

Steam ultrasonic flowmeter for permanent installation

Transmitter for permanent outdoor wall or pipe mounting

Features

- Exact and highly reliable measurement of saturated and superheated steam for temperatures up to max. 356 °F by means of the clamp-on principle
- Physical quantities volumetric flow rate and mass flow rate available in a transmitter without additional steam calculator
- Installation and start-up do not require any pipe work and are carried out without any process interruptions and cooling down of the steam system
- Non-invasive, wear-free and pressure constant measurement
- Maintenance-free acoustic coupling using permanent coupling foil
- High measurement accuracy even at very low as well as high flow rates and independent of the flow direction (bidirectional)
- Automatic loading of calibration data and transducer recognition
- Bidirectional communication and support of common bus technologies (Modbus, Profibus PA, Foundation Fieldbus, BACnet)
- Advanced self-diagnosis and possibilities for event-based triggering of data recording for the supervision and control of critical processes
- Transmitter and transducers are separately calibrated (traceable to national standards)
- The measurement is zero point stable and drift free

Applications

- Food and beverage industry
- Pharmaceutical industry
- Chemical industry
- Manufacturing industries



FLUXUS G721ST-****A



FLUXUS G721ST-****S



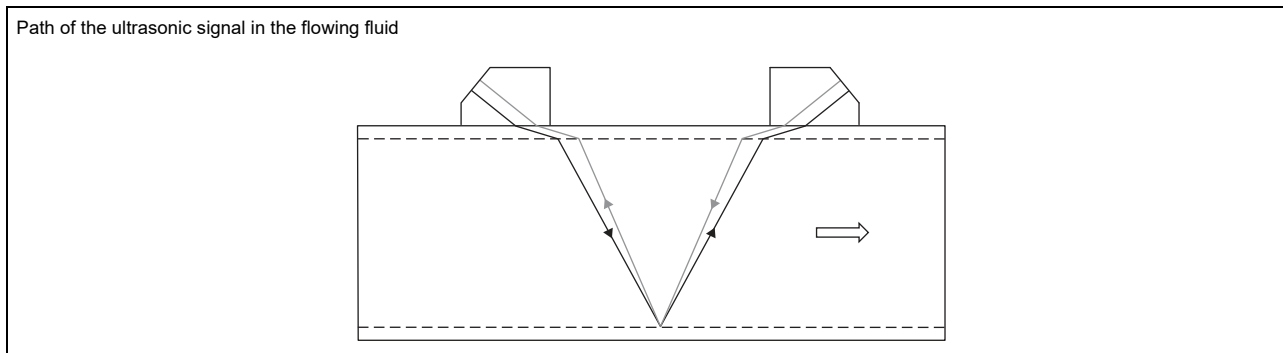
PermaRail

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Function

Measurement principle

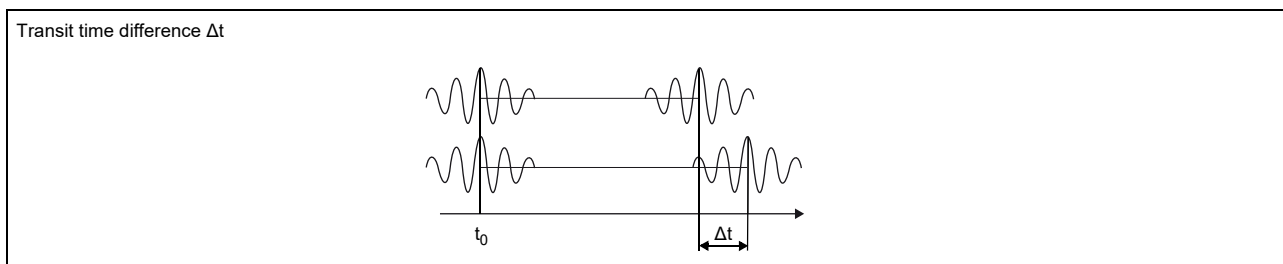
The transducers are mounted on the pipe which is completely filled with the fluid. The ultrasonic signals are emitted alternately by a transducer and received by the other. The physical quantities are determined from the transit times of the ultrasonic signals.



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

The transit time difference 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.

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



Calculation of volumetric flow rate

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

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_y - average of transit times in the fluid

Calculation of mass flow

The mass flow is calculated on the base of operating density and volume flow:

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

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

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

where

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

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. 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. The transducers are mounted on opposite sides of the pipe.

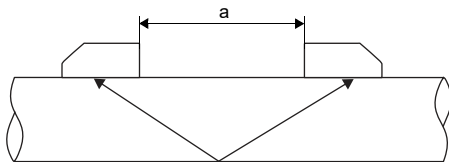
- **direct mode**

Diagonal arrangement with 1 sound path. This should be used in the case of a high signal attenuation by the fluid, pipe or coatings.

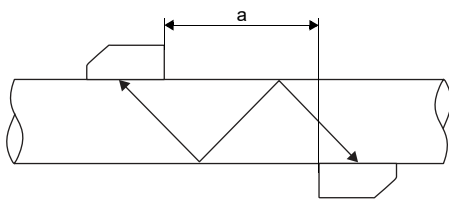
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

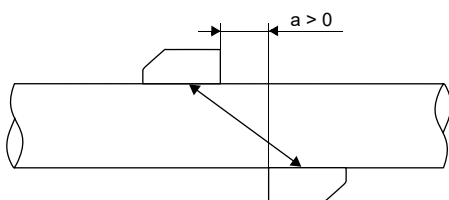
Reflect arrangement, number of sound paths: 2



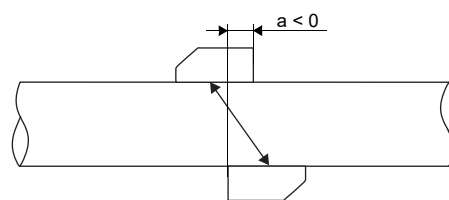
Diagonal arrangement, number of sound paths: 3



Direct mode, number of sound paths: 1

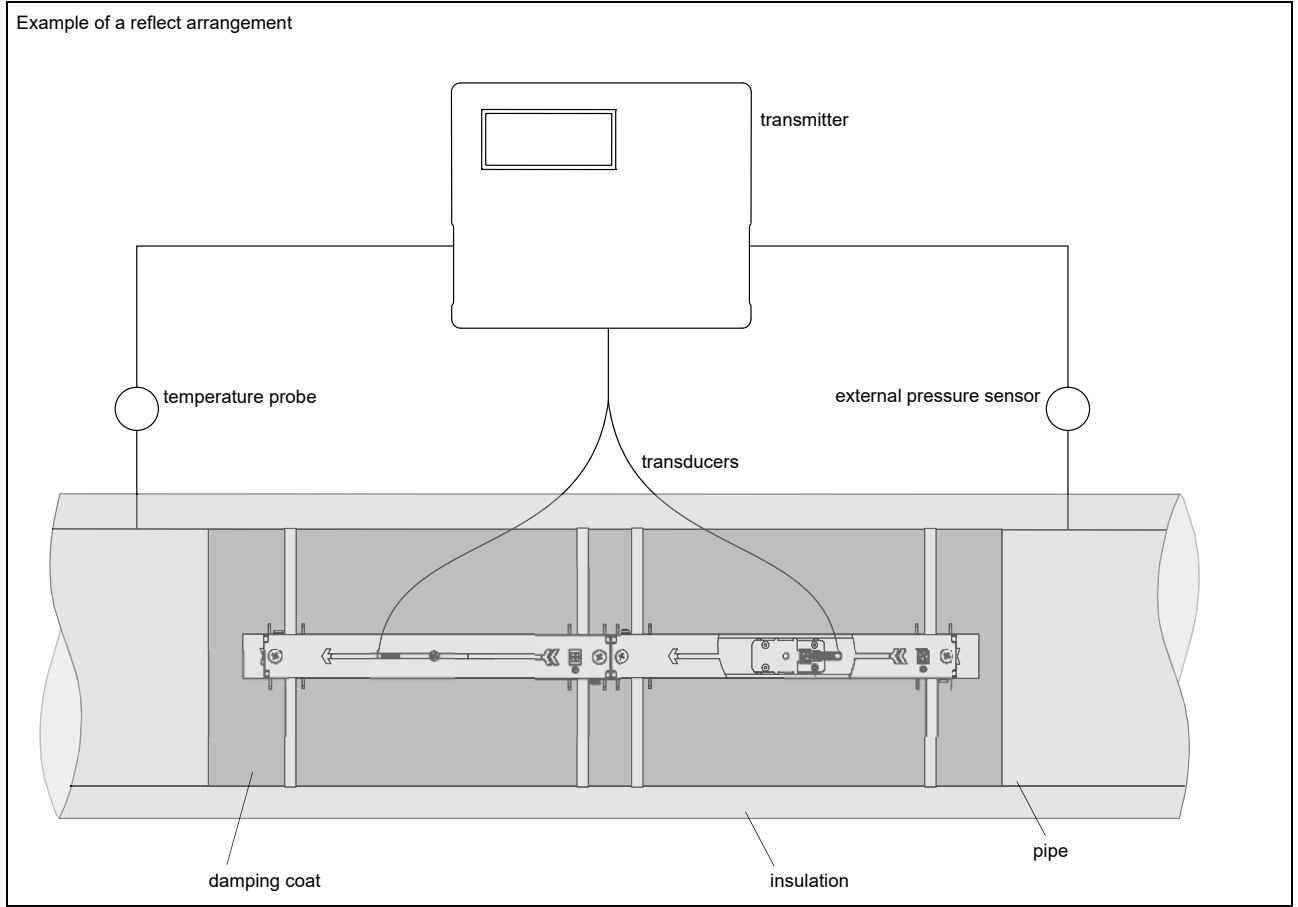


Direct mode, number of sound paths: 1, negative transducer distance





a - transducer distance

Typical measurement setup



Transmitter

Technical data

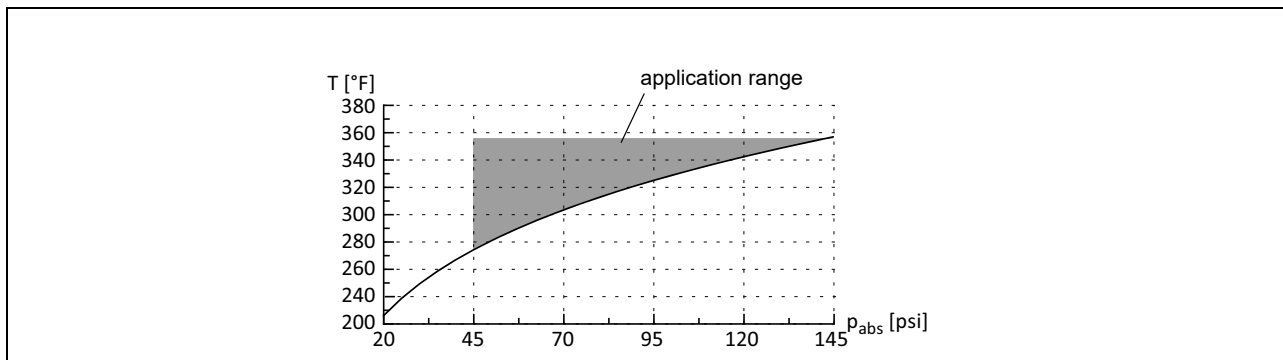
	FLUXUS G721ST-NN0*A	FLUXUS G721ST-NN0*S
		
design	standard field device	field device with stainless steel housing
application	steam measurement	
measurement		
measurement principle	test measurement to validate the application required in advance transit time difference correlation principle	
flow velocity	ft/s	depending on pipe diameter and transducer, see diagrams
repeatability	0.15 % of reading ± 0.02 ft/s	
fluid	saturated steam, superheated steam	
fluid pressure	psi (a)	44 to 145
fluid temperature	°F	275 to 356
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5.1-2011	
measurement uncertainty (volumetric flow rate)		
measurement uncertainty at the measuring point	± 1 to 3 % of reading ± 0.02 ft/s, depending on application	
transmitter		
power supply	<ul style="list-style-type: none"> • 100 to 230 V/50 to 60 Hz or • 20 to 32 V DC or • 11 to 16 V DC 	
power consumption	W	< 15
number of measuring channels	1, optional: 2	
damping	s	0 to 100 (adjustable)
measuring cycle	Hz	100 to 1000 (1 channel)
response time	s	1 (1 channel), option: 0.02
housing material	aluminum, powder coated	stainless steel 316L
degree of protection	IP66	
dimensions	in	see dimensional drawing
weight	lb	11.9 11.2
fixation	wall mounting, optional: 2" pipe mounting	
ambient temperature	°F	-40 to +140 (< -4 °F without operation of the display)
display	128 x 64 dots, backlight	
menu language	English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian	
measuring functions		
physical quantities	operating 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	
communication interfaces		
service interfaces	measured value transmission, parametrization of the transmitter: <ul style="list-style-type: none"> • USB • LAN 	
process interfaces	max. 1 option: <ul style="list-style-type: none"> • RS485 (ASCII sender) • Modbus RTU¹ • BACnet MS/TP • Profibus PA¹ • FF H1¹ • Modbus TCP¹ • BACnet IP 	
accessories		
serial data kit	USB cable	
software	<ul style="list-style-type: none"> • FluxDiagReader: download of measured values and parameters, graphical presentation • FluxDiag (optional): download of measurement data, graphical presentation, report generation, parametrization of the transmitter 	
data logger		
loggable values	all physical quantities, totaled values and diagnostic values	
capacity	max. 800 000 measured values	

¹ with inputs and including parametrization of the transmitter

		FLUXUS G721ST-NN0*A	FLUXUS G721ST-NN0*S
outputs			
The outputs are galvanically isolated from the transmitter.			
• switchable current output			
The switchable current outputs are menu selectable all together as passive or active.			
number		2 (1 measuring channel), optional: 4 (2 measuring channels)	
range	mA	4 to 20 (3.2 to 22)	
accuracy		0.04 % of reading $\pm 3 \mu\text{A}$	
active output		$R_{\text{ext}} < 350 \Omega$	
passive output		$U_{\text{ext}} = 8 \text{ to } 30 \text{ V}$, depending on R_{ext} ($R_{\text{ext}} < 1 \text{ k}\Omega$ at 30 V)	
• binary output			
number		3	
optorelay		26 V/100 mA	
binary output as alarm output			
• functions		limit, change of flow direction or error	
binary output as pulse output			
• functions		mainly for totalizing	
• pulse value	units	0.01 to 1000	
• pulse width	ms	optorelay: 1 to 1000	
inputs			
The inputs are galvanically isolated from the transmitter.			
• temperature input			
number		1 (1 measuring channel), optional: 2 (2 measuring channels)	
type		Pt100/Pt1000	
connection		4-wire	
range	$^{\circ}\text{F}$	-238 to +1040	
resolution	K	0.01	
accuracy		$\pm 0.01 \%$ of reading $\pm 0.03 \text{ K}$	
• current input			
number		1 (1 measuring channel), optional: 2 (2 measuring channels)	
accuracy		0.1 % of reading $\pm 10 \mu\text{A}$	
active input		$U_{\text{int}} = 24 \text{ V}$, $R_{\text{int}} = 50 \Omega$, $P_{\text{int}} < 0.5 \text{ W}$, not short-circuit proof	
• range	mA	0 to 20	
passive input		$R_{\text{int}} = 50 \Omega$, $P_{\text{int}} < 0.3 \text{ W}$	
• range	mA	-20 to +20	

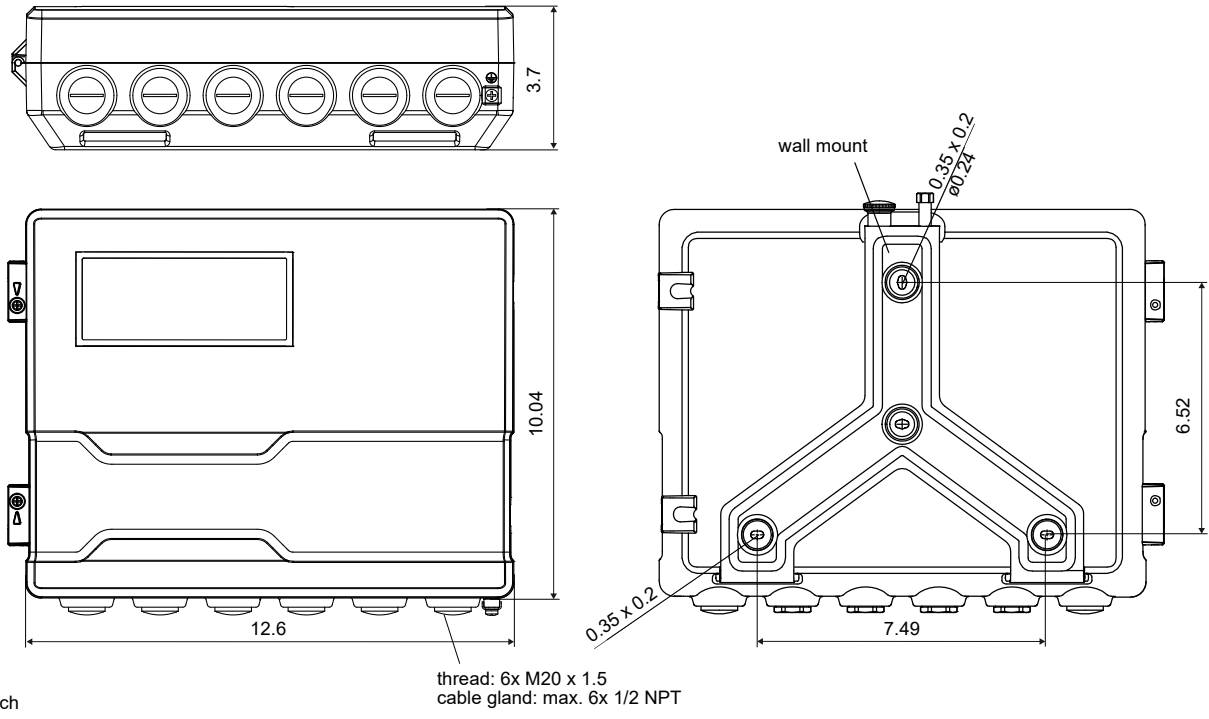
¹ with inputs and including parametrization of the transmitter

Saturated steam pressure curve



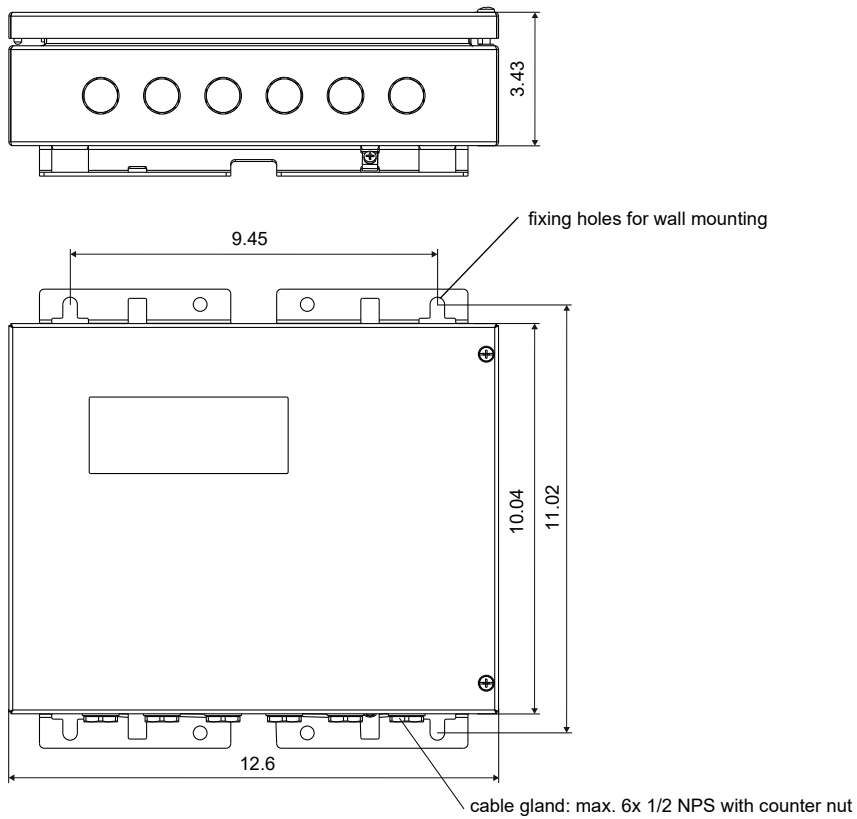
Dimensions

*721**-****A



in inch

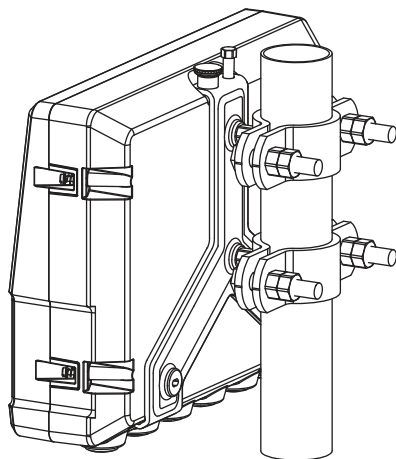
*721**-****S



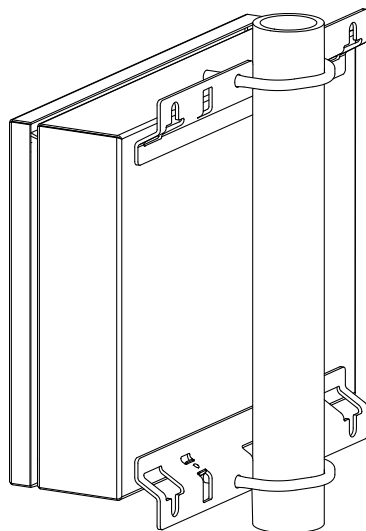
in inch

2" pipe mounting kit

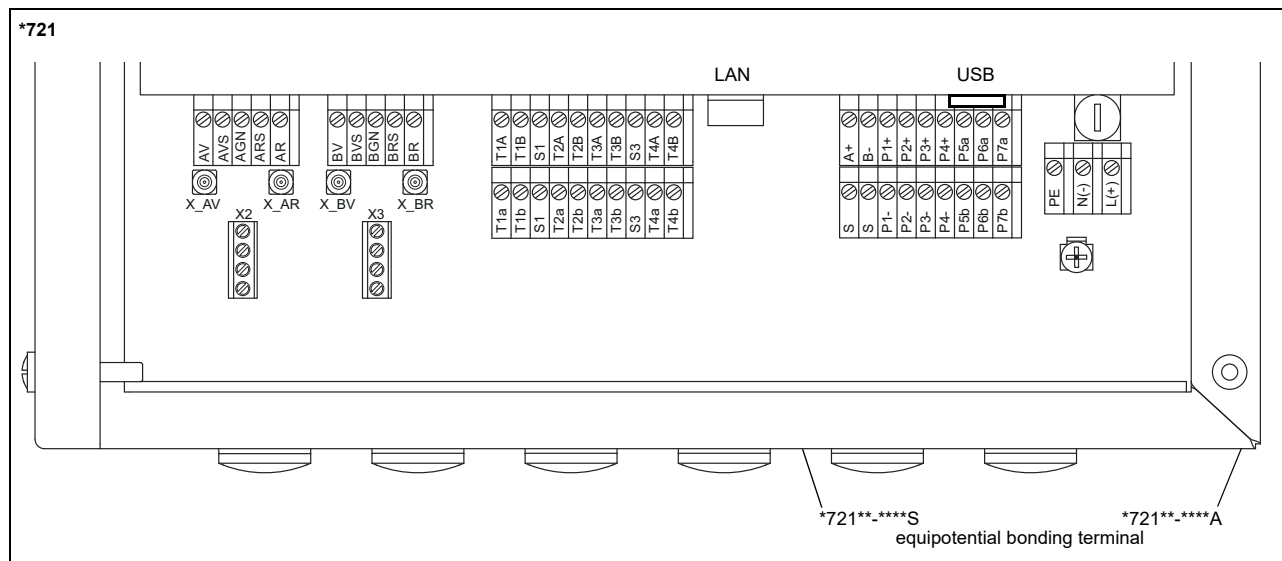
*721**_****A



*721**_****S



Terminal assignment



power supply ¹		
terminal	connection (AC)	connection (DC)
PE	earth	earth
N(-)	neutral	-
L(+)	phase	+

transducers							
extension cable				transducer cable			
measuring channel A				measuring channel B			
terminal	connection	terminal	connection	transducer	terminal	terminal	connection
AV	signal	BV	signal	↑	X_AV	X_BV	SMB connector
AVS	shield	BVS	shield	↕	X_AR	X_BR	SMB connector
ARS	shield	BRS	shield				
AR	signal	BR	signal				

outputs ¹					
terminal	connection	terminal	connection	communication interface	
P1+ to P4+ P1- to P4-	current output	A+	signal +	<ul style="list-style-type: none"> • RS485¹ • Modbus RTU¹ • BACnet MS/TP¹ • Profibus PA¹ • FF H1¹ 	
		B-	signal -		
		101	shield		
P5a to P7a P5b to P7b	binary output	USB	type B	<ul style="list-style-type: none"> • service (FluxDiag/FluxDiagReader) • service (FluxDiag/FluxDiagReader) • BACnet IP • Modbus TCP 	
		LAN	RJ45		

analog inputs ¹					
terminal	temperature probe		passive sensor	active sensor	
	direct connection	connection with extension cable	connection	connection	
T1a to T2a	red	white	not connected	not connected	
T1A to T2A	red	black	-	+	
T1b to T2b	white	red	+	not connected	
T1B to T2B	white	green	not connected	-	
S1, S3	-	-	not connected	not connected	

¹ cable (by customer):
 - e.g., flexible leads, with insulated wire end ferrules, lead cross sectional area: AWG14 to 24
 - outer diameter of the cable (*721**-****S with ferrite nut): max. 0.3 in

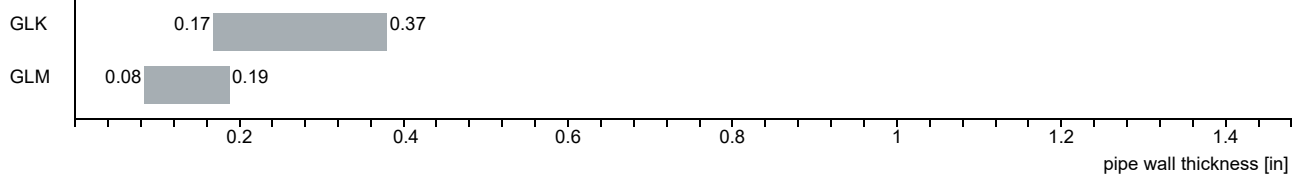
Transducers

Transducer selection

Step 1

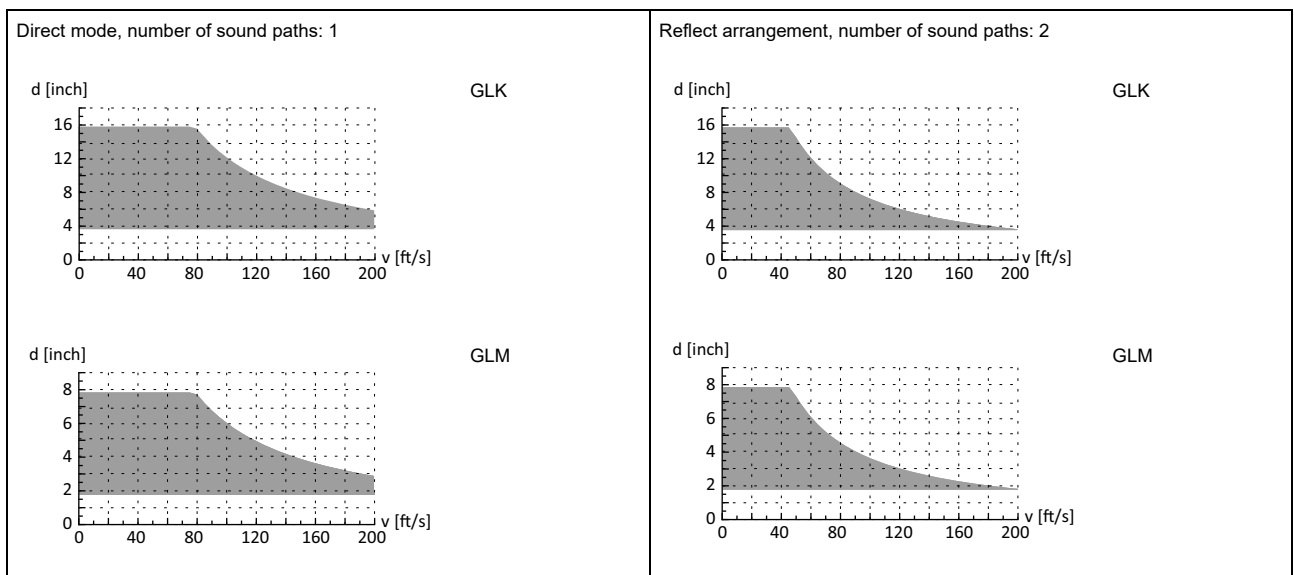
pipe wall thickness

transducer order code

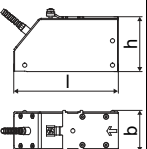
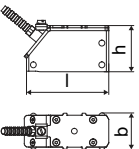


Step 2

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



Technical data

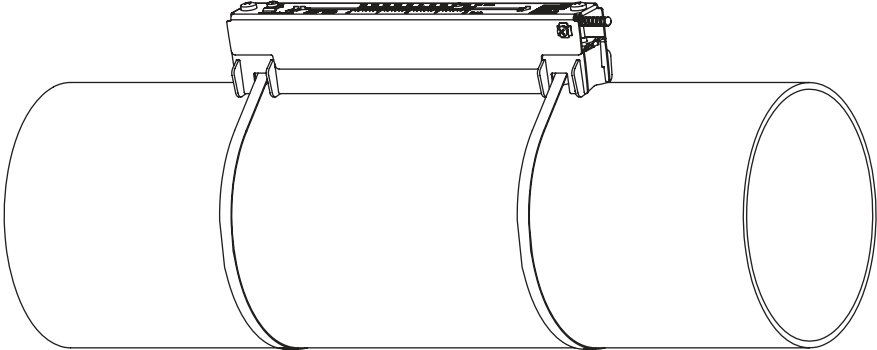
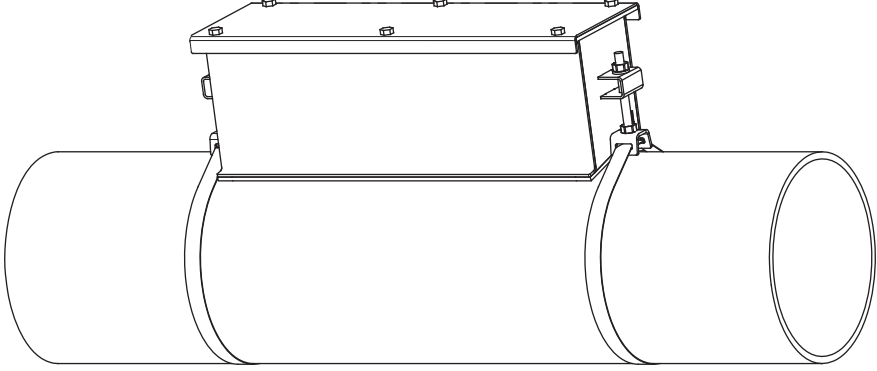
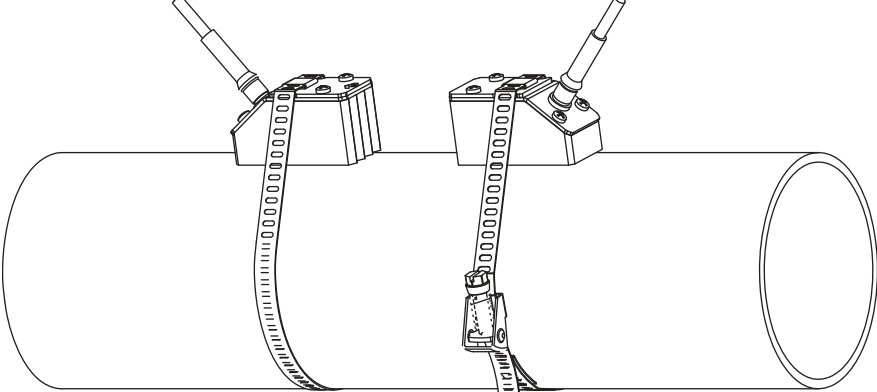
order code		GLK-SNNTS/**	GLM-SNNTS/**
technical type		G(RT)K1S52	G(RT)M1S52
transducer frequency	MHz	0.5	1
inner pipe diameter d			
min.	in	3.5	1.8
max.	in	15.7	7.9
pipe wall thickness			
min.	in	0.17	0.08
max.	in	0.37	0.19
material			
housing		PPSU with stainless steel cap 316Ti	PPSU with stainless steel cap 316Ti
contact surface		PPSU	PPSU
degree of protection		IP65	IP65
transducer cable			
type		1699	1699
length	ft	16	13
length (***,***/LC)	ft	29	29
dimensions			
length l	in	5.06	2.91
width b	in	2.01	1.3
height h	in	2.66	1.59
dimensional drawing			
weight (without cable)	lb	1.8	0.35
storing temperature			
min.	°F	-40	-40
max.	°F	+356	+356
operating temperature¹			
min.	°F	212	212
max.	°F	356	356
warm-up time	h	3	1
temperature compensation		x	x

¹ completely thermally insulated transducer installation necessary

Transducer mounting fixture

Order code

1, 2	3	4	5	6	7 to 9	no. of character
transducer mounting fixture	transducer	measurement arrangement	size	fixation	outer pipe diameter	option
PL						PermaLok
VL						PermaRail
	K					transducers with transducer frequency K
	M					transducers with transducer frequency M
		D				reflect arrangement or diagonal arrangement/direct mode
		R				reflect arrangement
			S			small
			M			medium
			L			large
				S		tension straps
					T36	1.6 to 14.2 in
					013	0.39 to 5.1 in
					036	5.1 to 14.2 in
					092	14.2 to 36.2 in
					SK1	0.5 to 2.5 in
					SK2	3 to 6 in
					SK3	8 to 10 in
					SK4	12 to 18 in
						OS housing with stainless steel 316
						Z special design

<p>PermaRail (VLK, VLM)</p> 	<p>material: stainless steel 304, 301, 410 option OS: 316Ti, 316L, 17-7PH inner length: VLK: 13.7 in, option IP68: 14.5 in VLM: 9.2 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</p>
<p>PermaLok PL</p> 	<p>material: stainless steel 316</p>
<p>quick release clasp and tension straps</p> 	<p>material: stainless steel 410, 200</p>

Coupling materials for transducers

type	ambient temperature °F
coupling pad type VT ¹	14 to +392
coupling compound type E ²	-22 to +392

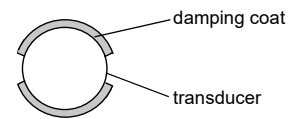
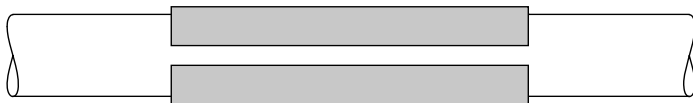
¹ fluid temperature 392 °F; min. 2 years

² in combination with type VT only

Damping coat

The damping coat will be used to reduce acoustic noise influences on the measurement.

Example (diagonal arrangement)

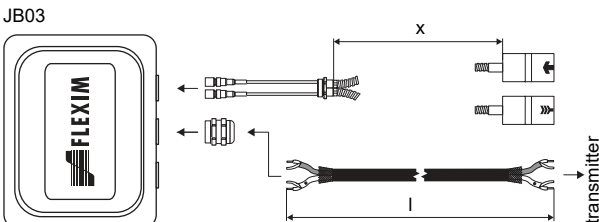
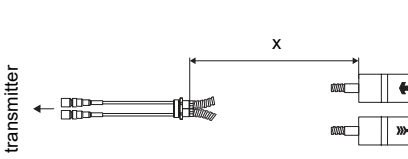


Technical data

order code		ACC-PE-GNNN-DPL1
material		multipolymeric matrix/inorganic ceramic coating
packing drum	gal	1
properties		heat resistant, inert
fluid temperature when applying	°F	50 to 392
drying time (example)		approx. 3 h at 68 °F approx. 15 min at 302 °F
temperature resistance in dry state	°F	max. 1202
durability of the packing drum (unopened)		2 years

Observe installation instructions (TI_DampingCoat).

Connection systems

connection system TS		
connection with extension cable	direct connection	transducers technical type
		*****52

Cable

transducer cable	
type	1699
weight	lb/ft 0.06
ambient temperature	°F -67 to +392
cable jacket	
material	PTFE
outer diameter	in 0.11
thickness	in 0.01
color	brown
shield	x
sheath	
material	stainless steel 316Ti
outer diameter	in 0.31

extension cable			
type		2615	5245
weight	lb/ft	0.12	0.26
ambient temperature	°F	-22 to +158	-22 to +158
properties		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		PUR	PUR
outer diameter	in	max. 0.47	max. 0.47
thickness	in	0.08	0.08
color		black	black
shield		x	x
sheath			
material		-	steel wire braid with copolymer sheath
outer diameter	in	-	max. 0.61

Cable length

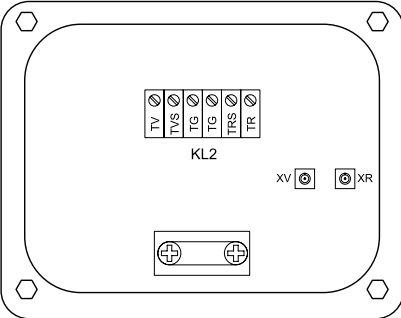
transducer frequency		G, H, K		M, P		Q	
transducers technical type		x		x		x	
*R***5*	ft	16	≤ 984	13	≤ 984	9	≤ 295
option LC: *L***5*	ft	29	≤ 984	29	≤ 984	29	≤ 295

x = transducer cable length

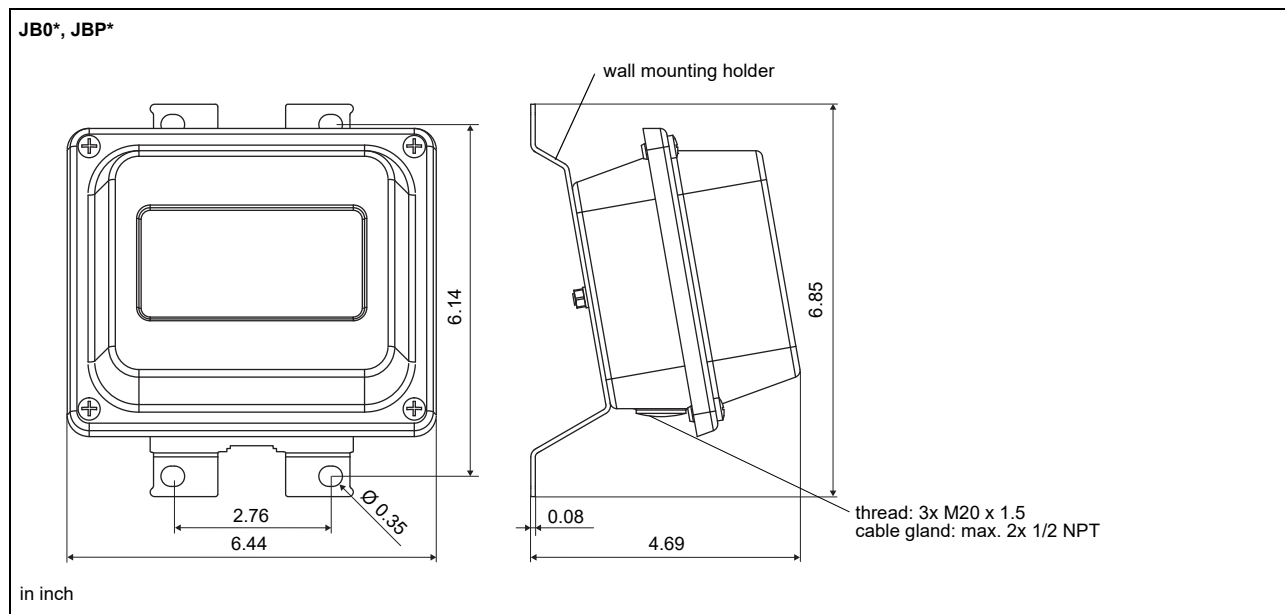
l = max. length of extension cable (depending on application)

Junction box

Technical data

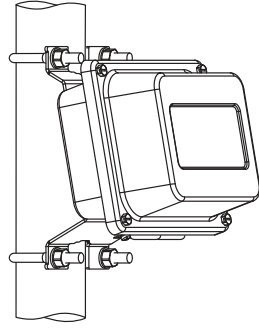
JB03														
weight	lb	2.6 lb												
fixation		wall mounting optional: 2" pipe mounting												
material														
housing		stainless steel 316L												
gasket		silicone												
degree of protection		IP67												
ambient temperature														
min.	°F	-40												
max.	°F	+176												
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"></div> <div style="width: 65%;"> <p>Connection</p>  </div> </div>														
<p>Transducers</p> <table border="1"> <thead> <tr> <th></th> <th>terminal</th> <th>connection</th> <th>transducer</th> </tr> </thead> <tbody> <tr> <td></td> <td>XV</td> <td>SMB connector</td> <td>↑</td> </tr> <tr> <td></td> <td>XR</td> <td>SMB connector</td> <td>⤴</td> </tr> </tbody> </table>				terminal	connection	transducer		XV	SMB connector	↑		XR	SMB connector	⤴
	terminal	connection	transducer											
	XV	SMB connector	↑											
	XR	SMB connector	⤴											
<p>Extension cable</p> <table border="1"> <thead> <tr> <th>terminal strip</th> <th>terminal</th> <th>connection</th> </tr> </thead> <tbody> <tr> <td rowspan="4">KL2</td> <td>TV</td> <td>signal</td> </tr> <tr> <td>TVS</td> <td>internal shield</td> </tr> <tr> <td>TRS</td> <td>internal shield</td> </tr> <tr> <td>TR</td> <td>signal</td> </tr> </tbody> </table>			terminal strip	terminal	connection	KL2	TV	signal	TVS	internal shield	TRS	internal shield	TR	signal
terminal strip	terminal	connection												
KL2	TV	signal												
	TVS	internal shield												
	TRS	internal shield												
	TR	signal												

Dimensions



2" pipe mounting kit

JB**



Clamp-on temperature probe (optional)

Technical data

PT13N		
design		clamp-on
type		PT1000
connection		4-wire
measuring range	°F	-40 to +392
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
accuracy ΔT (2x Pt matched according to EN 1434-1)		$\leq 0.03 \text{ }^\circ\text{F}$ (at 50 °F)
housing		360 brass alloy
degree of protection		NEMA 4
dimensions		
length l	in	0.79
width b	in	0.59
height h	in	0.49
dimensional drawing		
weight	lb	0.437
accessories		
thermal conductivity foil 482 °F		x
Connection system		
connection with extension cable		direct connection
extension cable 		
Connection		
	temperature probe	
	red	
	red	
	white	
	white	
Cable		
	temperature probe	extension cable
type	4 x 24 AWG	4 x 18 AWG
standard length	ft 20	-
max. length	ft -	656
cable jacket	PTFE	LS PVC

Fixation

<p>tension strap PT13N</p>	<p>material: stainless steel 301, 410 thermal insulation necessary</p>
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Junction box

	<p>Connection</p> <table border="1"> <thead> <tr> <th>temperature probe</th> <th>extension cable</th> </tr> </thead> <tbody> <tr> <td>red</td> <td>white</td> </tr> <tr> <td>red</td> <td>black</td> </tr> <tr> <td>white</td> <td>green</td> </tr> <tr> <td>white</td> <td>red</td> </tr> </tbody> </table>	temperature probe	extension cable	red	white	red	black	white	green	white	red
temperature probe	extension cable										
red	white										
red	black										
white	green										
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