

### Portable ultrasonic flowmeter for gas, steam and liquids in hazardous areas

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

#### Features

- Configurable as multifunctional measuring system:
  - Flow measurement of gases, compressed air and saturated steam up to max. 180 °C
  - Flow and thermal energy measurement of liquids
- Precise bidirectional and highly dynamic flow measurement with the non-invasive clamp-on technology
- 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
- 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 tight; resistant against oil, many liquids and dirt
- Extremely resistant carbon fiber housing
- Robust, water-tight (IP67) transport case with comprehensive accessories
- Compact and very lightweight, allowing the measuring system to be easily carried as personal luggage, e.g. for off-shore visits
- Covered by ATEX/IECEx zone 2 certification
- Li-Ion battery provides up to 25 hours of measurement operation
- User-friendly design
- QuickFix for a simple and fast transmitter fixation, e.g. on pipes
- Transducers available for a wide range of inner pipe diameters and fluid temperatures
- Rugged transducers (ATEX/IECEx zone 1 and 2, resistant to rough environments, dust and humidity)

#### Applications

Designed for the following industries:

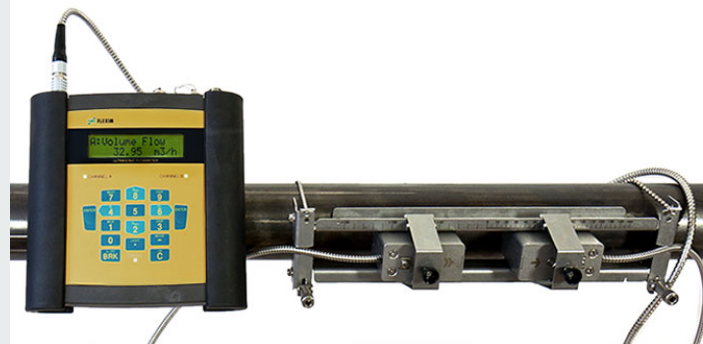
- Upstream (on- and offshore)
- Midstream and downstream (pipelines and refineries)
- Chemical industry
- Energy sector (e.g. HVAC, geothermal, power plants)



FLUXUS G608



Measurement with transducers mounted with the portable Variofix VP



Measurement with the flow transmitter fixed to the pipe with the QuickFix pipe mounting fixture

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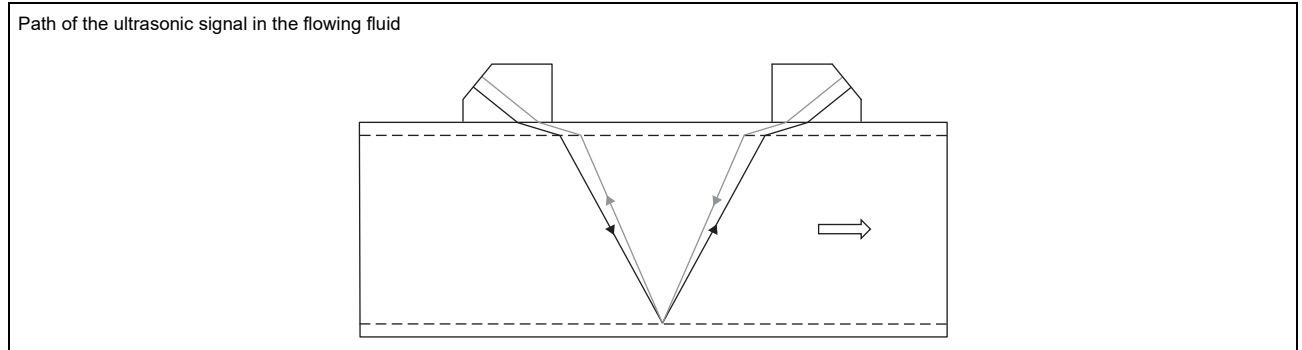
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## Function

### Measurement principle

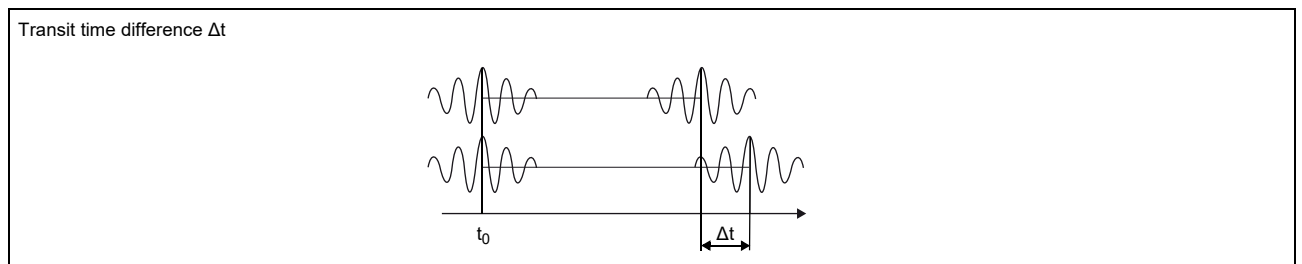
The transducers are mounted on the pipe which is completely filled with the fluid. The ultrasonic signals are emitted alternately by a transducer and received by the other. The physical quantities are determined from the transit times of the ultrasonic signals.



As the fluid where the ultrasound propagates is flowing, the transit time of the ultrasonic signal in flow direction is shorter than the one against the flow direction.

The transit time difference  $\Delta t$  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.

The integrated microprocessors control the entire measuring cycle. The received ultrasonic signals are checked for measurement usability and evaluated for their reliability. Noise signals are eliminated.



### Calculation of volumetric flow rate

$$\dot{V} = k_{Re} \cdot A \cdot k_a \cdot \frac{\Delta t}{2 \cdot t_{\gamma}}$$

where

- $\dot{V}$  - volumetric flow rate
- $k_{Re}$  - fluid mechanics calibration factor
- $A$  - cross-sectional pipe area
- $k_a$  - acoustical calibration factor
- $\Delta t$  - transit time difference
- $t_{\gamma}$  - average of transit times in the fluid

### Calculation of mass flow rate

The mass flow rate is calculated from the operating density and the volumetric flow rate:

$$\dot{m} = \rho \cdot \dot{V}$$

The operating density of the fluid is calculated as the function of pressure and temperature of the fluid:

$$\rho = f(p, T)$$

where

- $\rho$  - operating density
- $p$  - fluid pressure
- $T$  - fluid temperature
- $\dot{m}$  - mass flow rate
- $\dot{V}$  - volumetric flow rate

### Calculation of standard volumetric flow rate

The standard volumetric flow rate can be selected as physical quantity. It is calculated with the following formula:

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

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 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. If temperature inputs are installed (optional), the 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, e.g. according to AGA8 or GERG

### 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**

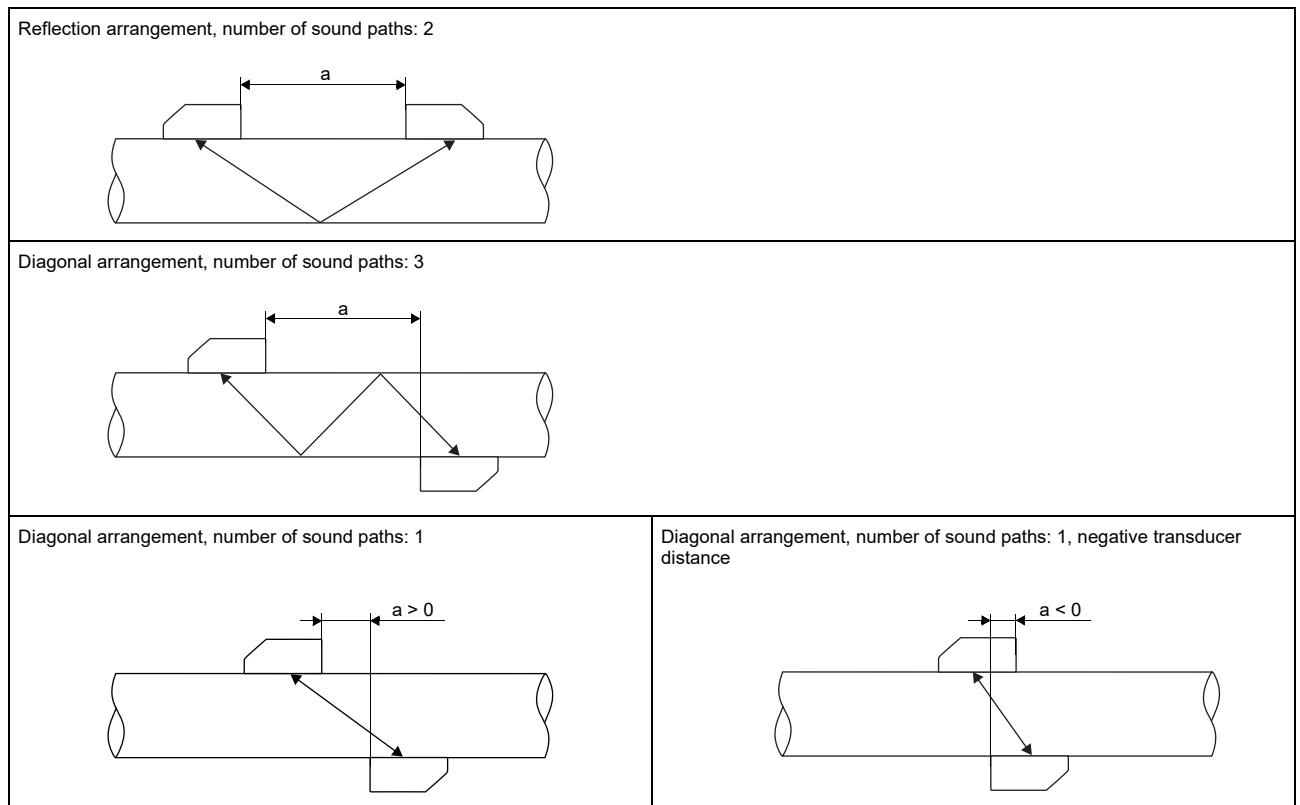
The number of sound paths is even. The transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easy.

- **diagonal arrangement**

The number of sound paths is odd. 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.

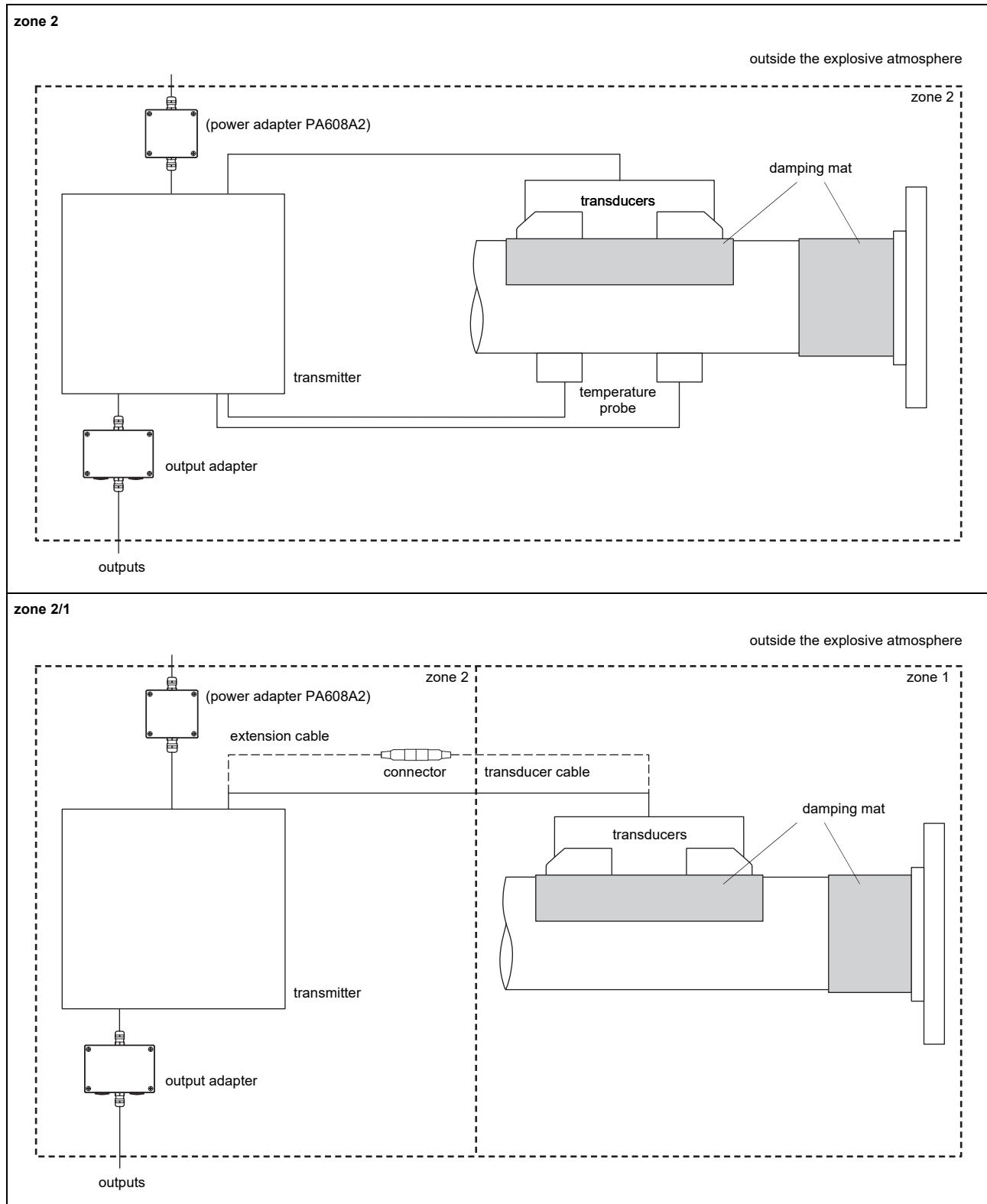
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

### Typical measurement setup



# Transmitter

## Technical data

		FLUXUS G608**-A2	FLUXUS G608ST-A2 (steam measurement <sup>2</sup> )
			
design		portable, zone 2	
<b>measurement</b>			
measurement principle		transit time difference correlation principle	
flow velocity	m/s	0.01...35, depending on pipe diameter	depending on pipe diameter and transducer, see diagrams
repeatability		0.15 % MV ±0.005 m/s	
fluid		all acoustically conductive gases, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane	saturated steam, superheated steam
fluid pressure	bar (a)	see transducers	3...10
fluid temperature	°C	see transducers	135...180 transducers zone 2: max. 165 transducers zone 1: max. 155
temperature compensation		corresponding to the recommendations in ANSI/ASME MFC-5.1-2011	
<b>measurement uncertainty (volumetric flow rate)</b>			
measurement uncertainty of the measuring system <sup>1</sup>		±0.3 % MV ±0.005 m/s	±0.3 % MV ±0.005 m/s
measurement uncertainty at the measuring point		±1...2 % MV ±0.005 m/s, depending on the application	±1...3 % MV ±0.005 m/s, depending on the application
<b>transmitter</b>			
power supply		<ul style="list-style-type: none"> <li>• 100...230 V/50...60 Hz (power supply unit, outside the explosive atmosphere)</li> <li>• 10.5...15 V DC (socket at transmitter, with power adapter PA608A2 (optional) and power connection adapter PA608NN (optional))</li> <li>• integrated battery</li> </ul>	
integrated battery		Li-Ion, 7.2 V/6.2 Ah	
operating time	h	<ul style="list-style-type: none"> <li>• &gt; 14 (without outputs, inputs and backlight)</li> <li>• &gt; 25 (1 measuring channel, ambient temperature &gt; 10 °C, without outputs, inputs and backlight)</li> </ul>	
power consumption	W	< 6 (with outputs, inputs and backlight), charging: 18	
number of measuring channels		2	
damping	s	0...100 (adjustable)	
measuring cycle	Hz	100...1000 (1 channel)	
response time	s	1 (1 channel), option: 0.07	
housing material		PA, TPS, PC, Polyester, stainless steel	
degree of protection		IP65	
dimensions	mm	see dimensional drawing	
weight	kg	2.2	
fixation		QuickFix pipe mounting fixture	
ambient temperature	°C	-10...+60	
display		2 x 16 characters, dot matrix, backlight	
menu language		English, German, French, Dutch, Spanish	
<b>explosion protection</b>			
• ATEX/IECEX			
marking		CE 0637  II3G II2D Ex nA nC ic [ic] IIC (T6)T4 Gc T <sub>a</sub> -10...+(50)60 °C Ex tb IIIC T100 °C Db	
certification ATEX		IBExU10ATEX1067	
certification IECEX		IECEX IBE 12.0006	
intrinsic safety parameters		U <sub>m</sub> = 16 V DC intrinsically safe inputs: U <sub>o</sub> = 22 V, I <sub>o</sub> = 6 mA, P <sub>o</sub> = 33 mW, C <sub>o</sub> = 450 nF, L <sub>o</sub> = 10 mH C <sub>i</sub> = 1.8 nF, L <sub>i</sub> = 10 µH	
<b>measuring functions</b>			
physical quantities		operating volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity	operating volumetric flow rate, mass flow rate, flow velocity
totaliser		volume, mass	
calculation functions		average, difference, sum	
diagnostic functions		sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times	

<sup>1</sup> with aperture calibration of the transducers

<sup>2</sup> test measurement to validate the application required in advance (especially for pipe diameters < 100 mm)

For the technical data in the flow measurement of liquids mode see Technical specification TSFLUXUS\_F608xx-A2V\*.\*.

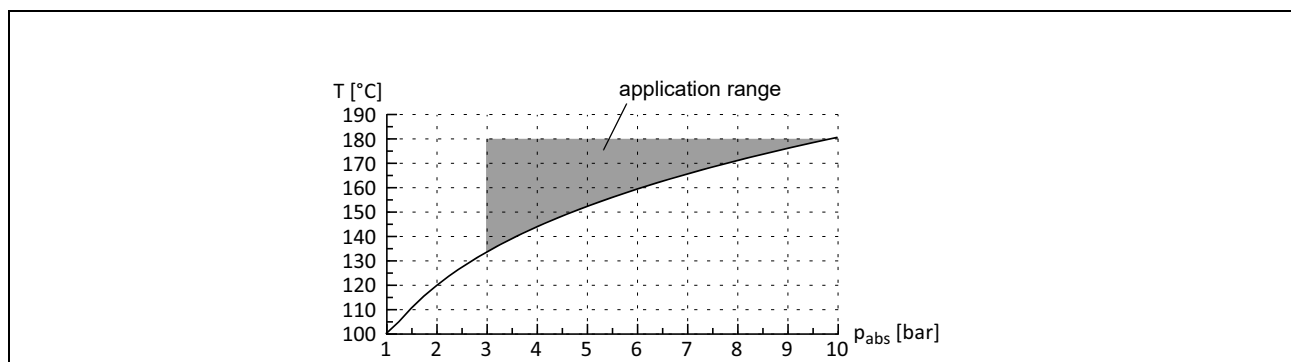
FLUXUS G608**-A2		FLUXUS G608ST-A2 (steam measurement <sup>2</sup> )
<b>communication interfaces</b>		
service interfaces	<ul style="list-style-type: none"> <li>• RS232</li> <li>• USB (with adapter)</li> </ul>	
<b>accessories</b>		
data transmission kit	<ul style="list-style-type: none"> <li>• cable RS232</li> <li>• adapter RS232 - USB</li> </ul>	
software	<ul style="list-style-type: none"> <li>• FluxDiagReader: reading of measured values and parameters, graphical presentation</li> <li>• FluxDiag (optional): reading of measurement data, graphical presentation, report generation</li> </ul>	
adapter	<ul style="list-style-type: none"> <li>• output adapter (necessary, option)</li> <li>• input adapter (if number of inputs &gt; 2)</li> </ul>	
transport case	dimensions: 500 x 400 x 190 mm	
<b>data logger</b>		
loggable values	all physical quantities, totalised physical quantities and diagnostic values	
capacity	> 100 000 measured values	
<b>outputs</b>		
The outputs are galvanically isolated from the transmitter.		
number	analog outputs: max. 4 <ul style="list-style-type: none"> <li>• 0, 2 or 4 active current outputs or passive current outputs or frequency outputs or</li> <li>• 2 active current outputs and 2 passive current outputs or</li> <li>• 2 active current outputs and 2 frequency outputs or</li> <li>• 2 passive current outputs and 2 frequency outputs</li> </ul> binary outputs: max. 4	
<b>• current output</b>		
range	mA	0/4...20
accuracy		0.1 % MV ±15 µA
active output		R <sub>ext</sub> < 200 Ω
passive output		U <sub>ext</sub> = 4...9 V, depending on R <sub>ext</sub> (R <sub>ext</sub> < 200 Ω at 9 V)
<b>• frequency output</b>		
range	kHz	0...5
open collector		24 V/4 mA
<b>• binary output</b>		
optorelay		26 V/100 mA
binary output as alarm output		
• functions	limit, change of flow direction or error	
binary output as pulse output		
• functions	mainly for totalising	
• pulse value	units	0.01...1000
• pulse width	ms	1...1000
<b>inputs</b>		
The inputs are galvanically isolated from the transmitter.		
number	max. 4	
<b>• temperature input</b>		
intrinsic safety		
type	Pt100/Pt1000	
connection	4-wire	
range	°C	-150...+560
resolution	K	0.01
accuracy	±0.01 % MV ±0.03 K	

<sup>1</sup> with aperture calibration of the transducers

<sup>2</sup> test measurement to validate the application required in advance (especially for pipe diameters < 100 mm)

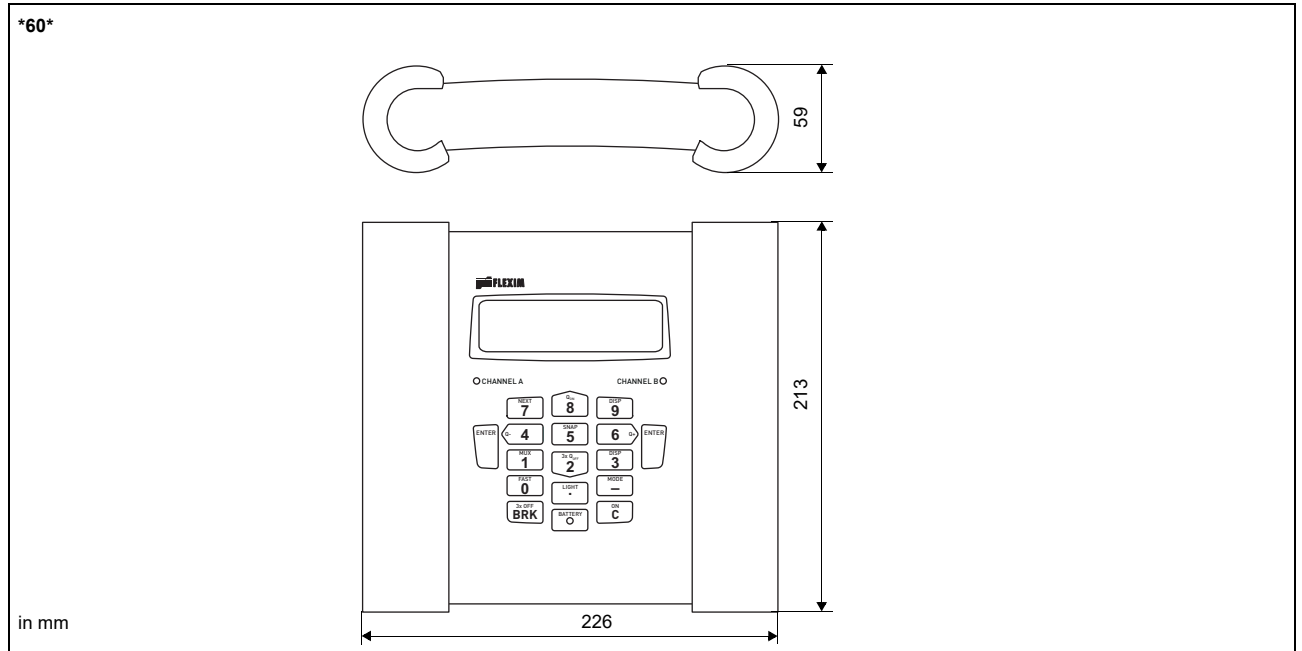
For the technical data in the flow measurement of liquids mode see Technical specification TSFLUXUS\_F608xx-A2V\*.\*.

### Saturated steam pressure curve





### Dimensions

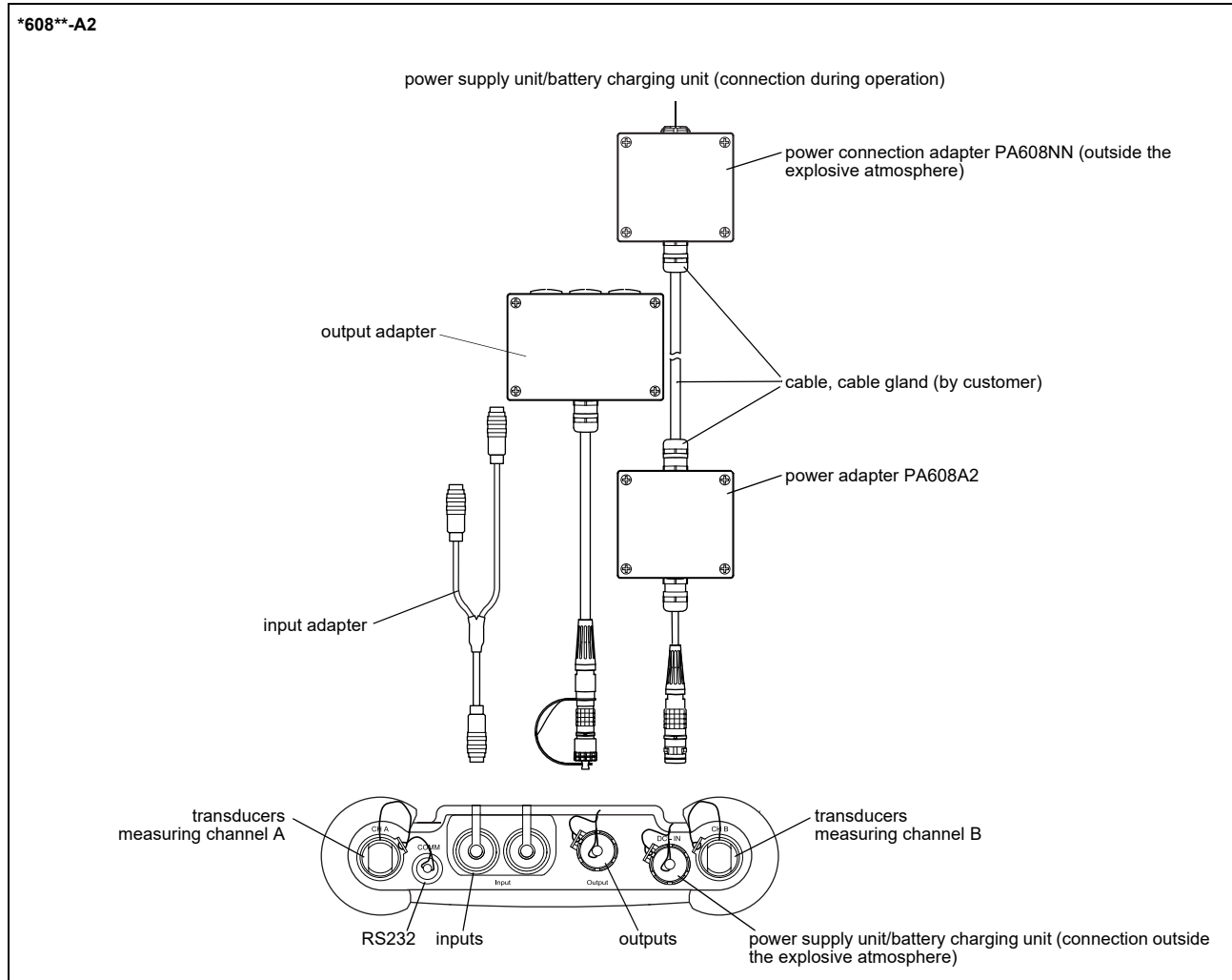


### Standard scope of supply

	G608 Standard	G608 CA-Energy	G608ST-A2 Steam
application	flow measurement of gas and liquids 2 independent measuring channels calculation of standard volumetric flow rate		
		calculation of standard volumetric flow rate with optional use of current measured temperature values liquids: integrated thermal energy computer for monitoring of energy flows	calculation of mass flow rate according to saturated steam pressure curve
<b>outputs</b>			
passive current output	2	2	2
binary output	2	2	2
<b>inputs</b>			
temperature input	-	4	4
<b>accessories</b>			
transport case	x	x	x
power supply unit, mains cable	x	x	x
battery	x	x	x
power adapter PA608A2 <sup>1</sup>	-	-	-
power connection adapter PA608NN <sup>1</sup>	-	-	-
output adapter <sup>1</sup>	-	-	-
input adapter	-	2	2
QuickFix pipe mounting fixture for transmitter	x	x	x
data transmission kit	x	x	x
measuring tape	x	x	x
wall thickness probe	-	x	x
operating instruction, safety instructions, Quick start guide	x	x	x
connector board at the upper side of the transmitter			

<sup>1</sup> to be ordered separately, if required

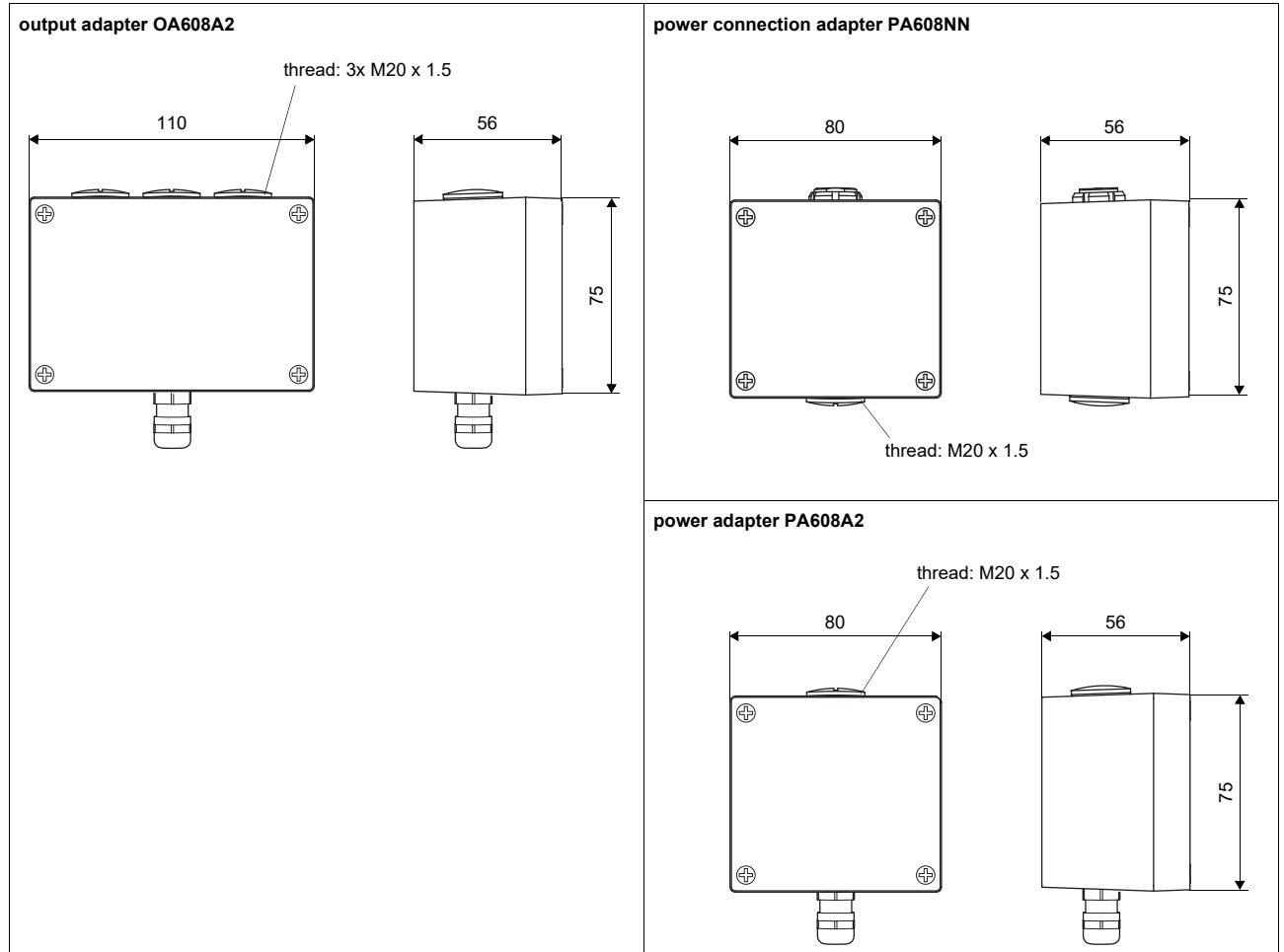
### Adapters



### Technical data

	output adapter	power adapter	power connection adapter
technical type	OA608A2	PA608A2	PA608NN
connection voltage		10.5...15 V DC	
weight	kg 0.26	0.26	0.32
<b>material</b>			
housing	polyester		polyester
gasket	silicone		chloroprene
degree of protection	IP66		IP65
<b>ambient temperature</b>			
min.	°C -20		-10
max.	°C +90		+60
<b>explosion protection</b>			
• ATEX			
marking	CE (Ex) II3G Ex nA IIC T6 Gc Ta -10...+60 °C		-

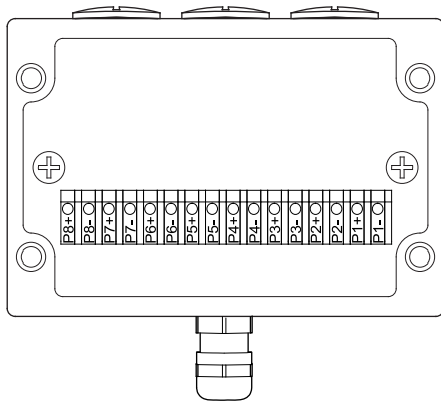
**Dimensions**



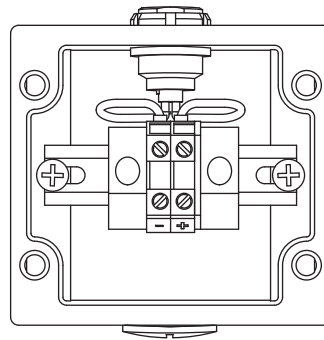
in mm

### Terminal assignment

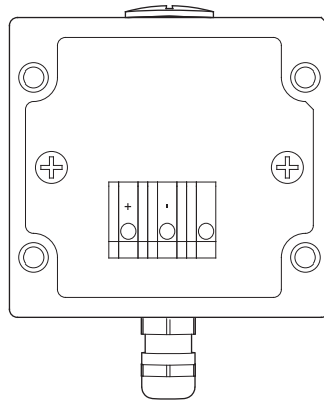
output adapter OA608A2



power connection adapter PA608NN<sup>1</sup>



power adapter PA608A2<sup>1</sup>



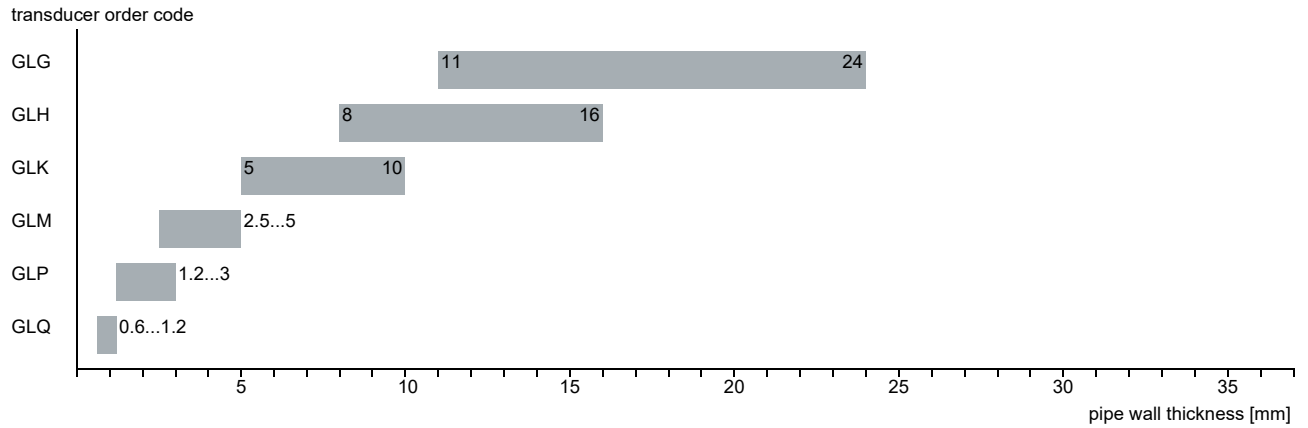
<sup>1</sup> cable PA608A2 - PA608NN (by customer):  
length: max. 30 m  
wire cross-section: 1.5...2.5 mm<sup>2</sup>

## Transducers

### Transducer selection (gas measurement)

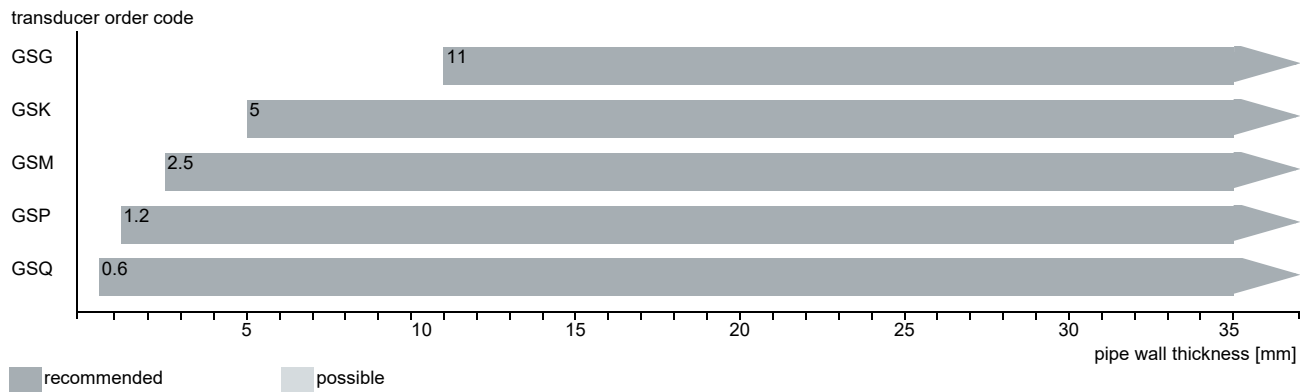
#### Step 1a

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:

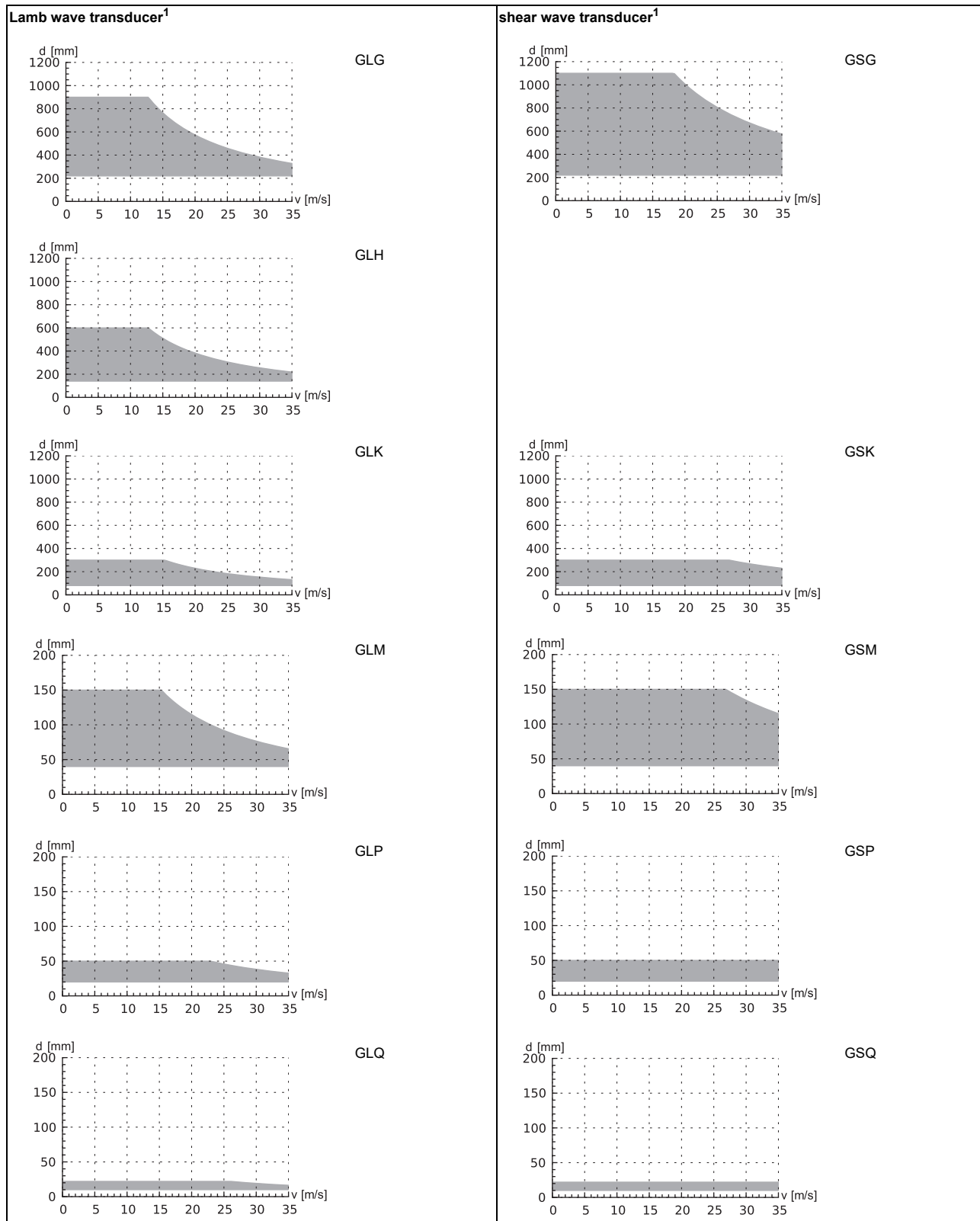


#### Step 2

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.



<sup>1</sup> 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 <sup>1</sup> [bar]		
	metal pipe		plastic pipe
	min.	min. extended	min.
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 <sup>1</sup> [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

<sup>1</sup> depending on the application, typical absolute value for natural gas, nitrogen, compressed air

d - inner pipe diameter

### Example

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

### Step 4

for the characters 4...11 of the transducer order code (ambient temperature, explosion protection, connection system, extension cable) see page 17

### Step 5

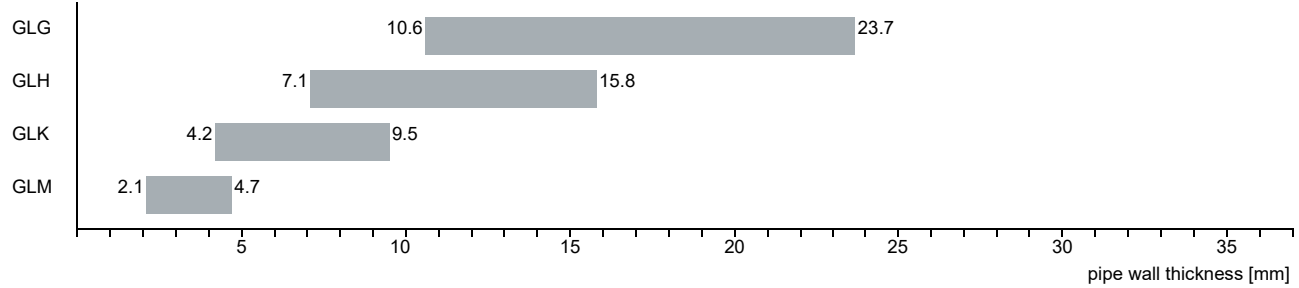
for the technical data of the selected transducer see page 18 et seqq.

### Transducer selection (G\*\*1S\*3, steam measurement)

#### Step 1

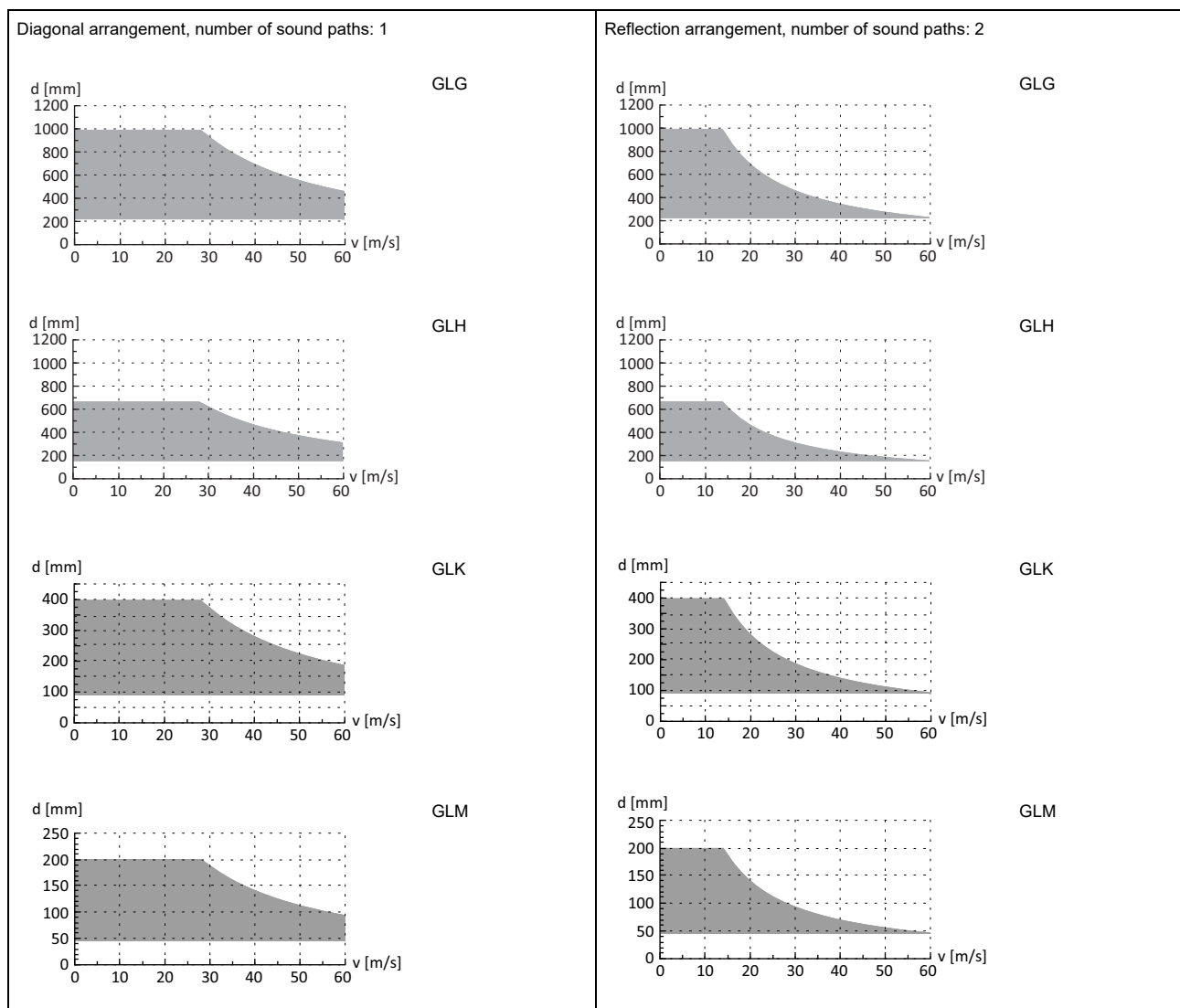
pipe wall thickness

transducer order code



#### Step 2

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



inner pipe diameter and max. flow velocity for a steam application

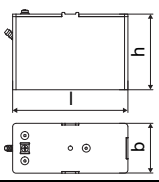
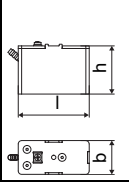
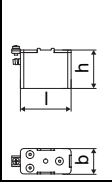


### Transducer order code

1, 2	3	4	5, 6	7, 8	9...11	no. of character				
transducer	transducer frequency	-	ambient temperature	explosion protection	connection system	-	extension cable	/	option	description
GS										set of ultrasonic flow transducers for gas measurement, shear wave
GL										set of ultrasonic flow transducers for gas measurement, Lamb wave
	G									0.2 MHz
	H									0.3 MHz
	K									0.5 MHz
	M									1 MHz
	P									2 MHz
	Q									4 MHz
		N								normal temperature range
		E								extended temperature range
		S								higher temperatures
			A2							ATEX zone 2/IECEX zone 2
			A1							ATEX zone 1/IECEX zone 1
				NL						with Lemo connector
							XXX			0 m: without extension cable > 0 m: with extension cable (connector outside of ATEX zone 1/IECEX zone 1)
									LC	long transducer cable

## Technical data

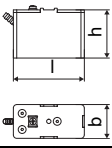
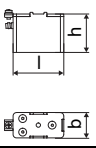
### Shear wave transducers (zone 2, NL)

order code		GSG-N*2NL/**	GSK-N*2NL/**	GSM-N*2NL/**	GSP-N*2NL/**	GSQ-N*2NL/**
technical type		G(DL)G1NH1	G(DL)K1NH1	G(DL)M2NH1	G(DL)P2NH1	G(DL)Q2NH1
transducer frequency	MHz	0.2	0.5	1	2	4
<b>fluid pressure<sup>1</sup></b>						
min. extended	bar	metal pipe: 20				
min.	bar	metal pipe: 30, plastic pipe: 1				
<b>inner pipe diameter d<sup>2</sup></b>						
min. extended	mm	180	60	30	15	7
min. recommended	mm	220	80	40	20	10
max. recommended	mm	900	300	150	50	22
max. extended	mm	1100	360	180	60	30
<b>pipe wall thickness</b>						
min.	mm	11	5	2.5	1.2	0.6
<b>material</b>						
housing		PEEK with stainless steel cover and transducer shoe 304 (1.4301)				
contact surface		PEEK				
degree of protection		IP65	IP66			IP65
<b>transducer cable</b>						
type		1699				
length	m	5		4		3
length (***_*****/LC)	m	9				
<b>dimensions</b>						
length l	mm	136.5		84	70	
width b	mm	59		40	30	
height h	mm	90.5		59	47.5	
dimensional drawing						
weight (without cable)	kg	1.674		0.504	0.251	
<b>pipe surface temperature</b>						
min.	°C	-40				
max.	°C	+130				
<b>ambient temperature</b>						
min.	°C	-40				
max.	°C	+130				
temperature compensation		x				
<b>explosion protection</b>						
• ATEX/IECEx						
order code		GSG-NA2NL/**	GSK-NA2NL/**	GSM-NA2NL/**	GSP-NA2NL/**	GSQ-NA2NL/**
pipe surface temperature (Ex)						
• min.	°C	-55				
• max.	°C	gas: +190, dust: +180				
marking		CE 0637 Ex I13G I12D Ex nA IIC T6...T3 Gc Ex tb IIIC T80 °C...T185 °C Db				
certification ATEX		IBExU10ATEX1163 X				
certification IECEx		IECEx IBE 12.0005X				

<sup>1</sup> depending on the application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> 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

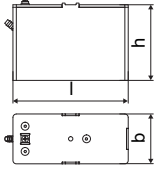
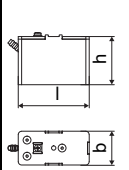
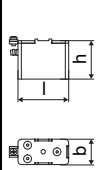

**Shear wave transducers (zone 2, NL, extended temperature range)**

order code		GSM-E*2NL/**	GSP-E*2NL/**	GSQ-E*2NL/**
technical type		G(DL)M2EH5	G(DL)P2EH5	G(DL)Q2EH5
transducer frequency	MHz	1	2	4
<b>fluid pressure<sup>1</sup></b>				
min. extended	bar	metal pipe: 20		
min.	bar	metal pipe: 30, plastic pipe: 1		
<b>inner pipe diameter d<sup>2</sup></b>				
min. extended	mm	30	15	7
min. recommended	mm	40	20	10
max. recommended	mm	150	50	22
max. extended	mm	180	60	30
<b>pipe wall thickness</b>				
min.	mm	2.5	1.2	0.6
<b>material</b>				
housing		PI with stainless steel cover and transducer shoe 304 (1.4301)		
contact surface		PI		
degree of protection		IP66		IP56
<b>transducer cable</b>				
type		6111		
length	m	4		3
length (**-*****/LC)	m	9		
<b>dimensions</b>				
length l	mm	84		70
width b	mm	40		30
height h	mm	59		47.5
dimensional drawing				
weight (without cable)	kg	0.505		0.252
<b>pipe surface temperature</b>				
min.	°C	-30		
max.	°C	+200		
<b>ambient temperature</b>				
min.	°C	-30		
max.	°C	+200		
temperature compensation		x		
<b>explosion protection</b>				
<b>• ATEX/IECEX</b>				
order code		GSM-EA2NL/**	GSP-EA2NL/**	GSQ-EA2NL/**
pipe surface temperature (Ex)				
• min.	°C	-45		
• max.	°C	gas: +235, dust: +225		
marking		CE 0637 Ex II 3G II 2D Ex nA IIC T6...T2 Gc Ex tb IIIA T80 °C...230 °C Db		
certification ATEX		IBExU10ATEX1163 X		
certification IECEX		IECEX IBE 12.0005X		

<sup>1</sup> depending on the application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> 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

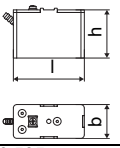
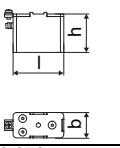
**Shear wave transducers (zone 1, NL)**

order code		GSG-N*1NL/**	GSK-N*1NL/**	GSM-N*1NL/**	GSP-N*1NL/**	GSQ-N*1NL/**
technical type		G(DL)G1NW1	G(DL)K1NW1	G(DL)M2NW1	G(DL)P2NW1	G(DL)Q2NW1
transducer frequency	MHz	0.2	0.5	1	2	4
<b>fluid pressure<sup>1</sup></b>						
min. extended	bar	metal pipe: 20				
min.	bar	metal pipe: 30, plastic pipe: 1				
<b>inner pipe diameter d<sup>2</sup></b>						
min. extended	mm	180	60	30	15	7
min. recommended	mm	220	80	40	20	10
max. recommended	mm	900	300	150	50	22
max. extended	mm	1100	360	180	60	30
<b>pipe wall thickness</b>						
min.	mm	11	5	2.5	1.2	0.6
<b>material</b>						
housing		PEEK with stainless steel cover and transducer shoe 304 (1.4301)				
contact surface		PEEK				
degree of protection		IP65	IP66			IP65
<b>transducer cable</b>						
type		1699				
length	m	5		4		3
length (**-****/LC)	m	9				
<b>dimensions</b>						
length l	mm	136.5		84	70	
width b	mm	59		40	30	
height h	mm	90.5		59	47.5	
dimensional drawing						
weight (without cable)	kg	1.674		0.504	0.251	
<b>pipe surface temperature</b>						
min.	°C	-40				
max.	°C	+130				
<b>ambient temperature</b>						
min.	°C	-40				
max.	°C	+130				
temperature compensation		x				
<b>explosion protection</b>						
<b>• ATEX/IECEX</b>						
order code		GSG-NA1NL/**	GSK-NA1NL/**	GSM-NA1NL/**	GSP-NA1NL/**	GSQ-NA1NL/**
pipe surface temperature (Ex)						
• min.	°C	-55				
• max.	°C	+180				
marking		CE 0637  II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC T80 °C...T185 °C Db				
certification ATEX		IBExU07ATEX1168 X				
certification IECEX		IECEX IBE 08.0007X				

<sup>1</sup> depending on the application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> 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

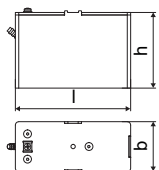
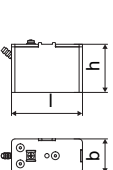
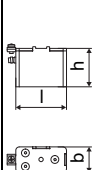
**Shear wave transducers (zone 1, NL, extended temperature range)**

order code		GSM-E*1NL/**	GSP-E*1NL/**	GSQ-E*1NL/**
technical type		G(DL)M2EW5	G(DL)P2EW5	G(DL)Q2EW5
transducer frequency	MHz	1	2	4
<b>fluid pressure<sup>1</sup></b>				
min. extended	bar	metal pipe: 20		
min.	bar	metal pipe: 30, plastic pipe: 1		
<b>inner pipe diameter d<sup>2</sup></b>				
min. extended	mm	30	15	7
min. recommended	mm	40	20	10
max. recommended	mm	150	50	22
max. extended	mm	180	60	30
<b>pipe wall thickness</b>				
min.	mm	2.5	1.2	0.6
<b>material</b>				
housing		PI with stainless steel cover and transducer shoe 304 (1.4301)		
contact surface		PI		
degree of protection		IP66		IP56
<b>transducer cable</b>				
type		6111		
length	m	4		3
length (***_*****/LC)	m	9		
<b>dimensions</b>				
length l	mm	84		70
width b	mm	40		30
height h	mm	59		47.5
dimensional drawing				
weight (without cable)	kg	0.505		0.252
<b>pipe surface temperature</b>				
min.	°C	-30		
max.	°C	+200		
<b>ambient temperature</b>				
min.	°C	-30		
max.	°C	+200		
temperature compensation		x		
<b>explosion protection</b>				
<b>• ATEX/IECEX</b>				
order code		GSM-EA1NL/**	GSP-EA1NL/**	GSQ-EA1NL/**
pipe surface temperature (Ex)				
• min.	°C	-45		
• max.	°C	+225		
marking		CE 0637 Ex II2G II2D Ex q IIC T6...T2 Gb Ex tb IIIA T80 °C...T230 °C Db		
certification ATEX		IBExU07ATEX1168 X		
certification IECEX		IECEX IBE 08.0007X		

<sup>1</sup> depending on the application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> 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

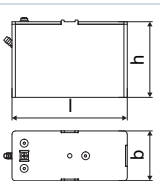
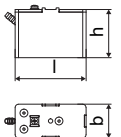
**Lamb wave transducers (zone 2, NL)**

order code		GLG-N*2NL/**	GLH-N*2NL/**	GLK-N*2NL/**	GLM-N*2NL/**	GLP-N*2NL/**	GLQ-N*2NL/**
technical type		G(RT)G1NH3	G(RT)H1NH3	G(RT)K1NH3	G(RT)M1NH3	G(RT)P1NH3	G(RT)Q1NH3
transducer frequency	MHz	0.2	0.3	0.5	1	2	4
<b>fluid pressure<sup>1</sup></b>							
min. extended	bar	metal pipe: 10		metal pipe: 10 (d > 120 mm) 3 (d < 120 mm)	metal pipe: 3 (d < 60 mm)	metal pipe: 3 (d < 35 mm)	metal pipe: 3 (d < 15 mm)
min.	bar	metal pipe: 15 plastic pipe: 1		metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1	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
<b>inner pipe diameter d<sup>2</sup></b>							
min. extended	mm	180	110	60	30	15	7
min. recommended	mm	220	140	80	40	20	10
max. recommended	mm	900	600	300	150	50	22
max. extended	mm	1400	1000	360	180	60	30
<b>pipe wall thickness</b>							
min.	mm	11	8	5	2.5	1.2	0.6
max.	mm	24	16	10	5	3	1.2
<b>material</b>							
housing		PPSU with stainless steel cover and transducer shoe 304 (1.4301)					
contact surface		PPSU					
degree of protection		IP66			IP65		
<b>transducer cable</b>							
type		1699					
length	m	5			4		3
length (**-*****/LC)	m	9					
<b>dimensions</b>							
length l	mm	136.5			84		70
width b	mm	59			40		30
height h	mm	90.5			59		47.5
dimensional drawing							
weight (without cable)	kg	1.652			0.504		0.251
<b>pipe surface temperature</b>							
min.	°C	-40					
max.	°C	+130					
<b>ambient temperature</b>							
min.	°C	-40					
max.	°C	+130					
temperature compensation		x					
<b>explosion protection</b>							
<b>• ATEX/IECEX</b>							
order code		GLG-NA2NL/**	GLH-NA2NL/**	GLK-NA2NL/**	GLM-NA2NL/**	GLP-NA2NL/**	GLQ-NA2NL/**
pipe surface temperature (Ex)		• min. °C -50 • max. °C gas: +165, dust: +155					
marking		CE 0637 Ex II 3G II 2D Ex nA IIC T6...T3 Gc Ex tb IIIC T80 °C...T160 °C Db					
certification ATEX		IBExU10ATEX1163 X					
certification IECEX		IECEX IBE 12.0005X					

<sup>1</sup> depending on the application, typical absolute value for natural gas, nitrogen, compressed air

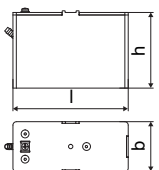
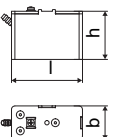
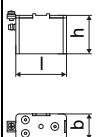

<sup>2</sup> Lamb wave transducer:  
 typical values for natural gas, nitrogen, oxygen; pipe diameters for other fluids on request  
 inner pipe diameter max. recommended: in reflection arrangement (diagonal arrangement) and for a flow velocity of 15 m/s (30 m/s)  
 inner pipe diameter max. extended: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

**Lamb wave transducers (zone 2, steam measurement, NL)**

order code		GLG-SA2NL/**	GLH-SA2NL/**	GLK-SA2NL/**	GLM-SA2NL/**
technical type		G(RT)G1SH3	G(RT)H1SH3	G(RT)K1SH3	G(RT)M1SH3
transducer frequency	MHz	0.2	0.3	0.5	1
<b>inner pipe diameter d</b>					
min.	mm	225	150	90	45
max.	mm	1000	667	400	200
<b>pipe wall thickness</b>					
min.	mm	10.6	7.1	4.2	2.1
max.	mm	23.7	15.8	9.5	4.7
<b>material</b>					
housing		PPSU with stainless steel cover and transducer shoe 304 (1.4301)			
contact surface		PPSU			
degree of protection		IP65			
<b>transducer cable</b>					
type		1699			
length	m	5			4
length (***_****/LC)	m	9			
<b>dimensions</b>					
length l	mm	136.5			84
width b	mm	59			40
height h	mm	90.5			59
dimensional drawing					
weight (without cable)	kg	1.652			0.504
<b>storing temperature</b>					
min.	°C	-40			
max.	°C	+130			
<b>operating temperature</b>					
min.	°C	100			
max.	°C	165			
warm-up time	h	3			1
temperature compensation		x			
<b>explosion protection</b>					
• ATEX/IECEX					
pipe surface temperature (Ex)					
• min.	°C	-50			
• max.	°C	gas: +165, dust: +155			
marking		CE 0637 Ex II3G II2D Ex nA IIC T6...T3 Gc Ex tb IIIC T80 °C...T160 °C Db			
certification ATEX		IBExU10ATEX1163 X			
certification IECEX		IECEX IBE 12.0005X			

completely thermally insulated transducer installation necessary

**Lamb wave transducers (zone 1, NL)**

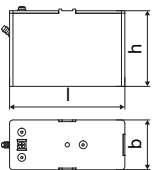
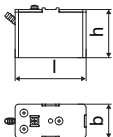
order code		GLG-N*1NL/**	GLH-N*1NL/**	GLK-N*1NL/**	GLM-N*1NL/**	GLP-N*1NL/**	GLQ-N*1NL/**
technical type		G(RT)G1NW3	G(RT)H1NW3	G(RT)K1NW3	G(RT)M1NW3	G(RT)P1NW3	G(RT)Q1NW3
transducer frequency	MHz	0.2	0.3	0.5	1	2	4
<b>fluid pressure<sup>1</sup></b>							
min. extended	bar	metal pipe: 10		metal pipe: 10 (d > 120 mm) 3 (d < 120 mm)	metal pipe: 3 (d < 60 mm)	metal pipe: 3 (d < 35 mm)	metal pipe: 3 (d < 15 mm)
min.	bar	metal pipe: 15 plastic pipe: 1		metal pipe: 15 (d > 120 mm) 10 (d < 120 mm) plastic pipe: 1	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
<b>inner pipe diameter d<sup>2</sup></b>							
min. extended	mm	180	110	60	30	15	7
min. recommended	mm	220	140	80	40	20	10
max. recommended	mm	900	600	300	150	50	22
max. extended	mm	1400	1000	360	180	60	30
<b>pipe wall thickness</b>							
min.	mm	11	8	5	2.5	1.2	0.6
max.	mm	24	16	10	5	3	1.2
<b>material</b>							
housing		PPSU with stainless steel cover and transducer shoe 304 (1.4301)					
contact surface		PPSU					
degree of protection		IP66			IP65		
<b>transducer cable</b>							
type		1699					
length	m	5			4		3
length (**-*****/LC)	m	9					
<b>dimensions</b>							
length l	mm	136.5			84		70
width b	mm	59			40		30
height h	mm	90.5			59		47.5
dimensional drawing							
weight (without cable)	kg	1.652			0.504		0.251
<b>pipe surface temperature</b>							
min.	°C	-40					
max.	°C	+130					
<b>ambient temperature</b>							
min.	°C	-40					
max.	°C	+130					
temperature compensation		x					
<b>explosion protection</b>							
<b>• ATEX/IECEx</b>							
order code		GLG-NA1NL/**	GLH-NA1NL/**	GLK-NA1NL/**	GLM-NA1NL/**	GLP-NA1NL/**	GLQ-NA1NL/**
pipe surface temperature (Ex)							
• min.	°C	-50					
• max.	°C	+155					
marking		CE0637  II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC T80 °C...T160 °C Db					
certification ATEX		IBExU07ATEX1168 X					
certification IECEx		IECEx IBE 08.0007X					

<sup>1</sup> depending on the application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> 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)



**Lamb wave transducers (zone 1, steam measurement, NL)**

order code		GLG-SA1NL/**	GLH-SA1NL/**	GLK-SA1NL/**	GLM-SA1NL/**
technical type		G(RT)G1SW3	G(RT)H1SW3	G(RT)K1SW3	G(RT)M1SW3
transducer frequency	MHz	0.2	0.3	0.5	1
<b>inner pipe diameter d</b>					
min.	mm	225	150	90	45
max.	mm	1000	667	400	200
<b>pipe wall thickness</b>					
min.	mm	10.6	7.1	4.2	2.1
max.	mm	23.7	15.8	9.5	4.7
<b>material</b>					
housing		PPSU with stainless steel cover and transducer shoe 304 (1.4301)			
contact surface		PPSU			
degree of protection		IP65			
<b>transducer cable</b>					
type		1699			
length	m	5			4
length (***_****/LC)	m	9			
<b>dimensions</b>					
length l	mm	136.5			84
width b	mm	59			40
height h	mm	90.5			59
dimensional drawing					
weight (without cable)	kg	1.652			0.504
<b>storing temperature</b>					
min.	°C	-40			
max.	°C	+130			
<b>operating temperature</b>					
min.	°C	100			
max.	°C	155			
warm-up time	h	3			1
temperature compensation		x			
<b>explosion protection</b>					
• ATEX/IECEX					
pipe surface temperature (Ex)					
• min.	°C	-50			
• max.	°C	+155			
marking		CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC T80 °C...T160 °C Db			
certification ATEX		IBExU07ATEX1168 X			
certification IECEX		IECEX IBE 08.0007X			

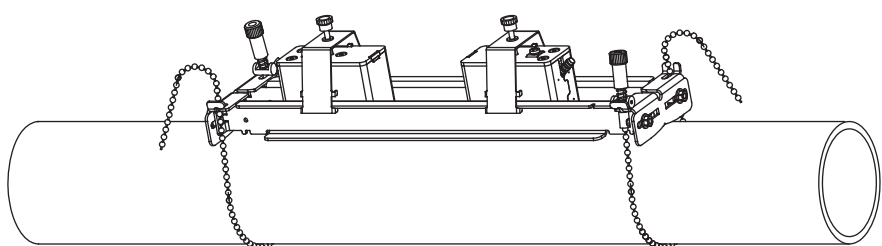
completely thermally insulated transducer installation necessary

# Transducer mounting fixture

## Order code

1, 2	3	4	5	6	7...9	no. of character
transducer mounting fixture	transducer	measurement arrangement	size	fixation	outer pipe diameter	description
VP						portable Variofix
	A					all transducers
		D				reflection arrangement or diagonal arrangement
		R				reflection arrangement
			M			medium
				C		chains
				N		without fixation
					055	10...550 mm

**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

## Coupling materials for transducers

normal temperature range (4th character of transducer order code = N)		extended temperature range (4th character of transducer order code = E)		higher temperatures (4th character of transducer order code = S)
< 100 °C	< 170 °C	< 150 °C	< 200 °C	< 180 °C
coupling compound type N	coupling compound type E	coupling compound type E	coupling compound type E or H	coupling compound type E <sup>1</sup> and coupling foil type VT

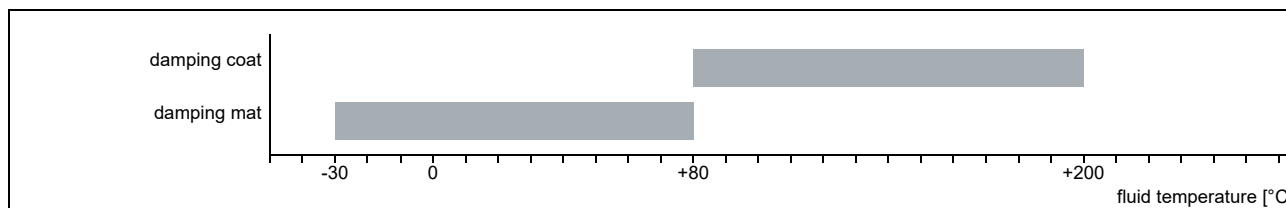
<sup>1</sup> in combination with type VT only

### Technical data

type	ambient temperature °C
coupling compound type N	-30...+130
coupling compound type E	-30...+200
coupling compound type H	-30...+250
coupling foil type VT	-10...+200

### Damping material (optional)

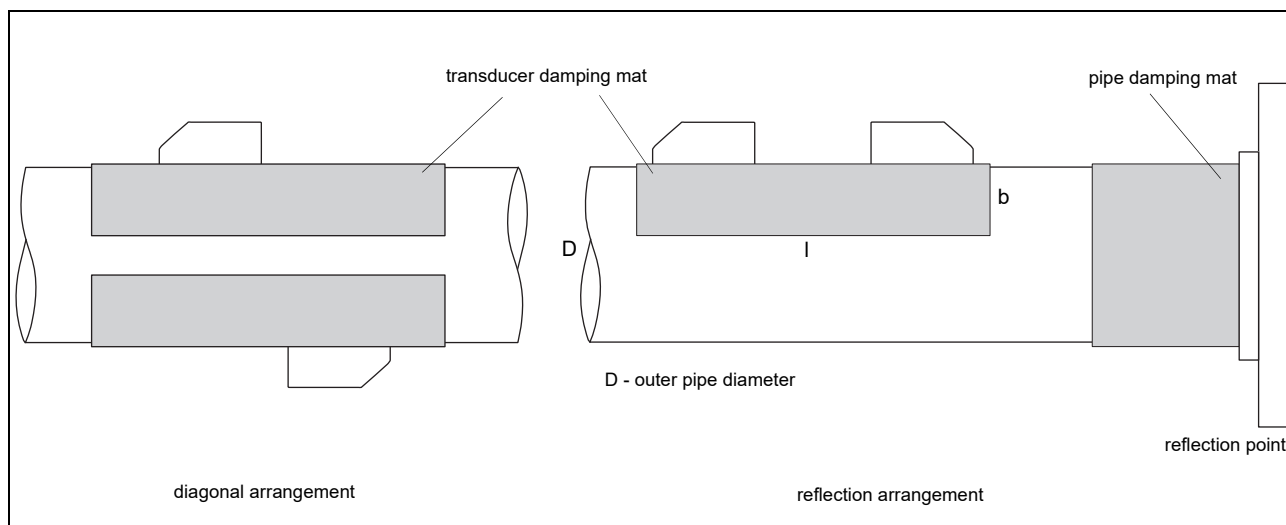
Damping material will be used for the gas measurement to reduce acoustic noise influences on the measurement.



### Damping mats

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				
<b>transducer damping mat</b>														
D	for temporary installation (multiple use), fixed with coupling compound	< 80	450 x 115 x 0.5	-	-	-	-	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				
<b>pipe damping mat</b>														
A	for temporary installation (multiple use), fixed with coupling compound	< 300	300 x 115 x 0.5	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 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

### Damping coat

For high temperatures it is recommended to apply the damping coat onto the pipe. In case of steam measurement it is mandatory.

### Technical data

order code		ACC-PE-GNNN-/DPL1
material		multipolymeric matrix/inorganic ceramic coating
packing drum	I	1
properties		heat resistant, inert

Observe installation instructions (TI\_DampingCoat).

### Dimensioning

transducer frequency	number of packing drums		
	outer pipe diameter		
	≤300	≤500	≤700
	mm		
F	3	4	5
G	2	3	4
H	2	2	3
K	2	2	-
M	2	-	-
P	1	-	-
Q	1	-	-

## Connection systems

connection system NL	
direct connection/connection with extension cable	transducers technical type
	*****W* *****H*

### Cable

transducer cable			
type		1699	6111
weight	kg/m	0.094	0.092
ambient temperature	°C	-55...+200	-100...+225
cable jacket			
material		PTFE	PFA
outer diameter	mm	2.9	2.7
thickness	mm	0.3	0.5
colour		brown	white
shield		x	x
sheath			
material		stainless steel 304 (1.4301)	stainless steel 304 (1.4301)
outer diameter	mm	8	8

extension cable			
type		1750	
standard length	m	5 10	
weight	kg/m	0.12	
ambient temperature	°C	< 80	
cable jacket			
material		PE	
outer diameter	mm	6	
thickness	mm	0.5	
colour		black	
shield		x	
sheath			
material		stainless steel 304 (1.4301)	
outer diameter	mm	9	

### Cable length

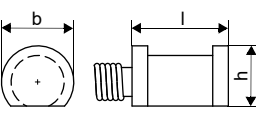
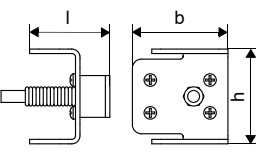

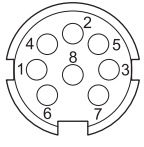

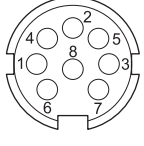
transducer frequency	F, G, H, K			M, P			Q			S			
connection system NL													
transducers technical type	x	y	l	x	y	l	x	y	l	x	y	l	
*(DR)***W*	m	2	3	≤ 10	2	2	≤ 10	2	1	≤ 10	-	-	-
*(DR)***H*													
option LC: *(LT)***W*	m	2	7	≤ 10	7	2	≤ 10	8	1	≤ 10	-	-	-
*(LT)***H*													

x, y - transducer cable length

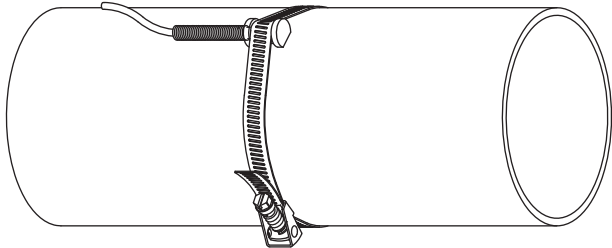
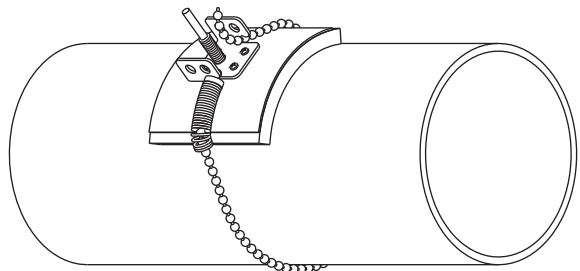
l - max. length of extension cable

# Clamp-on temperature probe (optional)

## Technical data

PT12N				
design	clamp-on with connector			
type	Pt100			
connection	4-wire			
measuring range	°C -30...+250			
accuracy T	$\pm(0.15 \text{ °C} + 2 \cdot 10^{-3} \cdot  T \text{ [°C]} )$ class A			
accuracy $\Delta T$ (2x Pt matched according to EN 1434-1)	$\leq 0.1 \text{ K}$ ( $3 \text{ K} < \Delta T < 6 \text{ K}$ ), more corresponding to EN 1434-1			
response time	s 50			
housing	aluminum			
degree of protection	IP54			
<b>dimensions</b>				
length l	mm 20			
width b	mm 15			
height h	mm 13			
dimensional drawing				
weight	kg 0.25 (without connector)			
<b>accessories</b>				
thermal conductivity paste 200 °C	x			
thermal conductivity foil 250 °C	x			
PT12F				
design	clamp-on short response time, with connector			
type	Pt100			
connection	4-wire			
measuring range	°C -50...+250			
accuracy T	$\pm(0.15 \text{ °C} + 2 \cdot 10^{-3} \cdot  T \text{ [°C]} )$ class A			
accuracy $\Delta T$ (2x Pt matched according to EN 1434-1)	$\leq 0.1 \text{ K}$ ( $3 \text{ K} < \Delta T < 6 \text{ K}$ ), more corresponding to EN 1434-1			
response time	s 8			
housing	PEEK, stainless steel 304 (1.4301), copper			
degree of protection	IP54			
<b>dimensions</b>				
length l	mm 14			
width b	mm 30			
height h	mm 27			
dimensional drawing				
weight	kg 0.32 (without connector)			
<b>accessories</b>				
thermal conductivity paste 200 °C	x			
thermal conductivity foil 250 °C	x			
plastic protection plate, insulation foam	x			
Connection system				
<b>direct connection/connection with extension cable</b>				
				
<b>Connection</b>				
	temperature probe	extension cable	connector	
	red	grey	2	
	red/blue	red	6	
	white/blue	blue	1	
	white	white	7	
<b>Cable</b>			temperature probe	extension cable
type		4 x 0.25 mm² black	LIYCY 8 x 0.14 mm² grey	
standard length	m	3	5/10/25	
max. length	m	-	100	
cable jacket		PTFE	PVC	
Connection system				
<b>direct connection/connection with extension cable</b>				
				
<b>Connection</b>				
	temperature probe	extension cable	connector	
	red	grey	2	
	red/blue	red	6	
	white/blue	blue	1	
	white	white	7	
<b>Cable</b>			temperature probe	extension cable
type		4 x 0.25 mm² black	LIYCY 8 x 0.14 mm² grey	
standard length	m	3	5/10/25	
max. length	m	-	100	
cable jacket		PTFE	PVC	

### Fixation

<p><b>tension strap PT12N</b></p>  <p>The diagram shows a cylindrical component with a tension strap PT12N attached to its side. The strap is made of a woven material and is secured with a metal clasp and a spring mechanism.</p>	<p>material: stainless steel 301 (1.4310), 410 (1.4006) thermal insulation necessary</p>
<p><b>ball chain PT12F</b></p>  <p>The diagram shows a cylindrical component with a ball chain PT12F attached to its side. The chain is made of stainless steel and is secured with a metal bracket and a spring mechanism.</p>	<p>material: stainless steel 316L (1.4404) length: 1 m</p>



### 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.

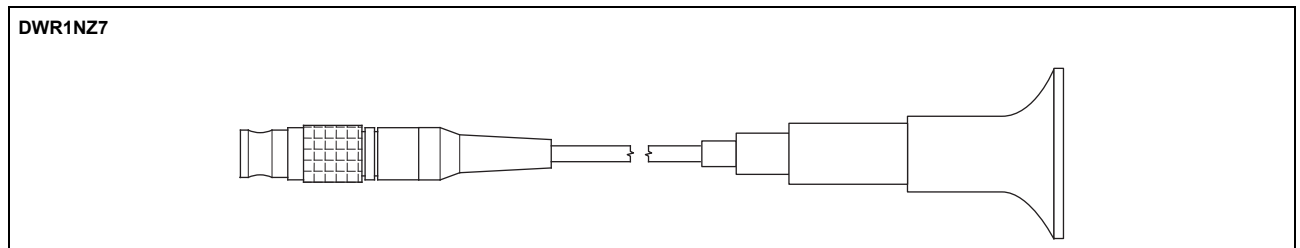
### Technical data

		<b>DWR1NZ7</b>
order code		ACC-PO-G601-/W6
measuring range <sup>1</sup>	mm	1...250
resolution	mm	0.01
accuracy		1 % ±0.1 mm
fluid temperature	°C	-20...+200, short-time peak max. 500
explosion protection		-
<b>cable</b>		
type		2616
length	m	1.5

<sup>1</sup> 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

		<b>2616</b>
ambient temperature	°C	<200
<b>cable jacket</b>		
material		FEP
outer diameter	mm	5.1
colour		black
shield		x



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