

Ultrasonic Flow Metering System for Water and Wastewater

- Partially and fully-filled channels, pipes and surface waters
- Multiple-path technology ensures highly precise measurement
- Virtually maintenance-free

deltawave**VER2** & deltawave**VER2** LEAN

made by systec



deltawave^{VER2} provides precise measurement for all hydrological tasks and can be used in virtually any application: in filled and partially-filled pipes, open channels, canals and rivers. deltaxwave^{VER2} functions even under extreme conditions, maintenance and calibration-free and reliably. The measurement system continuously monitors itself, and its multi-channel design ensures redundant safety.



Depending on your application requirements and budget, you may select a 2-, 4- or 8-path hardware version. In particular the new 2 path version deltaxwave^{VER2} LEAN is for demanding applications with limited budgets.

deltawave^{VER2} is in use in a wide variety of industrial settings:

Water and Wastewater Management

Special advantages: Maintenance-free, deposits of biomass and dirt on the transducers have virtually no effect on measurement quality. IDM accuracy in filled and partially-filled cross-section area or open channel! No culverts required. Back-ups and back flows are reliably detected and measured.

• Treatment plants for industrial and municipal services

Applications include:

- Monitoring of treatment plant inflow and outflow according to the (German) self-monitoring regulation (EkVO)
- Monitoring of rainwater catchment basins
- Feeding of parallel basins
- Recirculation control and optimization

• Wastewater treatment associations and public utilities

Metering of exact discharge quantities for accounting purposes

- Detection of false water quantities
- Checking and recording of canal hydrology

Thermal and Hydro Power Stations

Special advantages: IDM accuracy in pressurized piping with minimal construction effort. Reliable quantity detection in inflow for river-sited power plants, turbine acceptance measurements. Installation/removal possible under operating conditions. Exact calculation of cooling water volume with public authorities.

• Thermal Power Stations

Here, deltaxwave^{VER2} reliably carries out

- monitoring of tapped and recycled cooling water volumes for accounting purposes
- Energy balancing to avoid impermissible flow heating
- Online efficiency measurement
- District heating accounting measurements

• Storage and Pumped Storage Power Stations

- Turbine and pump monitoring
- Optimization of turbine efficiency
- Turbine acceptance per IEC 60041 and ASME PTC 18
- Monitoring of required water volumes
- Leak detection, even under dynamic operating conditions
- Measurements possible up to 100 bar – even in large pipes

• Low Head River Hydro Power Stations

- Efficiency optimization and vane control
- Monitoring of environmental protection requirements
- Monitoring of fish ladders

Perfect Accuracy
for Accounting
Applications

Turbine acceptance
and optimization

WaveVER2

Truly versatile, always precise and usable

Detect leaks quickly
and accurately – even
under dynamic operating
conditions

General advantages:

- Flow measurement regardless of fluctuations in temperature, pressure, density and viscosity
- Virtually no loss of pressure
- Retrofit installation possible without disrupting piping
- Maintenance-free
- Standardized discharge equations per ISO6416, IEC 60041 and ASME PTC 18

Water management, environmental protection and hydrography

Special advantages: Continual discharge measurement, high accuracy, no maintenance required, detection of flooding events without the need for "rapid deployment troops", massive data storage, all communication interfaces RS232, MODBUS, M-BUS, USB, Micro SD-Card), detection of speed profiles.

- Flood monitoring
- Monitoring of adherence to environment regulations, e.g. for hydropower stations
- Discharge monitoring, e.g. from sewage treatment plants
- Monitoring of vessel navigability
- Low power consumption (remote area)

Leak Detection in Penstock

Applications

deltawaveVER2 is the perfect basis for a reliable and safe penstock protection. Digital communication of the inlet and outlet meters with the DCS ensure highest accuracy not only of the measurement but also of the transmission of the values. The transmitted diagnostic data, which is also included in the Bus-protocols, ensures proper operation of the meters and help operators to avoid false emergency shut downs.

syslec Controls has installed many penstock protection meters and will support you in the perfect setup of your safety operation procedure. Perfect matching meters and a penstock shut down strategy will ensure safe operation and fast reaction in case of a penstock damage.

Which is why the deltaxwaveVER2 employs a significantly more powerful monitoring concept:

- 2 independent monitoring circuits
- Evaluation of digital meter readings via BUS comparison of simultaneous (analog) values
- Also suitable for dynamic conditions such as operational start-up and shutdown
- Better than 0.3% leakage uncertainty via calibration
- Extensive fault monitoring
- Fully digital measurement data acquisition and leakage analysis

District heating reference meter

deltawaveVER2 can be equipped with high temperature transducers, withstanding pressures up to 16 bars and temperatures up to 160°C. If desired, syslec can supply spool pieces with ready installed sensors- calibrated on national reference metrology test beds.

In particular for billing applications of main pipe district heating applications, the meter needs to have the highest possible accuracy and reliability. The wetted ultrasonic flowmeter deltaxwaveVER2 is the ideal meter for that: Accuracies of < 0,5% after calibration, ISO60041-path arrangement, ISO9000 tracability, DAKKS or NIST calibration and many more advantages make deltaxwaveVER2 the meter of choice for this application.

Since deltaxwaveVER2 is a digital time measurement, drift effects will not affect the meters accuracy. The transducers are free of wear and tear and with no pressure loss.



Innovative measurement process, precise evaluation

Correlation method permits measurement under most difficult requirements

Ultrasonic signals are disturbed by a large number of influencing factors; this includes EMC radiation, gas or solid impurity loading, machine noise etc. For conventional ultrasonic devices to be able to reliably pick out the ultrasonic signals in this "ambient noise", the signal amplitude must be a multiple of the noise.

For deltawave^{VER2}, 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 deltawave^{VER2} user are reliable and stable measurement data even under extremely unfavorable conditions.

Smartdamp – reacts immediately and is damped as well

The problem in the case of normal damping of the first order is well known:

You "pay" for nicely smoothened measurement values in the form of a slow reaction of the measuring instrument to rapid spikes in measured values. The smoothened measured values are required for stable regulation, yet the realtime jump response is essential too. Consequently, with most measuring instruments the user's only choice remains a compromise between moderate control quality and only minimally adequate reaction to jerky changes in measured values.

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

High-Tech Ultrasonic Transducer

High Signal Exploitation

deltawave^{VER2} ultrasonic transducers provide 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. The high signal exploitation means that a significantly more stable signal is achieved compared to other ultrasonic transducers and clamp-on-systems. This also makes possible the measurement of media that are poor conductors of sound or under high solid and gas loading, – and that at path lengths of more than 100 m.

The assembly plate comes with standard impact protection which reliably protects the transducer from damage from floating debris.



Short Response and Reverberation Times

Fast response and short reverberation of the ultrasonic transducer has a number of advantages: The maximum signal amplitude is quickly available, hence the signal is more easily recognizable. An ingenious structural shape and special casting materials make this advantageous transducer behavior possible.

High pressure/high-temperature transducers

Our high-pressure transducers for pressures exceeding 100 bar can e.g. be used in storage power stations. For applications involving invoicing services for district heating networks, for example, we manufacture high-temperature transducers which operate at up to 140°C.

deltawaveVER2

Maintenance-free, no culverts, no long approach paths

Plug and Play
Hardware

Intelligent Evaluation

Transit time measurement with highest resolution of flow speed

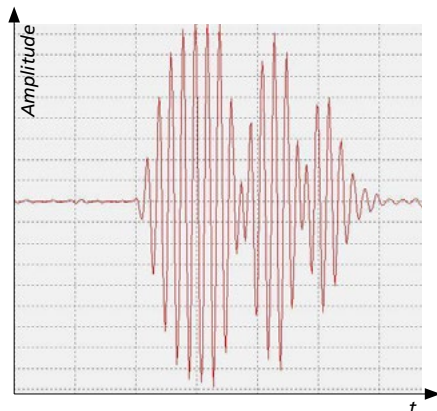
deltawaveVER2's electronics measure the transit time difference of the ultrasonic signals running with and against the direction of flow with astonishing precision. The evaluation technology developed by systec Controls boasts a resolution of up to < 30 psec.

Consequently, deltaxwaveVER2 reliably measures even the smallest flow speeds. And because the transit time measurement is a purely digital time measurement, the electronics function in drift-free, maintenance-free manner.

Reliable signal detection by transmitting encoded signals

To exclude the possibility of wrong measurements with certainty, deltaxwaveVER2 transmits encoded 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, mismeasurements caused by noise are practically elimi-

nated. This becomes possible thanks to the extremely powerful ultrasonic transducers, which can cleanly convert such encoded transmission signals into ultrasonic signals.



Encoded signals: typical signal packet with two 180° phase shifts for reliable signal recognition.

High-performance hardware architecture

Multiboard Concept

deltawaveVER2 is a multiboard system with a main board and attached ultrasonic boards. The 4 path meter can easily be upgraded with a second ultrasonic board to a 8 path system. Since each board has its own processor, the system performance is always high independent of the number of operated paths. In other meters based on single processor multiplex architectures, the measurement rate and performance will be reduced when more paths are operated. This has negative effects on accuracy and dynamics of the measurement.

The main board of deltaxwaveVER2 has modern PC interfaces such as USB and SD-Card for easy setup, diagnosis and datalog. Also analogue and digital I/O are available for connecting deltaxwaveVER2 to DCS-systems and bus-interfaces for digital communication (M-Bus, Modbus, RS232 and RS485).

The low power consumption offers the possibility, to operate the meter with solar panels or with battery power for off grid applications.

SOS Technology for perfect reliability

The brandnew self optimizing signal (SOS) technology ensures proper operation under the most challenging applications where other flowmeters fail.

Other flowmeters are using fixed signals at fixed frequencies to generate the acoustic burst. The acoustic burst is often a single voltage peak or 3-4 peaks in a row.

deltawaveVER2 uses a unique technology, that varies the frequency and the sent burst to get the optimum received signal. The bursts used from

deltawaveVER2 are code burst (similar to morse codes) which can be identified by a numerical algorithm in the received signal. deltaxwaveVER2 analyses by its SOS technology the received signal in terms of quality and varies the frequency and the sent burst code to the optimum correlation result.

This is a big advantage in particular for challenging applications with high particles or gas loads, ambient EMC noise or high turbulences in the fluid. These influences effect the received signals massively and might lead to failures in the measurement.

The result is more reliable and more stable flow readings.

Developed along a modular concept, adaptable



Description	deltawaveVER2 flow transmitter Ultrasonic multimeter flow-meter	deltawaveVER2 LEAN flow transmitter Ultrasonic multimeter flow-meter	High pressure / High temperature transducer for external mounting on pipes and under operating conditions (optional)
Technical Data	Number of acoustic paths: typically up to 8 Power Supply: 90 - 240 VAC // 23 Watt 24 VDC // 11 Watt Protection Degree: IP66 Display: Key operation, LED backlit Display: 320 x 240 pixels, Interfaces: USB, RS232, RS485-Modbus, M-Bus (Meter-Bus) Measurement Type: Multiple-path ultrasonic transit time difference (bidirectional) Outputs: 2 x 4...20mA, 2 x pulse, 1 x relays Inputs: 2 x 4...20 mA Output Signals: flow, mean flow velocity, level, temperature, function alarm, threshold alarms, volume meter Data Logger: Integrated, 4 GB Dimensions (wxhxd): 300 x 400 x 155 mm Weight: ca. 9.1 kg Mounting: Wall-mounted, M8/M10	Number of acoustic paths: typically up to 2 Power Supply: 90 - 240 VAC // 22 Watt 24 VDC // 10 Watt Protection Degree: IP65 Display: Key operation, LED backlit Display: 320 x 240 pixels, Interfaces: USB, RS232, RS485-Modbus, M-Bus (Meter-Bus) Measurement Type: Multiple-path ultrasonic transit time difference (bidirectional) Outputs: 2 x 4...20mA, 2 x pulse, 1 x relays Inputs: 2 x 4...20 mA Output Signals: flow, mean flow velocity, level, temperature, function alarm, threshold alarms, volume meter Data Logger: Integrated, 4 GB Dimensions (wxhxd): 260 x 240 x 120 mm Weight: ca. 1.3 kg Mounting: Wall-mounted, M8/M10	Frequency: 1 MHz / 500 kHz Path Lengths: 0.1 - 7 m (Type 1 MHz) 0.5 - 40 m (Type 500 kHz) Pressure Range: High-pressure version: Up to 100 bar High-temperature version (only 1 MHz): up to 28 bar Temperature Range: High-pressure version: -40...80°C High-temperature Version: (only 1 MHz): -40...140°C Pipe Size: DN800 and higher Cable Length: 10 - 150 m Accessories: Exchange armature (Exchange Kit) for switching out transducers under operating conditions
Certifications	CE, Exd	CE	CE, Eexm



WaveVER2

Autonomous Components, Highest Reliability



deltawave 1.0 MHz ultrasonic transducer For wall mounting in pipes, channels and surface waters	deltawave 0.5 MHz ultrasonic transducer For wall mounting in pipes, channels and surface waters	deltawave 0.2 MHz ultrasonic transducer For installation in larger canals and surface waters	deltawave quicklock For external mounting on pipe, optionally under operating conditions
Frequency: 1 MHz Path Lengths: 0.1..7 m Temperature Range: -40..80°C Ex to 60°C Pressure Range: max. 10 bar(g) Material (contact with medium): PVC / PU / V4A (others upon request) Cable Length: 10 – 150 m Cable Type: RG 58 Sensor delivered with standard wall mounting, other mounting systems available, e.g. mounting rails or locking rings.	Frequency: 0.5 MHz Path Lengths: 0.5..40 m Temperature Range: -40..80°C Ex -20...60°C Pressure Range: max. 3 bar(g) Material (contact with medium): PVC / PU / V4A (others upon request) Cable Length: 10 – 150 m Cable Type: RG 58 Sensor delivered with standard wall mounting, other mounting systems available, e.g. mounting rails or locking rings.	Frequency: 0.2 MHz Path Lengths: 3..150 m Temperature Range: -40..80°C Pressure Range: max. 2 bar(g) Material (contact with medium): PVC / PU / V4A (others upon request) Cable Length: 10 - 300 m Cable Type: RG 58 Sensor assembly is specifically configured and manufactured depending on application.	Frequency: 1 MHz Path Lengths: 0.1..7 m Temperature Range: -40..80°C Pressure Range: PN 6 / PN100 Material (contact with medium): PVC / V4A (others upon request) Cable Length: 10 - 150 m Cable Type: RG 58 Sensor can be delivered in different installation configurations. Optionally, installation and removal possible under operating conditions (Quicklock version).
Ex Zone 2 und Zone 1	Ex Zone 2 und Zone 1		

Proven measurement process, simple installation

Basis of Calculation

The calculation of flow speed is based on the ultrasonic transit time process: two ultrasonic transducers emit sound waves into the medium at an angle α (15 - 75°). The two transducers function reciprocally as receiver and transmitter, and together form a so-called acoustic path. This type of transducer pair combines to form an acoustic path. The ultrasonic signals (T1) emitted by the transducer positioned upstream are accelerated by the flow, while the ultrasonic signals (T2) from the transducer located downstream are delayed. The transit time difference (T2-T1) between the pair is a direct measurement of the mean flow speed over the path length. Given a known geometry, this allows the flow to be calculated according to the formula $Q = A \times v_m$,

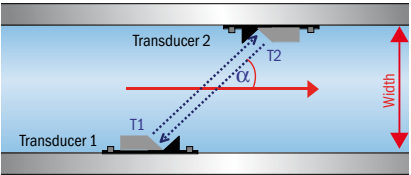
whereby:

- A= the cross-sectional area or so-called hydraulic surface
- v_m = mean flow speed over the cross-section

deltawave^{VER2} calculates the transit time difference with an extremely high resolution of less than 1 mm/s. The calculation of the flow and discharge conforms to international standard, and of course in addition to (rectangular) channels is also suitable for drains and surface waters with virtually any cross-section geometry.

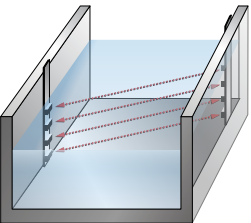
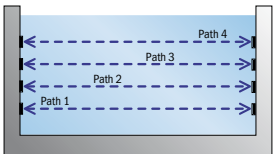
High accuracy via multiple-path measurement

Even with just a single acoustic path, under ideal conditions a reproducible and reliable determination of the discharge is possible. At the same time, the flow conditions in large pipes and open or partially filled channels are very com-



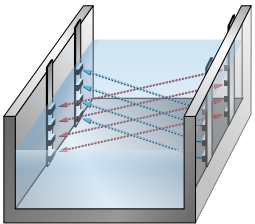
Schema Kanal (Draufsicht)

plex. Short inlet runs, changing water levels, back flow, channel roughness, wind and waves represent just some of the many disrupting factors in performing such measurements. Multiple-path measurement is necessary to precisely determine the relevant mean flow velocity under such difficult conditions. By arranging multiple acoustic paths – typically 4 – flow speeds are measured at different heights, the flow profile is optimally calculated and the mean flow velocity is precisely determined. The table below provides an overview of which deltawave^{VER2} equipment achieves the relevant accuracies.



Large channel widths commonly lack the necessary inlet conditions, leading to significantly reduced measurement accuracy when using other measurement methods due to the subsequently

distorted flow profile (turbulences). deltawave^{VER2} supports crosswise measurement, in which two acoustic paths are installed at each measuring level and whose measured speed values are then determined. Disruptive influences and turbulences are thus fully compensated for – and use is possible virtually without any inlet length.



Among others, measuring accuracy was calculated and verified at the Authority for Environmental Engineering and Water Engineering (VPUW) at the University of Kassel.

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, systec 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, your systec Controls agent can also perform the measurement recording on-site.

The design and mounting of the transducer is individually customized to the measurement environment.

Inlet Path	Accuracies*				
	> 10D			< 5D	
Paths / Crosswise Measurements	2	4	6	2x2	4x2
 Filled pipes and filled rectangular cross-sections	< 2%	0,5%	0,3%	< 2%	0,5%
 Open channels Partially filled pipes, running water	3%	2%	1%	3%	2%

*Accuracies effective starting at $v = 0.1$ m/s

Installation in open channels

The transducers can be installed directly on the surface of the channel or on special mounting rails which enables them to be pulled under operational conditions. Connecting a level measurement device (4...20 mA) makes possible correct discharge calculation under changing 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. Using welding sockets in the Quick-lock construction form or an external exchange armature, the transducers can be installed and replaced while operations are running and at operating pressures up to 100 bar and – all entirely without interrupting operations.

In the case of partially filled pipes, the measurement system is only augmented by a single additional level meter.

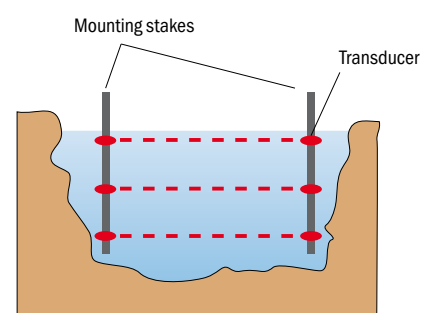


Installation Examples for Surface Waters

Installation is possible on bridges and dams, as well as at a distance from the banks. In channels where the banks are not uniform in cross-section or are covered by vegetation, international standards permit the transducers to be mounted on stakes that must be inserted at a certain distance from the banks. In particular, when the ratio between "unmeasured" and "measured" flow is low, the correction (calibration) to be carried out is also less and the generated measurement inaccuracies are within tolerance.

Even complex channel configurations can be recorded in the deltawaveVER2 via up to 256 plotting points.

In cooperation with the measurement point operator, systec Control develops customized and easy-to-assemble fastenings adapted to the flow channel.



Self-explanatory, convenient, safe and able to be monitored over the internet

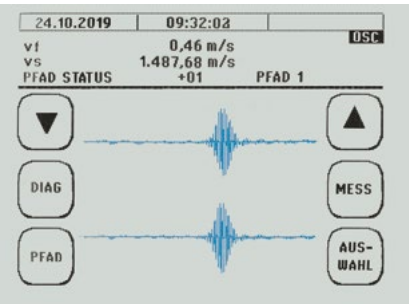
Parameterization

deltawaveVER2 can be conveniently and easily prepared for measurement, even for very complex applications.

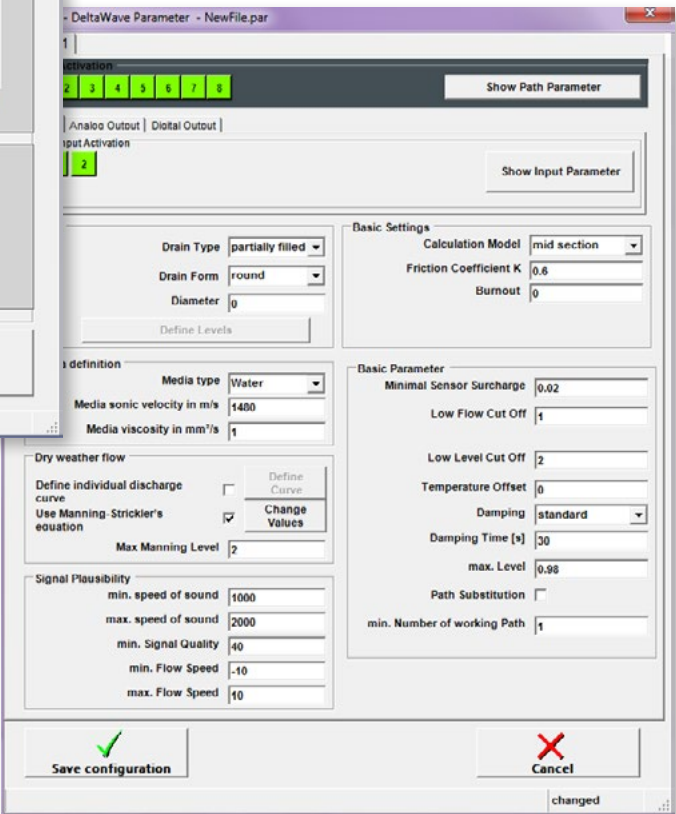
The accompanying Windows software enables intuitive and largely self-explanatory parameterization.

After finalizing the parameters, they can easily be stored on deltaxwaveVER2's SD card or transmitted to deltaxwaveVER2 via USB. Irksome maneuvering of the laptop under often rough conditions at the measurement site is this eliminated. Even updates, can be installed with this method

Oscilloscope Function



The integrated oscilloscope function allows for rapid verification of signal quality directly within the device. This function makes it possible to visually display the signals, as well as the simple and quick check of all acoustic paths.



deltawaveVER2

Discharge Method

Depending on your application, there are a large number of ISO-standardized discharge models that ensure optimum accuracy and traceability of measurement results. ISO6416 is followed for measurement of discharge flow in partially filled channels, with IEC41 and ASME PTC 18 observed for filled channels. For alternately wholly filled / partially filled channels deltawaveVER2 automatically switches to the correct standard.

Convenient Expansion Options

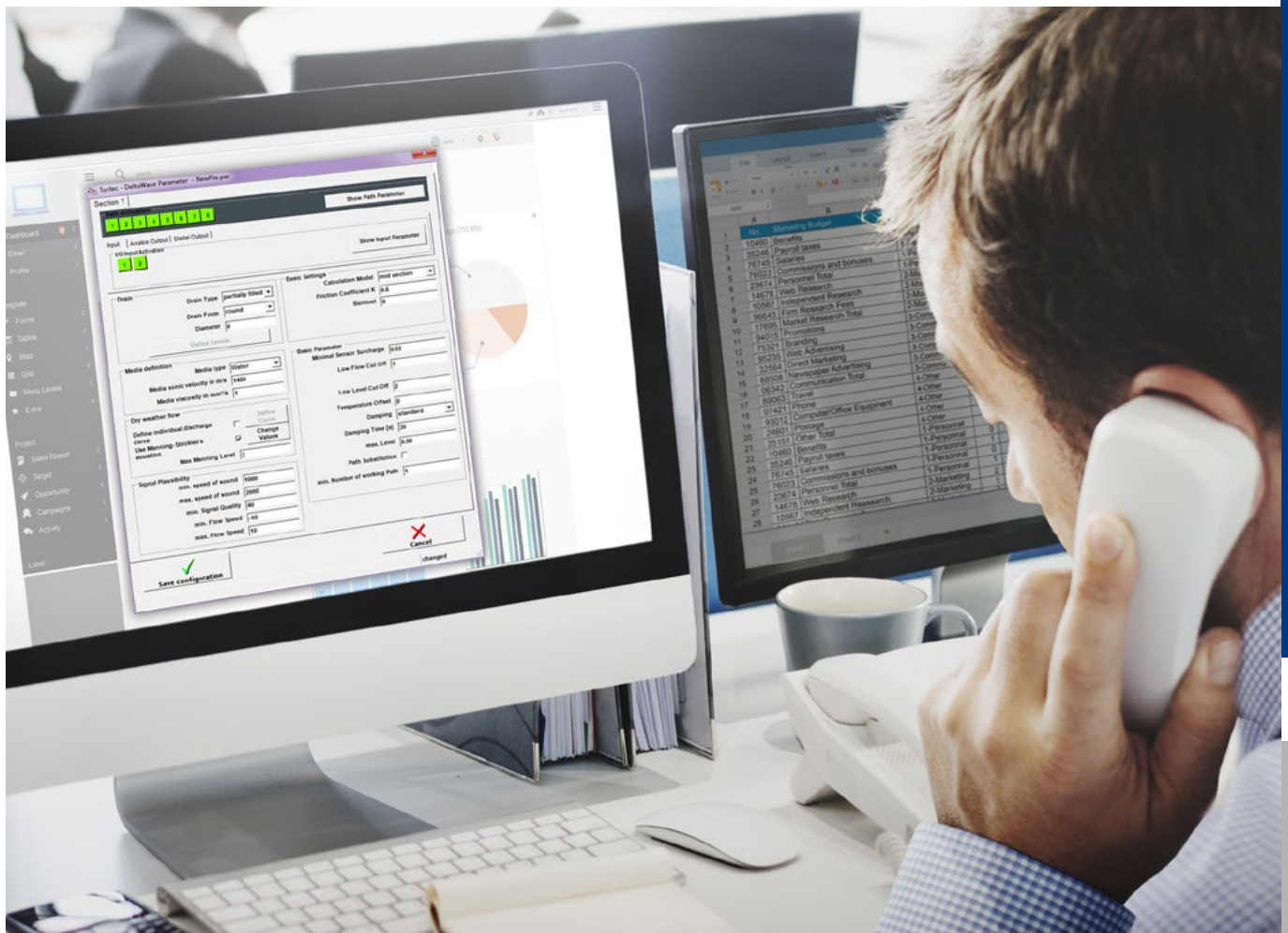
With one deltawaveVER2 measurement transducer, it is possible to realize up to four different measurement sites (sections) with a total maximum of 16 paths. Naturally, deltawaveVER2 can be retroactively expanded: simply insert additional ultrasonic or I/O boards into the evaluation unit, switch on – and done! Recognition is automatic, simply plug and play.

Safety

With deltawaveVER2, safety is first and foremost. deltawaveVER2's main computer operates based on a highly secure embedded Linux operating system with a hierarchical security schema. Without a password, only the 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 deltawaveVER2 is integrated into a computer network, parameters can be changed directly via any PC running Windows, the device status can be queried and stored measurement values can be read. deltawaveVER2 can internally store the measured values for 40 (!) years. Therefore, repeatedly searching for the measurement point is eliminated. deltawaveVER2 works fully automatically in the background without disturbing the work flow of the measurement technician



Flow metering technology “by systec”



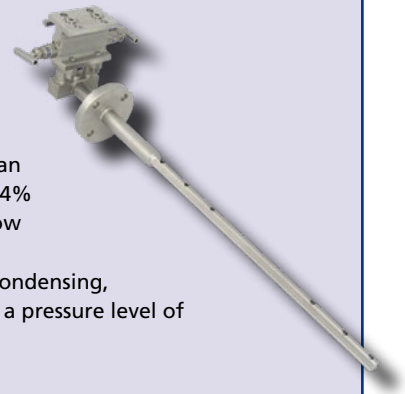
deltaflowC

The deltaflowC measures the mass flow of gases in pipes and channels. Thanks to the integrated differential pressure, pressure and temperature sensors and patented microprocessor technology, measurement accuracies of greater than 2% can be achieved. The deltaflowC is particularly impressive on the strength of its high dynamic performance, zero-point stability and ease of operation. Practical, maintenance-free and available at good value for money, deltaflowC enables you to keep your process costs under control.

deltaflow for flow metering of gas, steam and liquids

The deltaflow pitot tube has proven its effectiveness a thousand times over for measuring the flow and volume measurement of gas, steam and liquids in pipes. Pitot tubes induce the lowest pressure loss of all differential pressure elements, which means that many applications can look forward to energy savings of several thousand Euros per year. With an accuracy of up to 0.4% of the measured value as tested by the Physikalisch-Technische Bundesanstalt (PTB), the deltaflow probe can also be reliably used in the most adverse conditions.

deltaflow is extremely robust and TÜV (German Technical Inspection Agency) tested for use in condensing, aggressive and dirty flue gases. deltaflow is available for pipe diameters from 1 mm – 15 m and a pressure level of up to 690 bar and can thus be used for the vast majority of flow applications.



deltawaveC

deltawaveC devices are available in two different series: the deltaxwaveC-P for mobile / sampling measurements, and the deltaxwaveC-F, used for continuous measurements in fixed installations. Both units use the proven and highly precise ultrasonic transit time difference method. By using the latest digital signal processors, these robust gauges are extremely accurate and drift-free. Thanks to clamp-on technology, the ultrasonic transducers can be installed in a matter of minutes. No time-consuming work is required to cut or penetrate your pipes. This option, and the elimination of process interruptions, mean that deltaxwaveC devices are key to optimizing operating costs.



The head office of systec Controls is located in Puchheim, near Munich. Here, we develop and manufacture our products according to DIN EN ISO 9001. But innovation and product quality alone are not enough for us. We have also had our systems tested by independent institutes – with clear,

proven success. And of course, we are there for you even after the installation of your system. Our service-crew will assist you at your plant.

systec Controls – the specialist in flow measurement technology.

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