Technical specification

FLUXUS G722ST-LT

Steam ultrasonic flowmeter for permanent installation

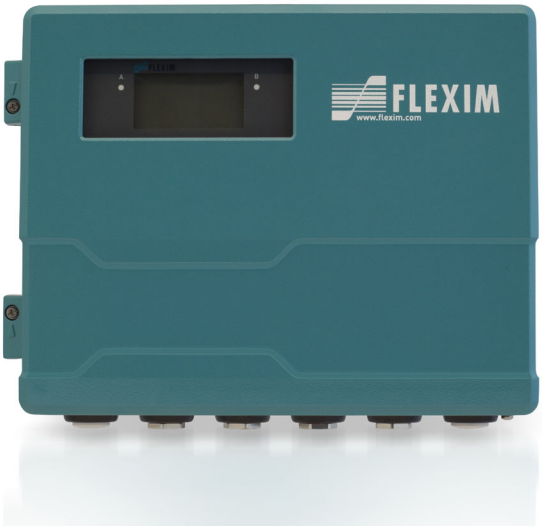
Transmitter for permanent outdoor wall or pipe mounting

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
- Synchronized channel averaging to reduce turbulence-related fluctuations of the measured value
- 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 for use in hazardous areas are available
- 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 G722ST-LT (aluminum housing)

FLUXUS G722ST-LT (stainless steel housing)

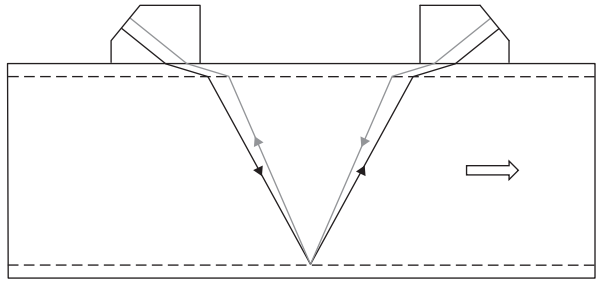
PermaRail

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

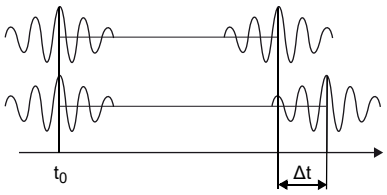


As the fluid where the ultrasound propagates is flowing, the transit time of the ultrasonic signal in flow direction is shorter than the one against the flow direction.

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 rate

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

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

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

$\rho = f(p, T)$

where

ρ - operating density

p - fluid pressure

T - fluid temperature

$\dot{m}$ - mass flow rate

$\dot{V}$ - volumetric flow rate

Number of sound paths

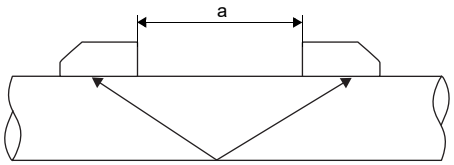
The number of sound paths is the number of transits of the ultrasonic signal through the fluid in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **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 easy.
- **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.

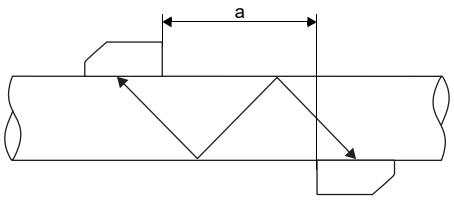
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

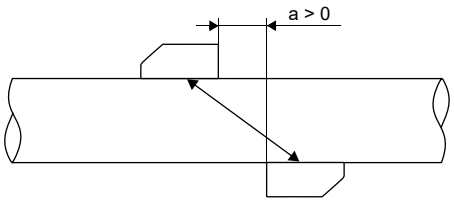
Reflect arrangement, number of sound paths: 2



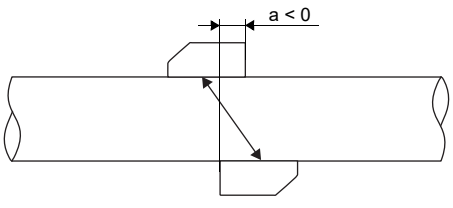
Diagonal arrangement, number of sound paths: 3



Direct mode, number of sound paths: 1



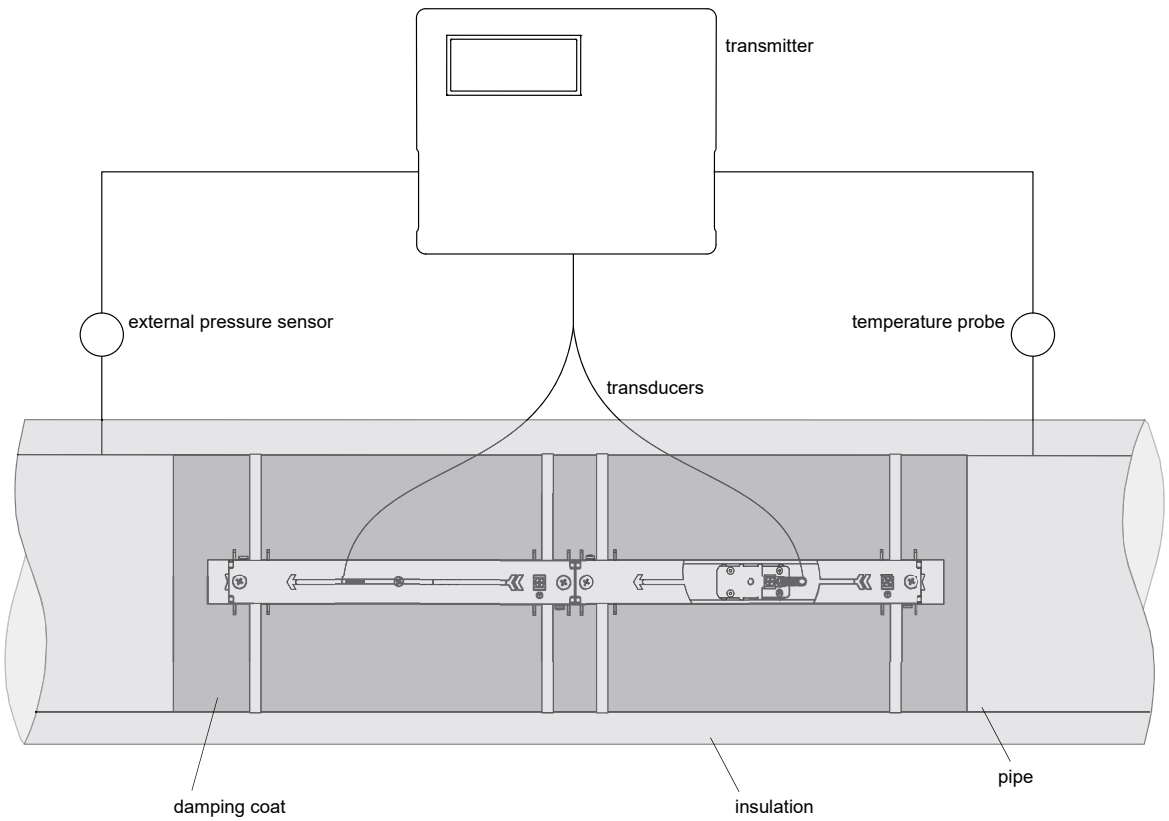
Direct mode, number of sound paths: 1, negative transducer distance



a - transducer distance

Typical measurement setup

Example of a reflect arrangement



Transmitter

Technical data

		FLUXUS G722ST-NN0*A G722ST-NN0*S	FLUXUS G722ST-A20*A G722ST-A20*S	FLUXUS G722ST-F20*A G722ST-F20*S
		 		
design		standard field device	standard field device zone 2	standard field device FM Class I Div. 2
application		steam measurement[2]		
measurement				
measurement principle		transit time difference correlation principle		
synchronized channel averaging		x (2 measuring channels necessary)		
flow velocity	ft/s	depending on pipe diameter and transducer, see diagrams		
repeatability		0.15 % MV ±0.02 ft/s		
fluid		saturated steam, superheated steam		
fluid pressure	psia	44 to 145		
fluid temperature	°F	275 to 356	275 to 311 (see pipe surface temperature (Ex) of selected transducer)	275 to 329
temperature compensation		corresponding to the recommendations in ANSI/ASME MFC-5.1-2011		
measurement uncertainty (volumetric flow rate)				
measurement uncertainty of the measuring system[1]		±0.3 % MV ±0.02 ft/s includes calibration certificate traceable to NIST		
measurement uncertainty at the measuring point		±1 to 3 % MV ±0.02 ft/s, depending on the 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 or stainless steel 316L		
degree of protection		IP66		aluminum housing: IP66/NEMA 4X stainless steel housing: IP65
dimensions	inch	see dimensional drawing		
weight	lb	aluminum housing: 11.9 stainless steel housing: 11.2		
fixation		wall mounting, optional: 2" pipe mounting		
ambient temperature	°F	-40 to +140 (< -4 °F without operation of the display)		aluminum housing: -40 to +131/140 (< -4 °F without operation of the display) stainless steel housing: -4 to +131/140
display		128 x 64 pixels, backlight		
menu language		English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian		
explosion protection				
• ATEX/IECEx				
marking		-	CE 0637 Ex II3G II2D Ex nA nC ic IIC T4 Gc Ex tb IIIC T120 °C Db T_a -40...+60 °C	-
certification ATEX		-	IBExU11ATEX1015	-
certification IECEx		-	IECEx IBE 11.0008	-
• FM				
marking		-	-	G721**-F20*S2, G721**-F20*S3: FM APPROVED NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 G721**-F20*S1: FM APPROVED NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A

[1] with aperture calibration of the transducers

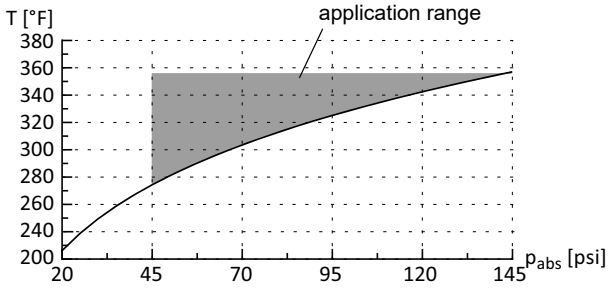
[2] test measurement to validate the application required in advance

		FLUXUS G722ST-NN0*A G722ST-NN0*S	FLUXUS G722ST-A20*A G722ST-A20*S	FLUXUS G722ST-F20*A G722ST-F20*S
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 • BACnet MS/TP • Profibus PA • FF H1 • Modbus TCP • BACnet IP		
accessories				
data transmission kit		USB cable		
software		• FluxDiagReader: reading of measured values and parameters, graphical presentation • FluxDiag (optional): reading of measurement data, graphical presentation, report generation, parametrization of the transmitter		
data logger				
loggable values		all physical quantities, totalized physical quantities and diagnostic values		
capacity		max. 800 000 measured values		
outputs				
		The outputs are galvanically isolated from the transmitter.		
• switchable current output				
		All switchable current outputs are jointly switched to active or passive.		
number		2 (1 measuring channel), optional: 4 (2 measuring channels)		
range	mA	4 to 20 (3.2 to 22)		
accuracy		0.04 % MV ±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)		
• digital output				
functions		• frequency output • binary output • pulse output		
number		3		
operating parameters		5 to 30 V/< 100 mA		
frequency output				
• range	kHz	0 to 5		
binary output				
• binary output as alarm output		limit, change of flow direction or error		
pulse output				
• functions		mainly for totalizing		
• pulse value	units	0.01 to 1000		
• pulse width	ms	0.05 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 % MV ±0.03 K		
• current input				
number		1 (1 measuring channel), optional: 2 (2 measuring channels)		
accuracy		0.1 % MV ±10 µA		
active input • range	mA	U_{int} = 24 V, R_{int} = 50 Ω, P_{int} < 0.5 W, not short-circuit proof 0 to 20		
passive input • range	mA	R_{int} = 50 Ω, P_{int} < 0.3 W -20 to +20		

[1] with aperture calibration of the transducers

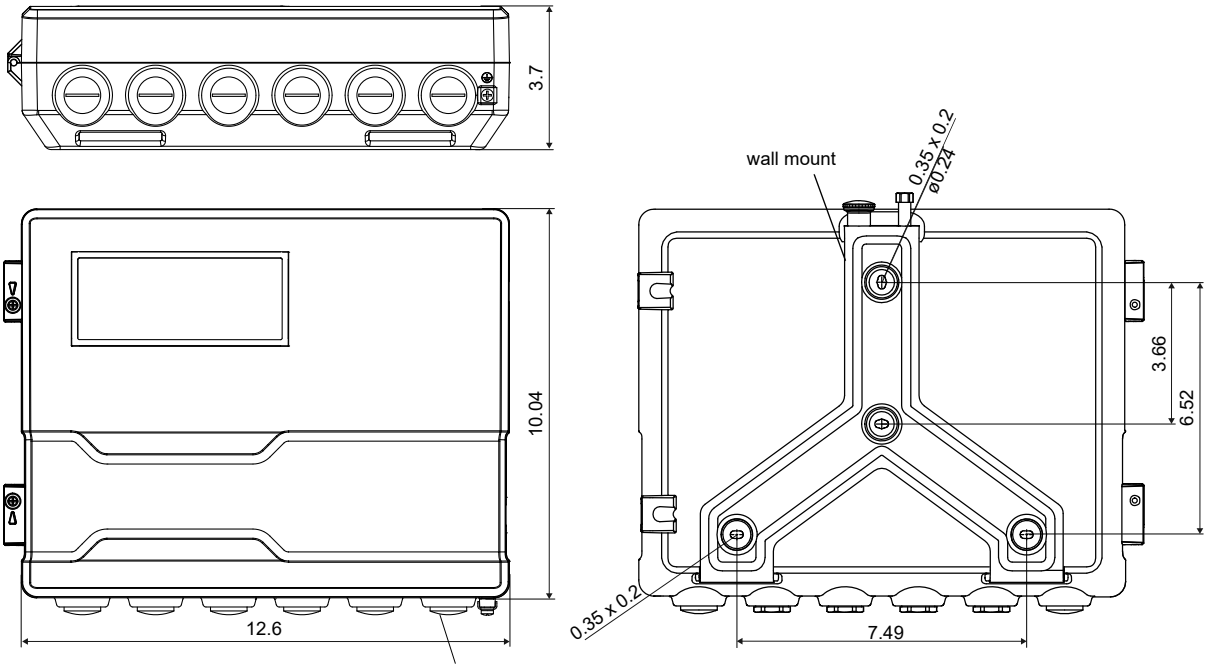
[2] test measurement to validate the application required in advance

Saturated steam pressure curve



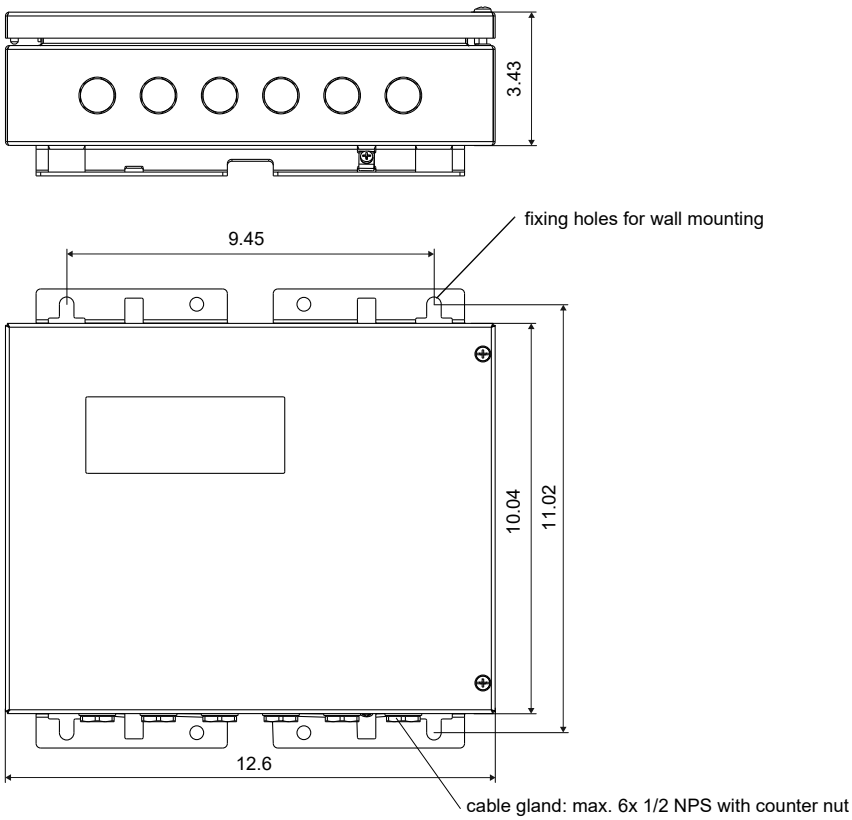
Dimensions

72-****A**



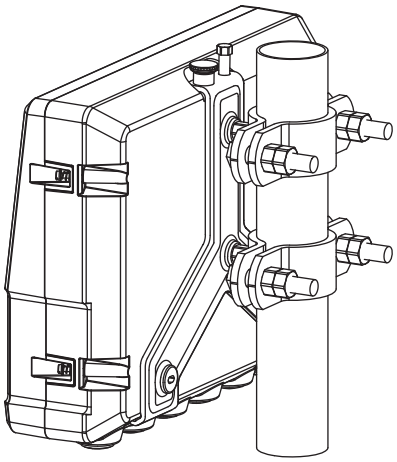
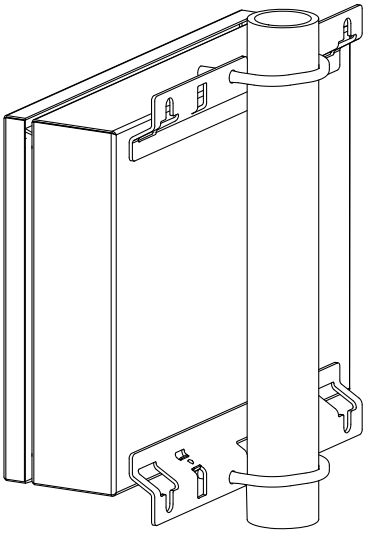
in inch

72-****S**

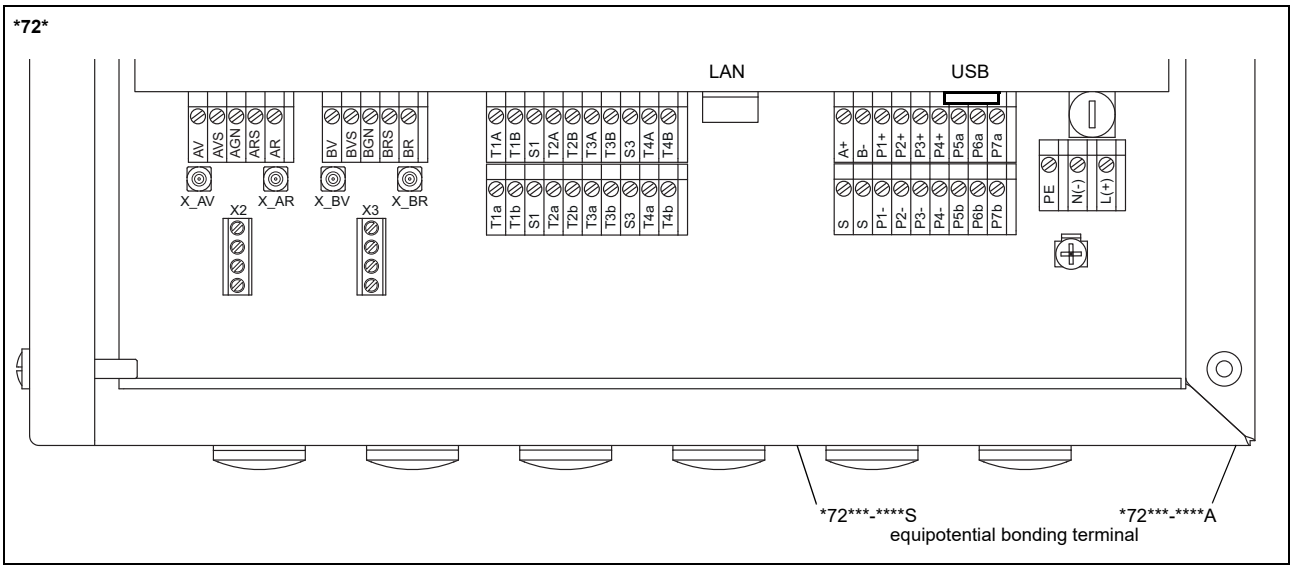


in inch

2" pipe mounting kit

72-****A** 	order code: ACC-PE-*721-/PMK4
72-****S** 	order code: ACC-PE-*721-/PMK6

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**
P1+ to P4+ P1- to P4-	current output
P5a to P7a P5b to P7b	digital output

terminal	**connection**	**communication interface**
A+	signal +	• RS485[1] • Modbus RTU[1] • BACnet MS/TP[1] • Profibus PA[1] • FF H1[1]
B-	signal -	
101	shield	
USB	type B Hi-Speed USB 2.0 Device	• service (FluxDiag/ FluxDiagReader)
LAN	RJ45 10/100 Mbps Ethernet	• 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	shield	shield	not connected	not connected

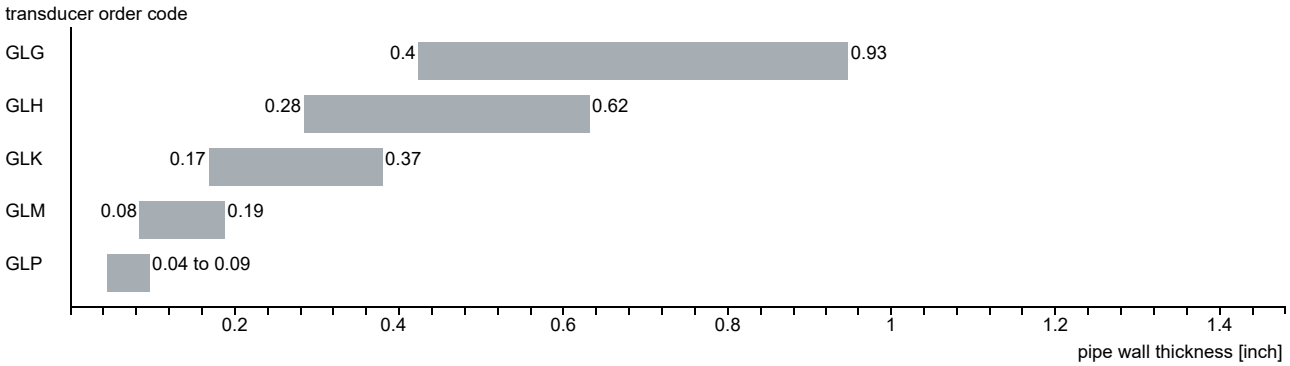
[1] cable (by customer):
- e.g., flexible wires, with insulated wire ferrules, wire cross-section: AWG14 to 24
- outer diameter of the cable (*72***-****S with ferrite nut): max. 0.3 inch

Transducers

Transducer selection

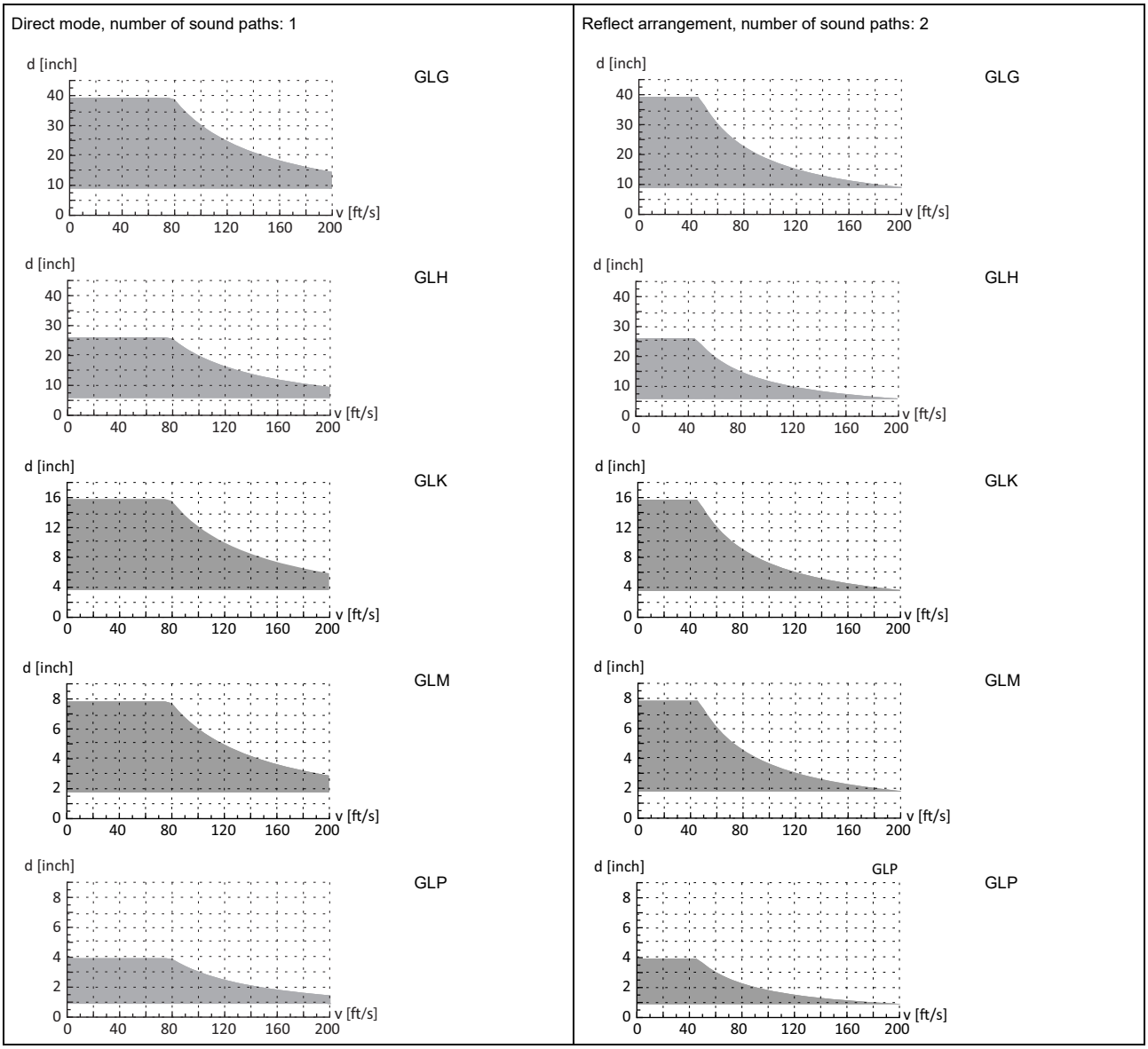
Step 1

pipe wall thickness



Step 2

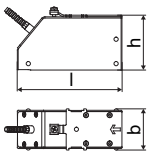
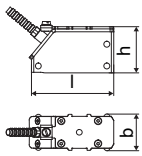
inner pipe diameter d dependent on the flow velocity v of the fluid in the pipe



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

Technical data

Lamb wave transducers (zone 2 - FM Class I Div. 2 - nonEx, steam measurement, TS)

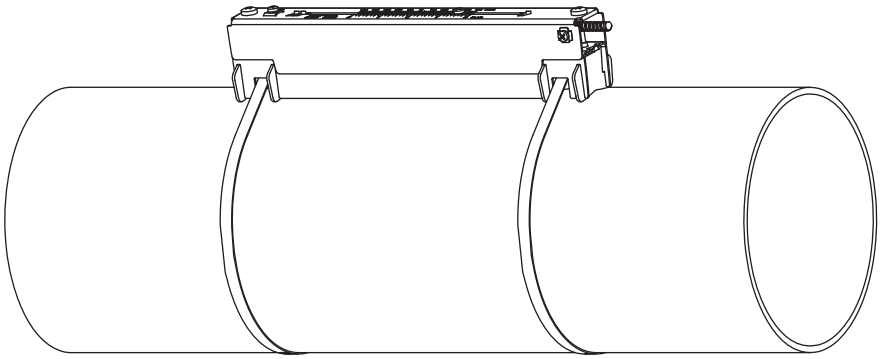
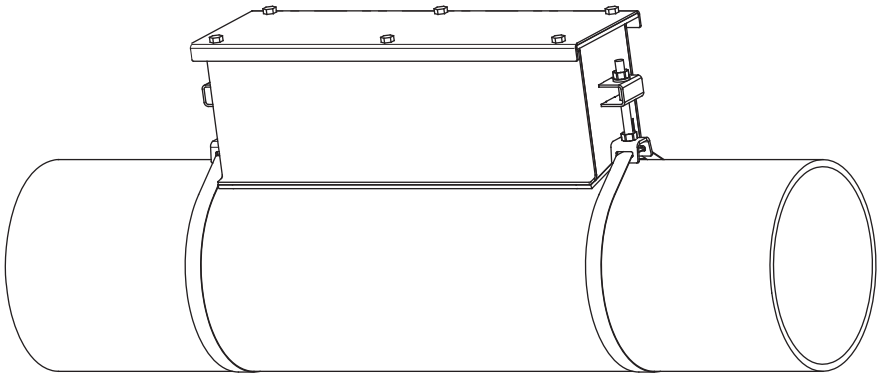
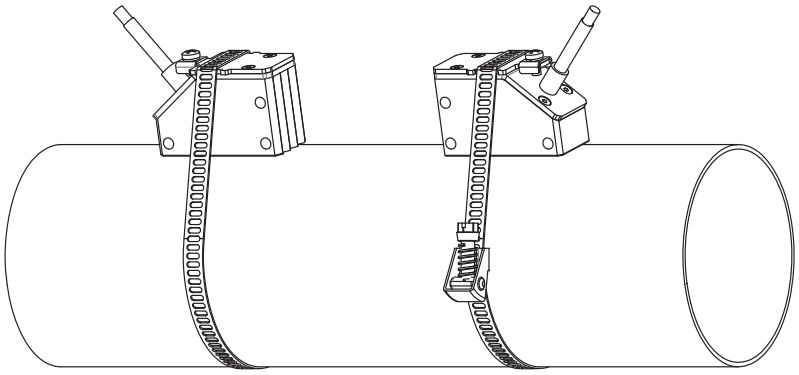
order code		GLG-S**TS/**	GLH-S**TS/**	GLK-S**TS/**	GLM-S**TS/**	GLP-SNNTS/**
technical type		G(RT)G1S52	G(RT)H1S52	G(RT)K1S52	G(RT)M1S52	G(RT)P1S52
transducer frequency	MHz	0.2	0.3	0.5	1	2
fluid pressure		see saturated steam pressure curve				
inner pipe diameter d						
min.	inch	8.9	5.9	3.5	1.8	0.91
max.	inch	39.4	26.3	15.7	7.9	3.9
pipe wall thickness						
min.	inch	0.42	0.28	0.17	0.08	0.04
max.	inch	0.93	0.62	0.37	0.19	0.09
material						
housing		PPSU with stainless steel cover 316Ti				
contact surface		PPSU				
degree of protection		IP65				
transducer cable						
type		1699				
length	ft	16			13	
length (***-*****/LC)	ft	29			29	
dimensions						
length l	inch	5.06			2.91	
width b	inch	2.01			1.3	
height h	inch	2.66			1.59	
dimensional drawing						
weight (without cable)	lb	1.8			0.35	
storing temperature						
min.	°F	-40				
max.	°F	+356				
operating temperature[1]						
min.	°F	212				
max.	°F	356				
warm-up time	h	3			1	
temperature compensation		x				
explosion protection						
• ATEX/IECEx						
order code		GLG-SA2TS/**	GLH-SA2TS/**	GLK-SA2TS/**	GLM-SA2TS/**	-
pipe surface temperature (Ex)						
• min.	°C	-50				-
• max.	°C	gas: +165, dust: +155				-
marking		CE 0637 Ex II3G II2D Ex nA IIC T6...T3 Gc Ex tb IIIC T80 °C...T160 °C Db				-
certification ATEX		IBExU10ATEX1163 X				-
certification IECEx		IECEx IBE 12.0005X				-
• FM						
order code		GLG-SF2TS/**	GLH-SF2TS/**	GLK-SF2TS/**	GLM-SF2TS/**	-
pipe surface temperature (Ex)						
• min.	°F	-40				-
• max.	°F	+329				-
degree of protection		IP66				-
marking		FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860				-

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 G, H, K
	M									transducers with transducer frequency M, P
			D							reflect arrangement or diagonal arrangement/direct mode
			R							reflect arrangement
				S						small
				L						large
						S				tension straps
							T36			1.6 to 14.2 inch
							013			0.39 to 5.1 inch
							036			5.1 to 14.2 inch
							092			14.2 to 36.2 inch
							200			36.2 to 78.7 inch
							450			78.7 to 177.2 inch
							SK1			0.5 to 2.5 inch
							SK2			3 to 6 inch
							SK3			8 to 10 inch
							SK4			12 to 18 inch
							SK5			20 to 36 inch
							SK6			42 to 100 inch
									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 inch, **VLM**: 9.2 inch dimensions: **VLK**: 16.65 x 3.54 x 3.66 inch **VLM**: 12.17 x 2.24 x 2.48 inch
PermaLok PL 	material: stainless steel 316 dimensions: **PLK-RL**: 19.25 x 3.9 x 3.95 inch **PLK-DS**: 13.25 x 3.85 x 3.95 inch **PLM**: 25.25 x 3.08 x 3.15 inch **PLQ**: 13.37 x 2.68 x 2.4 inch weight: **PLK-RL**: 6 lb **PLK-DS**: 4.2 lb **PLM**: 6.6 lb **PLQ**: 2.8 lb
quick release clasps 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

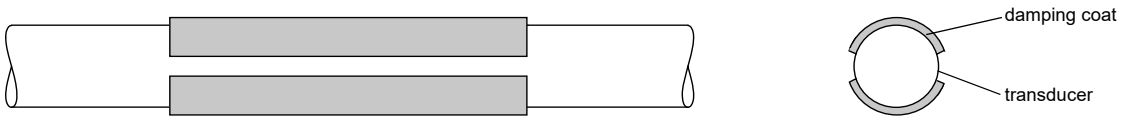
[1] fluid temperature 392 °F: min. 2 years

[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

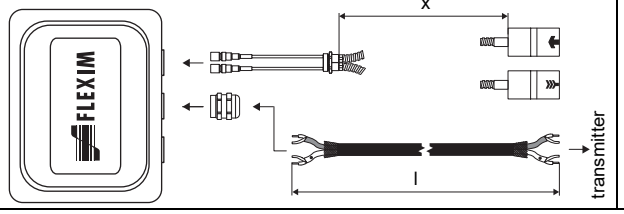
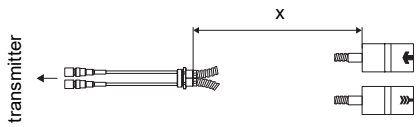
order code		ACC-PE-GNNN-/DPL1
material		multipolymeric matrix/inorganic ceramic coating
packing drum	gal	1
properties		heat resistant, inert
fluid temperature when applying	°F	50 to 392
drying time (example)		approx. 3 h at 68 °F approx. 15 min at 302 °F
temperature resistance in dry state	°F	max. 1202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

Observe installation instructions (TI_DampingCoat).

Dimensioning

transducer frequency	**number of packing drums**		
	outer pipe diameter		
	≤11.8	≤19.7	≤27.6
	inch		
G	1	1	2
H	1	1	1
K	1	1	-
M	1	-	-
P	1	-	-

Connection systems

connection system TS		
connection with extension cable	direct connection	transducers technical type
JB02, JB03, JB04 		*****52

Cable

transducer cable		
type		**1699**
weight	lb/ft	0.06
ambient temperature	°F	-67 to +392
cable jacket		
material		PTFE
outer diameter	inch	0.11
thickness	inch	0.01
color		brown
shield		x
sheath		
material		stainless steel 316Ti
outer diameter	inch	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	inch	max. 0.47	max. 0.47
thickness	inch	0.08	0.08
color		black	black
shield		x	x
sheath			
material		-	steel wire braid with copolymer sheath
outer diameter	inch	-	max. 0.61

Cable length

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

x = transducer cable length

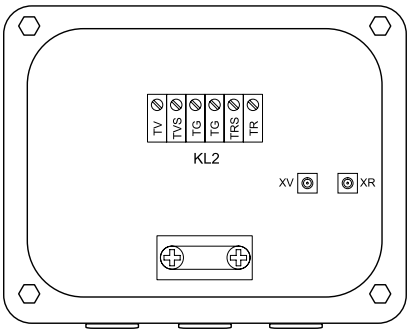
l = max. length of extension cable (depending on the application)

Junction box

Technical data

JB02, JB03, JB04		
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
explosion protection		
• **ATEX**		
junction box		JB02
marking		CE Ex II3G Ex nA IIC (T6)...T4 Gc II3D Ex tc IIIC T 100 °C Dc Ta -40...+(70)80 °C
• **FM**		
junction box		JB04
marking		FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ T6 Ta = -40...+60 °C

Connection



Transducers

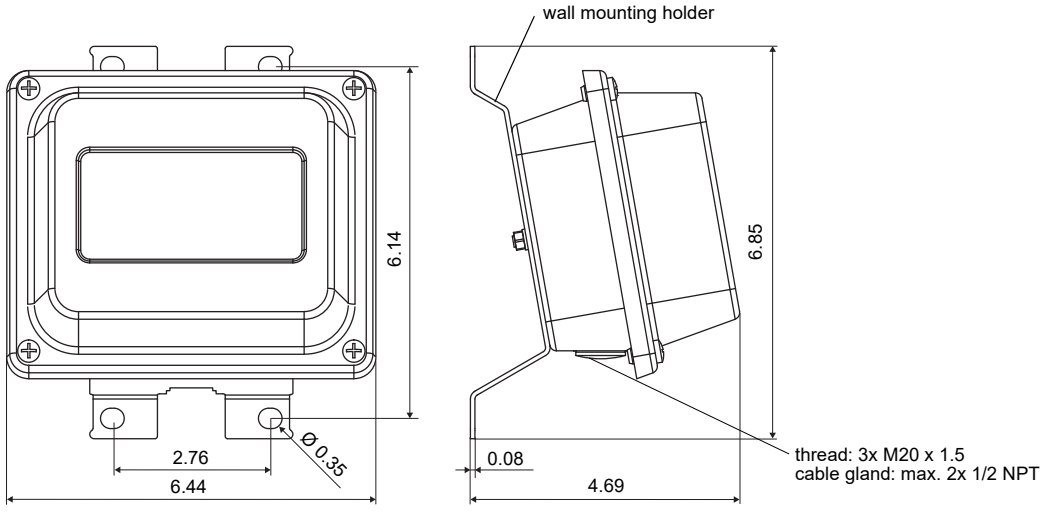
	terminal	connection	transducer
	XV	SMB connector	
	XR	SMB connector	

Extension cable

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

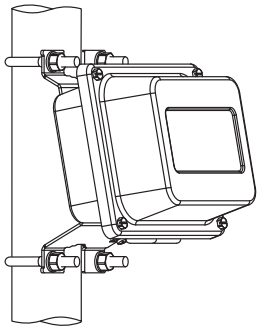
Dimensions

JB0*, JBP*



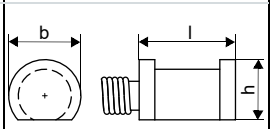
in inch

2" pipe mounting kit

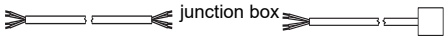
JB** 	order code: ACC-PE-GNNN-/JBPMK4

Clamp-on temperature probe (optional)

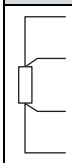
Technical data

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	inch	0.79
width b	inch	0.59
height h	inch	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

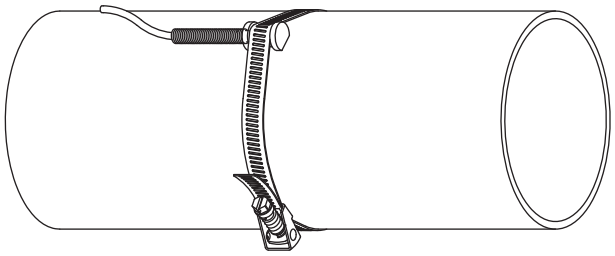
	temperature probe
	red
	red
	white
	white

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

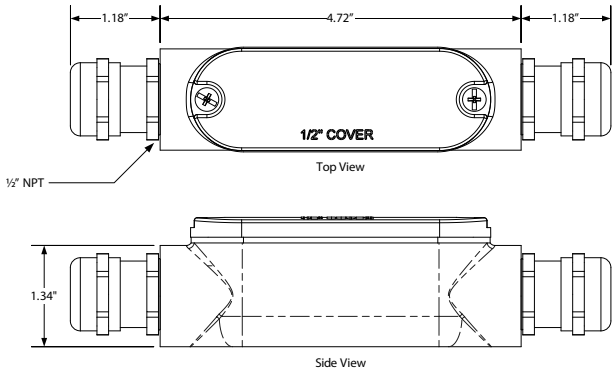
Fixation

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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