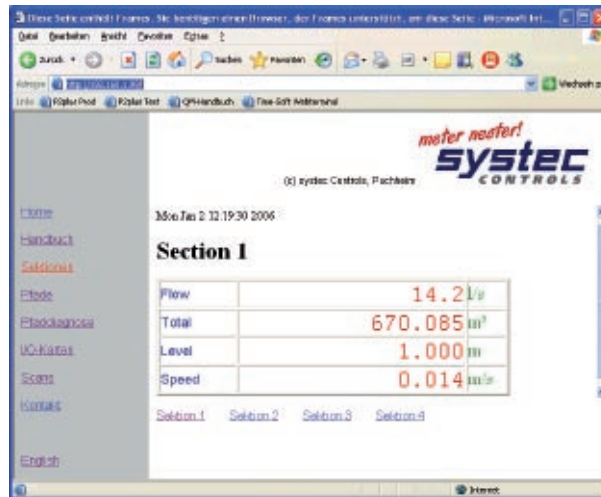
deltawave can be conveniently and easily prepared for measurement, even for very complex applications. Complete parameterization essentially consists of the input of the channel shape, definition of the path configuration, definition of the inputs and outputs as well as the selection of the discharge method.

The accompanying Windows-software makes possible an intuitive and mostly self-explanatory parameterization.

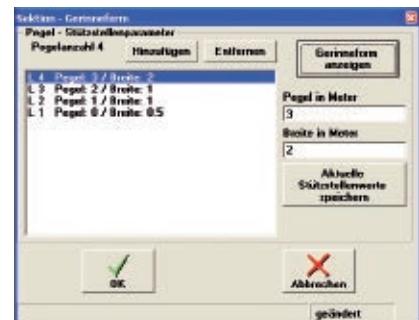
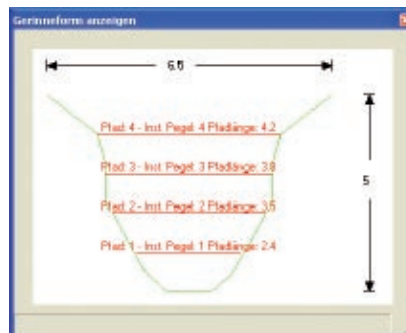
After completion of the parameters, they can be stored, from the workplace-PC or laptop, on a common memory stick and copied to the instrument. To do so, all that must be done is to connect the stick to deltaxwave – the parameters are then copied fully automatically.

Troublesome maneuvering of the laptop under often rough measurement location conditions is thus eliminated. Even updates, software enhancements or layout changes of the display are easily possible with this tool.

Alternatively, deltaxwave can also be connected via LAN with the Intranet or Internet and comfortably parameterized and updated via FTP. Reading the current measurement values is easily possible by means of the Webserver integrated in deltaxwave.



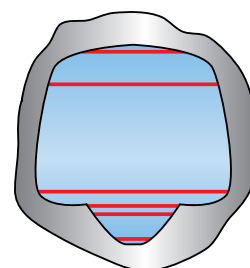
Channel shape



To deploy deltaxwave in a pipe, only the inner diameter has to be input for defining the channel shape. Other channel shapes are quite easily defined by inputting a plotting point table. The user-friendly software permits a graphical examination of the input.

Inputting up to 128 plotting points makes an exact definition of the measurement point geometry possible. Therefore, a highly accurate determination of the flow becomes possible even in the case of complex cross-sections.

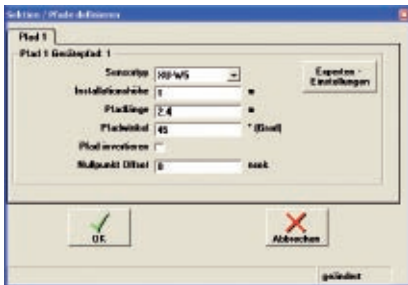
Depending on whether the channel is angular, round or natural, deltaxwave connects the plotting points with straight lines or a spline. This increases the accuracy of the flow calculation even in round channels or natural running waters.



deltawave

Path configuration

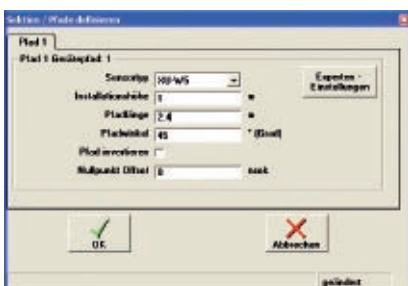
In the path configuration, it is necessary to input the respective path parameters. Essentially, these are the transducer type, the path height, path length and the path angle. In addition, from the menu „Expert settings“, there is the option to influence additional parameters like signal coding – the parameterization software of deltaxwave is a transparent as well as comprehensive tool for individual configuration requirements.



Inputs and Outputs

All inputs and outputs are freely parameterizable and scalable in the case of deltaxwave.

Apart from the outflow data, e.g. the level, flow speeds, medium temperature or other quantities of interest can also be transmitted. By means of switches on the I/O-card, the analog outputs can be operated both actively (24 V DC from deltaxwave) as well as passively (24 V DC from external voltage source).



With the digital outputs (2 relay outputs and 2 frequency outputs per board with output frequencies between 1 and 400 Hz), counting pulses or alarms can be led to the outside.

An I/O-board has 8 analog inputs, 4 analog as well as 4 digital outputs. If additional inputs and outputs are required the number of inputs and outputs can be doubled by simple plug-and-play by plugging in another I/O-card.

Discharge method

Depending on your application, there are a large number of ISO-standardized discharge models that ensure optimum accuracy.

After the installation of the ultrasonic transducers, the specific parameters of the measurement point like medium definition and calculation coefficients (which are to be simply taken from the manual) can be transmitted to the instrument with the help of the software „DeltaWave Parameters“.

Convenient Expansion options

With one deltaxwave measurement transducer, it is possible to realize up to four different measurement points (sections) with a total of maximum 16 paths. deltaxwave can be retrospectively expanded: Simply insert additional ultrasonic or I/O boards in the evaluation unit, switch on – done! Recognition is automatic, by plug-and-play.

Safety

There is a great deal of importance attached to safety at deltaxwave. The main computer of deltaxwave works with a highly secure embedded Linux operating system with a hierarchical security concept.

Without a password, only a display of the current operations data and reading the data logger are possible. For other tasks, there are different access rights „User / Service / Administrator“, which are password protected. This makes unintentional or malicious interference in the measurement task practically impossible.

Remote operation

If deltaxwave is integrated in a computer network, parameters can be changed, the device status queries and saved measured values can be read directly from the Windows-PC; deltaxwave can save the measured values of 40 (!) years internally. Therefore, repeatedly searching for the measurement point is eliminated.

deltaxwave works fully automatically without disturbing the work flow of the measurement technician.



Durchflussmesstechnik „by systec“



deltaflow

deltaflow for universal, exact and extremely low pressure-loss flow measurement

The backup pressure probe deltaflow measures the flow of gas, vapor and fluids according to the extremely accurate differential pressure principle. Owing to the structural shape being so suitable from a flow-dynamics standpoint, the deltaflow generates practically no constriction at all and thus effects the lowest pressure loss among all the known differential pressure transmitters.

As a result of this alone, users of the deltaflow can save several hundred thousand Euro per year at the corresponding measurement points.

deltaflow is certified by the (German) Technical Inspection Association (TÜV) and can be deployed at high pressure (up to 690 bar) and in the Eex-area.

There are various different production materials available for your individual application (e.g. 1.4571, 1.4828, Hastelloy C4 and others).

flowcom made by systec

Anyone who takes measurements professionally must also evaluate them professionally. flowcom is the ideal enhancement to deltaflow or any other flow measurement system. It compensates the error of flow meters that is dependent on pressure and temperature and calculates mass and volume flows of gas. In steam, it can additionally calculate energy quantities. It is TÜV-certified for suitability and UAL-permitted according to 13th and 17th of the (German) Federal Emission-Control Ordinances (BImSchV).



portaflowX clamp-on flow measurement for fluids from Fuji Electric

The portable buckle-on flow measuring instrument portaflowX and its fixed-installation sister TimeDelta determine the flow of fluids in pipes according to the highly accurate running time process.

This series of instruments are distinguished by the very simple operation, highest accuracy and extremely competitive prices. With the new ABM process, pipe diameters from 13 to 6000 mm at temperatures of -40 to +200 °C and turbidity of up to 10,000 mg/l can be measured.



The head office of the systec Controls company is located in Puchheim near Munich. Here, we develop and manufacture our products according to DIN EN ISO 9000:2000. But innovation and product quality alone are not enough for us. We have also had our systems tested by independent institutes – with a clear, provable success. And of course, we are there

for you even after the installation of your plant. You can get us on our Hotline **24 hours a day and 7 days a week.**

systec Controls - the specialist in flow measurement technology.

Überreicht durch:

Clever messen!
systec
CONTROLS

Mess- und Regeltechnik GmbH
Lindberghstraße 4
D - 82178 Puchheim
Tel.: 0 89 / 8 09 06 - 0
Fax: 0 89 / 8 09 06 - 2 00
info@systec-controls.de

systec Controls Hotline
089 - 809 06 108

www.systec-controls.de