

Portable ultrasonic flow measurement of gas

Portable instrument for non-invasive, quick ultrasonic flow measurement with clamp-on technology for all types of piping

Features

- Precise bi-directional and highly dynamic flow measurement with the non-invasive clamp-on technology
- High precision at fast and slow flow rates, high temperature and zero point stability
- Portable, easy-to-use flow transmitter with 2 flow channels, multiple inputs/outputs, an integrated data logger with a serial interface
- Water and dust-tight (IP65); resistant against oil, many liquids and dirt
- Li-Ion battery provides up to 14 hours of measurement operation
- Automatic loading of calibration data and transducer detection for a fast and easy set-up (less than 5 min), providing precise and long-term stable results
- User-friendly design
- Transducers available for a wide range of inner pipe diameters and fluid temperatures
- Probe for wall thickness measurement available
- Robust, water-tight (IP67) transport case with comprehensive accessories
- QuickFix for fast mounting of the flow transmitter in difficult conditions
- Including measurement of liquids

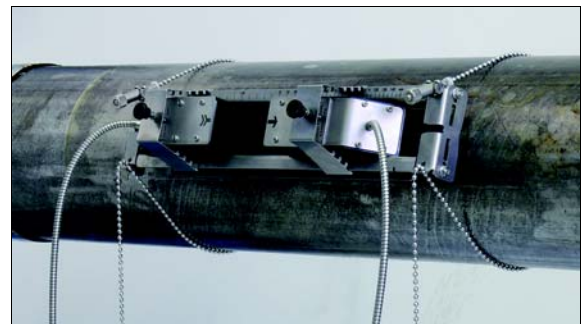
Applications

Designed for industrial use in harsh environments, in gas processing and natural gas extraction, chemical industry and in the petroleum industry. Practical applications:

- Measurement on natural gas pipelines and in natural gas storage installations
- Measurement of synthesized gas and injection gas
- Measurement for the gas supply industry
- Supervision of permanently installed meters, service and maintenance



FLUXUS G601 supported by handle



Measurement with transducers mounted with the portable Variofix VP



Measurement equipment in transport case

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Function

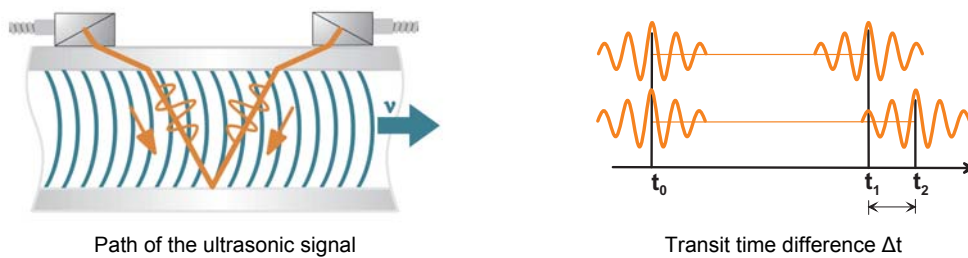
Measurement principle

In order to measure the flow of a fluid in a pipe, ultrasonic signals are used, employing the transit time difference principle. Ultrasonic signals are emitted by a transducer installed on the pipe and received by a second transducer. These signals are emitted alternately in the flow direction and against it.

As the fluid in which the signals propagate is flowing, the transit time of the ultrasonic signals in the flow direction is shorter than against the flow direction.

The transit time difference, Δt , is measured and allows the flowmeter to determine the average flow velocity along the propagation path of the ultrasonic signals. A flow profile correction is then performed in order to obtain the area averaged flow velocity, which is proportional to the volumetric flow rate.

Two integrated microprocessors control the entire measuring process. This allows the flowmeter to remove disturbance signals, and to check each received ultrasonic wave for its validity which reduces noise.



Calculation of volumetric flow rate

$$\dot{V} = k_{Re} \cdot A \cdot k_a \cdot \Delta t / (2 \cdot t_{fl})$$

where

- \dot{V} - volumetric flow rate
- k_{Re} - fluid mechanics calibration factor
- A - cross-sectional pipe area
- k_a - acoustical calibration factor
- Δt - transit time difference
- t_{fl} - transit time in the fluid

Number of sound paths

The number of sound paths is the number of transits of the ultrasonic signal through the fluid in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **reflection arrangement**

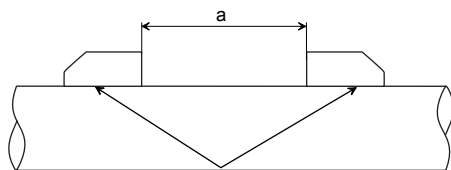
The number of sound paths is even. Both of the transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easier.

- **diagonal arrangement**

The number of sound paths is odd. Both of the transducers are mounted on opposite sides of the pipe. In the case of a high signal attenuation by the fluid, pipe and coatings, diagonal arrangement with 1 sound path will be used.

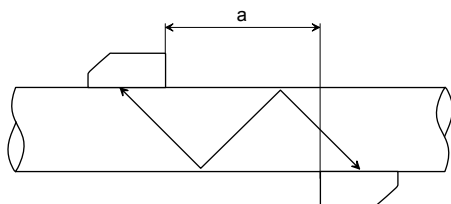
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the transmitter.

As the transducers can be mounted with the transducer mounting fixture in reflection arrangement or diagonal arrangement, the number of sound paths can be adjusted optimally for the application.

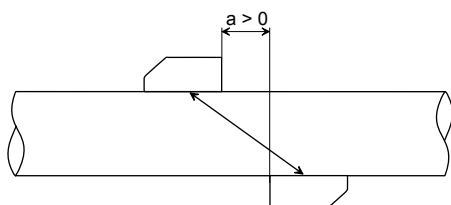


a - transducer distance

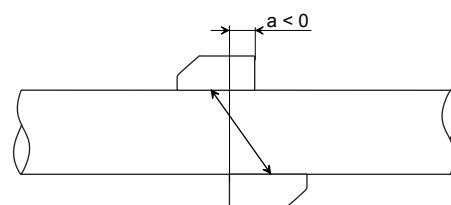
Reflection arrangement, number of sound paths: 2



Diagonal arrangement, number of sound paths: 3

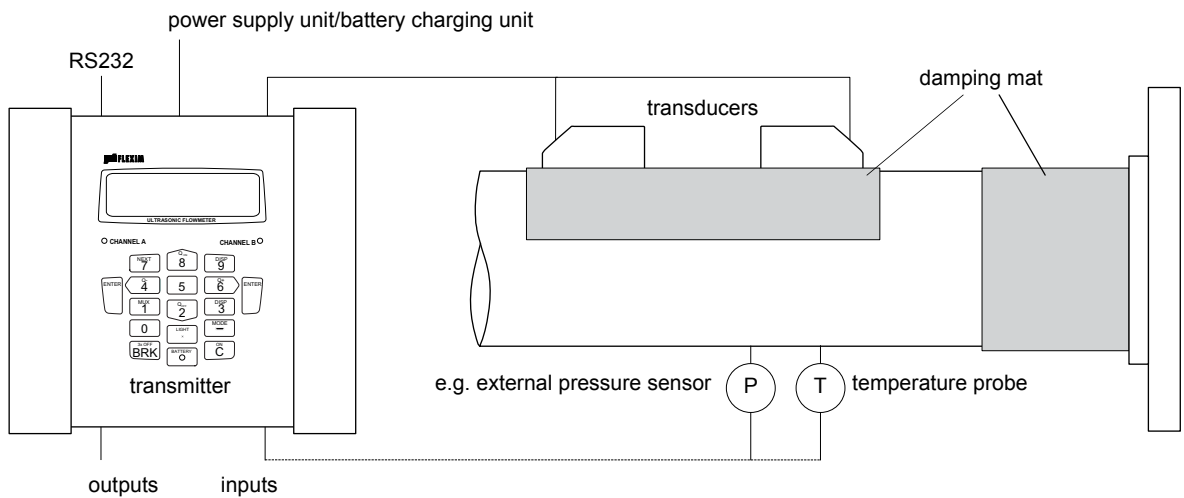


Diagonal arrangement, number of sound paths: 1



Diagonal arrangement, number of sound paths: 1, negative transducer distance

Typical measurement setup



Example of a reflection arrangement with connection of the inputs to an external process pressure and process temperature measurement for standard volumetric flow rate calculation

Standard volumetric flow rate

The standard volumetric flow rate can be selected as physical quantity to be measured. It will be calculated internally by:

$$\dot{V}_N = \dot{V} \cdot p/p_N \cdot T_N/T \cdot 1/K$$

where

- \dot{V}_N - standard volumetric flow rate
- \dot{V} - operating volumetric flow rate
- p_N - standard pressure (absolute value)
- p - operating pressure (absolute value)
- T_N - standard temperature in K
- T - operating temperature in K
- K - compressibility coefficient of the gas: ratio of the compressibility factors of the gas at operating conditions and at standard conditions Z/Z_N

The operational pressure p and the operational temperature T of the fluid will be entered directly as fixed values into the transmitter.

or:


If inputs are installed (optional), pressure and temperature can be measured by the customer and fed in the transmitter.

The gas compressibility coefficient K of the gas is entered in the transmitter:

- as fixed value or
- as approximation according to e.g. AGA8 or GERG

Flow transmitter

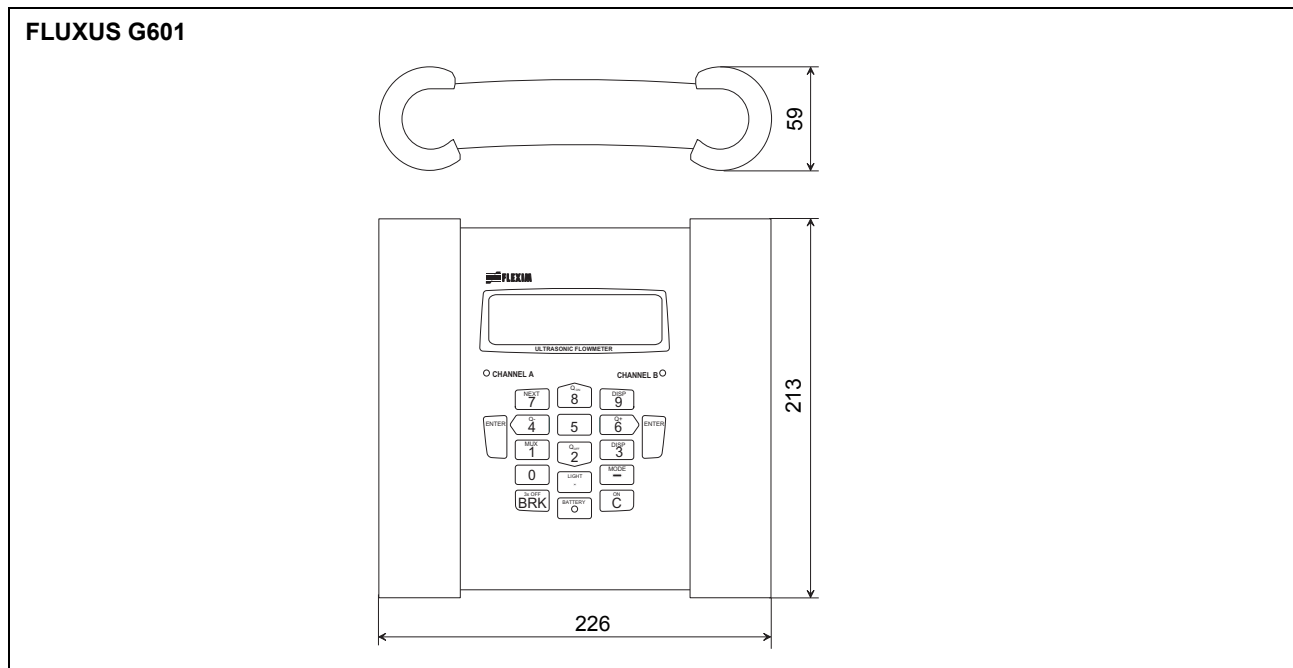
Technical data

| | |
|--|--|
| FLUXUS | G601 |
| design | portable |
| |  |
| measurement | |
| measurement principle | transit time difference correlation principle |
| flow velocity | 0.01...35 m/s, depending on pipe diameter |
| repeatability | 0.15 % of reading ± 0.01 m/s |
| fluid | all acoustically conductive gases, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane |
| temperature compensation | corresponding to the recommendations in ANSI/ASME MFC-5.1-2011 |
| accuracy | |
| volumetric flow rate | $\pm 1...3$ % of reading ± 0.01 m/s depending on application ± 0.5 % of reading ± 0.01 m/s with field calibration |
| flow transmitter | |
| power supply | 100...230 V/50...60 Hz (power supply unit) 10.5...15 V DC (socket at transmitter) integrated battery |
| integrated battery | Li-Ion, 7.2 V/4.5 Ah operating time (without outputs, inputs and backlight): > 14 h |
| power consumption | < 6 W |
| number of flow measuring channels | 2 |
| damping | 0...100 s, adjustable |
| measuring cycle (1 channel) | 100...1000 Hz |
| response time | 1 s (1 channel), option: 70 ms |
| housing material | PA, TPE, AutoTex, stainless steel |
| degree of protection according to IEC/EN 60529 | IP65 |
| dimensions | see dimensional drawing |
| weight | 2.1 kg |
| fixation | QuickFix pipe mounting fixture |
| ambient temperature | -10...+60 °C |
| display | 2 x 16 characters, dot matrix, backlight |
| menu language | English, German, French, Dutch, Spanish |
| measuring functions | |
| physical quantities | operating volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity |
| totalizer | volume, mass |
| calculation functions | average, difference, sum |
| diagnostic functions | sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times |
| data logger | |
| loggable values | all physical quantities, totalized values and diagnostic values |
| capacity | > 100 000 measured values |

| | |
|---|--|
| FLUXUS | G601 |
| communication | |
| interface | - process integration (optional): Modbus RTU - diagnosis: RS232/USB |
| serial data kit | |
| software (all Windows™ versions) | - FluxData: download of measurement data, graphical presentation, conversion to other formats (e.g. for Excel™) - FluxDiag (optional): online diagnostics and report generation - FluxSubstanceLoader: upload of fluid data sets |
| cable | RS232 |
| adapter | RS232 - USB |
| transport case | |
| dimensions | 500 x 400 x 190 mm |
| outputs | |
| | The outputs are galvanically isolated from the transmitter. |
| number | see standard scope of supply on page 9, max. on request |
| accessories | output adapter (if number of outputs > 4) |
| current output | |
| range | 0/4...20 mA |
| accuracy | 0.1 % of reading ±15 µA |
| active output | $R_{ext} < 750 \Omega$ ($U_{int} = 24 \text{ V DC}$) |
| passive output | $U_{ext} = 4...16 \text{ V}$, depending on R_{ext} $R_{ext} < 500 \Omega$ |
| frequency output | |
| range | 0...5 kHz |
| open collector | 24 V/4 mA |
| binary output | |
| optorelay | 26 V/100 mA |
| binary output as alarm output - functions | limit, change of flow direction or error |
| binary output as pulse output - pulse value - pulse width | mainly for totalizing 0.01...1000 units 1...1000 ms |
| inputs | |
| | The inputs are galvanically isolated from the transmitter. |
| number | see standard scope of supply on page 9, max. 4 |
| accessories | input adapter (if number of inputs > 2) |
| temperature input | |
| type | Pt100/Pt1000 |
| connection | 4-wire |
| range | -150...+560 °C |
| resolution | 0.01 K |
| accuracy | ±0.01 % of reading ±0.03 K |
| current input | |
| accuracy | 0.1 % of reading ±10 µA |
| passive input | $R_{int} = 50 \Omega$, $P_{int} < 0.3 \text{ W}$ |
| - range | -20...+20 mA |
| voltage input | |
| range | 0...1 V |
| accuracy | 0.1 % of reading ±1 mV |
| internal resistance | $R_{int} = 1 \text{ M}\Omega$ |

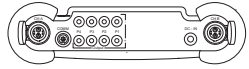
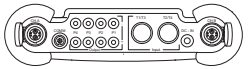
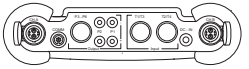

For the technical data in the flow measurement of liquids mode see Technical specification TSFLUXUS_F601Vx-x.

Dimensions

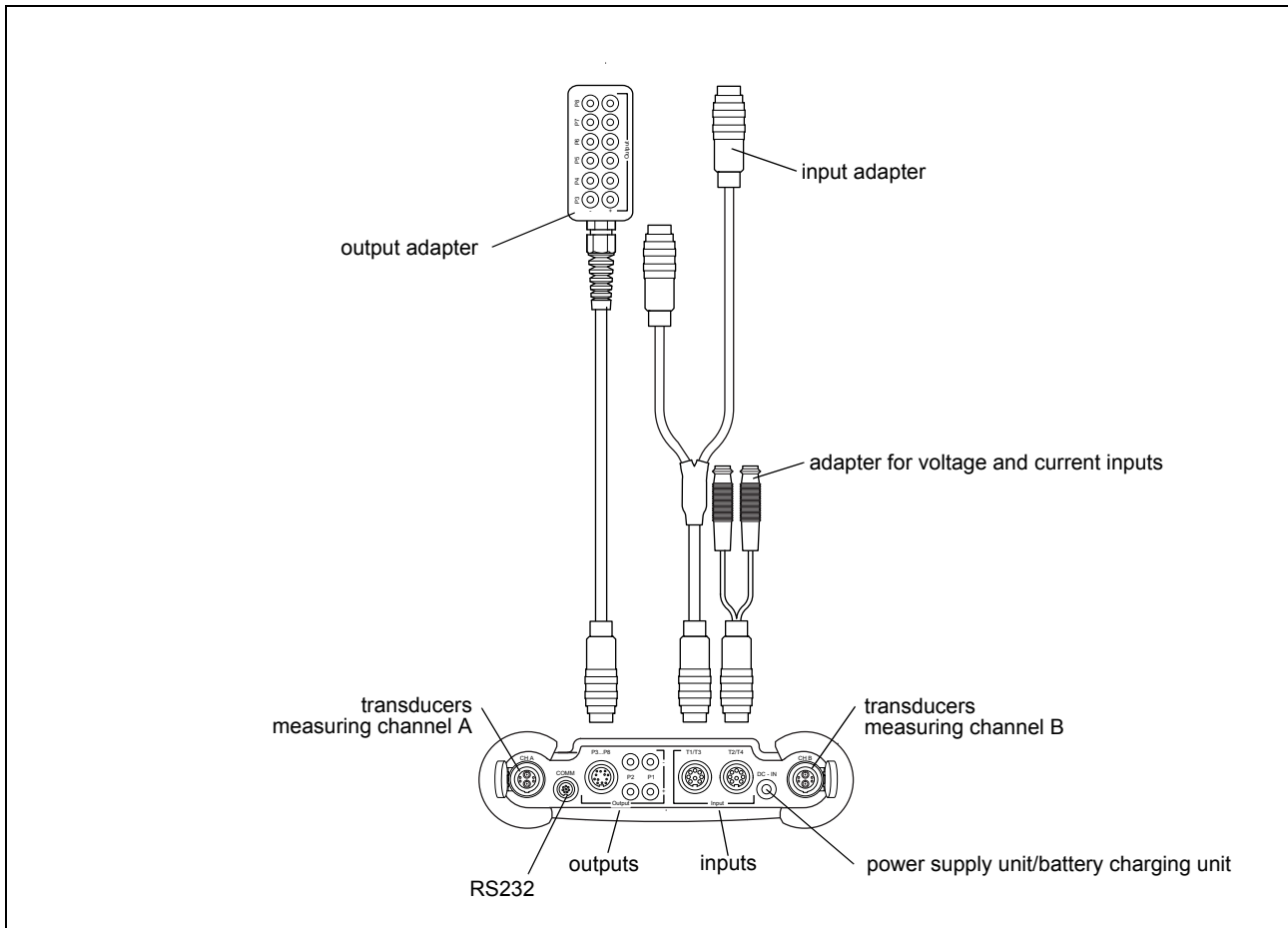


in mm

Standard scope of supply

| | G601 Standard | | G601 Extended Standard | | G601 Multi-functional | | G601 CA-Energy | |
|--|---|---|---|---|--|---|---|---|
| application | flow measurement on gas | | | | | | flow measurement on compressed air, industrial gases and liquids | |
| | 2 independent measuring channels | | | | | | | |
| | calculation of standard volumetric flow rate | calculation of standard volumetric flow rate, with optional use of current measured pressure and temperature values | | | | | | |
| | | | simultaneous monitoring of flow and energy flow | | simultaneous monitoring of 2 energy flows | | liquids: integrated heat flow computer for monitoring of energy flows | |
| outputs | | | | | | | | |
| passive current output | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| binary output | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 |
| frequency output | - | - | 1 | - | 1 | 0 | - | - |
| Modbus | - | x | - | x | - | x | - | x |
| inputs | | | | | | | | |
| temperature input | - | - | - | - | 1 | 1 | 2 | 2 |
| passive current input | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| voltage input | - | - | - | - | 1 | 1 | - | - |
| accessories | | | | | | | | |
| transport case | x | x | x | x | x | x | x | x |
| power supply unit, mains cable | x | x | x | x | x | x | x | x |
| battery | x | x | x | x | x | x | x | x |
| output adapter | - | - | - | - | x | x | - | - |
| input adapter | - | - | 2 | 2 | 2 | 2 | 2 | 2 |
| adapter for voltage and current inputs | - | - | - | - | 3 | 3 | 2 | 2 |
| QuickFix pipe mounting fixture for transmitter | x | x | x | x | x | x | x | x |
| serial data kit | x | x | x | x | x | x | x | x |
| measuring tape | x | x | x | x | x | x | x | x |
| wall thickness probe | - | - | - | - | x | x | x | x |
| user manual, Quick start guide | x | x | x | x | x | x | x | x |
| connector board at the upper side of the transmitter |  | |  | |  | |  | |

Connection of adapters



Example for the equipment of a transport case

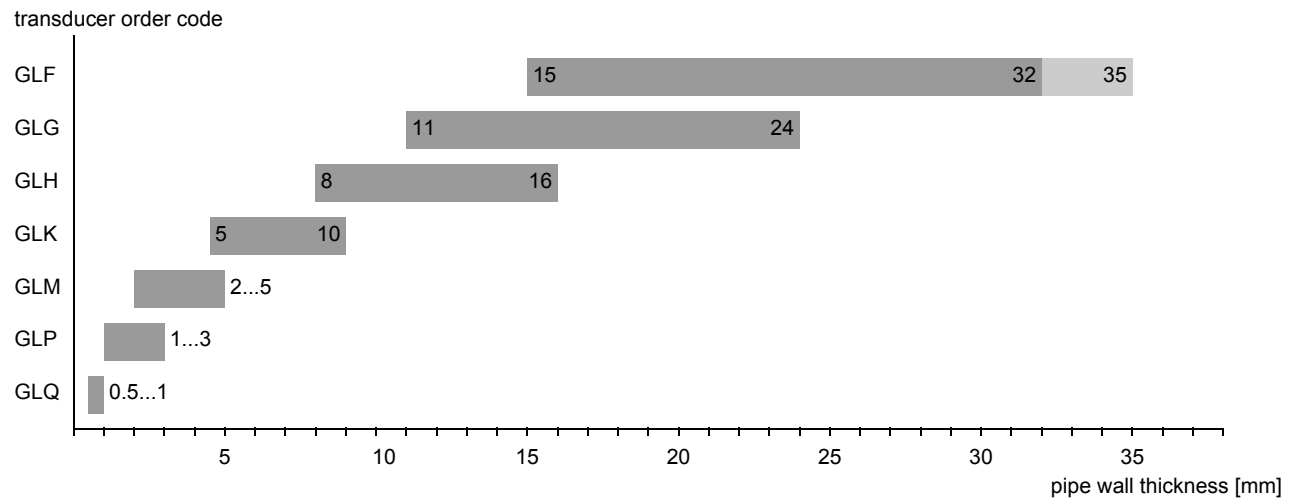


Transducers

Transducer selection

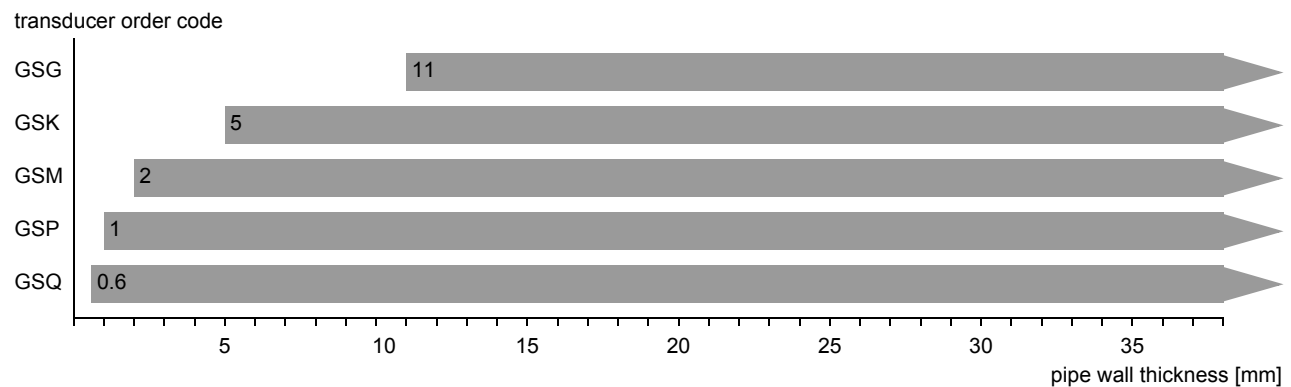
Step 1a

Select a Lamb wave transducer:



Step 1b

If the pipe wall thickness is not in the range of the Lamb wave transducers, select a shear wave transducer:



recommended
 possible

Step 2

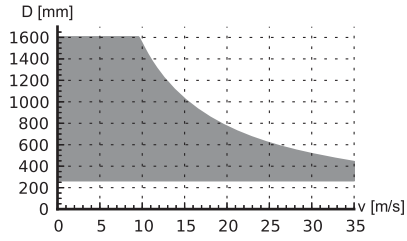
inner pipe diameter d dependent on the flow velocity v of the fluid in the pipe

The transducers are selected from the characteristics (see next page). Lamb wave transducers are selected from the left column, shear wave transducers from the right column.

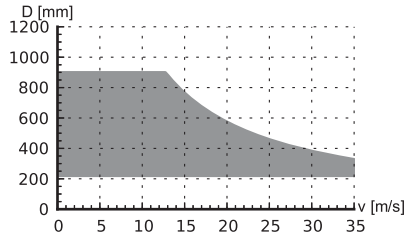
Lamb wave transducers: If the values d and v are not in the range, the diagonal arrangement with 1 sound path may be used, i.e. the same characteristics can be used with doubling the inner pipe diameter. If the values are still not in the range, shear waves transducers regarding the pipe wall thickness have to be selected in step 1b.

Lamb wave transducer¹

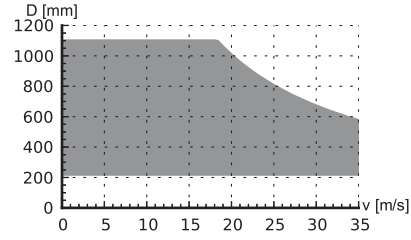
shear wave transducer¹



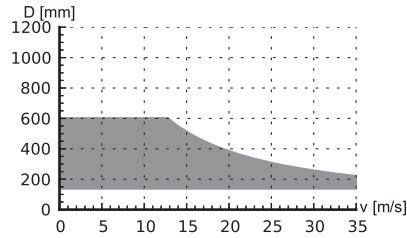
GLF



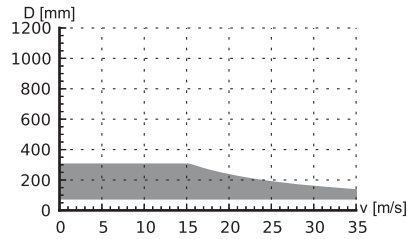
GLG



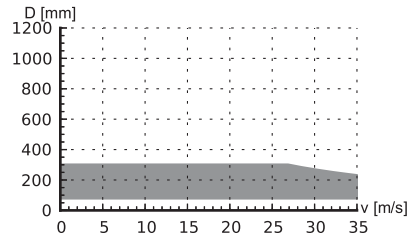
GSG



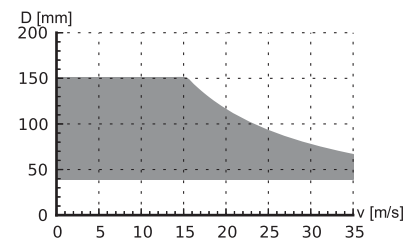
GLH



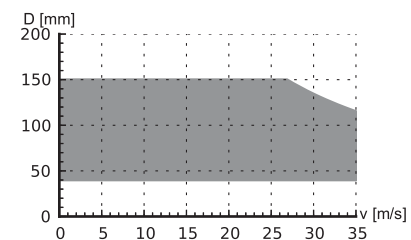
GLK



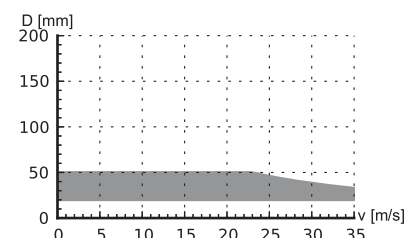
GSK



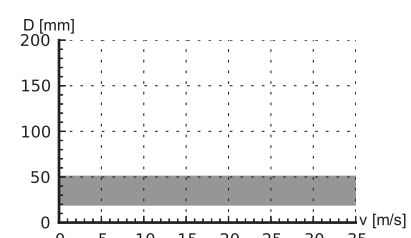
GLM



GSM

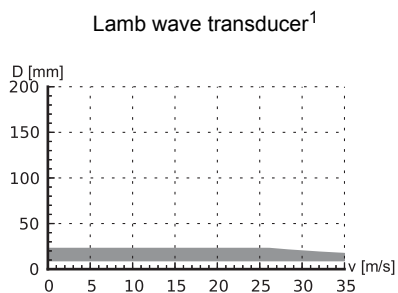


GLP

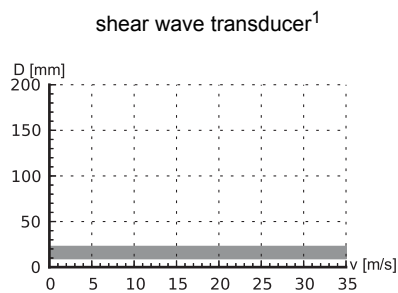


GSP

¹ inner pipe diameter and max. flow velocity for a typical application with natural gas, nitrogen, oxygen in reflection arrangement with 2 sound paths (Lamb wave transducers)/1 sound path (shear wave transducers)



GLQ



GSQ

¹ inner pipe diameter and max. flow velocity for a typical application with natural gas, nitrogen, oxygen in reflection arrangement with 2 sound paths (Lamb wave transducers)/1 sound path (shear wave transducers)

Step 3

min. fluid pressure

| Lamb wave transducer | | | |
|-----------------------|------------------------------------|-----------------------------------|--------------|
| transducer order code | fluid pressure ¹ [bar] | | |
| | metal pipe | | plastic pipe |
| | min. | min. extended | min. |
| GLF | 15 | 10 | 1 |
| GLG | 15 | 10 | 1 |
| GLH | 15 | 10 | 1 |
| GLK | 15 (d > 120 mm) 10 (d < 120 mm) | 10 (d > 120 mm) 3 (d < 120 mm) | 1 |
| GLM | 10 (d > 60 mm) 5 (d < 60 mm) | 3 (d < 60 mm) | 1 |
| GLP | 10 (d > 35 mm) 5 (d < 35 mm) | 3 (d < 35 mm) | 1 |
| GLQ | 10 (d > 15 mm) 5 (d < 15 mm) | 3 (d < 15 mm) | 1 |

| shear wave transducer | | | |
|-----------------------|-----------------------------------|---------------|--------------|
| transducer order code | fluid pressure ¹ [bar] | | |
| | metal pipe | | plastic pipe |
| | min. | min. extended | min. |
| GSG | 30 | 20 | 1 |
| GSK | 30 | 20 | 1 |
| GSM | 30 | 20 | 1 |
| GSP | 30 | 20 | 1 |
| GSQ | 30 | 20 | 1 |

¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

d - inner pipe diameter

Example

| step | | | | | |
|------|--|-----------|--------------------|-------------------|------------------|
| 1 | pipe wall thickness selected transducer | mm | 14.3 GLG or GLH | 8.6 GLH or GLK | 38 GS |
| 2 | inner pipe diameter max. flow velocity selected transducer | mm m/s | 581 15 GLG | 96.8 30 GLK | 143 30 GSK |
| 3 | min. fluid pressure selected transducer | bar | 20 GLG | 15 GLK | 40 GSK |

Step 4

for the characters 4...11 of the transducer order code (ambient temperature, explosion protection, connection system, extension cable) see page 15

Step 5

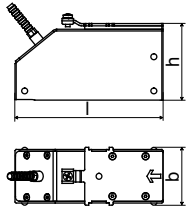
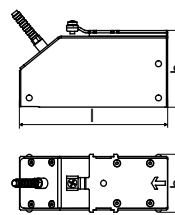
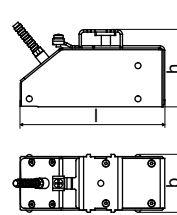
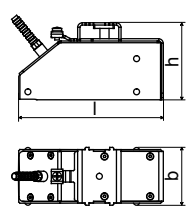
for the technical data of the selected transducer see page 16 et seqq.

Transducer order code

| 1, 2 | 3 | 4 | 5, 6 | 7, 8 | 9...11 | no. of character | | |
|------------|----------------------|---|---------------------|----------------------|-------------------|------------------|-----------------|--|
| transducer | transducer frequency | - | ambient temperature | explosion protection | connection system | - | extension cable | description |
| GL | | | | | | | | set of ultrasonic flow transducers for gas measurement, Lamb wave |
| GS | | | | | | | | set of ultrasonic flow transducers for gas measurement, shear wave |
| | F | | | | | | | 0.15 MHz (Lamb wave only) |
| | G | | | | | | | 0.2 MHz |
| | H | | | | | | | 0.3 MHz (Lamb wave only) |
| | K | | | | | | | 0.5 MHz |
| | M | | | | | | | 1 MHz |
| | P | | | | | | | 2 MHz |
| | Q | | | | | | | 4 MHz |
| | | | N | | | | | normal temperature range |
| | | | E | | | | | extended temperature range (FSM, FSP, FSQ) |
| | | | | NN | | | | not explosion proof |
| | | | | | NL | | | with Lemo connector |
| | | | | | | XXX | | cable length in m, for max. length of extension cable see page 25 |
| example | | | | | | | | |
| GL | K | - | N | NN | NL | - | 000 | Lamb wave transducer 0.5 MHz, normal temperature range, connection system NL with Lemo connector |
| | | - | | | | - | | |

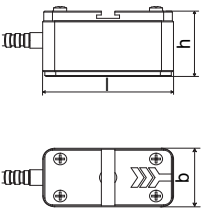
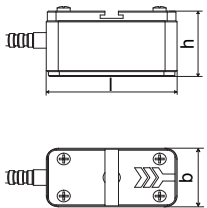
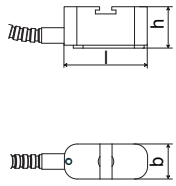
Technical data

Shear wave transducers

| | | | | | |
|--|------------|---|---|--|---|
| technical type | | GDG1NZ7 | GLG1NZ7 | GDK1NZ7 | GLK1NZ7 |
| order code | | GSG-NNNNL | GSG-NNNNL/LC | GSK-NNNNL | GSK-NNNNL/LC |
| transducer frequency | MHz | 0.2 | 0.2 | 0.5 | 0.5 |
| fluid pressure¹ | | | | | |
| min. extended min. | bar bar | metal pipe: 20 metal pipe: 30 plastic pipe: 1 | | metal pipe: 20 metal pipe: 30 plastic pipe: 1 | |
| inner pipe diameter d² | | | | | |
| min. extended | mm | 180 | 180 | 60 | 60 |
| min. recommended | mm | 220 | 220 | 80 | 80 |
| max. recommended | mm | 900 | 900 | 300 | 300 |
| max. extended | mm | 1100 | 1100 | 360 | 360 |
| pipe wall thickness | | | | | |
| min. | mm | 11 | 11 | 5 | 5 |
| material | | | | | |
| housing | | PEEK with stainless steel cap 304 (1.4301) | PEEK with stainless steel cap 304 (1.4301) | PEEK with stainless steel cap 304 (1.4301) | PEEK with stainless steel cap 304 (1.4301) |
| contact surface | | PEEK | PEEK | PEEK | PEEK |
| degree of protection according to IEC/EN 60529 | | IP67 | IP67 | IP67 | IP67 |
| transducer cable | | | | | |
| type | | 1699 | 1699 | 1699 | 1699 |
| length | m | 5 | 9 | 5 | 9 |
| dimensions | | | | | |
| length l | mm | 129.5 | 129.5 | 126.5 | 126.5 |
| width b | mm | 51 | 51 | 51 | 51 |
| height h | mm | 67 | 67 | 67.5 | 67.5 |
| dimensional drawing | |  |  |  |  |
| ambient temperature | | | | | |
| min. | °C | -40 | -40 | -40 | -40 |
| max. | °C | +130 | +130 | +130 | +130 |
| temperature compensation | | x | x | x | x |

¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

² shear wave transducer:
 typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request
 inner pipe diameter max. recommended/max. extended: in reflection arrangement and for a flow velocity of 15 m/s

| | | | | |
|--|-----|--|--|---|
| technical type | | GDM1NZ7 | GDP1NZ7 | GDQ1NZ7 |
| order code | | GSM-NNNNL | GSP-NNNNL | GSQ-NNNNL |
| transducer frequency | MHz | 1 | 2 | 4 |
| fluid pressure¹ | | | | |
| min. extended | bar | metal pipe: 20 | metal pipe: 20 | metal pipe: 20 |
| min. | bar | metal pipe: 30 plastic pipe: 1 | metal pipe: 30 plastic pipe: 1 | metal pipe: 30 plastic pipe: 1 |
| inner pipe diameter d² | | | | |
| min. extended | mm | 30 | 15 | 7 |
| min. recommended | mm | 40 | 20 | 10 |
| max. recommended | mm | 150 | 50 | 22 |
| max. extended | mm | 180 | 60 | 30 |
| pipe wall thickness | | | | |
| min. | mm | 2 | 1 | 0.6 |
| material | | | | |
| housing | | stainless steel 304 (1.4301) | stainless steel 304 (1.4301) | stainless steel 304 (1.4301) |
| contact surface | | PEEK | PEEK | PEEK |
| degree of protection according to IEC/EN 60529 | | IP67 | IP67 | IP67 |
| transducer cable | | | | |
| type | | 1699 | 1699 | 1699 |
| length | m | 4 | 4 | 3 |
| dimensions | | | | |
| length l | mm | 60 | 60 | 42.5 |
| width b | mm | 30 | 30 | 18 |
| height h | mm | 33.5 | 33.5 | 21.5 |
| dimensional drawing | |  |  |  |
| ambient temperature | | | | |
| min. | °C | -40 | -40 | -40 |
| max. | °C | +130 | +130 | +130 |
| temperature compensation | | x | x | x |

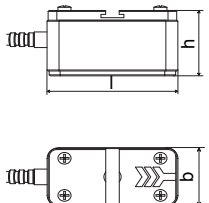
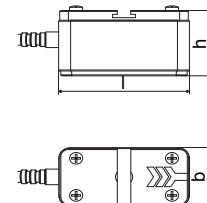
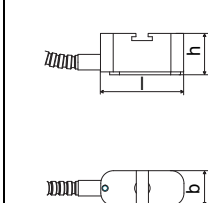
¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

² shear wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request

inner pipe diameter max. recommended/max. extended: in reflection arrangement and for a flow velocity of 15 m/s

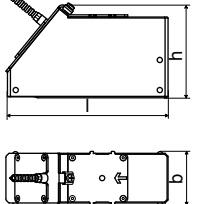
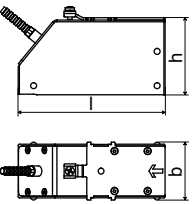
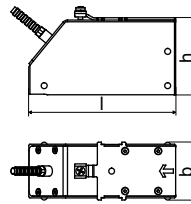
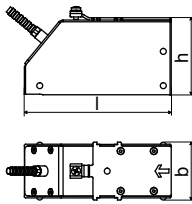
Shear wave transducers (extended temperature range)

| | | | | |
|--|------------|---|---|--|
| technical type | | GDM1EZ7 | GDP1EZ7 | GDQ1EZ7 |
| order code | | GSM-ENNNL | GSP-ENNNL | GSQ-ENNNL |
| transducer frequency | MHz | 1 | 2 | 4 |
| fluid pressure¹ | | | | |
| min. extended min. | bar bar | metal pipe: 20 metal pipe: 30 plastic pipe: 1 | metal pipe: 20 metal pipe: 30 plastic pipe: 1 | metal pipe: 20 metal pipe: 30 plastic pipe: 1 |
| inner pipe diameter d² | | | | |
| min. extended | mm | 30 | 15 | 7 |
| min. recommended | mm | 40 | 20 | 10 |
| max. recommended | mm | 150 | 50 | 22 |
| max. extended | mm | 180 | 60 | 30 |
| pipe wall thickness | | | | |
| min. | mm | 2 | 1 | 0.6 |
| material | | | | |
| housing | | stainless steel 304 (1.4301) | stainless steel 304 (1.4301) | stainless steel 304 (1.4301) |
| contact surface | | Sintimid | Sintimid | Sintimid |
| degree of protection according to IEC/EN 60529 | | IP65 | IP65 | IP65 |
| transducer cable | | | | |
| type | | 1699 | 1699 | 1699 |
| length | m | 4 | 4 | 3 |
| dimensions | | | | |
| length l | mm | 60 | 60 | 42.5 |
| width b | mm | 30 | 30 | 18 |
| height h | mm | 33.5 | 33.5 | 21.5 |
| dimensional drawing | |  |  |  |
| weight (without cable) | kg | 0.042 kg | 0.042 kg | 0.011 kg |
| ambient temperature | | | | |
| min. | °C | -30 | -30 | -30 |
| max. | °C | +200 | +200 | +200 |
| temperature compensation | | x | x | x |

¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

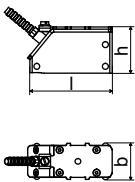
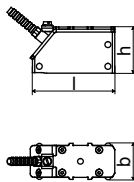
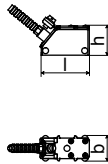
² shear wave transducer:
 typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request
 inner pipe diameter max. recommended/max. extended: in reflection arrangement and for a flow velocity of 15 m/s

Lamb Wave Transducers

| technical type | | GRF1NC3 | GRG1NC3 | GRH1NC3 | GRK1NC3 |
|--|-----|---|---|---|---|
| order code | | GLF-NNNNL | GLG-NNNNL | GLH-NNNNL | GLK-NNNNL |
| transducer frequency | | MHz 0.15 | 0.2 | 0.3 | 0.5 |
| fluid pressure¹ | | | | | |
| min. extended | bar | metal pipe: 10 | metal pipe: 10 | metal pipe: 10 | metal pipe: 10 (d > 120 mm) 3 (d < 120 mm) |
| min. | bar | metal pipe: 15 plastic pipe: 1 | metal pipe: 15 plastic pipe: 1 | metal pipe: 15 plastic pipe: 1 | metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1 |
| inner pipe diameter d² | | | | | |
| min. extended | mm | 220 | 180 | 110 | 60 |
| min. recommended | mm | 270 | 220 | 140 | 80 |
| max. recommended | mm | 1200 | 900 | 600 | 300 |
| max. extended | mm | 1600 | 1400 | 1000 | 360 |
| pipe wall thickness | | | | | |
| min. | mm | 15 | 11 | 8 | 5 |
| max. | mm | 32 | 24 | 16 | 10 |
| max. extended | mm | 35 | - | - | - |
| material | | | | | |
| housing | | PPSU with stainless steel cap 316Ti (1.4571) | PPSU with stainless steel cap 304 (1.4301) | PPSU with stainless steel cap 304 (1.4301) | PPSU with stainless steel cap 304 (1.4301) |
| contact surface | | PPSU | PPSU | PPSU | PPSU |
| degree of protection according to IEC/EN 60529 | | IP65 | IP65 | IP65 | IP65 |
| transducer cable | | | | | |
| type | | 1699 | 1699 | 1699 | 1699 |
| length | m | 5 | 5 | 5 | 5 |
| dimensions | | | | | |
| length l | mm | 163 | 128.5 | 128.5 | 128.5 |
| width b | mm | 54 | 51 | 51 | 51 |
| height h | mm | 91.3 | 67.5 | 67.5 | 67.5 |
| dimensional drawing | |  |  |  |  |
| ambient temperature | | | | | |
| min. | °C | -40 | -40 | -40 | -40 |
| max. | °C | +170 | +170 | +170 | +170 |
| temperature compensation | | x | x | x | x |

¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

² Lamb wave transducer:
 typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request
 inner pipe diameter max. recommended: in reflection arrangement (diagonal arrangement) and for a flow velocity of 15 m/s (30 m/s)
 inner pipe diameter max. extended: in reflection arrangement (diagonal arrangement) and for a flow velocity of 12 m/s (25 m/s)

| technical type | | GRM1NC3 | GRP1NC3 | GRQ1NC3 |
|--|-----|---|---|--|
| order code | | GLM-NNNNL | GLP-NNNNL | GLQ-NNNNL |
| transducer frequency | MHz | 1 | 2 | 4 |
| fluid pressure¹ | | | | |
| min. extended | bar | metal pipe: 3 (d < 60 mm) | metal pipe: 3 (d < 35 mm) | metal pipe: 3 (d < 15 mm) |
| min. | bar | metal pipe: 10 (d > 60 mm) 5 (d < 60 mm) plastic pipe: 1 | metal pipe: 10 (d > 35 mm) 5 (d < 35 mm) plastic pipe: 1 | metal pipe: 10 (d > 15 mm) 5 (d < 15 mm) plastic pipe: 1 |
| inner pipe diameter d² | | | | |
| min. extended | mm | 30 | 15 | 7 |
| min. recommended | mm | 40 | 20 | 10 |
| max. recommended | mm | 150 | 50 | 22 |
| max. extended | mm | 180 | 60 | 30 |
| pipe wall thickness | | | | |
| min. | mm | 2 | 1 | 0.5 |
| max. | mm | 5 | 3 | 1 |
| max. extended | mm | - | - | - |
| material | | | | |
| housing | | PPSU with stainless steel cap 304 (1.4301) | PPSU with stainless steel cap 304 (1.4301) | PPSU with stainless steel cap 304 (1.4301) |
| contact surface | | PPSU | PPSU | PPSU |
| degree of protection according to IEC/EN 60529 | | IP65 | IP65 | IP65 |
| transducer cable | | | | |
| type | | 1699 | 1699 | 1699 |
| length | m | 4 | 4 | 3 |
| dimensions | | | | |
| length l | mm | 74 | 74 | 42 |
| width b | mm | 32 | 32 | 22 |
| height h | mm | 40.5 | 40.5 | 25.5 |
| dimensional drawing | |  |  |  |
| ambient temperature | | | | |
| min. | °C | -40 | -40 | -40 |
| max. | °C | +170 | +170 | +170 |
| temperature compensation | | x | x | x |

¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

² Lamb wave transducer:

typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request

inner pipe diameter max. recommended: in reflection arrangement (diagonal arrangement) and for a flow velocity of 15 m/s (30 m/s)

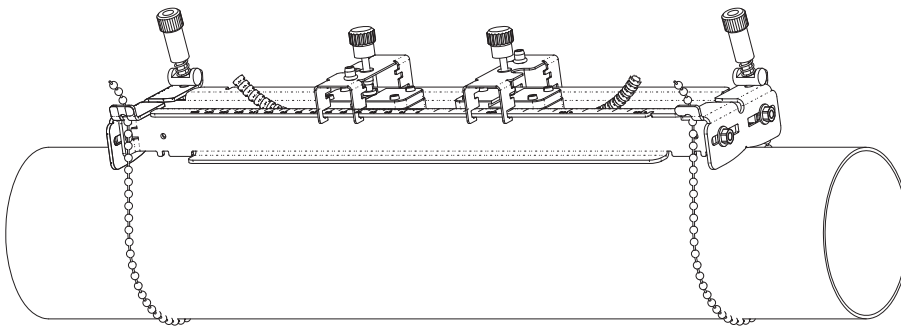
inner pipe diameter max. extended: in reflection arrangement (diagonal arrangement) and for a flow velocity of 12 m/s (25 m/s)

Transducer mounting fixture

Order code

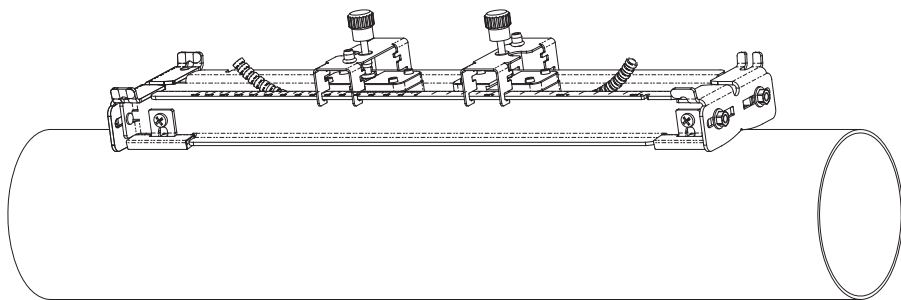
| 1, 2 | 3 | 4 | 5 | 6 | 7...9 | 10, 11 | no. of character | | | |
|-----------------------------|------------|---|-------------------------|------|-------|----------|---------------------|---|--------|--|
| transducer mounting fixture | transducer | - | measurement arrangement | size | - | fixation | outer pipe diameter | / | option | description |
| VP | | | | | | | | | | portable Variofix |
| TB | | | | | | | | | | tension belts |
| | A | | | | | | | | | all transducers |
| | | | D | | | | | | | reflection arrangement or diagonal arrangement |
| | | | R | | | | | | | reflection arrangement |
| | | | | S | | | | | | small |
| | | | | M | | | | | | medium |
| | | | | | | C | | | | chains |
| | | | | | | G | | | | tension belts |
| | | | | | | N | | | | without fixation |
| | | | | | | | 055 | | | 10...550 mm |
| | | | | | | | 150 | | | 50...1500 mm |
| | | | | | | | 210 | | | 50...2100 mm |
| example | | | | | | | | | | |
| VP | A | - | D | M | - | C | 055 | | | portable Variofix and chains |
| | | - | | | - | | | / | | |

portable Variofix VP and chains



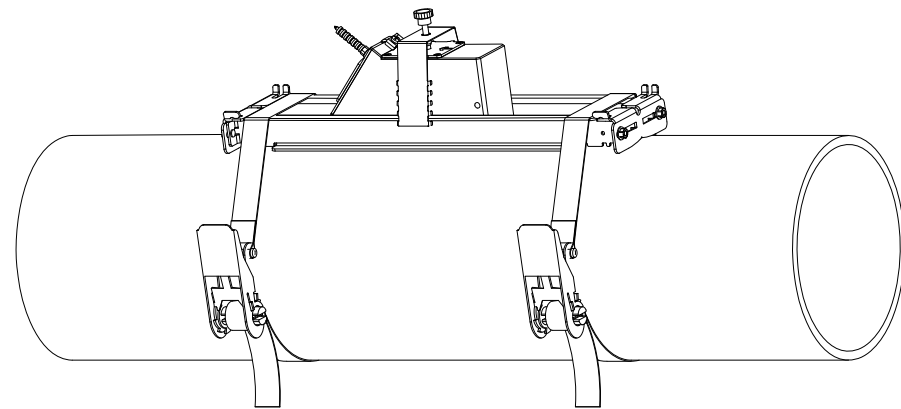
material: stainless steel 304 (1.4301), 301 (1.4310), 303 (1.4305)
 dimensions: 414 x 94 x 76 mm
 chain length: 2 m

portable Variofix VP and magnet (optional)

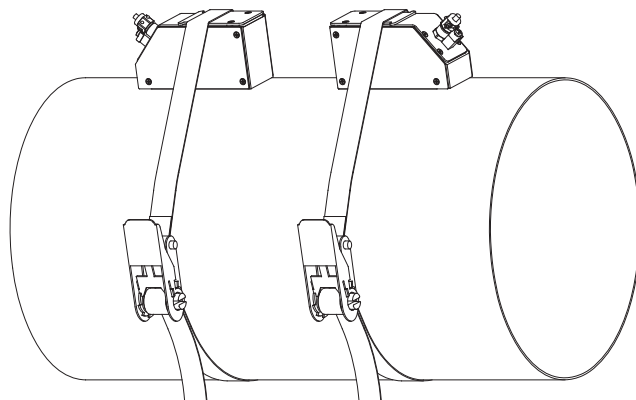


material: stainless steel 304 (1.4301), 301 (1.4310), 303 (1.4305)
 dimensions: 414 x 94 x 40 mm

portable Variofix VP and tension belts



tension belts TB



material: steel, powder coated and textile tension belt
 length: 5/7 m

ambient temperature: max. 60 °C
 outer pipe diameter: max. 1500/2100 mm

Coupling materials for transducers

| normal temperature range (4th character of transducer order code = N) | | extended temperature range (4th character of transducer order code = E) | |
|---|-----------------------------|---|----------------------------------|
| < 100 °C | < 170 °C | < 150 °C | < 200 °C |
| coupling compound type N | coupling compound type E | coupling compound type E | coupling compound type E or H |

Technical data

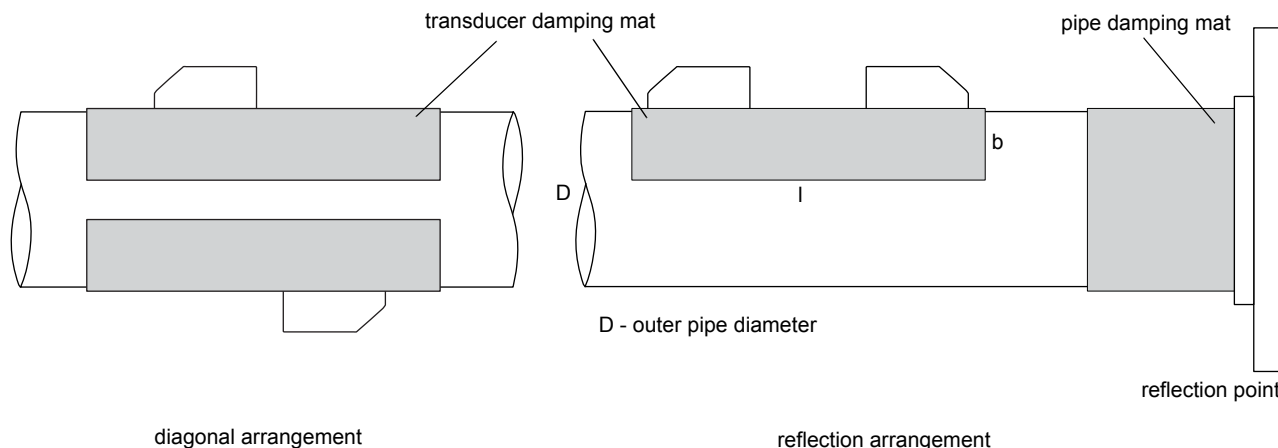
| type | ambient temperature °C | material |
|-----------------------------|---------------------------|----------------------|
| coupling compound type N | -30...+130 | mineral grease paste |
| coupling compound type E | -30...+200 | silicone paste |
| coupling compound type H | -30...+250 | fluoropolymer paste |

Damping mats (optional)

Damping mats will be used for the gas measurement to reduce acoustic noise influences on the measurement.

Transducer damping mats will be installed below the transducers.

Pipe damping mats will be installed at reflection points, e.g. flange, weld.



Selection of damping mats

| type | description | outer pipe diameter mm | dimensions l x b x h mm | transducer frequency | | | | | | | | technical type | ambient temperature °C | remark |
|-------------------------------|---|---------------------------|-------------------------------|----------------------|---|---|---|---|---|---|-------|----------------|---------------------------|------------------------------|
| | | | | F | G | H | K | M | P | Q | | | | |
| transducer damping mat | | | | | | | | | | | | | | |
| D | for temporary installation (multiple use), fixed with coupling compound | < 80 | 450 x 115 x 0.5 | - | - | - | - | x | x | x | x | D20S3 | -25...+60 | |
| | | ≥ 80 | 900 x 230 x 0.5 | - | - | - | x | x | - | - | D20S2 | | | |
| | | | 900 x 230 x 1.3 | x | x | x | - | - | - | - | D50S2 | | | |
| pipe damping mat | | | | | | | | | | | | | | |
| A | for temporary installation (multiple use), fixed with coupling compound | < 300 | 300 x 115 x 0.5 | x | x | x | x | x | x | x | x | A20S4 | -25...+60 | for quantity see table below |
| B | self-adhesive | ≥ 300 | l x 100 x 0.9 | x | x | x | x | x | x | - | - | B35R2 | -35...+50 | l - see table below |

Quantity for pipe damping mat - type A

(depending on the outer pipe diameter)

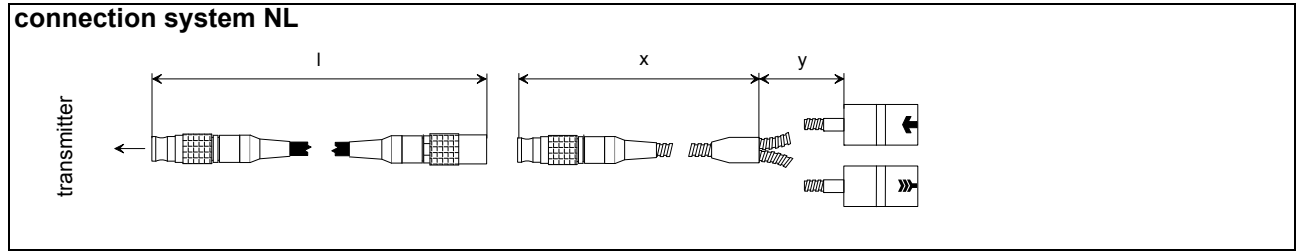
| outer pipe diameter D mm | transducer frequency | |
|-----------------------------|----------------------|------------|
| | F, G, H | K, M, P, Q |
| 100 | 12 | 6 |
| 200 | 24 | 12 |
| 300 | 32 | 16 |

Length of pipe damping mat - type B

(length l depending on transducer frequency and outer pipe diameter)

| outer pipe diameter D mm | transducer frequency | |
|-----------------------------|----------------------|--------------|
| | F, G, H m | K, M, P m |
| 300 | 12 | 6 |
| 500 | 32 | 16 |
| 1000 | 126 | 63 |

Connection systems



| transducer frequency (3d character of transducer order code) | | F, G, H, K | | | M, P | | | Q | | | S | | |
|--|--------------|------------|----------|----------------------|----------|----------|----------------------|----------|----------|----------------------|----------|----------|----------|
| N | cable length | x | y | l¹ | x | y | l¹ | x | y | l¹ | x | y | l |
| L | | m | 2 | 3 | ≤ 25 | 2 | 2 | ≤ 25 | 2 | 1 | ≤ 25 | 1 | 1 |

¹ > 25...100 m on request

x, y - transducer cable length

l - max. length of extension cable

Transducer cable

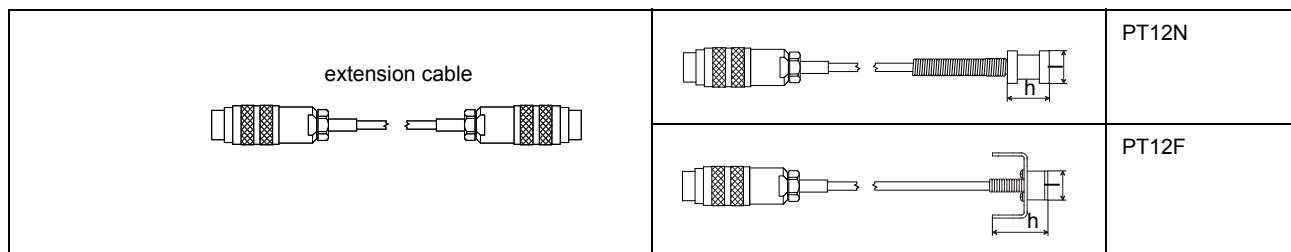
Technical data

| | | transducer cable | extension cable | |
|---------------------|----|------------------------------|-----------------|------------------------------|
| type | | 1699 | 2551 | 1750 |
| standard length | m | see table above | - | 5 10 |
| max. length | m | - | see table above | 10 |
| ambient temperature | °C | -55...+200 | -25...+80 | < 80 |
| cable jacket | | | | |
| material | | PTFE | TPE-O | PE |
| outer diameter | mm | 2.9 | 8 | 6 |
| thickness | mm | 0.3 | | 0.5 |
| colour | | brown | black | black |
| shield | | x | x | x |
| sheath | | | | |
| material | | stainless steel 304 (1.4301) | - | stainless steel 304 (1.4301) |
| outer diameter | mm | 8 | - | 9 |
| remark | | | | optional |

Clamp-on temperature probe (optional)

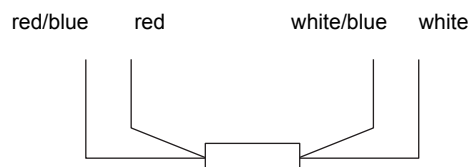
Technical data

| technical type | | PT12N | PT12F |
|---|----|---|---|
| design | | | short response time |
| type | | Pt100 | Pt100 |
| connection | | 4-wire | 4-wire |
| measuring range | | °C -30...+250 | -50...+250 |
| accuracy T | | $\pm(0.15\text{ °C} + 2 \cdot 10^{-3} \cdot T\text{ [°C] })$ class A | $\pm(0.15\text{ °C} + 2 \cdot 10^{-3} \cdot T\text{ [°C] })$ class A |
| accuracy ΔT (2x Pt matched according to EN 1434-1) | | $\leq 0.1\text{ K}$ (3 K < ΔT < 6 K), more corresponding to EN 1434-1 | $\leq 0.1\text{ K}$ (3 K < ΔT < 6 K), more corresponding to EN 1434-1 |
| response time | | s 50 | 8 |
| housing | | aluminum | PEEK, stainless steel 304 (1.4301), copper |
| degree of protection according to IEC/EN 60529 | | IP66 | IP66 |
| weight (without connector) | | kg 0.25 | 0.32 |
| fixation | | clamp-on | clamp-on |
| accessories | | | |
| thermal conductivity paste 200 °C | | x | x |
| thermal conductivity foil 250 °C | | x | x |
| plastic protection plate, insulation foam | | - | x |
| dimensions | | | |
| length l | mm | 15 | 14 |
| width b | mm | 15 | 30 |
| height h | mm | 20 | 27 |



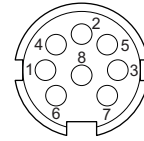
Connection

Temperature probe



Connector

| pin | cable of temperature probe | extension cable |
|---------|----------------------------|-----------------|
| 1 | white/blue | blue |
| 2 | red/blue | grey |
| 3, 4, 5 | not connected | |
| 6 | red | red |
| 7 | white | white |
| 8 | not connected | |



Cable

| | | cable of temperature probe | extension cable |
|-----------------|---|--------------------------------|-------------------------------------|
| type | | 4 x 0.25 mm ² black | LIYCY 8 x 0.14 mm ² grey |
| standard length | m | 3 | 5/10/25 |
| max. length | m | - | 200 |
| cable jacket | | PTFE | PVC |

Wall thickness measurement (optional)

The pipe wall thickness is an important pipe parameter which has to be determined exactly for a good measurement. However, the pipe wall thickness often is unknown.

The wall thickness probe can be connected to the transmitter instead of the flow transducers and the wall thickness measurement mode is activated automatically.

Acoustic coupling compound is applied to the wall thickness probe which then is placed firmly on the pipe. The wall thickness is displayed and can be stored directly in the transmitter.

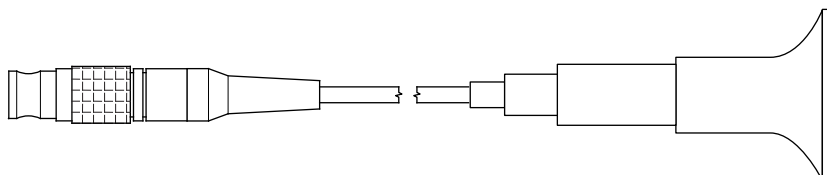
Technical data

| | | |
|------------------------------|----|---|
| technical type | | DWR1NZ7 |
| measuring range ¹ | mm | 1...250 |
| resolution | mm | 0.01 |
| accuracy | | 1 % ± 0.1 mm |
| fluid temperature | °C | -20...+200, short-time peak max. 500 |
| cable | | |
| type | | 2616 |
| length | m | 1.5 |

¹ The measuring range depends on the attenuation of the ultrasonic signal in the pipe. For strongly attenuating plastics (e.g. PFA, PTFE, PP) the measuring range is smaller.

Cable

| | | |
|---------------------|----|-------|
| type | | 2616 |
| ambient temperature | °C | <200 |
| cable jacket | | |
| material | | FEP |
| outer diameter | mm | 5.1 |
| colour | | black |
| shield | | x |



DWR1NZ7



FLEXIM GmbH
Wolfener Str. 36
12681 Berlin
Germany
Tel.: +49 (30) 93 66 76 60
Fax: +49 (30) 93 66 76 80

internet: www.flexim.com
e-mail: info@flexim.com

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