Portable Ultrasonic Flow Measurement of Gas in Hazardous Areas

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-intrusive clamp-on technology
- High precision at fast and slow flow rates, no temperature and zero drift
- Portable, easy-to-use flow transmitter with 2 flow channels, multiple inputs/outputs, an integrated data logger with a serial interface
- Extremely resistant carbon fiber housing
- Covered by ATEX zone 2 certification (Ex II3G), IP65 protection - No hot work permit required for hazardous areas
- Compact and very lightweight, allowing the measuring system to be easily carried as personal luggage, e.g. for offshore visits
- 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 (7...1600 mm) and fluid temperatures (-40...+200 °C)
- Rugged transducers (ATEX-Zone 1 und 2, resistant to rough environments, dust and humidity)
- Robust, water-tight (IP67) transport case with comprehensive accessories
- QuickFix for fast mounting of the flow transmitter in difficult conditions

FLUXUS G608 supported by handle

Measurement with transducers mounted by the portable Variofix VP

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

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)

Table of Contents

Function **3**
Measurement Principle 3
Calculation of Volumetric Flow Rate 3
Number of Sound Paths 4
Typical Measurement Setup 5
Standard Volumetric Flow Rate 6

Flow Transmitter **7**
Technical Data 7
Dimensions 9
Standard Scope of Supply 9
Adapters (optional) 10

Transducers **12**
Transducer Selection 12
Transducer Order Code 15
Technical Data 16

Transducer Mounting Fixture **25**

Coupling Materials for Transducers **26**

Connection Systems **27**
Transducer Cable 27

Damping Mats (optional) **28**

Clamp-on Temperature Probe (optional) **29**

Function

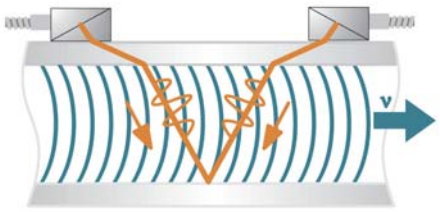
Measurement Principle

In order to measure the flow of a medium 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.

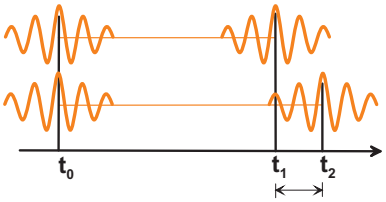
As the medium in which the signals propagate is flowing, the transit time of the ultrasonic signals in the flow direction is shorter than against the flow direction.

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.



Path of the ultrasonic signal



Transit time difference Δt

Calculation of Volumetric Flow Rate

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

where:

Q	-	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 medium

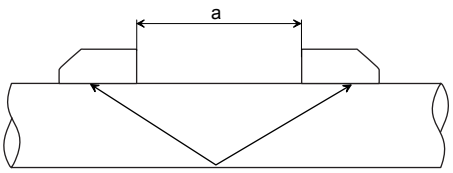
Number of Sound Paths

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

- **reflection mode**
  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 mode**
  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 medium, pipe and coatings, diagonal mode with 1 sound path will be used.

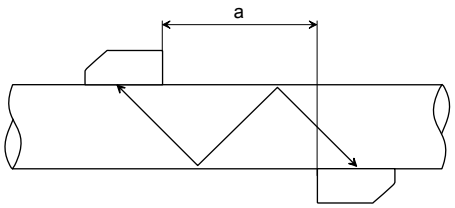
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

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

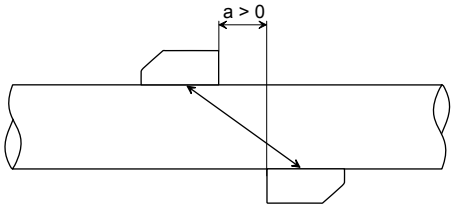


Reflection mode, number of sound paths: 2

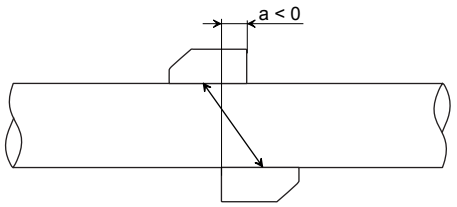
a - transducer distance



Diagonal mode, number of sound paths: 3



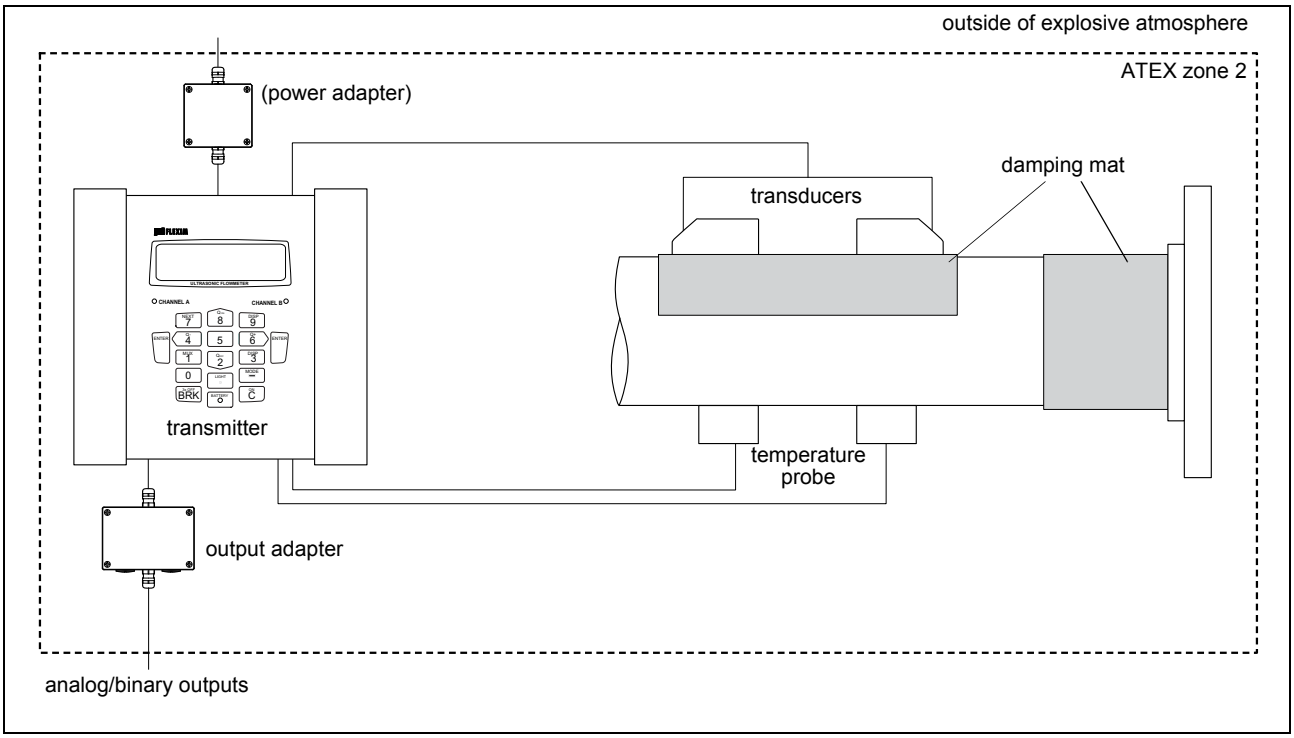
diagonal mode, number of sound paths: 1



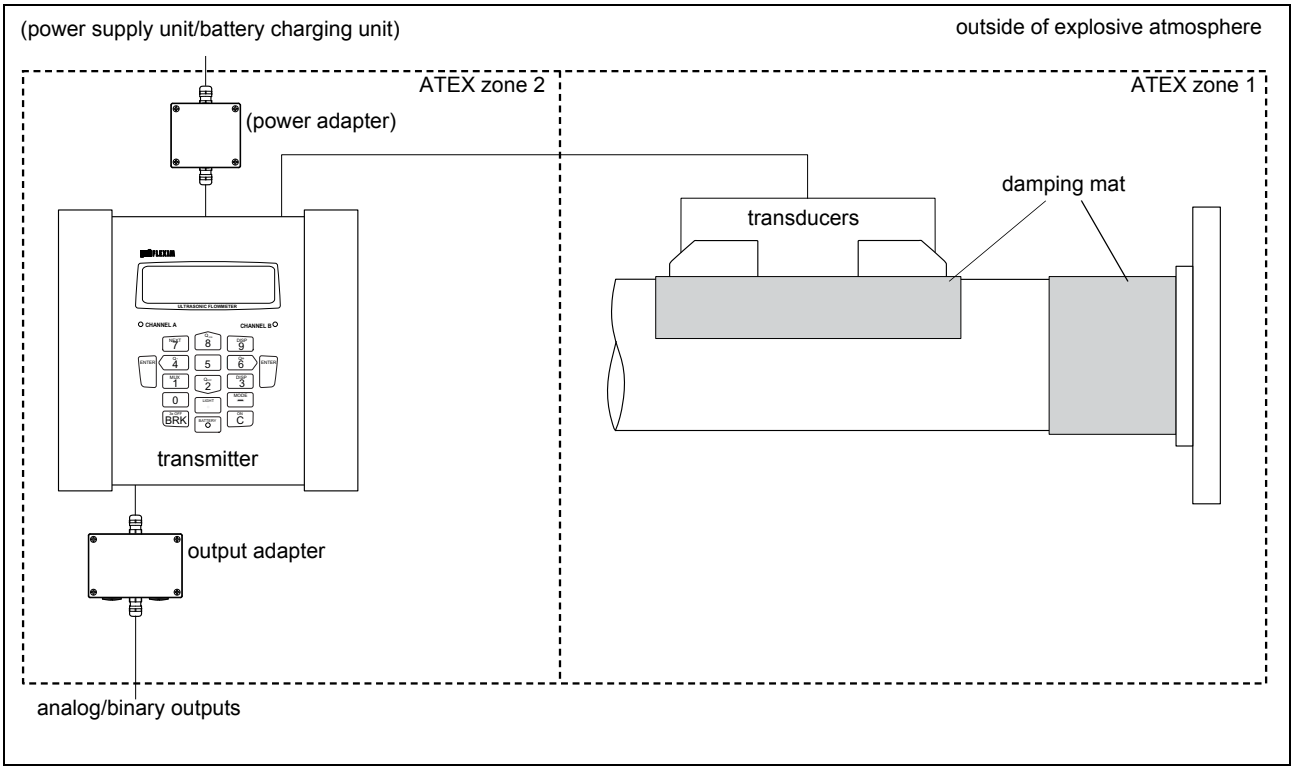
diagonal mode, number of sound paths: 1,
negative transducer distance

Typical Measurement Setup

ATEX zone 2



ATEX zone 2/ATEX zone 1



Standard Volumetric Flow Rate

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

$Q_N = Q \cdot p/p_N \cdot T_N/T \cdot 1/K$

where:

Q_N	-	standard volumetric flow rate
Q	-	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	-	gas compressibility factor

The operational pressure p and the operational temperature T of the medium 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 factor K will be entered in the transmitter:

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

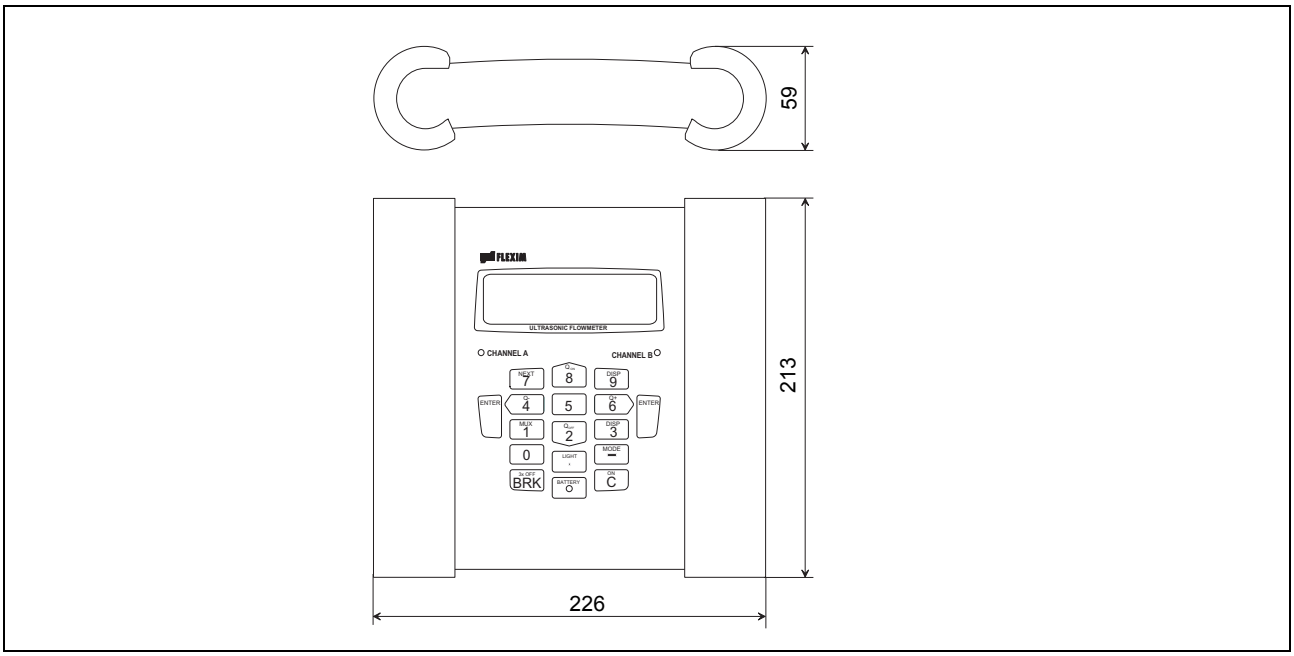
Flow Transmitter

Technical Data

FLUXUS		**G608**-A2**	
design		portable, ATEX zone 2	
			
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	
medium		all acoustically conductive gases, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane	
temperature compensation		corresponding to the recommendations in ANSI/ASME MFC-5M-1985	
accuracy			
- volumetric flow rate		± 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...240 V/50...60 Hz (power supply unit, outside of explosive atmosphere), 10.5...15 V DC (socket at transmitter, with power adapter (optional)), U_m = 16 V, integrated battery	
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	
signal attenuation		0...100 s, adjustable	
measuring cycle (1 channel)		100...1000 Hz	
response time		1 s (1 channel), option: 70 ms	
housing material		PA, TPS, PC, Polyester, stainless steel	
degree of protection according to IEC/EN 60529		IP65	
dimensions		see dimensional drawing	
weight		1.9 kg	
fixation		QuickFix pipe mounting fixture	
operating temperature		-10...+60 °C	
display		2 x 16 characters, dot matrix, backlight	
menu language		English, German, French, Dutch, Spanish	
explosion protection			
ATEX	category EPL zone	gas: 3G dust: 2D Gc Db 2 21	
	marking	without inputs: CE 0637; Ex II3G Ex nA nC ic IIC (T6)T4 Gc II2D Ex tb IIIC T 100 °C Db T_a -10...+(50)60 °C	with inputs: CE 0637; Ex II3G Ex nA nC [ic] IIC (T6)T4 Gc II2D Ex tb IIIC T 100 °C Db T_a -10...+(50)60 °C
	certification	IBExU10ATEX1067	
	type of protection	gas: non sparking dust: protection by enclosure temperature inputs: intrinsic safety	

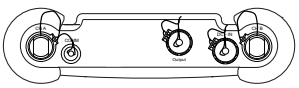
FLUXUS	**G608**-A2
measuring functions	
physical quantities	operating volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity
totalizer	volume, mass
calculation functions	average, difference, sum
diagnostic functions	sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times
data logger	
loggable values	all physical quantities, totalized values and diagnostic values
capacity	> 100 000 measured values
communication	
interface	RS232/USB
serial data kit	
software (all Windows™ versions)	- FluxData: download of measurement data, graphical presentation, conversion to other formats (e.g. for Excel™) - FluxKoef: creating medium 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
accessories	output adapter (optional)
	current output
range accuracy passive output	0/4...20 mA 0.1 % of reading ±15 µA U_{ext} = 4...9 V, depending on R_{ext} R_{ext} < 200 Ω
	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	 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
	temperature input
type connection range resolution accuracy intrinsic safety parameters	Pt100/Pt1000 4-wire -150...+560 °C 0.01 K ±0.01 % of reading ±0.03 K U_o = 22 V, I_o = 6 mA, P_o = 33 mW, C_o = 450 nF, L_o = 10 µH C_i = 1.8 nF, L_i = 10 µH

Dimensions

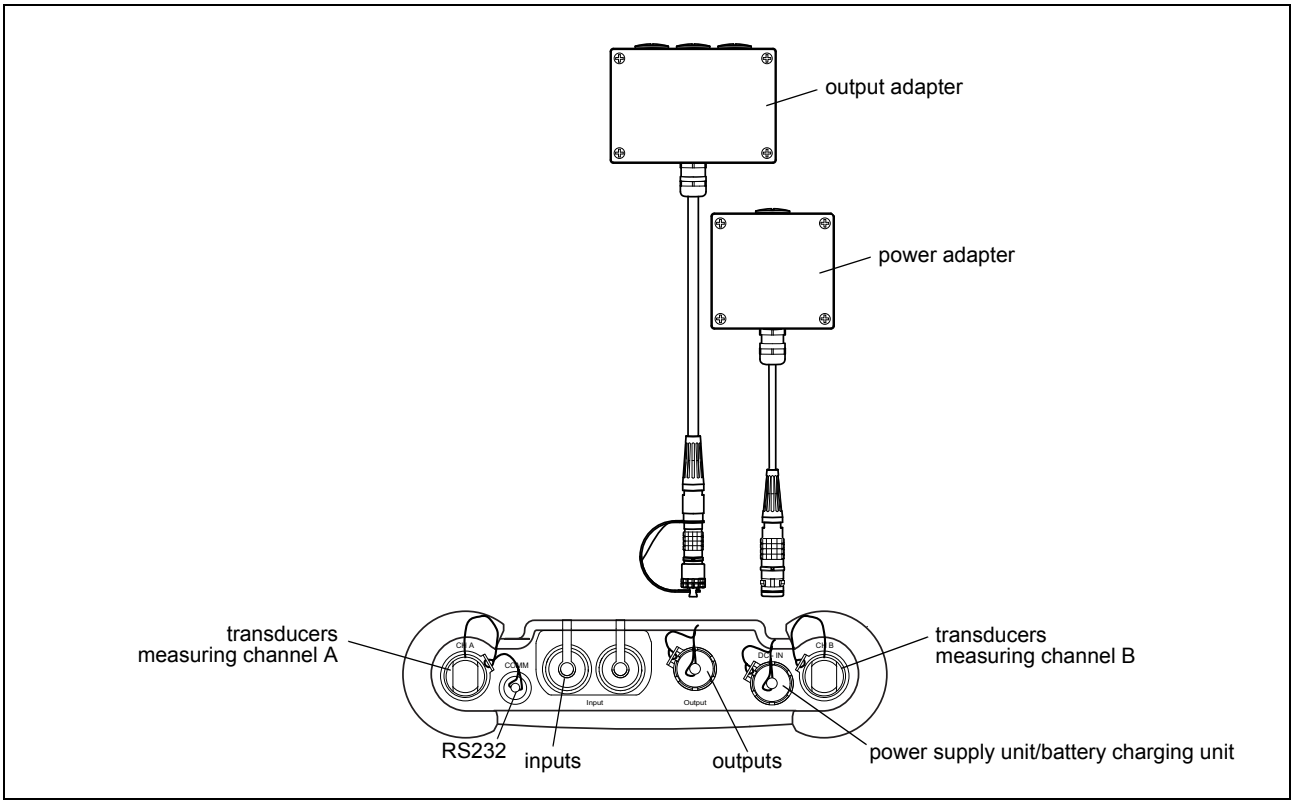


in mm

Standard Scope of Supply

	G608 Standard
order code	FLUXUS G608**-A22-3N-NN-2D-II-NN-NN
application	all flow measurements on gas
outputs	
passive current output	2
binary output	2
inputs	
temperature input	-
accessories	
transport case	x
power supply unit, mains cable	x
battery	x
QuickFix pipe mounting fixture for transmitter	x
serial data kit	x
measuring tape	x
user manual, safety instructions, Quick Start Guide	x
connector board at the upper side of the transmitter	

Adapters (optional)

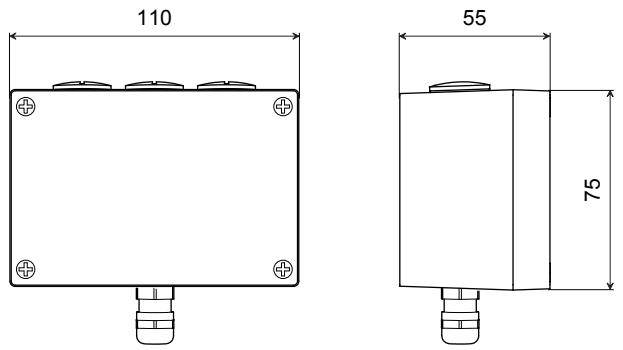


Technical Data

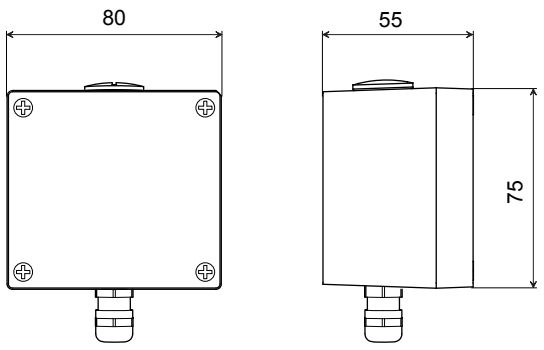
		output adapter	power adapter
technical type		**OA608A2**	**PA608A2**
dimensions		see dimensional drawing	
weight	kg	0.36	0.29
material			
housing gasket		polyester silicone	
degree of protection according to IEC/ EN 60529		IP66	
operating temperature			
min. max.	°C °C	-20 +90	
explosion protection			
ATEX zone		2	
ATEX marking		CE Ex II3G Ex nA II T6 Gc Ta -20...+60 °C	
ATEX type of protection		non sparking	

Dimensions

output adapter



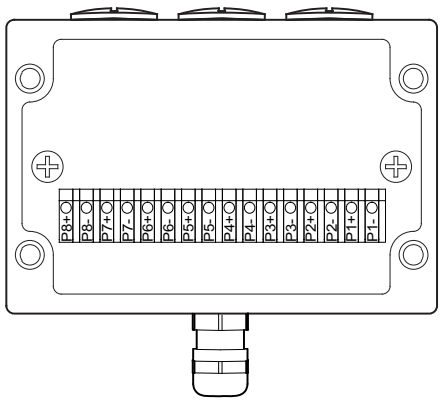
power adapter



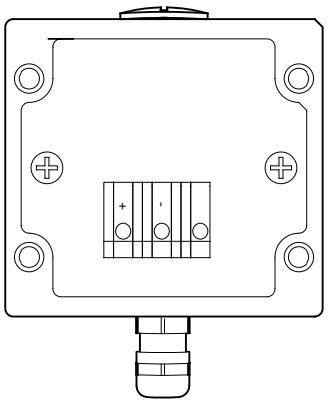
in mm

Terminal Assignment

output adapter



power adapter

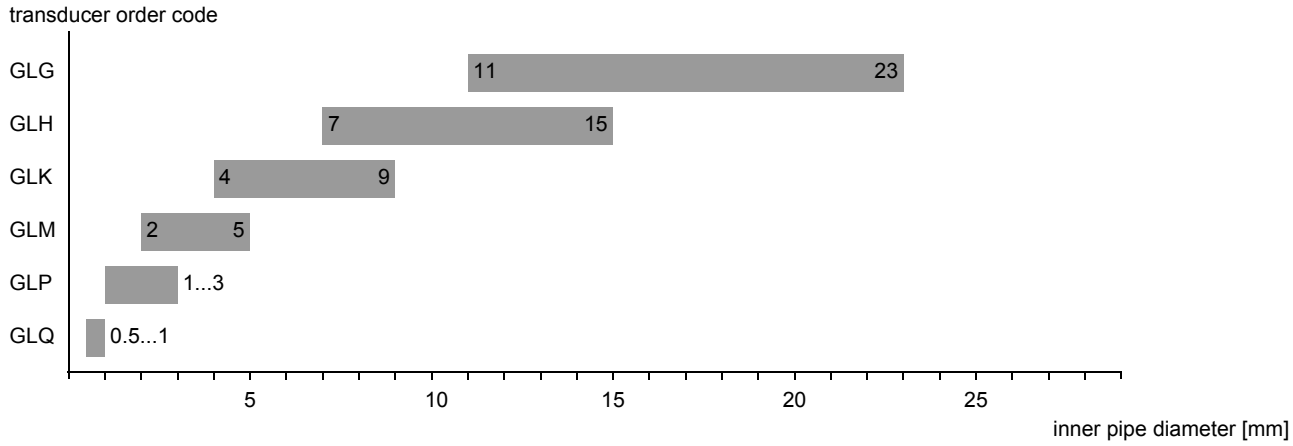


Transducers

Transducer Selection

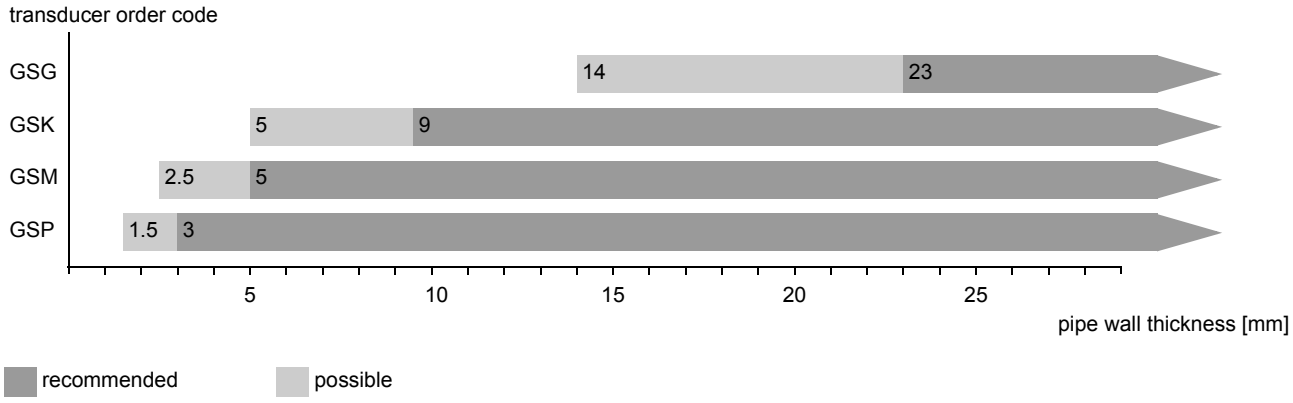
Step 1a

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:



Step 2

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

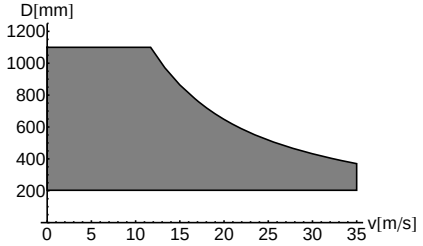
The transducers are selected from the characteristics (see next page). Lamb wave transducers are selected from the left column, shear wave transducers from the right column.

Lamb wave transducers: If the values d and v are not in the range, diagonal mode 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.

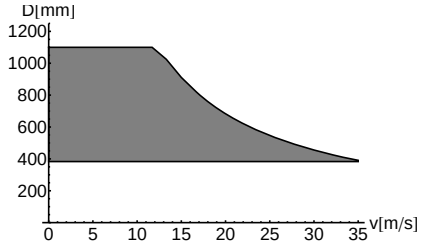
Lamb wave transducer[1]

shear wave transducer[1]

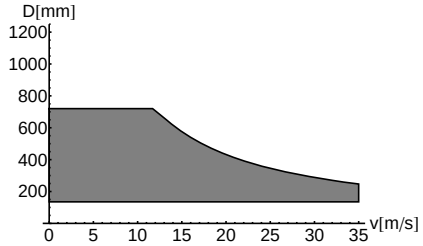
GLG



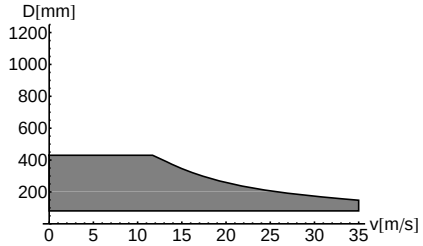
GSG



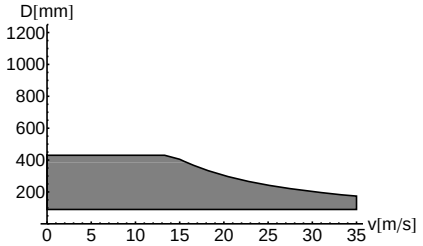
GLH



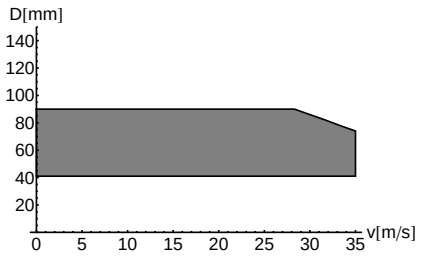
GLK



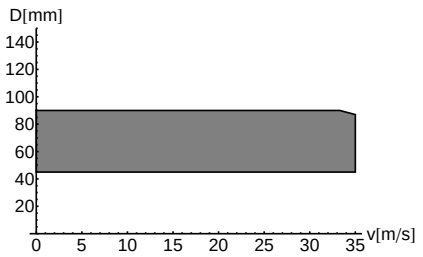
GSK



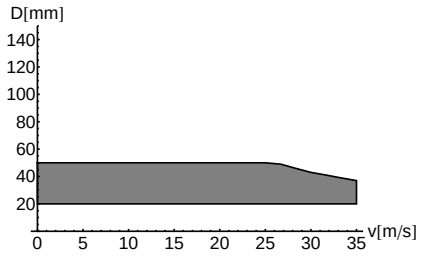
GLM



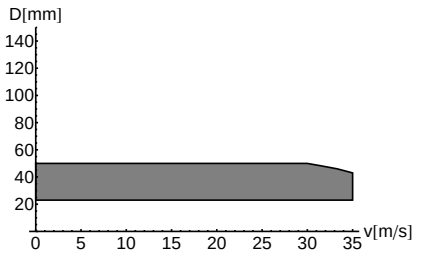
GSM



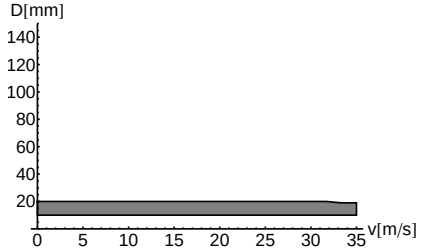
GLP



GSP



GLQ



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

Step 3

min. medium pressure

Lamb wave transducer			
transducer order code	medium pressure[1] [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) 5 (d < 120 mm)	1
GLM	10 (d > 60 mm) 5 (d < 60 mm)	-	1
GLP	10 (d > 35 mm) 5 (d < 35 mm)	-	1
GLQ	10 (d > 15 mm) 5 (d < 15 mm)	-	1

shear wave transducer			
transducer order code	medium 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

[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	12 GLG or GLH	12 GLG or GLH	12 GLG or GLH	30 GS
2	inner pipe diameter max. flow velocity selected transducer	mm m/s	800 15 GLG	600 15 GLG or GLH	800 30 values not in the range of the characteristics, but by using diagonal mode with 1 sound path, the inner pipe diameter in the characteristics is doubled: GLG	300 15 GSK
3	min. medium pressure selected transducer	bar	17 GLG	17 GLG or GLH influence of acoustic noise is reduced with increased transducer frequency, thus recommended: GLH	17 GLG	35 GSK

Step 4

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

Step 5

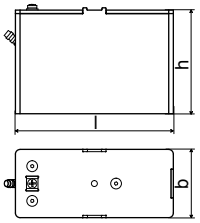
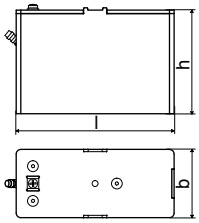
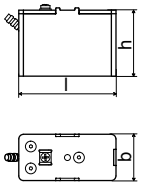
for the technical data of the selected transducer see page 16 et seqq.

Transducer Order Code

1, 2	3		4	5, 6	7, 8		9...11		12, 13	no. of character
transducer	transducer frequency	-	operating temperature	explosion protection	connection system	-	extension cable	/	option	description
GL										set of ultrasonic flow transducers for gas measurement, Lamb wave
GS										set of ultrasonic flow transducers for gas measurement, shear wave
	G									0.2 MHz
	H									0.3 MHz (Lamb wave only)
	K									0.5 MHz
	M									1 MHz
	P									2 MHz
	Q									4 MHz (Lamb wave only)
			N							normal temperature range
			E							extended temperature range (shear wave transducers with transducer frequency M, P)
				A1						ATEX zone 1
				A2						ATEX zone 2
					NL					with Lemo connector
							XXX			cable length in m, for max. length of extension cable see page 27 (connector outside of ATEX zone 1)
									LC	long transducer cable (ATEX zone 1)
example										
GL	K	-	N	A2	NL	-	030			Lamb wave transducer 0.5 MHz, normal temperature range, ATEX zone 2, connection system NL with Lemo connector and extension cable 30 m
		-				-		/		

Technical Data

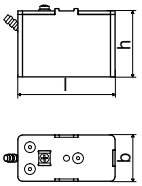
Shear Wave Transducers (zone 1)

technical type		GDG1NW1	GLG1NW1	GDK1NW1	GLK1NW1	GDM2NW1	GLM2NW1
order code		**GSG-NA1NL**	**GSG-NA1NL/LC**	**GSK-NA1NL**	**GSK-NA1NL/LC**	**GSM-NA1NL**	**GSM-NA1NL/LC**
transducer frequency	MHz	0.2		0.5		1	
medium pressure[1]							
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 d							
min. extended	mm	250		70		30	
min. recommended	mm	380		80		40	
max. recommended	mm	810		500		80	
max. extended	mm	1100		720		120	
pipe wall thickness							
min.	mm	14		5		2.5	
max.	mm	-		-		-	
material							
housing		PEEK with stainless steel cap and transducer shoe 304 (1.4301)		PEEK with stainless steel cap and transducer shoe 304 (1.4301)		PEEK with stainless steel cap and transducer shoe 304 (1.4301)	
contact surface		PEEK		PEEK		PEEK	
degree of protection according to IEC/ EN 60529		IP65		IP65		IP65	
transducer cable							
type		1699	1699	1699	1699	1699	1699
length	m	5	9	5	9	4	9
dimensions							
length l	mm	136.5		136.5		84	
width b	mm	59		59		40	
height h	mm	90.5		90.5		59	
dimensional drawing							
operating temperature							
min.	°C	-40		-40		-40	
max.	°C	+130		+130		+130	
temperature compensation		x		x		x	
explosion protection							
ATEX transducer		GSG-NA1NL	GSG-NA1NL/LC	GSK-NA1NL	GSK-NA1NL/LC	GSM-NA1NL	GSM-NA1NL/LC
category EPL zone		gas: 2/3G dust: 2D Gb/Gc Db 1/2 21		gas: 2/3G dust: 2D Gb/Gc Db 1/2 21		gas: 2/3G dust: 2D Gb/Gc Db 1/2 21	
explosion protection temperature (pipe surface)							
min.	°C	-55		-55		-55	
max.	°C	+180		+180		+180	
marking		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX	
certification		IBExU10ATEX1162 X		IBExU10ATEX1162 X		IBExU10ATEX1162 X	
type of protection		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure	
necessary transducer mounting fixture		-		-		-	

[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 gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

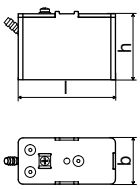
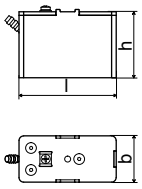
Shear Wave Transducers (zone 1)

technical type		GDP2NW1	GLP2NW1
order code		**GSP-NA1NL**	**GSP-NA1NL/LC**
transducer frequency	MHz	2	
medium pressure[1]			
min. extended min.	bar bar	metal pipe: 20 metal pipe: 30 plastic pipe: 1	
inner pipe diameter d			
min. extended min. recommended max. recommended max. extended	mm mm mm mm	15 20 40 60	
pipe wall thickness			
min. max.	mm mm	1.5 -	
material			
housing contact surface		PEEK with stainless steel cap and transducer shoe 304 (1.4301) PEEK	
degree of protection according to IEC/ EN 60529		IP65	
transducer cable			
type length	 m	1699 4	1699 9
dimensions			
length l width b height h	mm mm mm	84 40 59	
dimensional drawing			
operating temperature			
min. max.	°C °C	-40 +130	
temperature compensation		x	
explosion protection			
ATEX transducer		GSP-NA1NL	GSP-NA1NL/LC
category EPL zone		gas: 2/3G Gb/Gc 1/2	dust: 2D Db 21
explosion protection temperature (pipe surface)			
min. max.	°C °C	-55 +180	
marking		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX	
certification		IBExU10ATEX1162 X	
type of protection		gas: powder filling, non sparking dust: protection by enclosure	
necessary transducer mounting fixture		-	

[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 gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

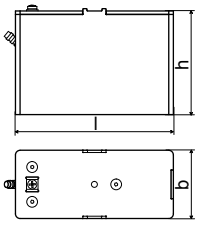
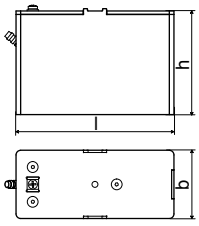
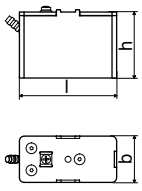
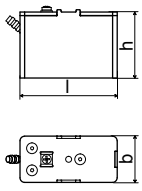
Shear Wave Transducers (zone 1, extended temperature range)

technical type		GDM2EW5	GLM2EW5	GDP2EW5	GLP2EW5
order code		**GSM-EA1NL**	**GSM-EA1NL/LC**	**GSP-EA1NL**	**GSP-EA1NL/LC**
transducer frequency	MHz	1		2	
medium pressure[1]					
min. extended	bar	metal pipe: 20		metal pipe: 20	
min.	bar	metal pipe: 30 plastic pipe: 1		metal pipe: 30 plastic pipe: 1	
inner pipe diameter d					
min. extended	mm	30		15	
min. recommended	mm	40		20	
max. recommended	mm	80		40	
max. extended	mm	120		60	
pipe wall thickness					
min.	mm	2.5		1.5	
max.	mm	-		-	
material					
housing		PI with stainless steel cap and transducer shoe 304 (1.4301)		PI with stainless steel cap and transducer shoe 304 (1.4301)	
contact surface		PI		PI	
degree of protection according to IEC/ EN 60529		IP56		IP56	
transducer cable					
type		6111	6111	6111	6111
length	m	4	9	4	9
dimensions					
length l	mm	84		84	
width b	mm	40		40	
height h	mm	59		59	
dimensional drawing					
operating temperature					
min.	°C	-30		-30	
max.	°C	+200		+200	
temperature compensation		x		x	
explosion protection					
ATEX transducer		GSM-EA1NL	GSM-EA1NL/LC	GSP-EA1NL	GSP-EA1NL/LC
category EPL zone		gas :2/3G dust: 2D Gb/Gc Db 1/2 21		gas: 2/3G dust: 2D Gb/Gc Db 1/2 21	
explosion protection temperature (pipe surface)					
min.	°C	-45		-45	
max.	°C	+225		+225	
marking		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIA TX		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIA TX	
certification		IBExU10ATEX1162 X		IBExU10ATEX1162 X	
type of protection		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure	
necessary transducer mounting fixture		-		-	

[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 gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

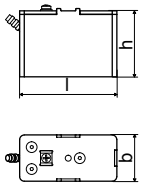
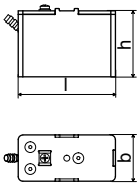
Shear Wave Transducers (zone 2)

technical type		GDG1NH1	GDK1NH1	GDM2NH1	GDP2NH1
order code		**GSG-NA2NL**	**GSK-NA2NL**	**GSM-NA2NL**	**GSP-NA2NL**
transducer frequency	MHz	0.2	0.5	1	2
medium pressure[1]					
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	metal pipe: 20 metal pipe: 30 plastic pipe: 1
inner pipe diameter d					
min. extended min. recommended max. recommended max. extended	mm mm mm mm	250 380 810 1100	70 80 500 720	30 40 80 120	15 20 40 60
pipe wall thickness					
min. max.	mm mm	14 -	5 -	2.5 -	1.5 -
material					
housing contact surface		PEEK with stainless steel cap and transducer shoe 304 (1.4301) PEEK	PEEK with stainless steel cap and transducer shoe 304 (1.4301) PEEK	PEEK with stainless steel cap and transducer shoe 304 (1.4301) PEEK	PEEK with stainless steel cap and transducer shoe 304 (1.4301) PEEK
degree of protection according to IEC/ EN 60529		IP65	IP65	IP65	IP65
transducer cable					
type length	 m	1699 5	1699 5	1699 4	1699 4
dimensions					
length l width b height h	mm mm mm	136.5 59 90.5	136.5 59 90.5	84 40 59	84 40 59
dimensional drawing					
operating temperature					
min. max.	°C °C	-40 +130	-40 +130	-40 +130	-40 +130
temperature compensation		x	x	x	x
explosion protection					
ATEX transducer		GSG-NA2NL	GSK-NA2NL	GSM-NA2NL	GSP-NA2NL
ATEX category EPL zone		gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21
ATEX **explosion protection temperature (pipe surface)**					
ATEX min. ATEX max.	°C °C	-55 +190	-55 +190	-55 +190	-55 +190
ATEX marking		CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db
ATEX certification		IBExU10ATEX1163 X	IBExU10ATEX1163 X	IBExU10ATEX1163 X	IBExU10ATEX1163 X
ATEX type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
ATEX necessary transducer mounting fixture		-	-	-	-

[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 gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

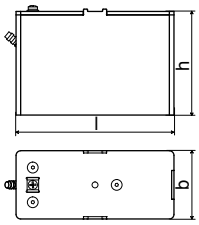
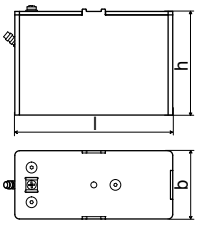
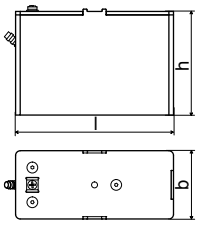
Shear Wave Transducers (zone 2, extended temperature range)

technical type		GDM2EH5	GDP2EH5
order code		**GSM-EA2NL**	**GSP-EA2NL**
transducer frequency	MHz	1	2
medium pressure[1]			
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 d			
min. extended min. recommended max. recommended max. extended	mm mm mm mm	30 40 80 120	15 20 40 60
pipe wall thickness			
min. max.	mm mm	2.5 -	1.5 -
material			
housing contact surface		PI with stainless steel cap and transducer shoe 304 (1.4301) PI	PI with stainless steel cap and transducer shoe 304 (1.4301) PI
degree of protection according to IEC/ EN 60529		IP56	IP56
transducer cable			
type length	 m	6111 4	6111 4
dimensions			
length l width b height h	mm mm mm	84 40 59	84 40 59
dimensional drawing			
operating temperature			
min. max.	°C °C	-30 +200	-30 +200
temperature compensation		x	x
explosion protection			
ATEX transducer		GSM-EA2NL	GSP-EA2NL
ATEX category EPL zone		gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21
ATEX **explosion protection temperature (pipe surface)**			
ATEX min. ATEX max.	°C °C	-45 +235	-45 +235
ATEX marking		CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIA TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIA TX Db
ATEX certification		IBExU10ATEX1163 X	IBExU10ATEX1163 X
ATEX type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
ATEX necessary transducer mounting fixture		-	-

[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 gases on request
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 15 m/s

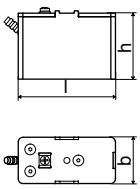
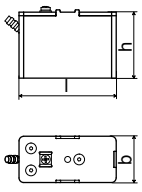
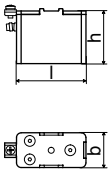
Lamb Wave Transducers (zone 1)

technical type		GRG1NW3	GTG1NW3	GRH1NW3	GTH1NW3	GRK1NW3	GTK1NW3
order code		**GLG-NA1NL**	**GLG-NA1NL/LC**	**GLH-NA1NL**	**GLH-NA1NL/LC**	**GLK-NA1NL**	**GLK-NA1NL/LC**
transducer frequency	MHz	0.2		0.3		0.5	
medium pressure[1]							
min. extended	bar	metal pipe: 10		metal pipe: 10		metal pipe: 10 (d > 120 mm), 5 (d < 120 mm)	
min.	bar	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 d							
min. extended	mm	190		120		60	
min. recommended	mm	220		140		80	
max. recommended	mm	900		600		300	
max. extended	mm	1600		1000		500	
pipe wall thickness							
min.	mm	11		7		4	
max.	mm	23		15		9	
material							
housing		PPSU with stainless steel cap and transducer shoe 304 (1.4301)		PPSU with stainless steel cap and transducer shoe 304 (1.4301)		PPSU with stainless steel cap and transducer shoe 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	1699	1699	1699
length	m	5	9	5	9	5	9
dimensions							
length l	mm	136.5		136.5		136.5	
width b	mm	59		59		59	
height h	mm	90.5		90.5		90.5	
dimensional drawing							
operating temperature							
min.	°C	-40		-40		-40	
max.	°C	+170		+170		+170	
temperature compensation		x		x		x	
explosion protection							
ATEX transducer		**G**LG-NA1NL	**G**LG-NA1NL/LC	**G**LH-NA1NL	**G**LH-NA1NL/LC	**G**LK-NA1NL	**G**LK-NA1NL/LC
category EPL zone		gas: 2/3G dust: 2D Gb/Gc Db 1/2 21		gas: 2/3G dust: 2D Gb/Gc Db 1/2 21		gas: 2/3G dust: 2D Gb/Gc Db 1/2 21	
explosion protection temperature (pipe surface)							
min.	°C	-55		-55		-55	
max.	°C	+140		+140		+140	
marking		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX	
certification		IBExU10ATEX1162 X		IBExU10ATEX1162 X		IBExU10ATEX1162 X	
type of protection		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure	
necessary transducer mounting fixture		-		-		-	

[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 gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

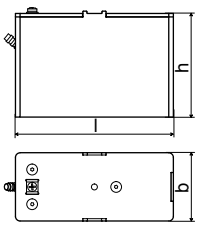
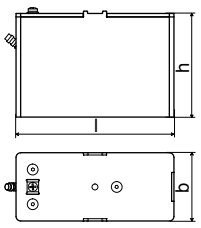
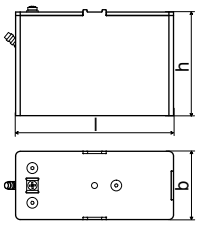
Lamb Wave Transducers (zone 1)

technical type		**G**RM1NW3	**G**TM1NW3	**G**RP1NW3	**G**TP1NW3	**G**RQ1NW3	**G**TQ1NW3
order code		**GLM-NA1NL**	**GLM-NA1NL/LC**	**GLP-NA1NL**	**GLP-NA1NL/LC**	**GLQ-NA1NL**	**GLQ-NA1NL/LC**
transducer frequency	MHz	1		2		4	
medium pressure[1]							
min. extended	bar	-		-		-	
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 d							
min. extended	mm	30		15		7	
min. recommended	mm	40		20		10	
max. recommended	mm	90		50		22	
max. extended	mm	150		70		35	
pipe wall thickness							
min.	mm	2		1		0.5	
max.	mm	5		3		1	
material							
housing		PPSU with stainless steel cap and transducer shoe 304 (1.4301)		PPSU with stainless steel cap and transducer shoe 304 (1.4301)		PPSU with stainless steel cap and transducer shoe 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	1699	1699	1699
length (9 m possible)	m	4	9	4	9	4	9
dimensions							
length l	mm	84		84		70	
width b	mm	40		40		30	
height h	mm	59		59		47.5	
dimensional drawing							
operating temperature							
min.	°C	-40		-40		-40	
max.	°C	+170		+170		+170	
temperature compensation		x		x		x	
explosion protection							
ATEX transducer		**G**LM-NA1NL	**G**LM-NA1NL/LC	**G**LP-NA1NL	**G**LP-NA1NL/LC	**G**LQ-NA1NL	**G**LQ-NA1NL/LC
category		gas: 2/3G dust: 2D		gas: 2/3G dust: 2D		gas: 2/3G dust: 2D	
EPL		Gb/Gc Db		Gb/Gc Db		Gb/Gc Db	
zone		1/2 21		1/2 21		1/2 21	
explosion protection temperature (pipe surface)							
min.	°C	-55		-55		-55	
max.	°C	+140		+140		+140	
marking		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX		CE 0637; Ex II2/3G Ex q nA IIC T6...T2 Gb/Gc II2D Ex tb IIIC TX	
certification		IBExU10ATEX1162 X		IBExU10ATEX1162 X		IBExU10ATEX1162 X	
type of protection		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure		gas: powder filling, non sparking dust: protection by enclosure	
necessary transducer mounting fixture		-		-		-	
remark						on request	

[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 gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

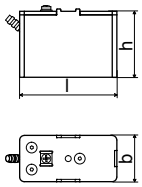
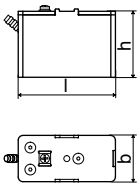
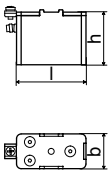
Lamb Wave Transducers (zone 2)

technical type		GRG1NH3	GRH1NH3	GRK1NH3
order code		**GLG-NA2NL**	**GLH-NA2NL**	**GLK-NA2NL**
transducer frequency	MHz	0.2	0.3	0.5
medium pressure[1]				
min. extended	bar	metal pipe: 10	metal pipe: 10	metal pipe: 10 (d > 120 mm) 5 (d < 120 mm)
min.	bar	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 d				
min. extended	mm	190	120	60
min. recommended	mm	220	140	80
max. recommended	mm	900	600	300
max. extended	mm	1600	1000	500
pipe wall thickness				
min.	mm	11	7	4
max.	mm	23	15	9
material				
housing		PPSU with stainless steel cap and transducer shoe 304 (1.4301)	PPSU with stainless steel cap and transducer shoe 304 (1.4301)	PPSU with stainless steel cap and transducer shoe 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	5	5	5
dimensions				
length l	mm	136.5	136.5	136.5
width b	mm	59	59	59
height h	mm	90.5	90.5	90.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
temperature compensation		x	x	x
explosion protection				
ATEX transducer		**G**LG-NA2NL	**G**LH-NA2NL	**G**LK-NA2NL
ATEX category EPL zone		gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21
ATEX **explosion protection temperature (pipe surface)**				
ATEX min.	°C	-55	-55	-55
ATEX max.	°C	+150	+150	+150
ATEX marking		CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db
ATEX certification		IBExU10ATEX1163 X	IBExU10ATEX1163 X	IBExU10ATEX1163 X
ATEX type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
ATEX necessary transducer mounting fixture		-	-	-

[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 gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Lamb Wave Transducers (zone 2)

technical type		**G**RM1NH3	**G**RP1NH3	**G**RQ1NH3
order code		**GLM-NA2NL**	**GLP-NA2NL**	**GLQ-NA2NL**
transducer frequency	MHz	1	2	4
medium pressure[1]				
min. extended min.	bar 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 d				
min. extended min. recommended max. recommended max. extended	mm mm mm mm	30 40 90 150	15 20 50 70	7 10 22 35
pipe wall thickness				
min. max.	mm mm	2 5	1 3	0.5 1
material				
housing contact surface		PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU	PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU	PPSU with stainless steel cap and transducer shoe 304 (1.4301) PPSU
degree of protection according to IEC/ EN 60529		IP65	IP65	IP65
transducer cable				
type length	 m	1699 4	1699 4	1699 3
dimensions				
length l width b height h	mm mm mm	84 40 59	84 40 59	70 30 47.5
dimensional drawing				
operating temperature				
min. max.	°C °C	-40 +170	-40 +170	-40 +170
temperature compensation		x	x	x
explosion protection				
ATEX transducer		**G**LM-NA1NL	**G**LP-NA1NL	**G**LQ-NA1NL
category EPL zone		gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21	gas: 3G dust: 2D Gc Db 2 21
explosion protection temperature (pipe surface)				
min. max.	°C °C	-55 +150	-55 +150	-55 +150
marking		CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db	CE 0637; Ex II3G Ex nA IIC T6...T2 Gc X II2D Ex tb IIIC TX Db
certification		IBExU10ATEX1163 X	IBExU10ATEX1163 X	IBExU10ATEX1163 X
type of protection		gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure	gas: non sparking dust: protection by enclosure
necessary transducer mounting fixture		-	-	-
remark				on request

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

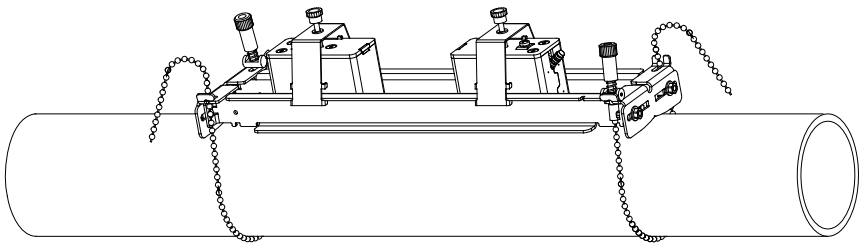
[2] Lamb wave transducer:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request
pipe diameter min. recommended/max. recommended: in reflection mode and for a flow velocity of 15 m/s
pipe diameter max. extended: in diagonal mode and for a flow velocity of 25 m/s

Transducer Mounting Fixture

Order Code

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

Coupling Materials for Transducers

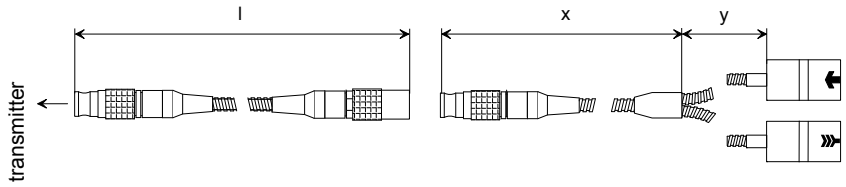
	normal temperature range (4th character of transducer order code = N)		**normal temperature range (4th character of transducer order code = E)**	
	< 100 °C	100...170 °C	< 150 °C	150...200 °C
< 2 h	coupling compound type N	coupling compound type E	coupling compound type E	coupling compound type E or H
< 24 h	coupling compound type N	coupling compound type E	coupling compound type E	coupling foil type VT

Technical Data

type	**Order Code**	**operating temperature** °C	**material**	**remark**
coupling compound type N	990739-1	-30...+130	mineral grease paste	
coupling compound type E	990739-2	-30...+200	silicone paste	
coupling compound type H	990739-3	-30...+250	fluoropolymer paste	
coupling foil type VT	990739-0	-10...+150, short-time peak max. 200	fluoroelastomer	for transducers with transducer frequency G, H, K
	990739-6			for shear wave transducers with transducer frequency M, P
	990739-14			for shear wave transducers IP68 and Lambwave transducers with transducer frequency M, P
	990739-15			for shear wave transducers with transducer frequency Q
	990739-5			for Lambwave transducers with transducer frequency Q

Connection Systems

connection system NL



	transducer frequency (3d character of transducer order code)		G, H, K			M, P			Q			S		
			x	**y**	**l**	**x**	**y**	**l**	**x**	**y**	**l**	**x**	**y**	**l**
N L	cable length	m	2	3	≤ 10	2	2	≤ 10	2	1	≤ 10	1	1	≤ 10
	cable length (option LC)	m	2	7	≤ 10	7	2	≤ 10	8	1	≤ 10	-	-	-

[1] > 25...100 m on request

x, y - transducer cable length

l - max. length of extension cable

Transducer Cable

Technical Data

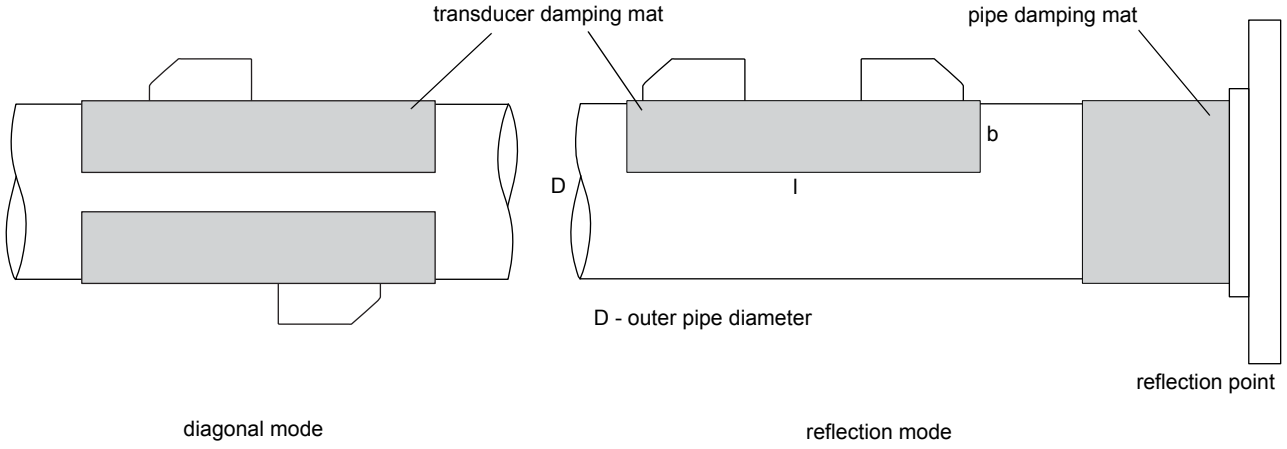
		transducer cable		extension cable
type		1699	6111	1750
standard length	m	see table above	see table above	5 10
operating temperature	°C	-55...+200	-100...+225	< 80
sheath				
material		stainless steel 304 (1.4301)	stainless steel 304 (1.4301)	stainless steel 304 (1.4301)
outer diameter	mm	8	8	9
cable jacket				
material		PTFE	PFA	PE
outer diameter	mm	2.9	2.7	6
thickness	mm	0.3	0.5	0.5
color		brown	white	black
shield		x	x	x

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 G	H	K	M	P	technical type	operating temperature °C	remark
transducer damping mat											
D	for temporary installation (multiple use), fixed with coupling compound	< 80	450 x 115 x 0.5	-	-	-	x	x	D20S3	-25...+60	
		≥ 80	900 x 230 x 0.5	-	-	x	x	-	D20S2		
			900 x 230 x 1.3	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	A20S4	-25...+60	for quantity see table below
B	self-adhesive	≥ 300	l x 100 x 0.9	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	transducer frequency	
mm	G, H	K, M, P
100	12	6
200	24	12
300	32	16

Length of Pipe Damping Mat - type B

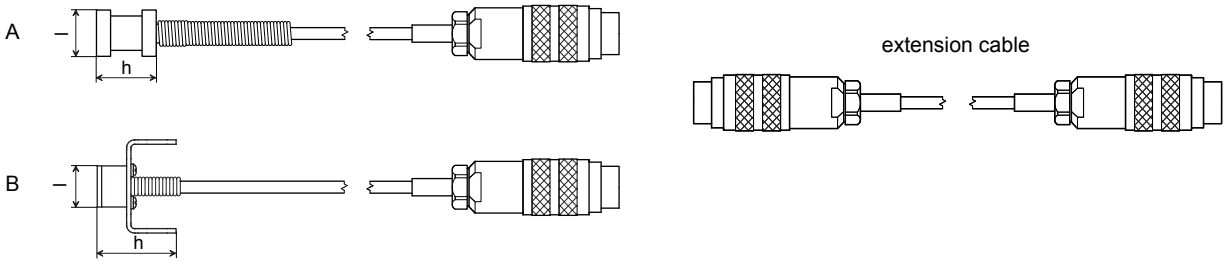
(length l depending on transducer frequency and outer pipe diameter)

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

Clamp-on Temperature Probe (optional)

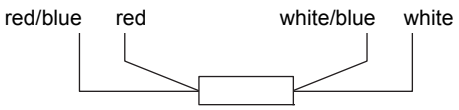
Technical Data

order code		**670415-1**	**670414-1**	**670415-2**	**670414-2**
design				short response time	
type		Pt100	Pt100 matched according to DIN 1434-1	Pt100	Pt100 matched according to DIN 1434-1
connection		4-wire		4-wire	
measuring range	°C	-30...+250		-50...+250	
accuracy T		±(0.15 °C + 2 · 10^{-3} · T [°C]), class A		±(0.15 °C + 2 · 10^{-3} · T [°C]), class A	
accuracy ΔT		-	≤ 0.1 K (3K < ΔT < 6 K), more corresponding to EN 1434-1	-	≤ 0.1 K (3K < 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	0.5	0.32	0.64
fixation		clamp-on		clamp-on	
accessories		-		plastic protection plate, insulation foam	
dimensions					
length l	mm	15		14	
width b	mm	15		30	
height h	mm	20		27	
dimensional drawing		A	A	B	



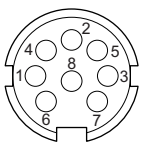
Connection

Temperature Probe



Connector

pin	cable of temperature probe	extension cable
1	white/blue	blue
2	red/blue	gray
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 mm² black or white	LIYCY 8 x 0.14 mm² gray
standard length	m	3	5/10
max. length	m	-	on request
cable jacket		PTFE	PVC

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