

Gas ultrasonic flowmeter for permanent installation

Transmitter for permanent outdoor wall or pipe mounting

Features

- Precise bi-directional and highly dynamic flow measurement with the non-invasive clamp-on technology
- High precision at fast and slow flow rates, high temperature and zero point stability
- Automatic loading of calibration data and transducer detection for a fast and easy set-up (less than 5 min), providing precise and long-term stable results
- User-friendly design
- Transducers available for a wide range of inner pipe diameters and fluid temperatures
- FM Class I Div. 2 approved transducers for hazardous areas available
- Measurement is unaffected by gas density, viscosity, composition, dust, humidity, temperature or pressure

Applications

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

- Measurement on natural gas pipelines and in natural gas storage installations
- Measurement of synthesized gas and injection gas
- Measurement for the gas supply industry



FLUXUS G704



FLUXUS G705



Measurement with transducers mounted with PermaRail

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Function

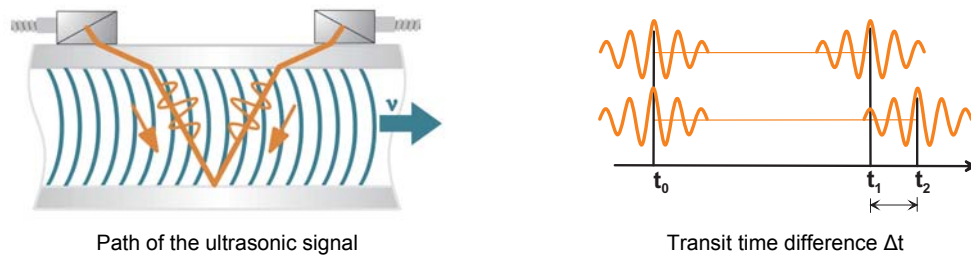
Measurement principle

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

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

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

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



Calculation of volumetric flow rate

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

where

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

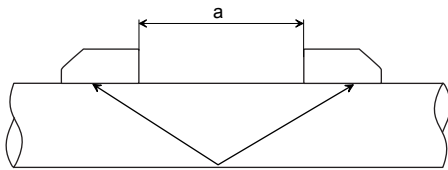
Number of sound paths

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

- **reflect arrangement**
The number of sound paths is even. Both of the transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easier.
- **diagonal arrangement**
The number of sound paths is odd. Both of the transducers are mounted on opposite sides of the pipe.
- **direct mode**
Diagonal arrangement with 1 sound path. This should be used in the case of a high signal attenuation by the fluid, pipe or coatings.

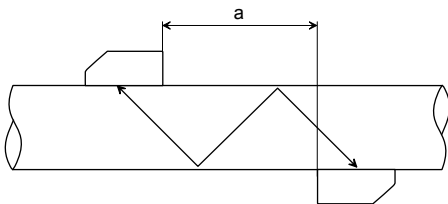
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

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

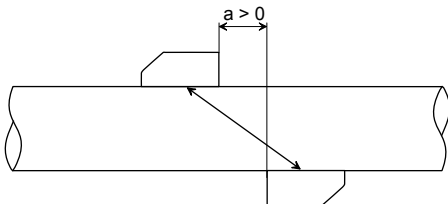


a = transducer distance

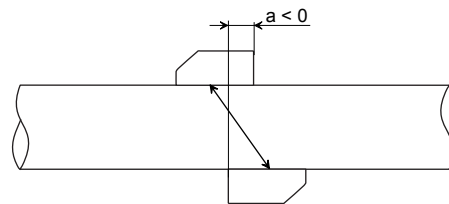
Reflect arrangement, number of sound paths: 2



Diagonal arrangement, number of sound paths: 3

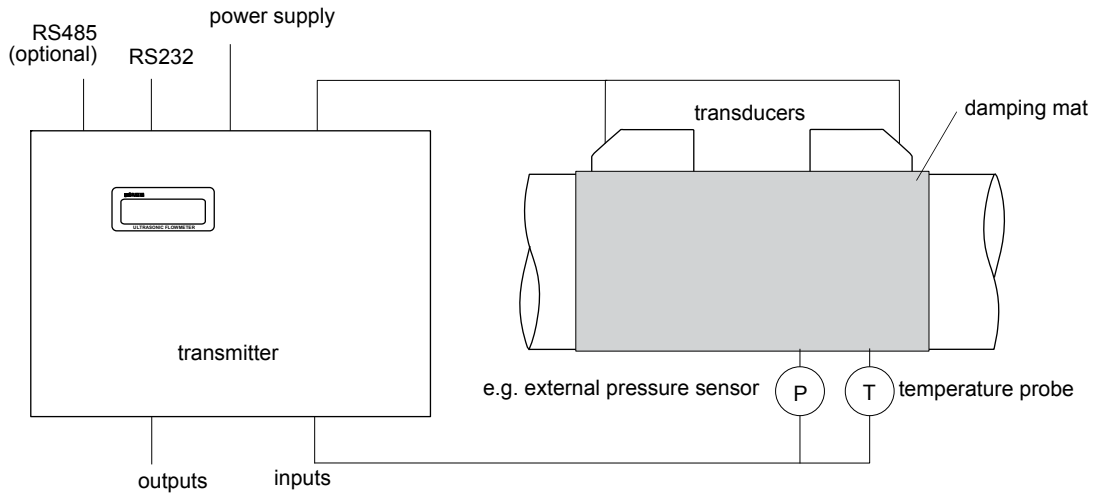


Direct mode, number of sound paths: 1



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

Typical measurement setup



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

Standard volumetric flow rate

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

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

where

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

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

or:







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

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

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

Flow transmitter

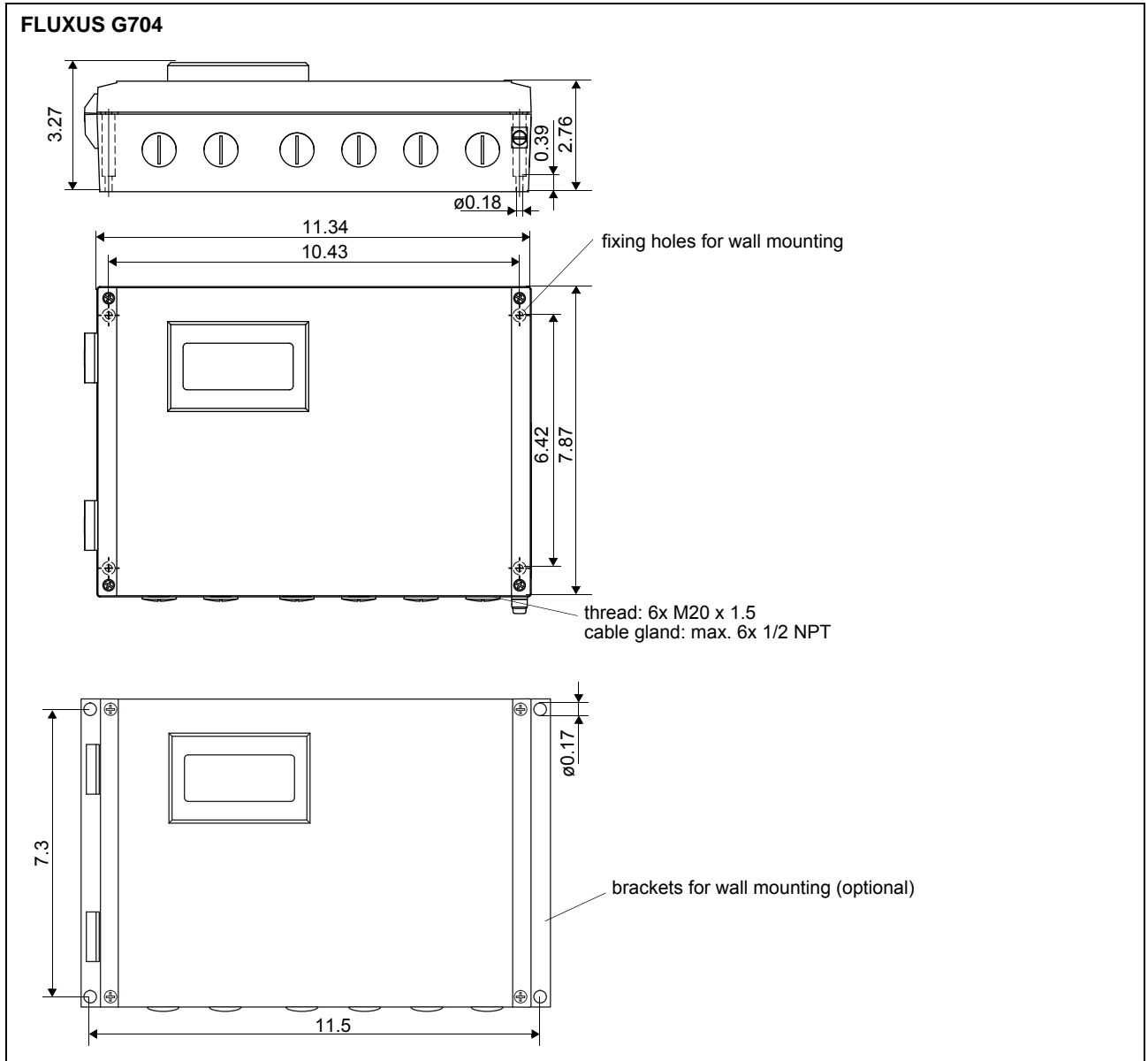
Technical data

FLUXUS		G704**-NN G704**-F2	G705**-NN G705**-F2 (G704.316SE)
design		standard field device	field device with stainless steel housing
			
measurement			
measurement principle	transit time difference correlation principle		
flow velocity	0.03 to 115 ft/s, depending on pipe diameter		
repeatability	0.15 % of reading ±0.03 ft/s		
fluid	all acoustically conductive gases, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane		
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5.1-2011		
accuracy			
volumetric flow rate	± 1 to 3 % of reading ±0.03 ft/s depending on application ± 0.5 % of reading ±0.03 ft/s with field calibration		
flow transmitter			
power supply	100 to 230 V/50 to 60 Hz or 20 to 32 V DC		
power consumption	< 15 W		
number of flow measuring channels	1, optional: 2		
damping	0 to 100 s, adjustable		
measuring cycle (1 channel)	100 to 1000 Hz		
response time	1 s (1 channel), option: 70 ms		
housing material	aluminum, powder coated	stainless steel 316L	
degree of protection	NEMA 4	NEMA 4X	
dimensions	see dimensional drawing		
weight	6.8 lb	10.8 lb	
fixation	wall mounting, optional: 2" pipe mounting		
ambient temperature	-4 to +131/140 °F		
display	2 x 16 characters, dot matrix, backlight		
menu language	English, German, French, Dutch, Spanish		
explosion protection (optional)			
F M	transmitter marking	G704**-F2 G70[1 or 2]Z2**[1 or 2]:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 Ta = 60 °C G70[1 or 2]Z2**9:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A Ta = 55 °C	G705**-F2 G703Z2**[1 or 2]:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 Ta = 60 °C G703Z2**9:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A Ta = 55 °C

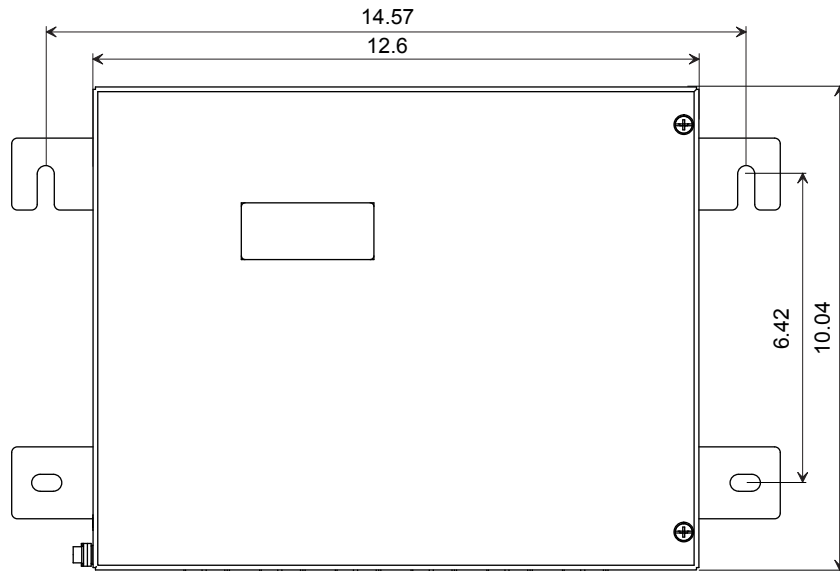
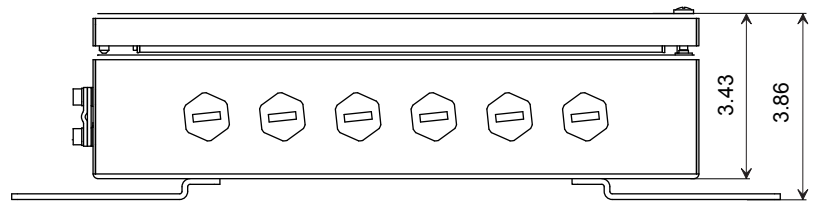
FLUXUS	G704**-NN G704**-F2	G705**-NN G705**-F2 (G704.316SE)
measuring functions		
physical quantities	operating volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity	
totalizer	volume, mass	
calculation functions	average, difference, sum (2 measuring channels necessary)	
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	
SD card, removable (nonEx, optional)		
loggable values	all physical quantities and totalized values	
capacity	min. 2 GB	
communication		
interface	- process integration (optional): RS485 (sender) or Modbus RTU or HART or FF H1 or BACnet MS/TP (nonEx) or BACnet IP (nonEx) or SD card (nonEx) - diagnosis: RS232	
serial data kit (optional)		
software	- FluxDiagReader: download of measured values and parameters, graphical presentation - FluxDiag (optional): download of measurement data, graphical presentation, report generation - FluxSubstanceLoader: upload of fluid data sets	
cable	RS232	
adapter	RS232 - USB	
outputs (optional)		
	The outputs are galvanically isolated from the transmitter.	
number	on request	
switchable current output		
	All switchable current outputs are switched to active or passive mode at the same time.	
- range	4 to 20 mA (3.2 to 22 mA)	
- accuracy	0.04 % of reading ±3 µA	
- active output	$R_{ext} < 350 \Omega$	
- passive output	$U_{ext} = 8 \text{ to } 30 \text{ V}$, depending on R_{ext} , $R_{ext} < 1 \text{ k}\Omega$	
current output		
current output		
- range	0/4 to 20 mA	
- accuracy	0.1 % of reading ±15 µA	
- active output	$R_{ext} < 500 \Omega$	
- passive output	$U_{ext} = 4 \text{ to } 24 \text{ V}$, depending on R_{ext} , $R_{ext} < 1 \text{ k}\Omega$	
current output I1 in HART mode		
- range	4 to 20 mA	
- passive output	$U_{ext} = 10 \text{ to } 24 \text{ V}$	
voltage output		
range	0 to 1 V or 0 to 10 V	
accuracy	0 to 1 V: 0.1 % of reading ±1 mV 0 to 10 V: 0.1 % of reading ±10 mV	
internal resistance	$R_{int} = 500 \Omega$	
frequency output		
range	0 to 5 kHz	
open collector	24 V/4 mA, $R_{int} = 66.5 \Omega$	
binary output		
Reed relay	48 V/100 mA, P1 to P4: $R_{int} = 22 \Omega$	
open collector	24 V/4 mA, P1 to P4: $R_{int} = 22 \Omega$	
optorelay	26 V/100 mA	
binary output as alarm output		
- functions	limit, change of flow direction or error	
binary output as pulse output	mainly for totalizing	
- pulse value	0.01 to 1000 units	
- pulse width	optorelay: 1 to 1000 ms Reed relay, open collector: 80 to 1000 ms	

FLUXUS	G704**-NN G704**-F2	G705**-NN G705**-F2 (G704.316SE)
inputs (optional)		
The inputs are galvanically isolated from the transmitter.		
number	max. 4, on request	
temperature input		
type	Pt100/Pt1000	
connection	4-wire	
range	-238 to +1040 °F	
resolution	0.01 K	
accuracy	±0.01 % of reading ±0.03 K	
current input		
accuracy	0.1 % of reading ±10 µA	
active input	U _{int} = 24 V, R _{int} = 50 Ω, P _{int} < 0.5 W, not short-circuit proof	
- range	0 to 20 mA	
passive input	R _{int} = 50 Ω, P _{int} < 0.3 W	
- range	-20 to +20 mA	
voltage input		
range	0 to 1 V	
accuracy	0.1 % of reading ±1 mV	
internal resistance	R _{int} = 1 MΩ	
binary input		
switching signal	5 to 30 V, 1 mA FM Class I Div. 2: 5 to 26 V, 1 mA	
functions	<ul style="list-style-type: none"> - resetting the measured values - resetting the totalizers - stopping the totalizers - activation of the measuring mode for highly dynamic flows 	

Dimensions



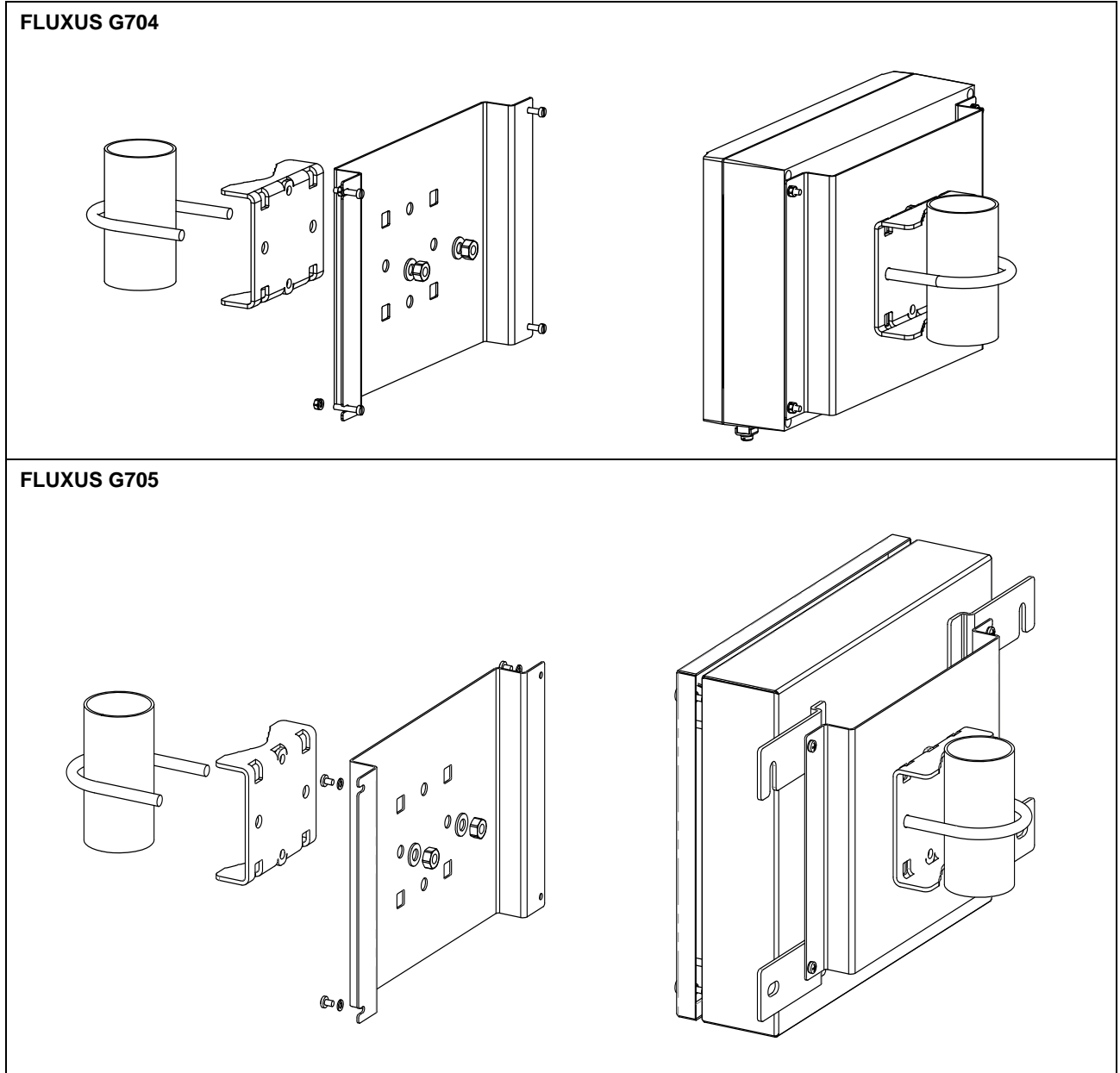
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cable gland: max. 6x 1/2 NPS with counter nut

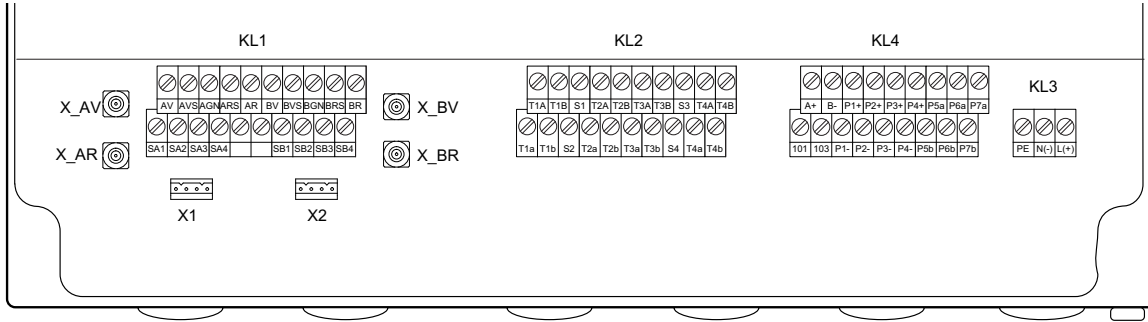
in inch

2" pipe mounting kit (optional)



Terminal assignment

FLUXUS G704, G705



power supply

terminal strip KL3

terminal	connection (AC)	connection (DC)
PE	earth	earth
N(-)	neutral	-
L(+)	phase	+

transducers

terminal strip KL1

extension cable (transducers ****LI*, *****52)			
transducer cable (transducers ****LI*)			
measuring channel A		measuring channel B	
terminal	connection	terminal	connection
AV	signal	BV	signal
AVS	shield	BVS	shield
ARS	shield	BRS	shield
AR	signal	BR	signal

transducer cable (transducers *****52)		
measuring channel A		measuring channel B
terminal		connection
X_AV	X_BV	SMB connector
X_AR	X_BR	SMB connector

outputs²

terminal strip KL4

terminal	connection
P1+ to P4+, P1- to P4-	current output, voltage output, frequency output or binary output (Reed relay, open collector)
P5a to P7a, P5b to P7b	binary output

communication interface

terminal strip KL4

terminal	connection
A+	signal +
B-	signal -
101	shield

analog inputs²

terminal strip KL2

terminal	temperature probe		passive current source	active current source
	with connector	without connector		
	direct connection	connection with extension cable	connection of an active input	connection of a passive input
T1a to T4a	red	red	not connected	not connected
T1A to T4A	red/blue	gray	-	+
T1b to T4b	white/blue	blue	+	not connected
T1B to T4B	white	white	not connected	-
S1 to S4	shield	shield	not connected	not connected

binary inputs²

terminal strip KL4

terminal
P1+ to P2+, P1- to P2-

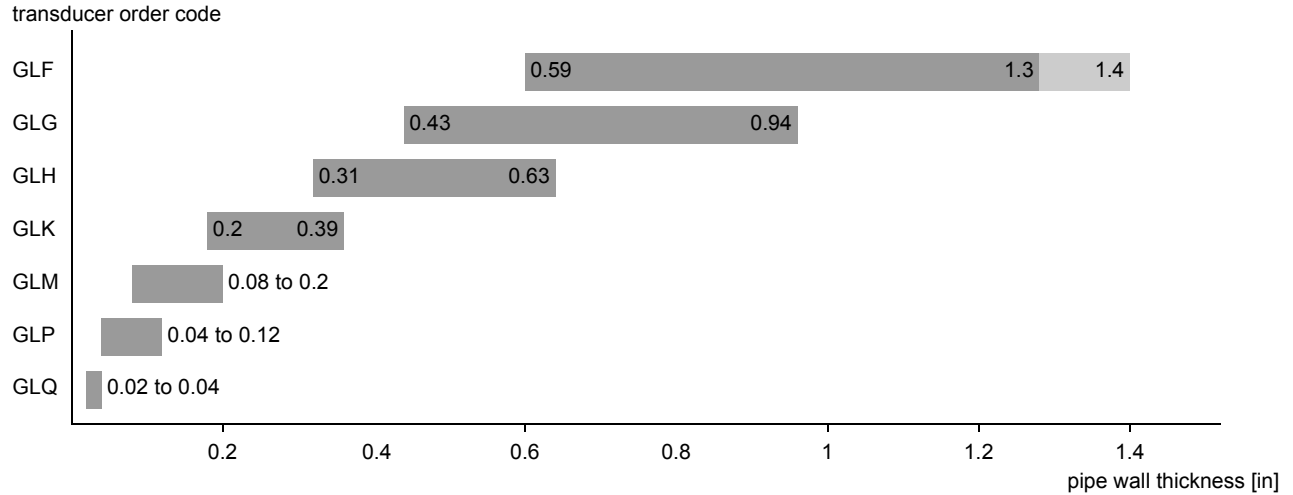
² The number, type and terminal assignment of the outputs and inputs will be customized.

Transducers

Transducer selection

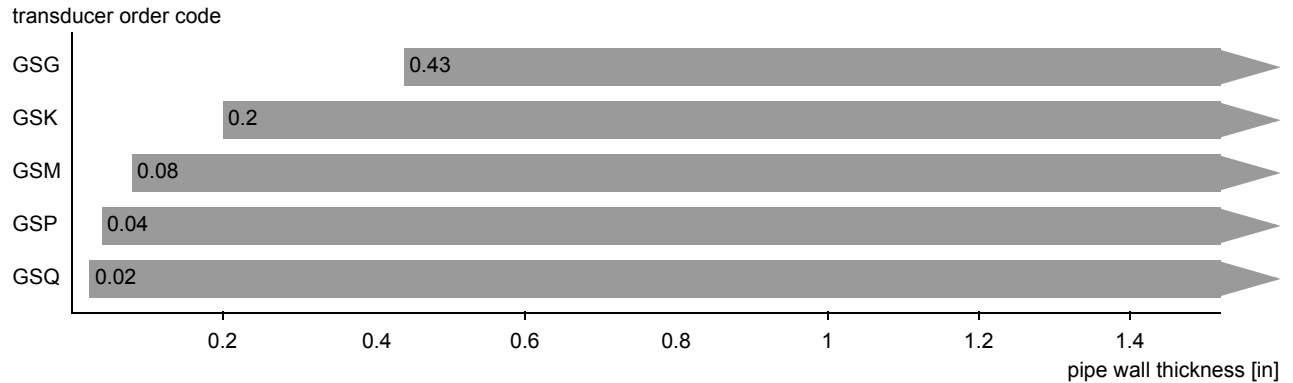
Step 1a

Select a Lamb wave transducer:



Step 1b

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



recommended
 possible

Step 2

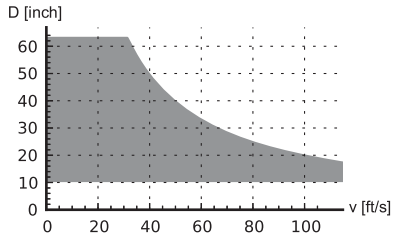
Inner pipe diameter d dependent on the flow velocity v of the fluid in the pipe

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

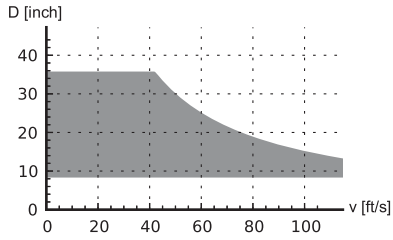
Lamb wave transducers: If the values d and v are not in the range, the diagonal arrangement with 1 sound path may be used, i.e. the same characteristics can be used with doubling the inner pipe diameter. If the values are still not in the range, shear waves transducers regarding the pipe wall thickness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

Lamb wave transducer¹

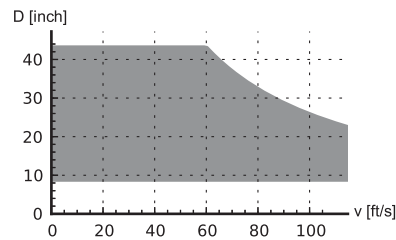
shear wave transducer¹



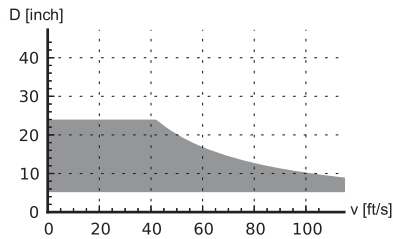
GLF



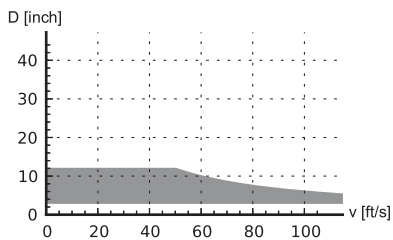
GLG



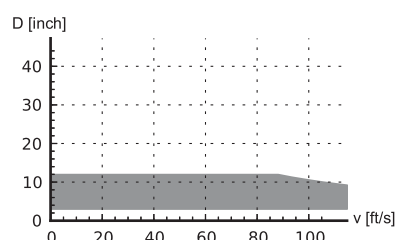
GSG



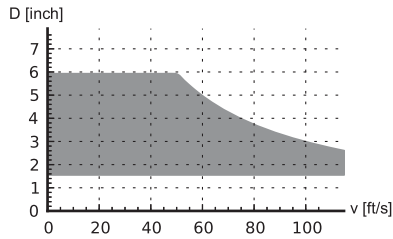
GLH



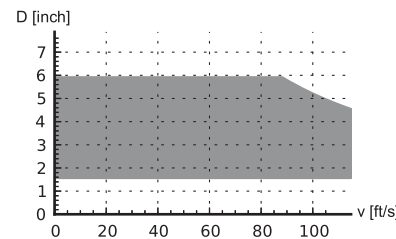
GLK



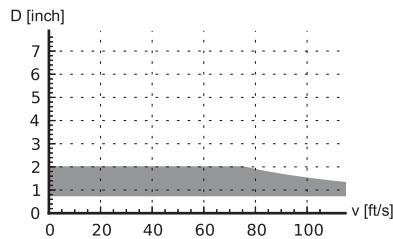
GSK



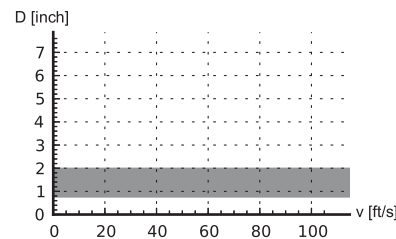
GLM



GSM

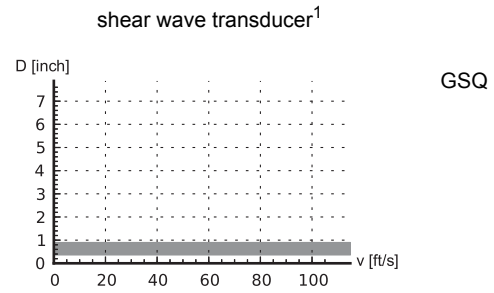
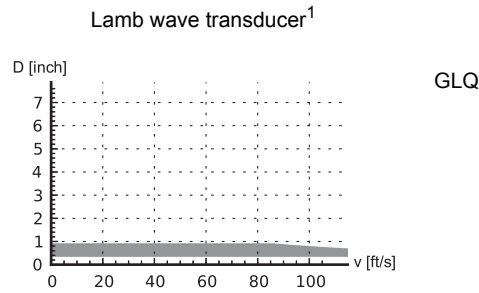


GLP



GSP

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



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

Step 3

min. fluid pressure

Lamb wave transducer			
transducer order code	fluid pressure ¹ [psi]		
	metal pipe		plastic pipe
	min.	min. extended	min.
GLF	218	145	15
GLG	218	145	15
GLH	218	145	15
GLK	218 (d > 4.7 in) 145 (d < 4.7 in)	145 (d > 4.7 in) 44 (d < 4.7 in)	15
GLM	145 (d > 2.4 in) 73 (d < 2.4 in)	44 (d < 2.4 in)	15
GLP	145 (d > 1.4 in) 73 (d < 1.4 in)	44 (d < 1.4 in)	15
GLQ	145 (d > 0.59 in) 73 (d < 0.59 in)	44 (d < 0.59 in)	15

shear wave transducer			
transducer order code	fluid pressure ¹ [psi]		
	metal pipe		plastic pipe
	min.	min. extended	min.
GSG	435	290	15
GSK	435	290	15
GSM	435	290	15
GSP	435	290	15
GSQ	435	290	15

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	in	0.56 GLG or GLH	0.34 GLH or GLK	1.5 GS
2	inner pipe diameter max. flow velocity selected transducer	in ft/s	22.9 49 GLG	3.8 98 GLK	5.6 98 GSK
3	min. fluid pressure selected transducer	psi	290 GLG	218 GLK	580 GSK

Step 4

for the characters 4 to 11 of the transducer order code (ambient temperature, explosion protection, connection system, extension cable) see page 16

Step 5

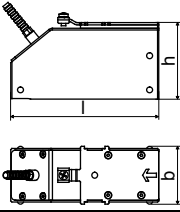
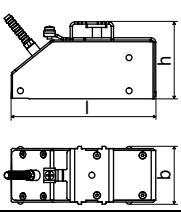


for the technical data of the selected transducer see page 17 et seqq.

Transducer order code

1, 2	3	4	5, 6	7, 8	9 to 11	12, 13	no. of character			
transducer	transducer frequency	-	ambient 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
	F									0.15 MHz (Lamb wave only)
	G									0.2 MHz
	H									0.3 MHz (Lamb wave only)
	K									0.5 MHz
	M									1 MHz
	P									2 MHz
	Q									4 MHz
		N								normal temperature range
		E								extended temperature range (FSM, FSP, FSQ)
			F2							FM Class I Div. 2
			NN							not explosion proof
				TS						direct connection or connection via junction box
						XXX				cable length in m, for max. length of extension cable see page 30 connection system TS: 0 m: without junction box > 0 m: with junction box
								IP68		degree of protection NEMA6P
								OS		housing with stainless steel 316
example										
GL	K	-	N	F2	TS	-	030			Lamb wave transducer 0.5 MHz, normal temperature range, FM Class I Div. 2, connection system TS with junction box and extension cable 30 m (98 ft)
		-				-		/		

Technical data

Shear wave transducers (FM Class I Div. 2 or not explosion proof)

technical type		GDG1N52	GDK1N52
order code		GSG-NF2TS GSG-NF2TS/OS GSG-NNNTS GSG-NNNTS/OS	GSK-NF2TS GSK-NF2TS/OS GSK-NNNTS GSK-NNNTS/OS
transducer frequency	MHz	0.2	0.5
fluid pressure¹			
min. extended	psi	metal pipe: 290	metal pipe: 290
min.	psi	metal pipe: 435 plastic pipe: 15	metal pipe: 435 plastic pipe: 15
inner pipe diameter d²			
min. extended	in	7.1	2.4
min. recommended	in	8.7	3.1
max. recommended	in	35.4	11.8
max. extended	in	43.3	14.2
pipe wall thickness			
min.	in	0.43	0.2
material			
housing		PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L
contact surface		PEEK	PEEK
degree of protection		NEMA 6	NEMA 6
transducer cable			
type		1699	1699
length	ft	16	16
dimensions			
length l	in	5.1	4.98
width b	in	2.01	2.01
height h	in	2.64	2.66
dimensional drawing			
ambient temperature			
min.	°F	-40	-40
max.	°F	+266	+266
temperature compensation		x	x
explosion protection			
F M	order code	GSG-NF2TS GSG-NF2TS/OS	GSK-NF2TS GSK-NF2TS/OS
	explosion protection temperature		
	min.	°F	-40
	max.	°F	+257
	marking	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
type of protection	non incandive		

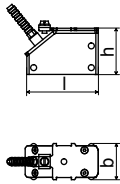
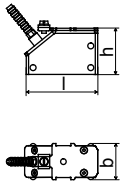
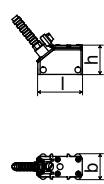



¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

² shear wave transducer:

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

inner pipe diameter max. recommended/max. extended: in reflect arrangement and for a flow velocity of 49 ft/s

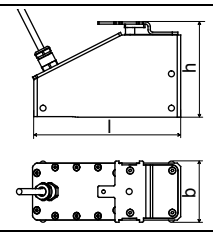
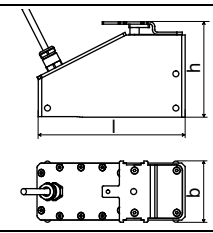
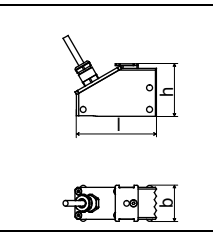
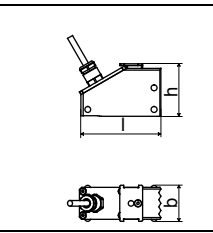
Shear wave transducers (FM Class I Div. 2 or not explosion proof)

technical type		GDM2N52	GDP2N52	GDQ2N52	
order code		GSM-NF2TS GSM-NF2TS/OS GSM-NNNTS GSM-NNNTS/OS	GSP-NF2TS GSP-NF2TS/OS GSP-NNNTS GSP-NNNTS/OS	GSQ-NF2TS GSQ-NF2TS/OS GSQ-NNNTS GSQ-NNNTS/OS	
transducer frequency	MHz	1	2	4	
fluid pressure¹					
min. extended min.	psi psi	metal pipe: 290 metal pipe: 435 plastic pipe: 15	metal pipe: 290 metal pipe: 435 plastic pipe: 15	metal pipe: 290 metal pipe: 435 plastic pipe: 15	
inner pipe diameter d²					
min. extended	in	1.2	0.59	0.28	
min. recommended	in	1.6	0.79	0.39	
max. recommended	in	5.9	2	0.87	
max. extended	in	7.1	2.4	1.2	
pipe wall thickness					
min.	in	0.08	0.04	0.02	
material					
housing		PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L	
contact surface		PEEK	PEEK	PEEK	
degree of protection		NEMA 6	NEMA 6	NEMA 6	
transducer cable					
type		1699	1699	1699	
length	ft	13	13	9	
dimensions					
length l	in	2.52	2.52	1.57	
width b	in	1.26	1.26	0.87	
height h	in	1.59	1.59	1	
dimensional drawing					
ambient temperature					
min.	°F	-40	-40	-40	
max.	°F	+266	+266	+266	
temperature compensation		x	x	x	
explosion protection					
F M	order code	GSM-NF2TS GSM-NF2TS/OS	GSP-NF2TS GSP-NF2TS/OS	GSQ-NF2TS GSQ-NF2TS/OS	
	explosion protection temperature				
	min.	°F	-40	-40	-40
	max.	°F	+374	+374	+374
	marking		 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
type of protection		non incandive	non incandive	non incandive	

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

² shear wave transducer:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request
inner pipe diameter max. recommended/max. extended: in reflect arrangement and for a flow velocity of 49 ft/s

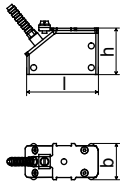
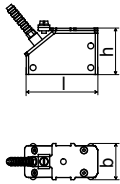
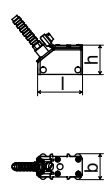



Shear wave transducers (not explosion proof, NEMA 6P)

technical type		GDG1LI8	GDK1LI8	GDM2LI8	GDP2LI8
order code		GSG-NNNTS/IP68	GSK-NNNTS/IP68	GSM-NNNTS/IP68	GSP-NNNTS/IP68
transducer frequency	MHz	0.2	0.5	1	2
fluid pressure¹					
min. extended	psi	metal pipe: 290	metal pipe: 290	metal pipe: 290	metal pipe: 290
min.	psi	metal pipe: 435 plastic pipe: 15	metal pipe: 435 plastic pipe: 15	metal pipe: 435 plastic pipe: 15	metal pipe: 435 plastic pipe: 15
inner pipe diameter d²					
min. extended	in	7.1	2.4	1.2	0.59
min. recommended	in	8.7	3.1	1.6	0.79
max. recommended	in	35.4	11.8	5.9	2
max. extended	in	43.3	14.2	7.1	2.4
pipe wall thickness					
min.	in	0.43	0.2	0.08	0.04
material					
housing		PEEK with stainless steel cap 316Ti	PEEK with stainless steel cap 316Ti	PEEK with stainless steel cap 316Ti	PEEK with stainless steel cap 316Ti
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection		NEMA 6P	NEMA 6P	NEMA 6P	NEMA 6P
transducer cable					
type		2550	2550	2550	2550
length	ft	39	39	39	39
dimensions					
length l	in	5.12	5.12	2.76	2.76
width b	in	2.13	2.13	1.26	1.26
height h	in	3.29	3.29	1.81	1.81
dimensional drawing					
ambient temperature					
min.	°F	-40	-40	-40	-40
max.	°F	+212	+212	+212	+212
temperature compensation		x	x	x	x

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

² shear wave transducer:
 typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request
 inner pipe diameter max. recommended/max. extended: in reflect arrangement and for a flow velocity of 49 ft/s

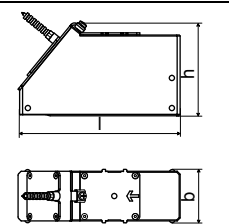
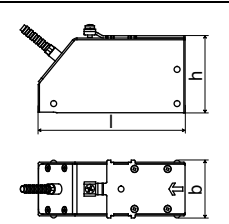
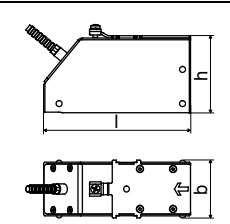
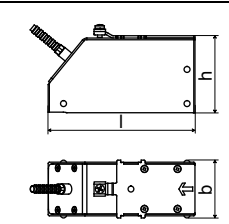




Shear wave transducers (extended temperature range, FM Class I Div. 2 or not explosion proof)

technical type		GDM2E52	GDP2E52	GDQ2E52	
order code		GSM-EF2TS GSM-EF2TS/OS GSM-ENNTS GSM-ENNTS/OS	GSP-EF2TS GSP-EF2TS/OS GSP-ENNTS GSP-ENNTS/OS	GSQ-EF2TS GSQ-EF2TS/OS GSQ-ENNTS GSQ-ENNTS/OS	
transducer frequency	MHz	1	2	4	
fluid pressure¹					
min. extended min.	psi psi	metal pipe: 290 metal pipe: 435 plastic pipe: 15	metal pipe: 290 metal pipe: 435 plastic pipe: 15	metal pipe: 290 metal pipe: 435 plastic pipe: 15	
inner pipe diameter d²					
min. extended	in	1.2	0.59	0.28	
min. recommended	in	1.6	0.79	0.39	
max. recommended	in	5.9	2	0.87	
max. extended	in	7.1	2.4	1.2	
pipe wall thickness					
min.	in	0.08	0.04	0.02	
material					
housing		PI with stainless steel cap 304, option OS: 316L	PI with stainless steel cap 304, option OS: 316L	PI with stainless steel cap 304, option OS: 316L	
contact surface		PI	PI	PI	
degree of protection		NEMA 4	NEMA 4	NEMA 4	
transducer cable					
type		6111	6111	6111	
length	ft	13	13	9	
dimensions					
length l	in	2.52	2.52	1.57	
width b	in	1.26	1.26	0.87	
height h	in	1.59	1.59	1	
dimensional drawing					
ambient temperature					
min.	°F	-22	-22	-22	
max.	°F	+392	+392	+392	
temperature compensation		x	x	x	
explosion protection					
F M	order code	GSM-EF2TS GSM-EF2TS/OS	GSP-EF2TS GSP-EF2TS/OS	GSQ-EF2TS GSQ-EF2TS/OS	
	explosion protection temperature				
	min.	°F	-40	-40	-40
	max.	°F	+455	+455	+455
	marking		 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
type of protection		non incandive	non incandive	non incandive	

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

² shear wave transducer:
typical values for natural gas, nitrogen, oxygen, pipe diameters for other fluids on request
inner pipe diameter max. recommended/max. extended: in reflect arrangement and for a flow velocity of 49 ft/s

Lamb wave transducers (FM Class I Div. 2 or not explosion proof)

technical type		GRF1N52	GRG1N52	GRH1N52	GRK1N52	
order code		GLG-NF2TS GLG-NF2TS/OS GLG-NNNTS GLG-NNNTS/OS	GLG-NF2TS GLG-NF2TS/OS GLG-NNNTS GLG-NNNTS/OS	GLH-NF2TS GLH-NF2TS/OS GLH-NNNTS GLH-NNNTS/OS	GLK-NF2TS GLK-NF2TS/OS GLK-NNNTS GLK-NNNTS/OS	
transducer frequency	MHz	0.15	0.2	0.3	0.5	
fluid pressure¹						
min. extended	psi	metal pipe: 145	metal pipe: 145	metal pipe: 145	metal pipe: 145 (d > 4.7 in) 44 (d < 4.7 in)	
min.	psi	metal pipe: 218 plastic pipe: 15	metal pipe: 218 plastic pipe: 15	metal pipe: 218 plastic pipe: 15	metal pipe: 218 (d > 4.7 in) 145 (d < 4.7 in) plastic pipe: 15	
inner pipe diameter d²						
min. extended	in	8.7	7.1	4.3	2.4	
min. recommended	in	10.6	8.7	5.5	3.1	
max. recommended	in	47.2	35.4	23.6	11.8	
max. extended	in	63	55.1	39.4	14.2	
pipe wall thickness						
min.	in	0.59	0.43	0.31	0.2	
max.	in	1.3	0.94	0.63	0.39	
max. extended	in	1.4	-	-	-	
material						
housing		PPSU with stainless steel cap 316Ti	PPSU with stainless steel cap 304, option OS: 316L	PPSU with stainless steel cap 304, option OS: 316L	PPSU with stainless steel cap 304, option OS: 316L	
contact surface		PPSU	PPSU	PPSU	PPSU	
degree of protection		NEMA 4	NEMA 6	NEMA 6	NEMA 6	
transducer cable						
type		1699	1699	1699	1699	
length	ft	16	16	16	16	
dimensions						
length l	in	6.42	5.06	5.06	5.06	
width b	in	2.13	2.01	2.01	2.01	
height h	in	3.59	2.66	2.66	2.66	
dimensional drawing						
ambient temperature						
min.	°F	-40	-40	-40	-40	
max.	°F	+338	+338	+338	+338	
temperature compensation		x	x	x	x	
explosion protection						
FM	order code	GLF-NF2TS GLF-NF2TS/OS	GLG-NF2TS GLG-NF2TS/OS	GLH-NF2TS GLH-NF2TS/OS	GLK-NF2TS GLK-NF2TS/OS	
	explosion protection temperature					
	min.	°F	-40	-40	-40	-40
	max.	°F	+329	+329	+329	+329
	marking		 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
type of protection		non incandive	non incandive	non incandive	non incandive	

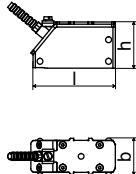
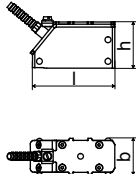
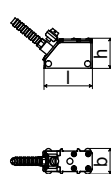
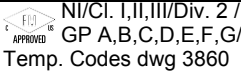
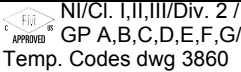
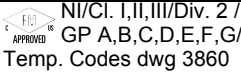
¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

² Lamb wave transducer:

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

inner pipe diameter max. recommended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 49 ft/s (98 ft/s)

inner pipe diameter max. extended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 39 ft/s (82 ft/s)

technical type		GRM1N52	GRP1N52	GRQ1N52	
order code		GLM-NF2TS GLM-NF2TS/OS GLM-NNNTS GLM-NNNTS/OS	GLP-NF2TS GLP-NF2TS/OS GLP-NNNTS GLP-NNNTS/OS	GLQ-NF2TS GLQ-NF2TS/OS GLQ-NNNTS GLQ-NNNTS/OS	
transducer frequency	MHz	1	2	4	
fluid pressure¹					
min. extended	psi	metal pipe: 44 (d < 2.4 in)	metal pipe: 44 (d < 1.4 in)	metal pipe: 44 (d < 0.59 in)	
min.	psi	metal pipe: 145 (d > 2.4 in) 73 (d < 2.4 in) plastic pipe: 15	metal pipe: 145 (d > 1.4 in) 73 (d < 1.4 in) plastic pipe: 15	metal pipe: 145 (d > 0.59 in) 73 (d < 0.59 in) plastic pipe: 15	
inner pipe diameter d²					
min. extended	in	1.2	0.59	0.28	
min. recommended	in	1.6	0.79	0.39	
max. recommended	in	5.9	2	0.87	
max. extended	in	7.1	2.4	1.2	
pipe wall thickness					
min.	in	0.08	0.04	0.02	
max.	in	0.2	0.12	0.04	
max. extended	in	-	-	-	
material					
housing		PPSU with stainless steel cap 304, option OS: 316L	PPSU with stainless steel cap 304, option OS: 316L	PPSU with stainless steel cap 304, option OS: 316L	
contact surface		PPSU	PPSU	PPSU	
degree of protection		NEMA 4	NEMA 4	NEMA 4	
transducer cable					
type		1699	1699	1699	
length	ft	13	13	9	
dimensions					
length l	in	2.91	2.91	1.65	
width b	in	1.26	1.26	0.87	
height h	in	1.59	1.59	1	
dimensional drawing					
ambient temperature					
min.	°F	-40	-40	-40	
max.	°F	+338	+338	+338	
temperature compensation		x	x	x	
explosion protection					
order code		GLM-NF2TS GLM-NF2TS/OS	GLP-NF2TS GLP-NF2TS/OS	GLQ-NF2TS GLQ-NF2TS/OS	
explosion protection temperature					
F M	min.	°F	-40	-40	
	max.	°F	+329	+329	
	marking				
	type of protection		non incandive	non incandive	

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

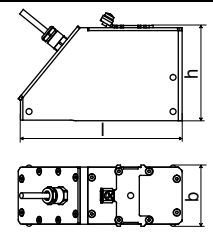
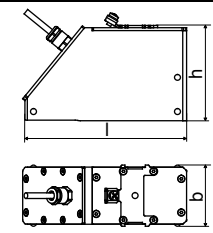
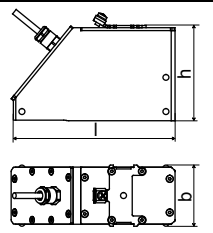
² Lamb wave transducer:

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

inner pipe diameter max. recommended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 49 ft/s (98 ft/s)

inner pipe diameter max. extended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 39 ft/s (82 ft/s)

Lamb wave transducers (not explosion proof, NEMA 6P)

technical type		GRG1LI8	GRH1LI8	GRK1LI8
order code		GLG-NNNTS/IP68	GLH-NNNTS/IP68	GLK-NNNTS/IP68
transducer frequency	MHz	0.2	0.3	0.5
fluid pressure¹				
min. extended	psi	metal pipe: 145	metal pipe: 145	metal pipe: 145 (d > 4.7 in) 44 (d < 4.7 in)
min.	psi	metal pipe: 218 plastic pipe: 15	metal pipe: 218 plastic pipe: 15	metal pipe: 218 (d > 4.7 in) 145 (d < 4.7 in) plastic pipe: 15
inner pipe diameter d²				
min. extended	in	7.5	4.7	2.4
min. recommended	in	8.7	5.5	3.1
max. recommended	in	35.4	23.6	11.8
max. extended	in	63	39.4	19.7
pipe wall thickness				
min.	in	0.43	0.28	0.16
max.	in	0.91	0.59	0.35
max. extended	in	-	-	-
material				
housing		PPSU with stainless steel cap 316Ti	PPSU with stainless steel cap 316Ti	PPSU with stainless steel cap 316Ti
contact surface		PPSU	PPSU	PPSU
degree of protection		NEMA 6P	NEMA 6P	NEMA 6P
transducer cable				
type		2550	2550	2550
length	ft	39	39	39
dimensions				
length l	in	5.65	5.65	5.65
width b	in	2.13	2.13	2.13
height h	in	3.29	3.29	3.29
dimensional drawing				
ambient temperature				
min.	°F	-40	-40	-40
max.	°F	+212	+212	+212
temperature compensation		x	x	x

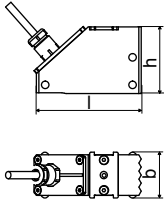
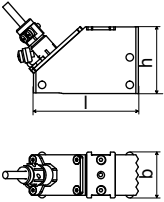
¹ depending on application, typical absolute value for natural gas, nitrogen, compressed air

² Lamb wave transducer:

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

inner pipe diameter max. recommended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 49 ft/s (98 ft/s)

inner pipe diameter max. extended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 39 ft/s (82 ft/s)

technical type		GRM1LI8	GRP1LI8
order code		GLM-NNNTS/IP68	GLP-NNNTS/IP68
transducer frequency	MHz	1	2
fluid pressure¹			
min. extended	psi	metal pipe: 44 (d < 2.4 in)	metal pipe: 44 (d < 1.4 in)
min.	psi	metal pipe: 145 (d > 2.4 in) 73 (d < 2.4 in) plastic pipe: 15	metal pipe: 145 (d > 1.4 in) 73 (d < 1.4 in) plastic pipe: 15
inner pipe diameter d²			
min. extended	in	1.2	0.59
min. recommended	in	1.6	0.79
max. recommended	in	5.9	2
max. extended	in	7.1	2.4
pipe wall thickness			
min.	in	0.08	0.04
max.	in	0.2	0.12
max. extended	in	-	-
material			
housing		PPSU with stainless steel cap 316Ti	PPSU with stainless steel cap 316Ti
contact surface		PPSU	PPSU
degree of protection		NEMA 6P	NEMA 6P
transducer cable			
type		2550	2550
length	ft	39	39
dimensions			
length l	in	2.87	2.87
width b	in	1.24	1.24
height h	in	1.81	1.81
dimensional drawing			
ambient temperature			
min.	°F	-40	-40
max.	°F	+212	+212
temperature compensation		x	x

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

² Lamb wave transducer:

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

inner pipe diameter max. recommended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 49 ft/s (98 ft/s)

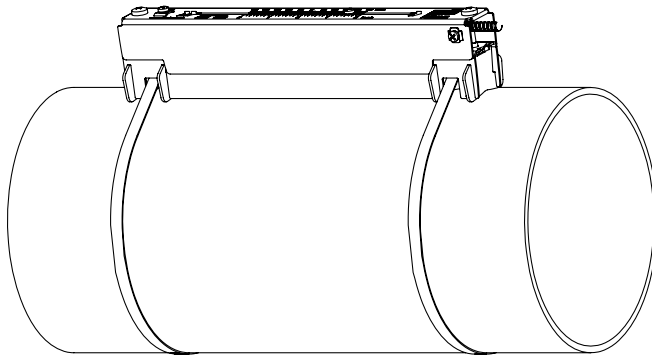
inner pipe diameter max. extended: in reflect arrangement (diagonal arrangement) and for a flow velocity of 39 ft/s (82 ft/s)

Transducer mounting fixture

Order code

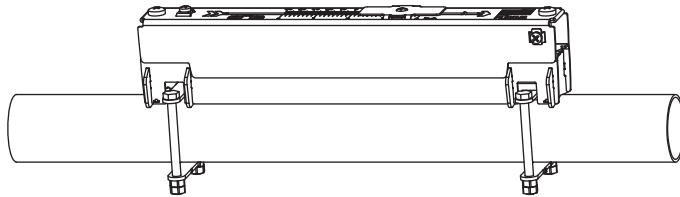
1, 2	3	4	5	6	7 to 9	10, 11	no. of character			
transducer mounting fixture	transducer	-	measurement arrangement	size	-	fixation	outer pipe diameter	/	option	description
PL										PermaLok
VL										PermaRail
	K									transducers with transducer frequency F (VCK-*L-****/IP68), G, H, K
	M									transducers with transducer frequency M, P
	Q									transducers with transducer frequency Q
			D							reflect arrangement or diagonal arrangement/direct mode
			R							reflect arrangement
				S						small
				M						medium
				L						large
						B				bolts
						S				tension straps
						W				welding
						N				without fixation
							SK1			0.5 to 2.5 in
							SK2			3 to 6 in
							SK3			8 to 10 in
							SK4			12 to 18 in
							SK5			20 to 36 in
							SK6			42 to 100 in
									IP68	degree of protection NEMA6P
									OS	housing with stainless steel 316
									Z	special design
example										
VL	K	-	D	S	-	S	200			PermaRail and tension straps for transducers with transducer frequency G, H, K
		-			-			/		

PermaRail (VLK, VLM, VLQ)



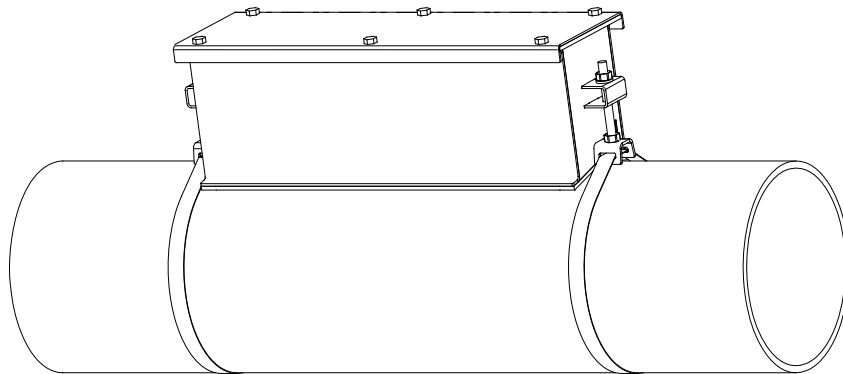
material: stainless steel 304, 301, 410
 option OS: 316, 316L, 17-7PH
 inner length:
VLK: 13.7 in,
 option IP68: 14.5 in
VLM: 9.2 in
VLQ: 6.9 in
 dimensions:
VLK: 16.65 x 3.54 x 3.66 in,
 option IP68: 17.44 x 3.7 x 4.13 in
VLM: 12.17 x 2.24 x 2.48 in
VLQ: 9.72 x 1.69 x 1.85 in

PermaRail with bolt mounting plates (VL*--B)**



material: stainless steel 304, 301, 410
 option OS: 316, 316L, 17-7PH
 inner length:
VLM: 9.2 in
VLQ: 6.9 in
 dimensions:
VLM: 12.17 x 2.24 x 2.48 in
VLQ: 9.72 x 1.69 x 1.85 in
 outer pipe diameter:
 max. 1.9 in

PermaLok PL



Coupling materials for transducers

	normal temperature range (4th character of transducer order code = N)		extended temperature range (4th character of transducer order code = E)	
	< 212 °F	< 338 °F	< 302 °F	< 392 °F
< 24 h	coupling compound type N or coupling pad type VT	coupling compound type E or coupling pad type VT	coupling compound type E or coupling pad type VT	coupling compound type E or H or coupling pad type VT
long time measurement	coupling pad type VT ¹	coupling pad type VT ²	coupling pad type VT ¹	coupling pad type VT ²

¹ < 5 years

² < 6 months

Technical data

type	ambient temperature °F	material
coupling compound type N	-22 to +266	mineral grease paste
coupling compound type E	-22 to +392	silicone paste
coupling compound type H	-22 to +482	fluoropolymer paste
coupling pad type VT	14 to +392	fluoroelastomer

Damping mats (optional)

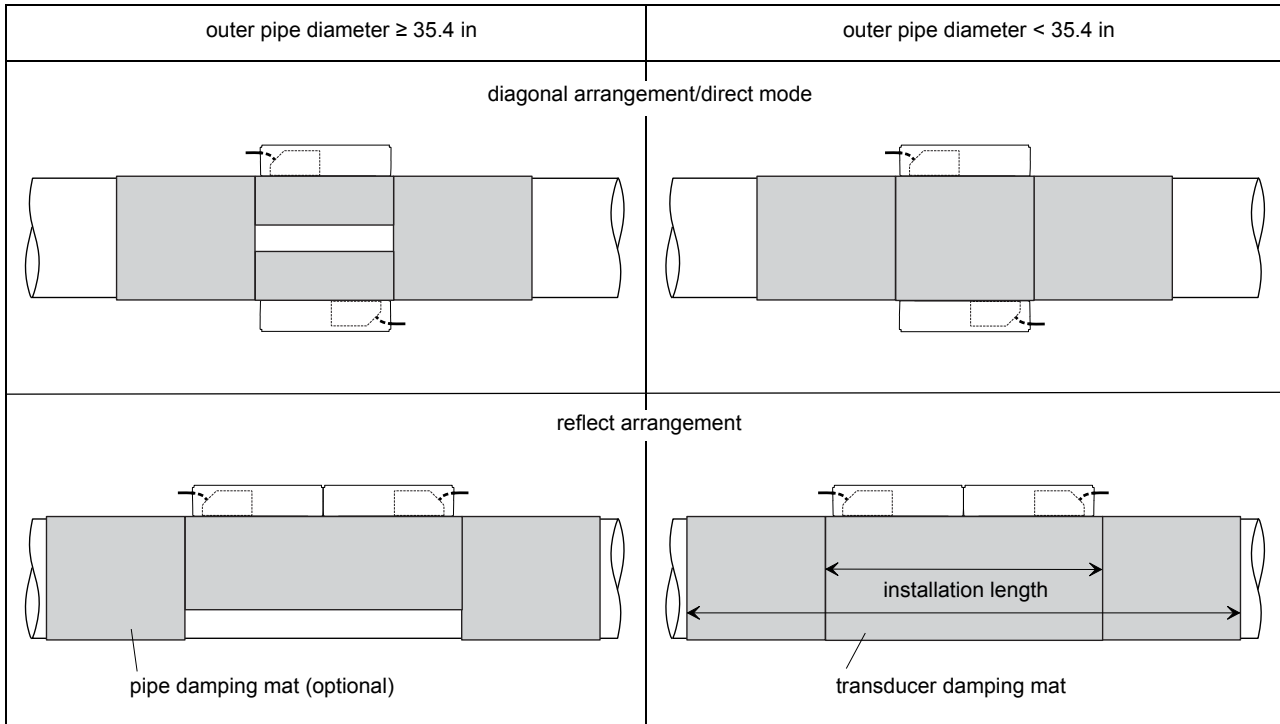
Damping mats will be used for the gas measurement to reduce acoustic noise influences on the measurement.

transducer damping mat

Transducer damping mats will be installed below the transducers.

pipe damping mat

Pipe damping mats will be installed if the sound propagation is disturbed at reflection points (e.g. flange, weld). Depending on the noise, the pipe damping mats will be installed at one or both sides of the transducer damping mat. If the local conditions are unknown, pipe damping mats should be installed.



Technical data

type		E30R4	E30R3
width	in	8.9	2
thickness	in	0.03	
length (per roll)	ft	32	
weight	lb/ft ²	2.2	
ambient temperature	°F	-22 to +1760	
properties		self-adhesive	

Dimensioning

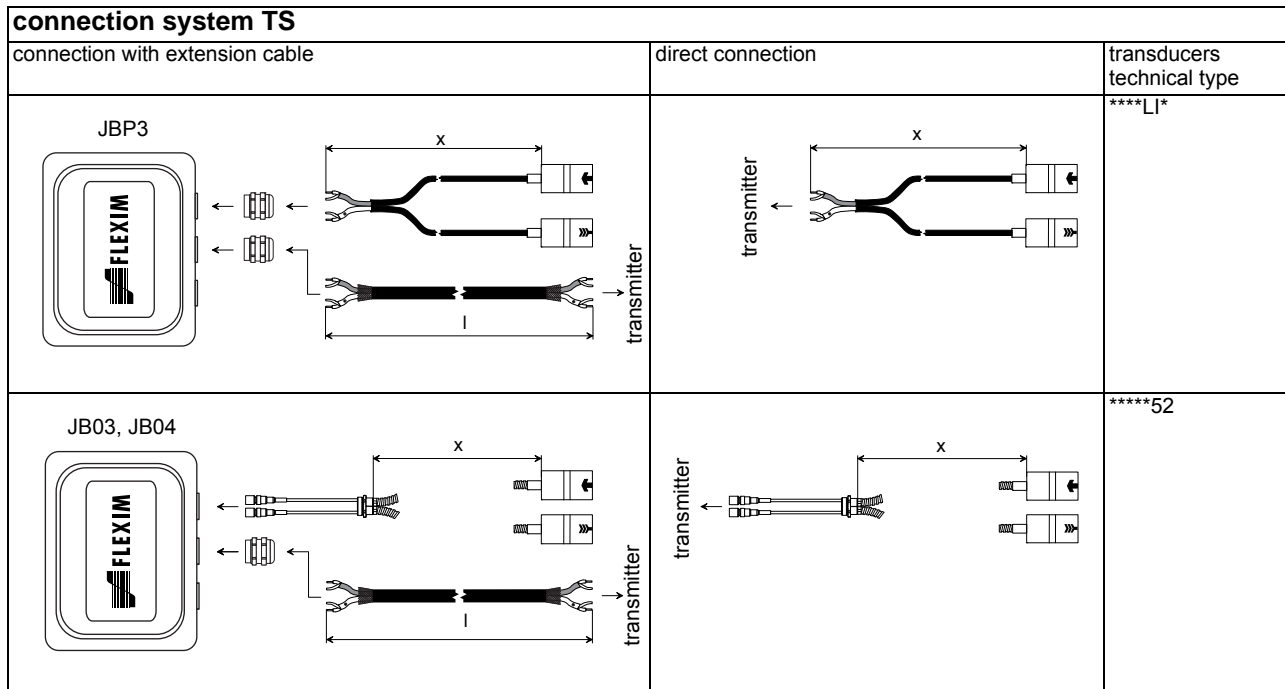
transducer		damping mat							
transducer mounting fixture	order code	type	number of layers	transducer damping mat			transducer damping mat + 2x pipe damping mat		
				max. installation length [in]	number of rolls ¹		max. installation length [in]	number of rolls ¹	
PermaRail									
VLK	GLG	E30R4	3	35	4	4	72	9	12
	GSG		3		4	4		9	10
	GLH		2		2	3		4	7
	GLK		1		1	1		2	2
	GSK		1		1	1		2	3
VLK-**-****/IP68	GLG	E30R4	3	36	5	5	75.2	10	13
	GSG		3		5	5		10	11
	GLH		2		2	3		5	7
	GLK		1		1	1		2	2
	GSK		1		1	1		2	2
VLM	GLM	E30R3	1	26	1	1	53.5	2	2
	GSM		1		1	1		2	2
	GLP		1		1	1		1	1
	GSP		1		1	1		1	1
VLQ	GLQ	E30R3	1	21.3	1	1	44.1	1	1
	GSQ		1		1	1		1	1

¹ calculation on the base of:

- max. installation length (installation of one transducer mounting fixture per transducer in reflect arrangement) and
- max. recommended pipe diameter (standard) or max. extended pipe diameter (extended)
(for inner pipe diameter max. recommended and max. extended see Technical Data of the Transducers from page 17)

² calculation for the number of rolls when both transducers are mounted in one transducer mounting fixture (reflect arrangement) or in diagonal arrangement/direct mode: number of rolls/2 and round up to the nearest integer

Connection systems



transducer frequency (3d character of transducer order code)		F, G, H, K		M, P		Q		S	
T	S	x	l	x	l	x	l	x	l
		cable length ft	16 ≤ 984	13 ≤ 984	9 ≤ 295	6 ≤ 131			
		cable length (option LC) ft	29 ≤ 984	-	-	-	-	-	-
		cable length (option IP68) ft	39 ≤ 984	39 ≤ 984	-	-	-	-	-

x = transducer cable length
l = max. length of extension cable


Transducer cable

Technical data

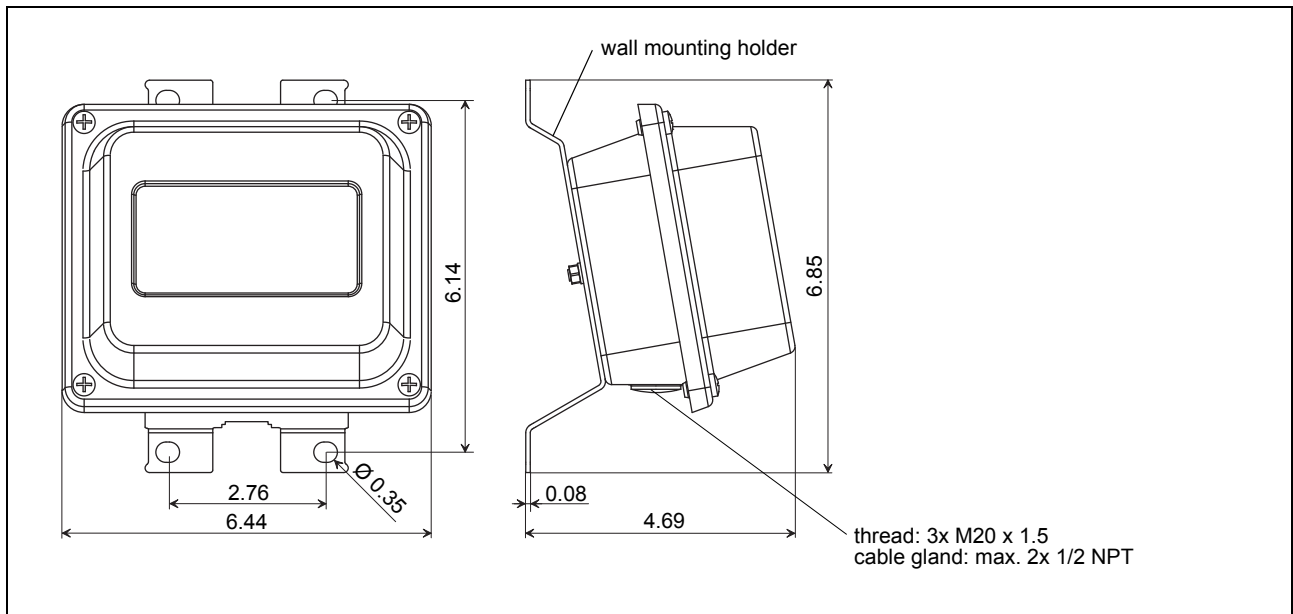
		transducer cable			extension cable	
type		1699	2550 (option IP68)	6111	2615	5245
standard length	ft	see table above				
max. length	ft	-				
ambient temperature	°F	-67 to +392	-40 to +212	-148 to +437	-22 to +158	-22 to +158
properties			longitudinal water tight		halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2	halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2
cable jacket						
material		PTFE	PUR	PFA	PUR	PUR
outer diameter	in	0.11	0.2 ±0.01	0.11	0.47	0.47
thickness	in	0.01	0.04	0.02	0.08	0.08
color		brown	gray	white	black	black
shield		x	x	x	x	x
sheath						
material		stainless steel 304 option OS: 316Ti	-	stainless steel 304 option OS: 316Ti	-	steel wire braid with copolymer sheath
outer diameter	in	0.31	-	0.31	-	0.61

Junction box

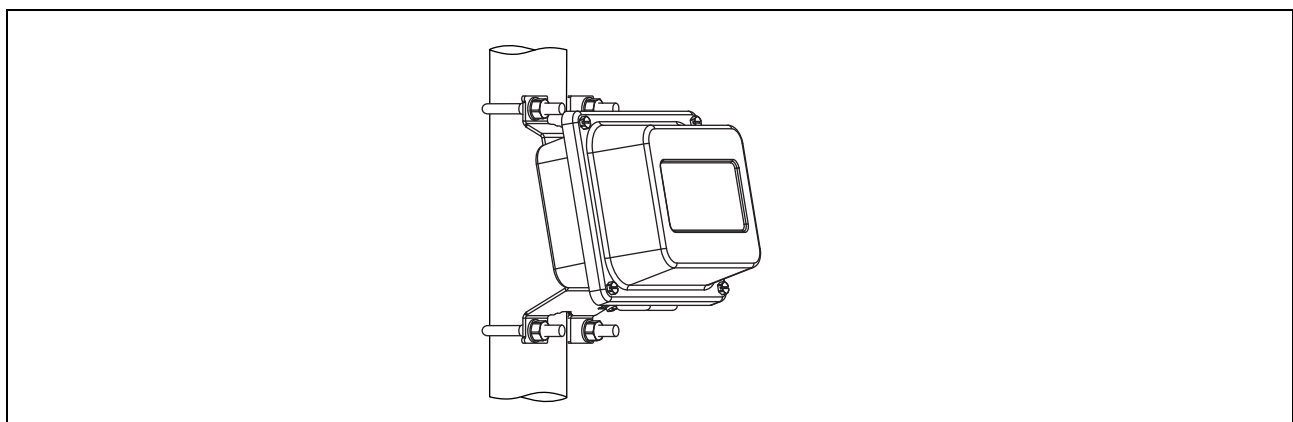
Technical data

technical type		JB03	JB04	JBP3
dimensions		see dimensional drawing	see dimensional drawing	see dimensional drawing
weight	lb	2.6 lb	2.6 lb	2.6 lb
fixation		wall mounting, optional: 2 " pipe mounting	wall mounting, optional: 2 " pipe mounting	wall mounting, optional: 2 " pipe mounting
material				
housing		stainless steel 316L	stainless steel 316L	stainless steel 316L
gasket		silicone	silicone	silicone
degree of protection		NEMA 6	NEMA 4X	NEMA 6
ambient temperature				
min.	°F	-40	-40	-40
max.	°F	+176	+176	+176
explosion protection				
F M	marking	-	 NI/Ci. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ T6 Ta = -40...+60 °C	-

Dimensions



2 " pipe mounting kit (optional)



Terminal assignment

JB03, JB04

transducers

terminal	connection
XV	transducer ↗, SMB connector
XR	transducer ↘, SMB connector
cable gland	external shield

extension cable

terminal strip KL2

terminal	connection
TV	signal
TVS	internal shield
TRS	internal shield
TR	signal
shield terminal	external shield

JBP3

transducers

terminal strip KL1

terminal	connection
TV	transducer ↗, signal
TVS	transducer ↗, internal shield
TRS	transducer ↘, internal shield
TR	transducer ↘, signal
cable gland	external shield

extension cable

terminal strip KL2

terminal	connection
TV	signal
TVS	internal shield
TRS	internal shield
TR	signal
shield terminal	external shield

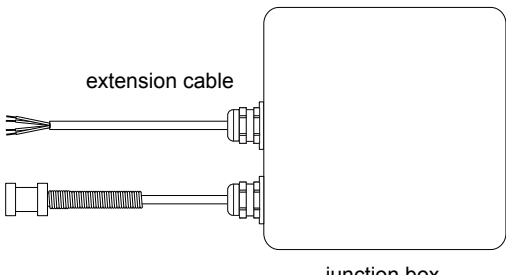
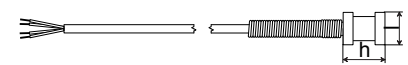
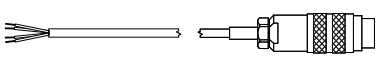
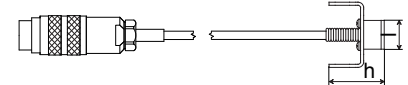
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Clamp-on temperature probe (optional)

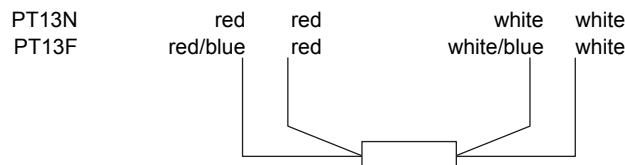
Technical data

technical type		PT13N	PT13F
design			short response time, with connector
type		Pt1000	Pt1000
connection		4-wire	4-wire
measuring range	°F	-40 to +392	-58 to +482
accuracy T		$\pm(0.27 \text{ }^\circ\text{F} + 2 \cdot 10^{-3} \cdot (T \text{ [}^\circ\text{F]} - 32 \text{ }^\circ\text{F}))$ class A	$\pm(0.27 \text{ }^\circ\text{F} + 2 \cdot 10^{-3} \cdot (T \text{ [}^\circ\text{F]} - 32 \text{ }^\circ\text{F}))$ class A
response time	s		8
housing		360 brass alloy	PEEK, stainless steel 304, copper
degree of protection			NEMA 4
weight	lb	0.437	0.7
fixation		clamp-on	clamp-on
accessories			
thermal conductivity paste 392 °F		-	x
thermal conductivity foil 482 °F		x	x
plastic protection plate, insulation foam		-	x
dimensions			
length l	in	0.59	0.55
width b	in	0.49	1.18
height h	in	0.79	1.06

connection with extension cable	direct connection	technical type
		PT13N
		PT13F

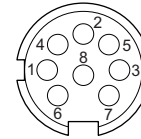
Connection

Temperature probe



Connector

pin	cable of temperature probe PT13F	cable of temperature probe PT13N	extension cable
1	white/blue	white	white
2	red/blue	red	black
3, 4, 5	not connected		
6	red	red	green
7	white	white	red
8	not connected		



Cable

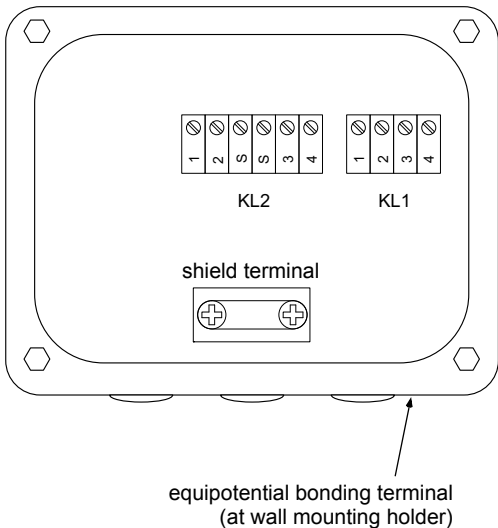
		cable of temperature probe		extension cable
temperature probe		PT13F	PT13N	
type		4 x 0.25 mm ² black	4 x 24 AWG	4 x 18 AWG
standard length	ft	9	20	-
max. length	ft	-	-	656
cable jacket		PTFE	PTFE	LS PVC

Junction box

technical type		JBT3
dimensions		see dimensional drawing
fixation		wall mounting optional: 2 " pipe mounting
material		
housing		stainless steel 316L
gasket		silicone
degree of protection		NEMA 6
cable gland		max. 2x 1/2 NPT
ambient temperature		
min.	°F	-40
max.	°F	+176

Terminal assignment

JBT3



equipotential bonding terminal
(at wall mounting holder)

temperature probe (PT13F)

terminal strip KL1

terminal	connection
1	red
2	red/blue
3	white
4	white/blue

temperature probe (PT13N)

terminal strip KL1

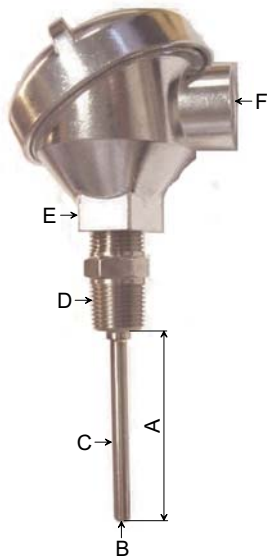
terminal	connection
1	red
2	red
3	white
4	white

extension cable

terminal strip KL2

terminal	connection
1	white
2	black
3	green
4	red

Wetted temperature probe (optional)



	type	Pt1000
A	insertion length	6 " or specified length
B	resistance	1 000 Ω, 00385
C	insertion length sheath material	6 " or specified length stainless steel 316
D	thread	1/2 " NPT HEX CPLG. spring loaded
E	head	aluminum screw cover head 4 terminal block
F	thread	3/4 " NPT

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