FLEXIM

Technical specification

FLUXUS G721ST

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 and 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

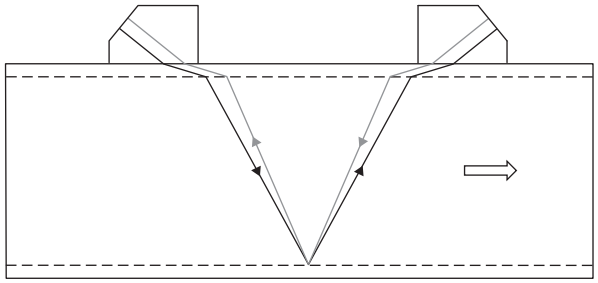
PermaRail

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.

Path of the ultrasonic signal in the flowing fluid

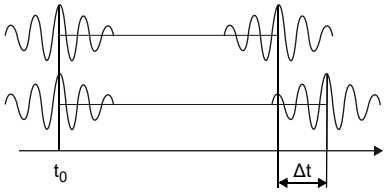


As the fluid where the ultrasound propagates is flowing, the transit time of the ultrasonic signal in flow direction is shorter than the one against the flow direction.

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.

Transit time difference Δt



Calculation of volumetric flow rate

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

where

$\dot{V}$ - volumetric flow rate

k_{Re} - fluid mechanics calibration factor

A - cross-sectional pipe area

k_a - acoustical calibration factor

Δt - transit time difference

t_γ - 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

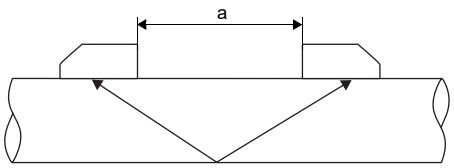
The number of sound paths is the number of transits of the ultrasonic signal through the fluid in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **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.

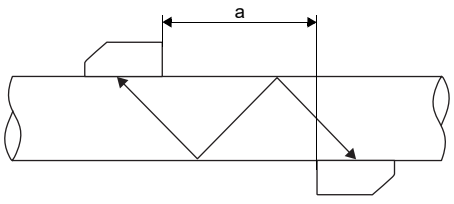
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

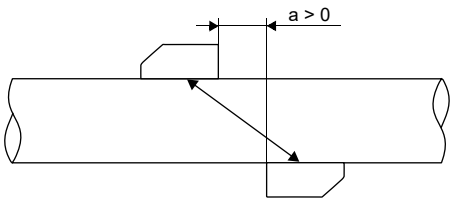
Reflect arrangement, number of sound paths: 2



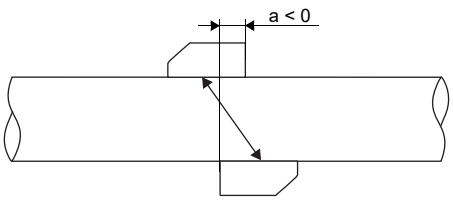
Diagonal arrangement, number of sound paths: 3



Direct mode, number of sound paths: 1



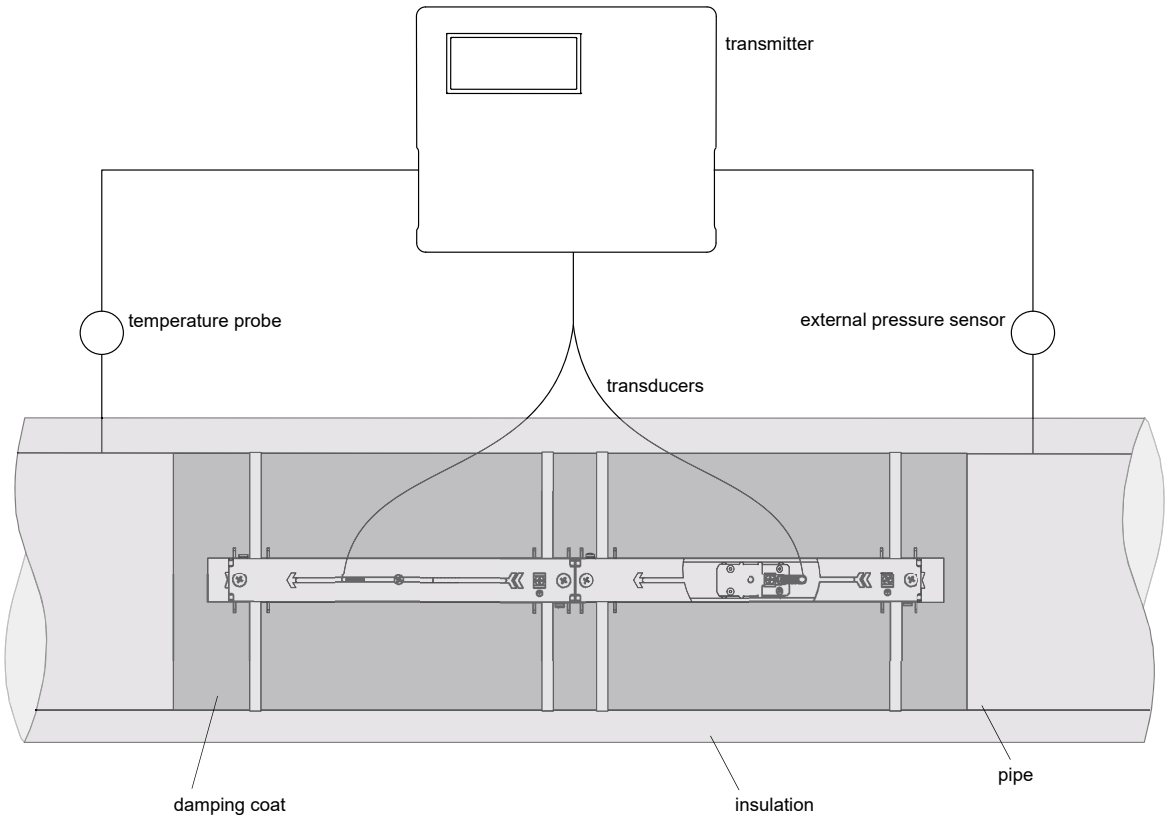
Direct mode, number of sound paths: 1, negative transducer distance



a - transducer distance

Typical measurement setup

Example of a reflect arrangement



Transmitter

Technical data

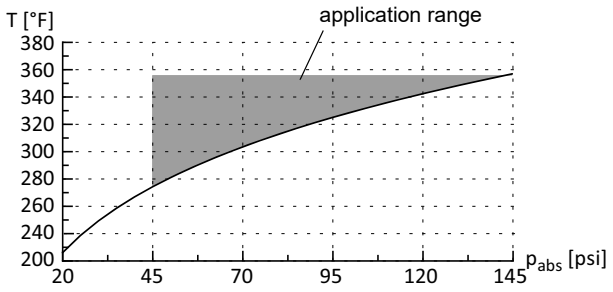
		FLUXUS G721ST-NN0*A	FLUXUS G721ST-NN0*S
			
design		standard field device	field device with stainless steel housing
application		steam measurement	
measurement			
		test measurement to validate the application required in advance	
measurement principle		transit time difference correlation principle	
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		• 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: • USB • LAN	
process interfaces		max. 1 option: • RS485 (ASCII sender) • Modbus RTU[1] • BACnet MS/TP • Profibus PA[1] • FF H1[1] • Modbus TCP[1] • BACnet IP	
accessories			
serial data kit		USB cable	
software		• 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, totalized 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 ±3 µA	
active output		R_{ext} < 350 Ω	
passive output		U_{ext} = 8 to 30 V, depending on R_{ext} (R_{ext} < 1 kΩ 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	°F	-238 to +1040	
resolution	K	0.01	
accuracy		±0.01 % of reading ±0.03 K	
• current input			
number		1 (1 measuring channel), optional: 2 (2 measuring channels)	
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	mA	0 to 20	
passive input		R_{int} = 50 Ω, P_{int} < 0.3 W	
• range	mA	-20 to +20	

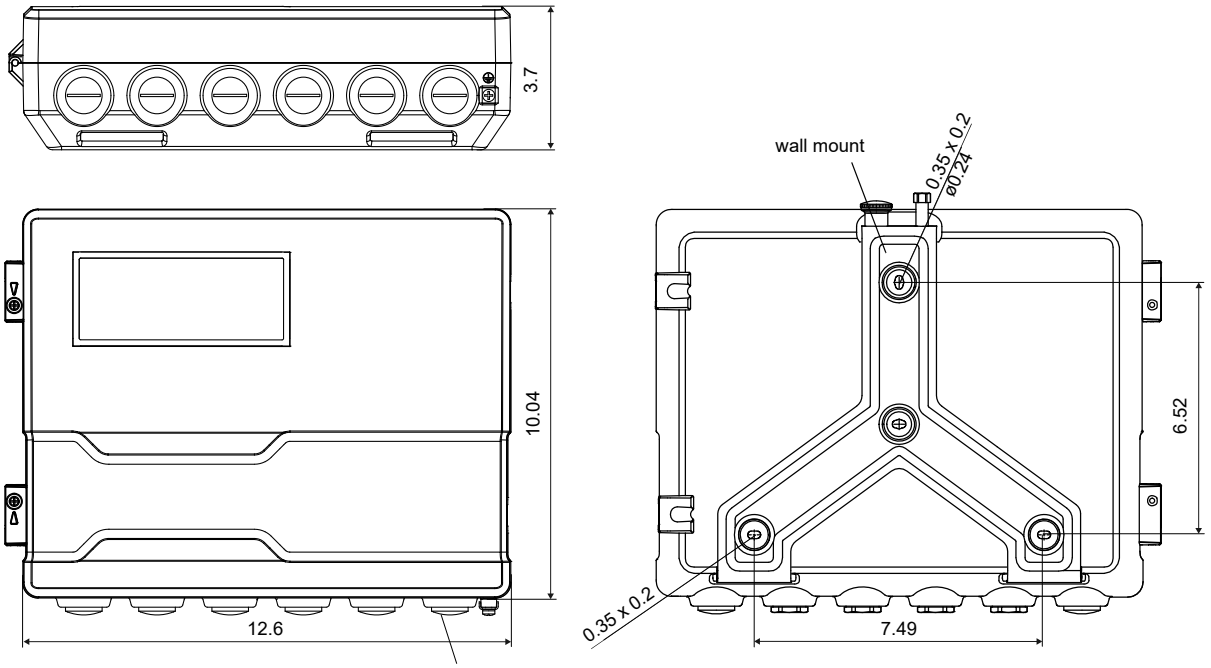
[1] with inputs and including parametrization of the transmitter

Saturated steam pressure curve



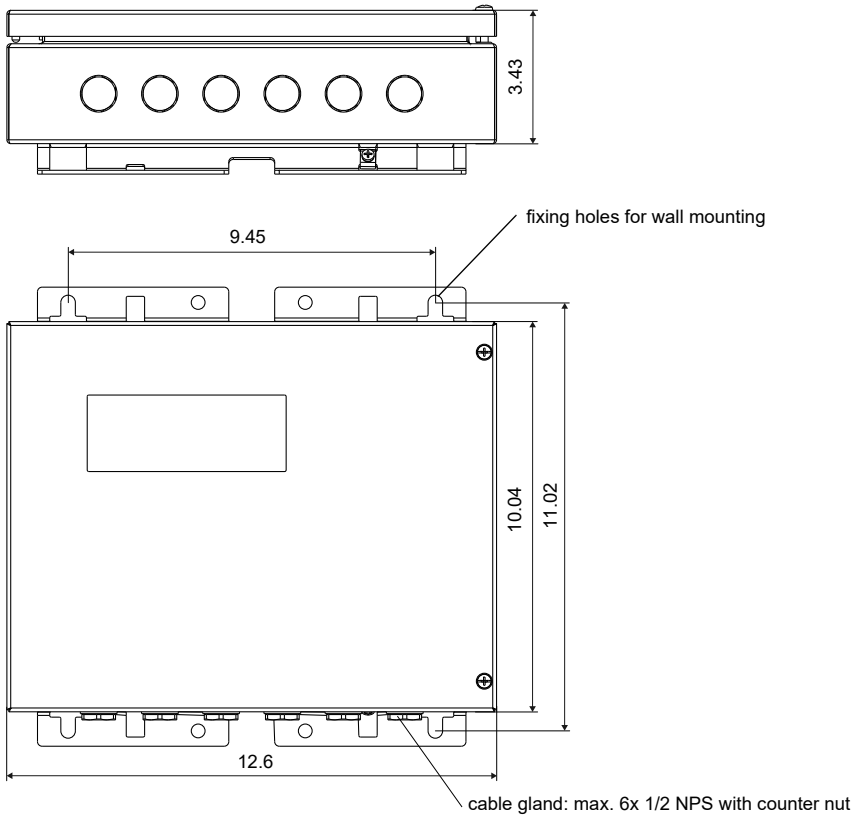
Dimensions

721**-*A**



in inch

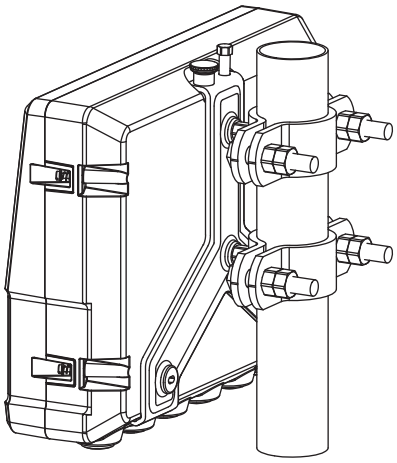
721**-*S**



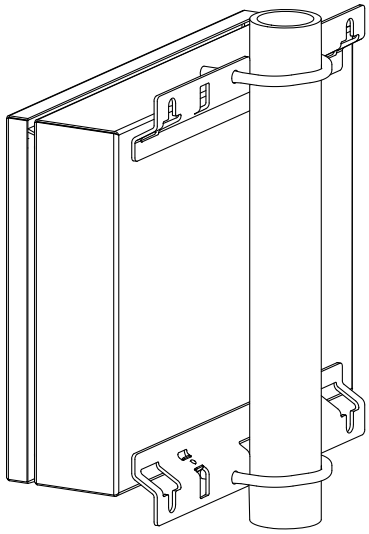
in inch

2" pipe mounting kit

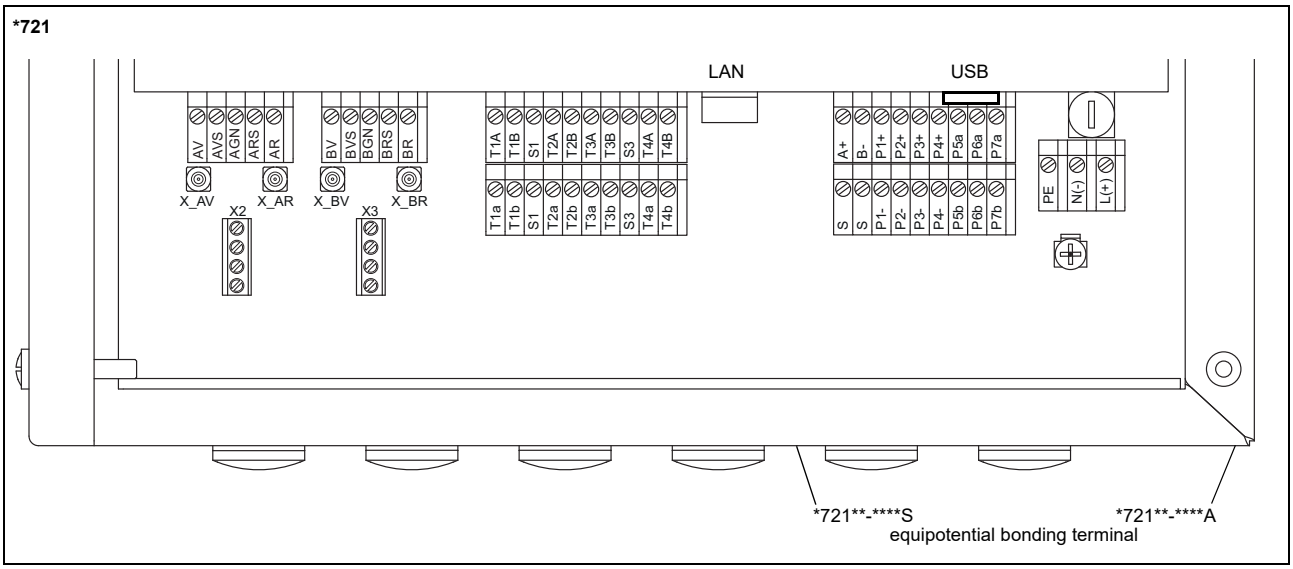
721**-*A**



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**			**measuring channel A**	**measuring channel B**	
terminal	**connection**	**terminal**	**connection**	**transducer**	**terminal**		**connection**
AV	signal	BV	signal		X_AV	X_BV	SMB connector
AVS	shield	BVS	shield				
ARS	shield	BRS	shield		X_AR	X_BR	SMB connector
AR	signal	BR	signal				

outputs[1]				
terminal	**connection**	**terminal**	**connection**	**communication interface**
P1+ to P4+ P1- to P4-	current output	A+	signal +	• RS485[1] • Modbus RTU[1] • BACnet MS/TP[1] • Profibus PA[1] • FF H1[1]
		B-	signal -	
P5a to P7a P5b to P7b	binary output	101	shield	
		USB	type B	• service (FluxDiag/ FluxDiagReader)
		LAN	RJ45	• service (FluxDiag/ FluxDiagReader) • BACnet IP • Modbus TCP

analog inputs[1]				
	temperature probe		**passive sensor**	**active sensor**
terminal	**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

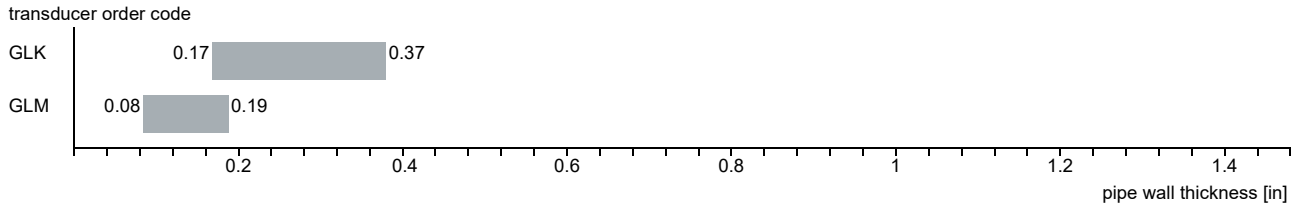
[1] cable (by customer):
- e.g., flexible leads, with insulated wire end ferrules, lead cross sectional area: AWG14 to 24
- outer diameter of the cable (*721**-****S with ferrite nut): max. 0.3 in

Transducers

Transducer selection

Step 1

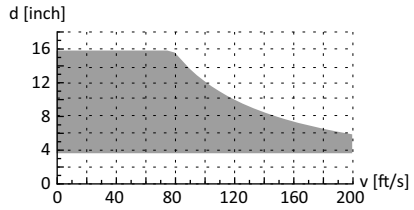
pipe wall thickness

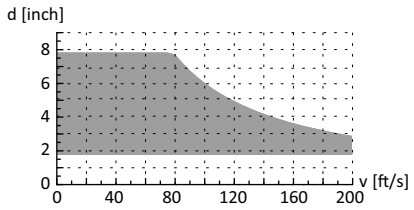


Step 2

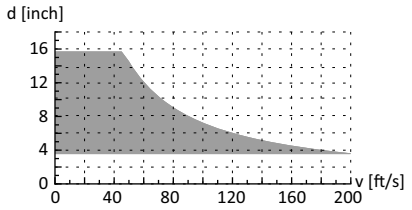
inner pipe diameter d dependent on the flow velocity v of the fluid in the pipe

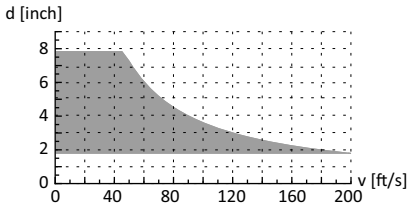
Direct mode, number of sound paths: 1



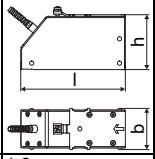
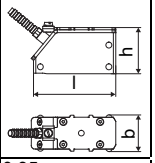


Reflect arrangement, number of sound paths: 2





Technical data

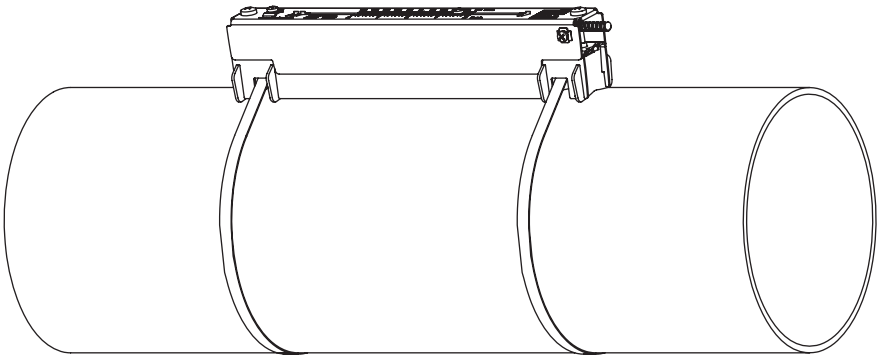
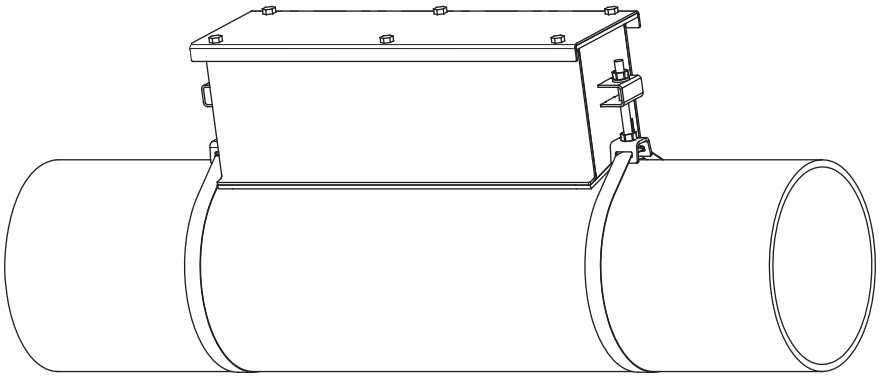
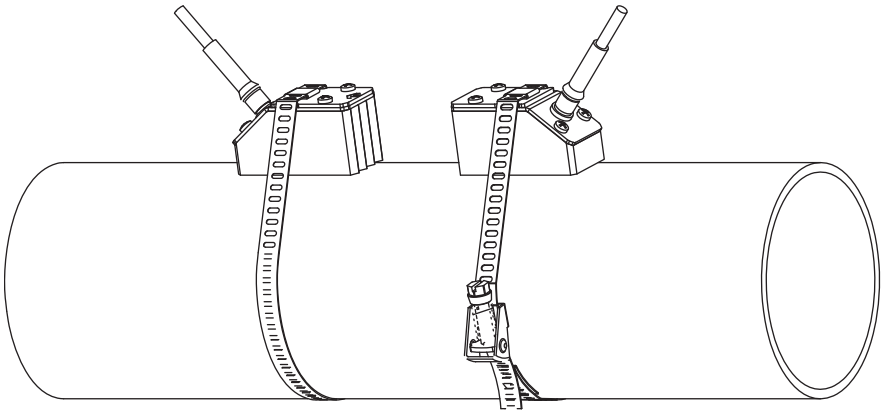
order code		GLK-SNNTS/**	GLM-SNNTS/**
technical type		G(RT)K1S52	G(RT)M1S52
transducer frequency	MHz	0.5	1
inner pipe diameter d			
min.	in	3.5	1.8
max.	in	15.7	7.9
pipe wall thickness			
min.	in	0.17	0.08
max.	in	0.37	0.19
material			
housing		PPSU with stainless steel cap 316Ti	PPSU with stainless 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 temperature[1]			
min.	°F	212	212
max.	°F	356	356
warm-up time	h	3	1
temperature com-pensation		x	x

[1] completely thermically 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**	**description**
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

PermaRail (VLK, VLM) 	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
PermaLok PL 	material: stainless steel 316
quick release clasp and tension straps 	material: stainless steel 410, 200

Coupling materials for transducers

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

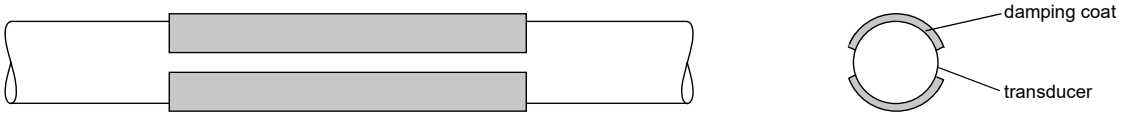
[1] fluid temperature 392 °F: min. 2 years

[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)

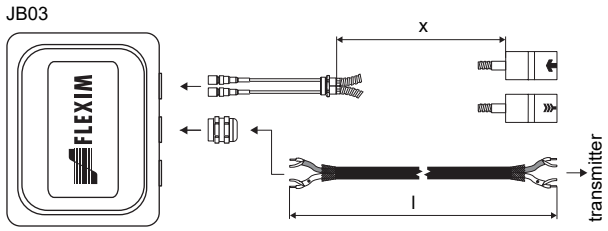
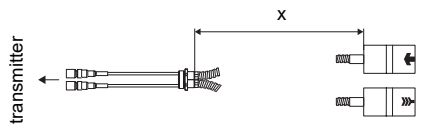


Technical data

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	l	x	l	x	l
*R***5*	ft	16	≤ 984	13	≤ 984	9	≤ 295
option LC: *L***5*	ft	29	≤ 984	29	≤ 984	29	≤ 295

x = transducer cable length

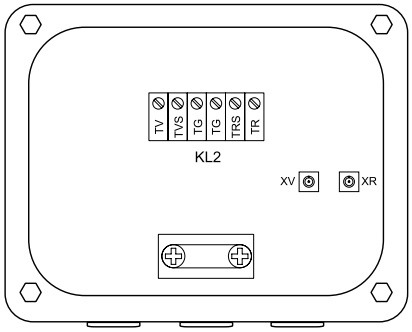
l = max. length of extension cable (depending on application)

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

Connection



Transducers

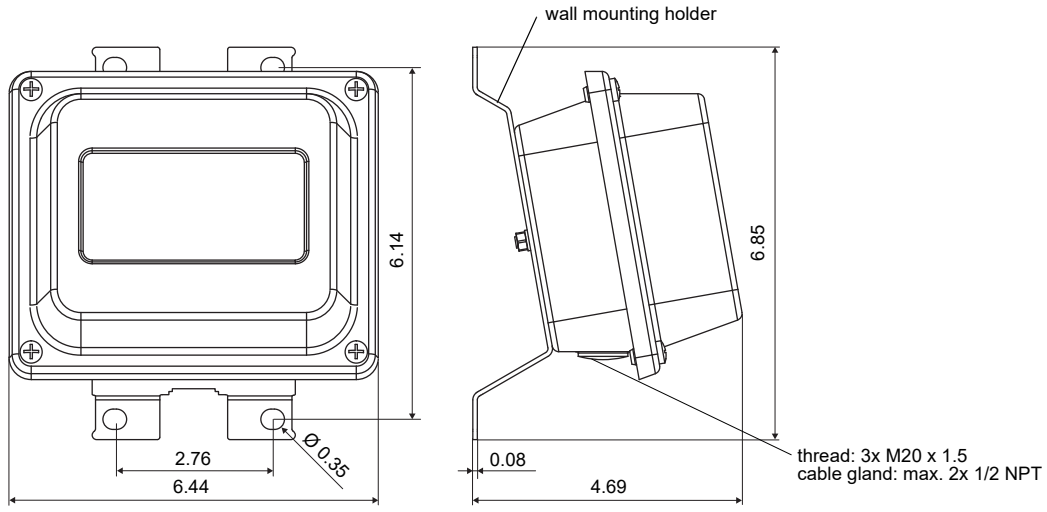
	terminal	connection	transducer
	XV	SMB connector	
	XR	SMB connector	

Extension cable

terminal strip	terminal	connection
KL2	TV	signal
	TVS	internal shield
	TRS	internal shield
	TR	signal

Dimensions

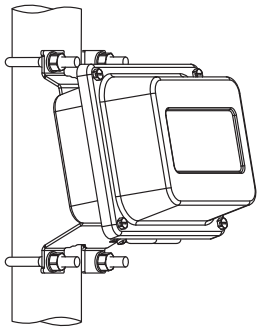
JB0*, JBP*



in inch

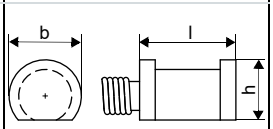
2" pipe mounting kit

JB**

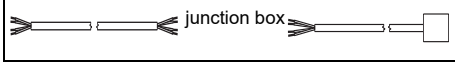


Clamp-on temperature probe (optional)

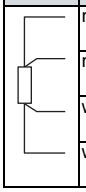
Technical data

PT13N		
design		clamp-on
type		Pt1000
connection		4-wire
measuring range	°F	-40 to +392
accuracy T		±(0.27 °F + 2 · 10^{-3} · (|T [°F]| - 32 °F)) class A
accuracy ΔT (2x Pt matched according to EN 1434-1)		≤ 0.03 °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

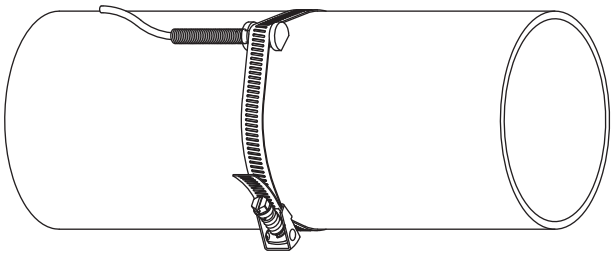
	temperature probe
	red
	red
	white
	white

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

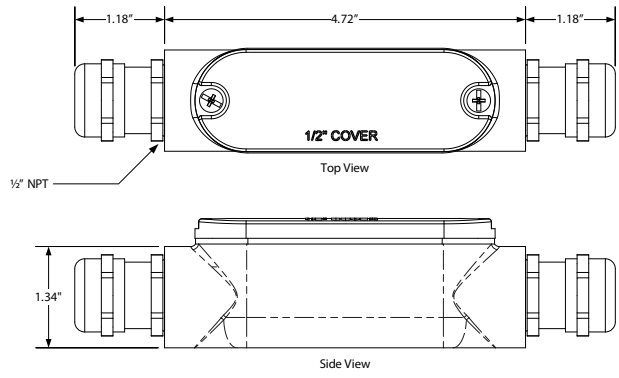
Fixation

tension strap PT13N



material: stainless steel 301, 410
thermal insulation necessary

Junction box



Connection

temperature probe	extension cable
red	white
red	black
white	green
white	red

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