

Permanently installed clamp-on ultrasonic measuring system for extremely low flows

Features and advantages

- Meter installation and start-up do not require any pipe work nor any process interruptions
- Extra low flow measurement system optimized for pipe sizes 0.39 to 2 inches
- Achieved accuracy of 1 % MV \pm 0.002 ft/s on extreme low flows – 1 gph and below – independent of wall thickness
- Matched transducers, advanced digital signal processing (DSP) and efficient algorithms ensure stable measurements at very low flows
- System calibration: transmitter and transducers calibrated together for improved low flow accuracy
- Automatic loading of calibration data and transducer recognition
- Bidirectional communication and support of common bus technologies (Profibus PA, Foundation Fieldbus, HART, Modbus, BACnet)
- Advanced self-diagnosis and possibilities for event-based triggering of data recording for the supervision and control of critical processes
- Rugged and hazardous area approved transducers and transmitters ATEX/IECEX zone 1/2, FM Class I Div. 1/2 (see also Technical specification F80xLF)
- Available in aluminum and stainless steel housing

Applications

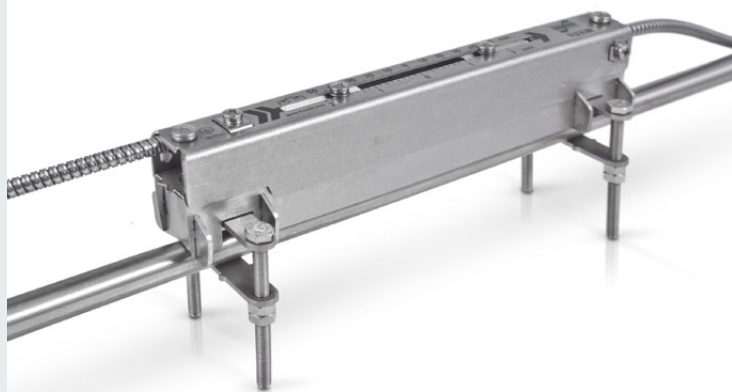
- Chemical injection for oil and gas
- Oil and gas exploration and production
- Chemical dosing in water and wastewater treatment
- Paint spray lines
- Pulp and paper industry
- Chemical and petrochemical industry
- Semiconductor industry



FLUXUS F721LF-****AL



FLUXUS F721LF-****ST



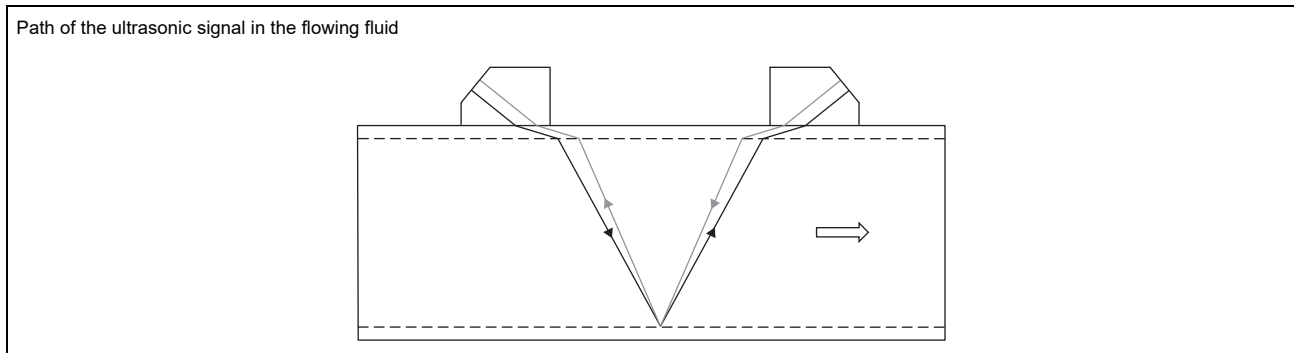
PermaRail with bolt mounting plates

Function	3
Measurement principle	3
Calculation of volumetric flow rate	3
Number of sound paths	4
Transmitter	5
Technical data	5
Diagrams	7
Dimensions	8
2" pipe mounting kit	9
Storage	9
Terminal assignment	10
Transducers	11
Technical data	11
Transducer mounting fixture	12
Coupling materials for transducers	13
Connection systems	14
Junction box	15
Technical data	15
Dimensions	16
2" pipe mounting kit	16
Clamp-on temperature probe (optional)	17
Technical data	17
Fixation	18
Junction box	18

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.

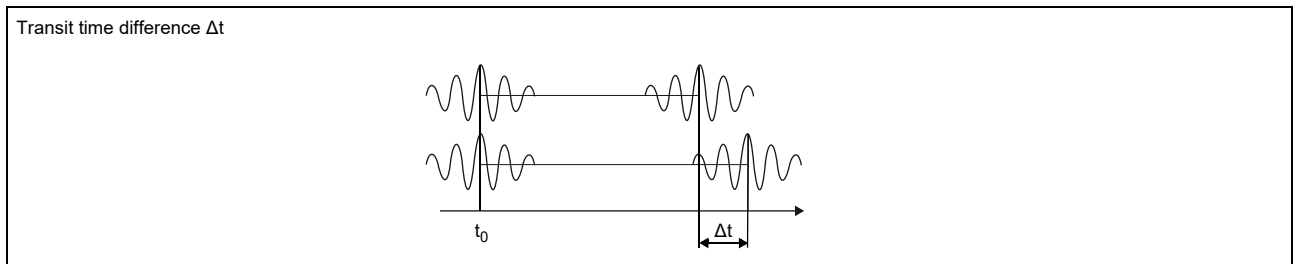


Transit time difference principle

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 mechanic calibration factor
- A - cross-sectional pipe area
- k_a - acoustic calibration factor
- Δt - transit time difference
- t_y - average of transit times in the fluid

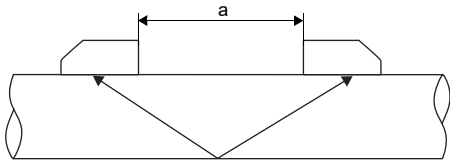
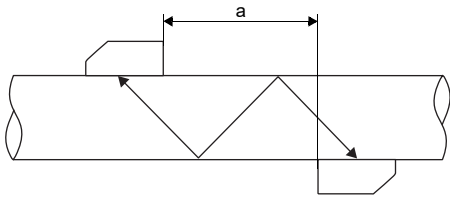
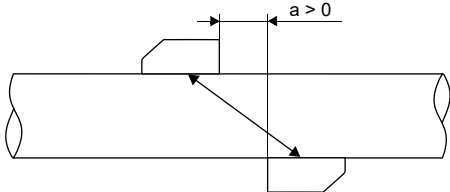
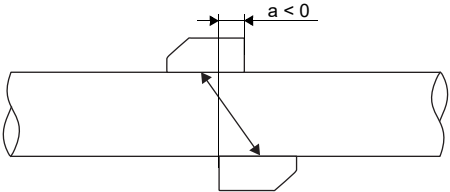
Number of sound paths

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. 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

Transmitter

Technical data

	FLUXUS F721LF-NNN**.*AL F721LF-NNN**.*ST	FLUXUS F721LF-A2N**.*AL F721LF-A2N**.*ST	FLUXUS F721LF-F2N**.*AL F721LF-F2N**.*ST
			
design	standard field device	field device with stainless steel housing zone 2	field device with stainless steel housing FM Class I Div. 2
application	eXtreme Low Flow (XLF) measurement for liquids		
measurement			
measurement principle	transit time difference correlation principle		
flow direction	bidirectional		
flow	depending on pipe diameter, see diagrams		
flow velocity	depending on pipe diameter, see diagrams		
repeatability	0.15 % MV ±0.002 ft/s ¹		
Reynolds number	< 1 000		
fluid	all acoustically conductive liquids with < 2 % gaseous or solid content in volume		
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5.1-2011		
measurement uncertainty (volumetric flow rate)			
measurement uncertainty of the measuring system	±0.3 % MV ±0.002 ft/s ¹		
measurement uncertainty at the measuring point	±1 % MV ±0.002 ft/s ¹		
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	
damping	s	0 to 100 (adjustable)	
measuring cycle	Hz	100 to 1000	
response time	s	1	
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 without operation of the display)	aluminum housing: -40 to +131/140 (< -4 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, Chinese	
explosion protection			
• ATEX/IECEx			
marking	-	F721**-A20*A, F721**-A20*S: CE 0637  II3G II2D Ex nA nC ic IIC T4 Gc Ex tb IIIC T120 °C Db T _a -40...+60 °C	-
certification	-	IBExU11ATEX1015, IECEx IBE 11.0008	-
• FM			
marking	-	-	F721**-F20**2, F721**-F20**3:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 F721**-F20**1:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A

¹ with LowFlow reference conditions (water: 68 °F, number of sound paths: 8, inner pipe diameter: 0.52 inch (other diameters see diagrams))

² outside the explosive atmosphere (housing cover open)

		FLUXUS F721LF-NNN**.*AL F721LF-NNN**.*ST	FLUXUS F721LF-A2N**.*AL F721LF-A2N**.*ST	FLUXUS F721LF-F2N**.*AL F721LF-F2N**.*ST
measuring functions				
physical quantities		volumetric flow rate, mass flow rate, flow velocity		
totalizer		volume, mass		
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 ² • LAN ²		
process interfaces		max. 1 option: • RS485 (ASCII sender) • Modbus RTU • BACnet MS/TP • HART • Profibus PA • FF H1 • Modbus TCP • BACnet IP	max. 1 option: • RS485 (ASCII sender) • Modbus RTU • BACnet MS/TP • HART • Profibus PA • FF H1 • Modbus TCP • BACnet IP	max. 1 option: • RS485 (ASCII sender) • Modbus RTU • BACnet MS/TP • HART • Profibus PA • FF H1 • Modbus TCP • BACnet IP
accessories				
data transmission kit		USB cable		
software		• FluxDiagReader: reading of measured values and parameters, graphical representation • FluxDiag (optional): reading of measurement data, graphical representation, report generation, parametrization of the transmitter		
data logger				
loggable values		all physical quantities, totaled physical quantities and diagnostic values		
capacity		max. 800 000 measured values		
outputs				
		The outputs are galvanically isolated from the transmitter.		
number		on request		
• switchable current output				
		All switchable current outputs are jointly switched to active or passive.		
range	mA	4 to 20 (3.2 to 22)		
accuracy		0.04 % MV ±3 µA		
active output		R _{ext} < 250 Ω		
passive output		U _{ext} = 8 to 30 V, depending on R _{ext} (R _{ext} < 1 kΩ at 30 V)		
• HART				
range	mA	4 to 20		
accuracy		0.1 % MV ±15 µA		
active output		U _{int} = 24 V, R _{ext} < 500 Ω		
passive output		U _{ext} = 10 to 24 V DC, depending on R _{ext} (R _{ext} < 1 kΩ at 24 V)		
• voltage output				
range	V	0 to 1 or 0 to 10		
accuracy		0 to 1 V: 0.1 % MV ±1 mV 0 to 10 V: 0.1 % MV ±10 mV		
internal resistance		R _{int} = 500 Ω		
• frequency output				
range	kHz	-	0 to 5	-
optorelay		-	24 V/4 mA, R _{int} = 66.5 Ω	-
• 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.		
number		max. 4, on request		
• temperature input				
type		Pt100/Pt1000		
connection		4-wire		
range	°F	-238 to +1040		
resolution	K	0.01		
accuracy		±0.01 % MV ±0.03 K		

¹ with LowFlow reference conditions (water: 68 °F, number of sound paths: 8, inner pipe diameter: 0.52 inch (other diameters see diagrams))

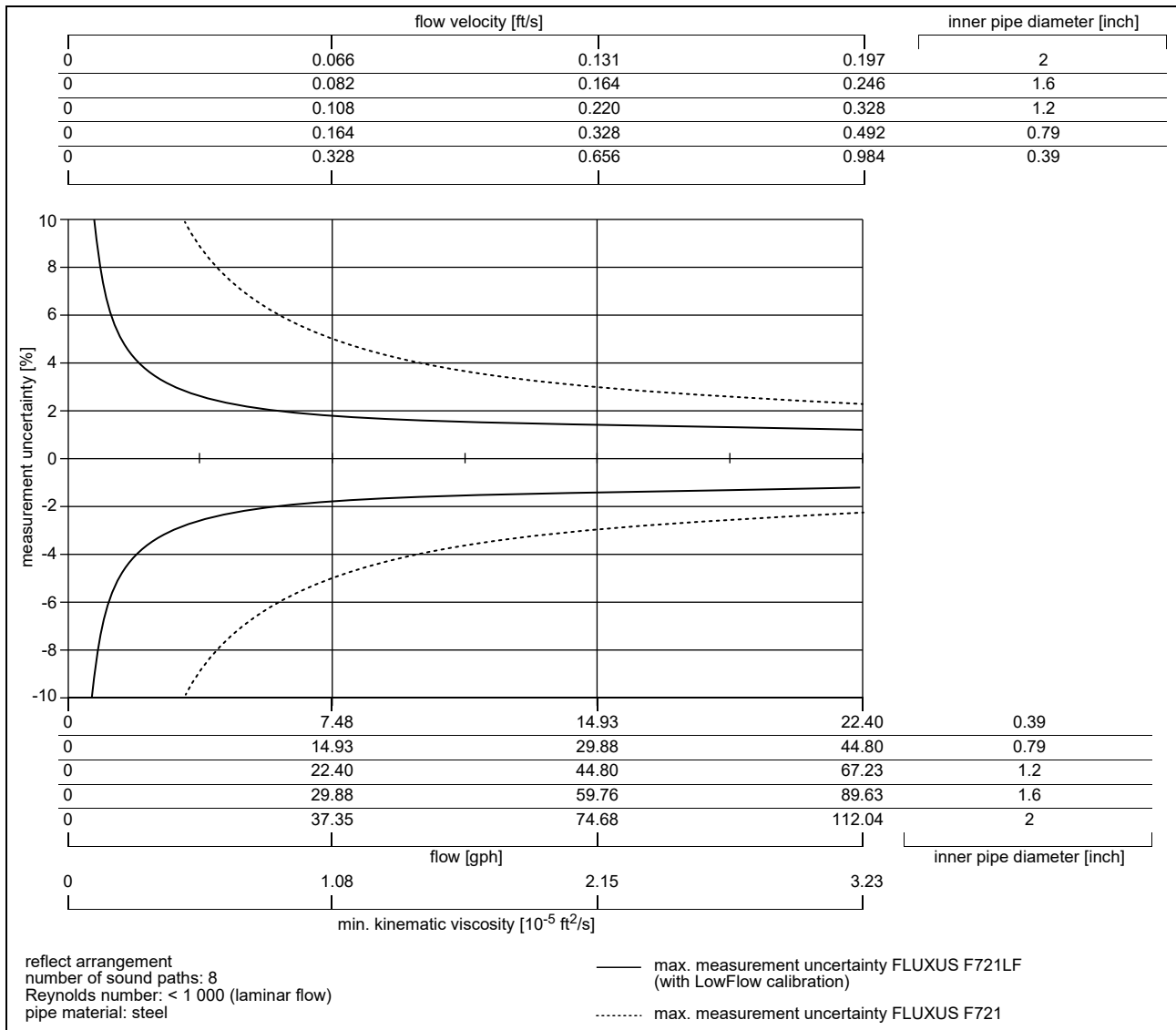
² outside the explosive atmosphere (housing cover open)

		FLUXUS F721LF-NNN**.*AL F721LF-NNN**.*ST	FLUXUS F721LF-A2N**.*AL F721LF-A2N**.*ST	FLUXUS F721LF-F2N**.*AL F721LF-F2N**.*ST
• current input				
accuracy		0.1 % MV ±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		
• voltage input				
range	V	0 to 1		
accuracy		0.1 % MV ±1 mV		
internal resistance		R _{int} = 1 MΩ		
• binary input				
switching signal		5 to 30 V, 1 mA		5 to 26 V, 1 mA
functions		<ul style="list-style-type: none">• reset of the measured values• reset of the totalizers• stop of the totalizers• activation of the measuring mode for highly dynamic flows		

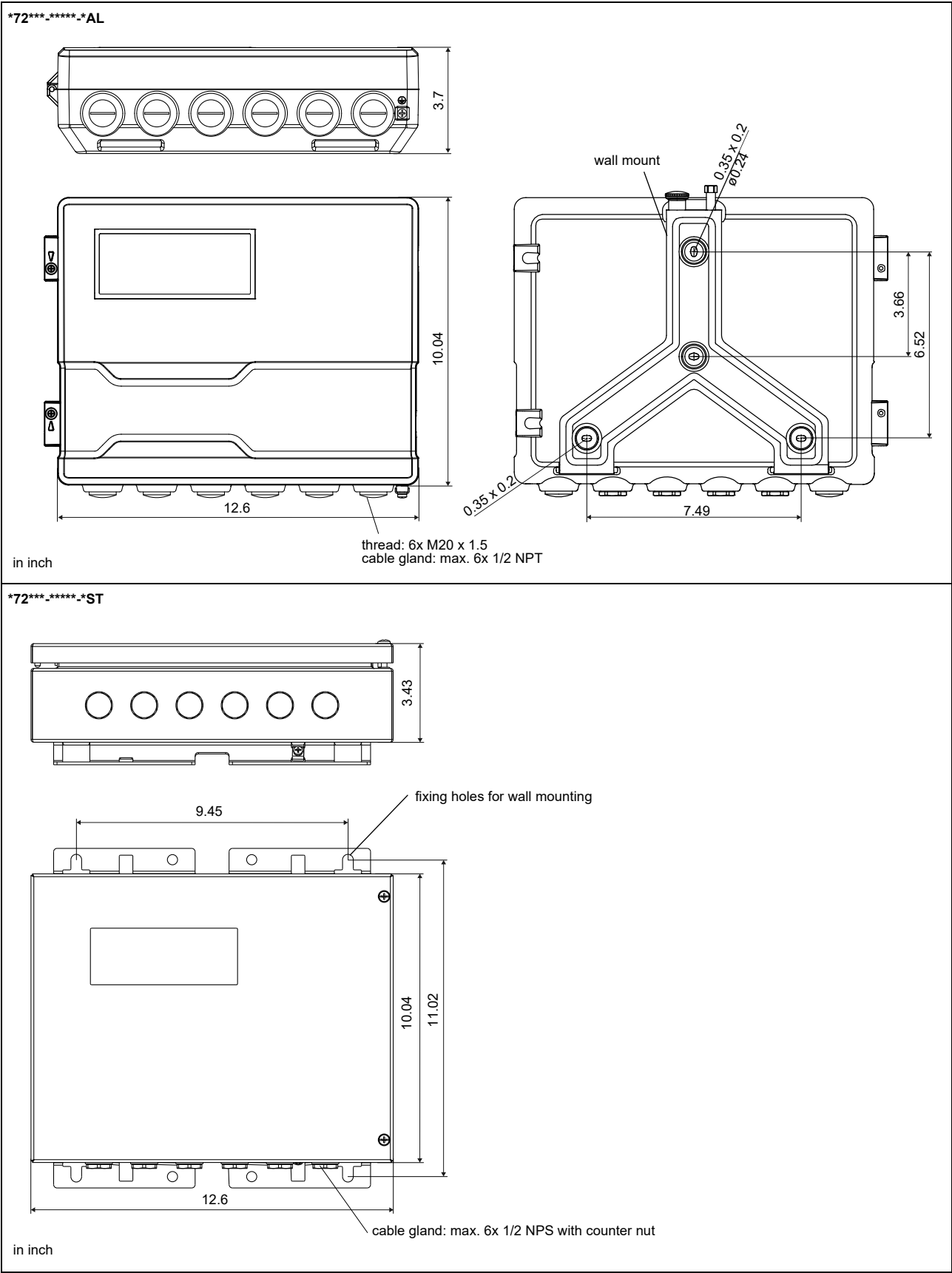
¹ with LowFlow reference conditions (water: 68 °F, number of sound paths: 8, inner pipe diameter: 0.52 inch (other diameters see diagrams))

² outside the explosive atmosphere (housing cover open)

Diagrams

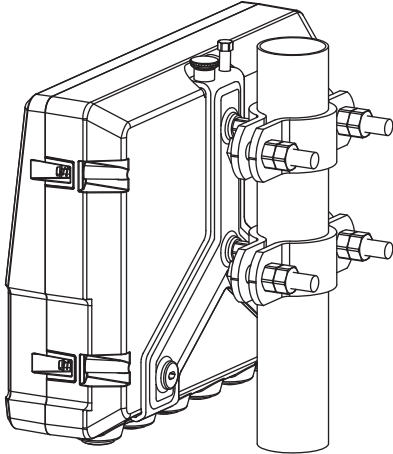


Dimensions



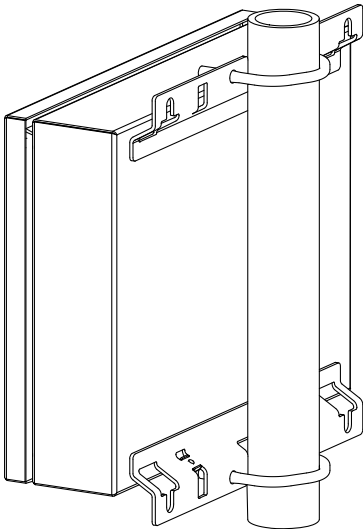
2" pipe mounting kit

*72***-*****-AL



item number: 721037-4

*72***-*****-ST

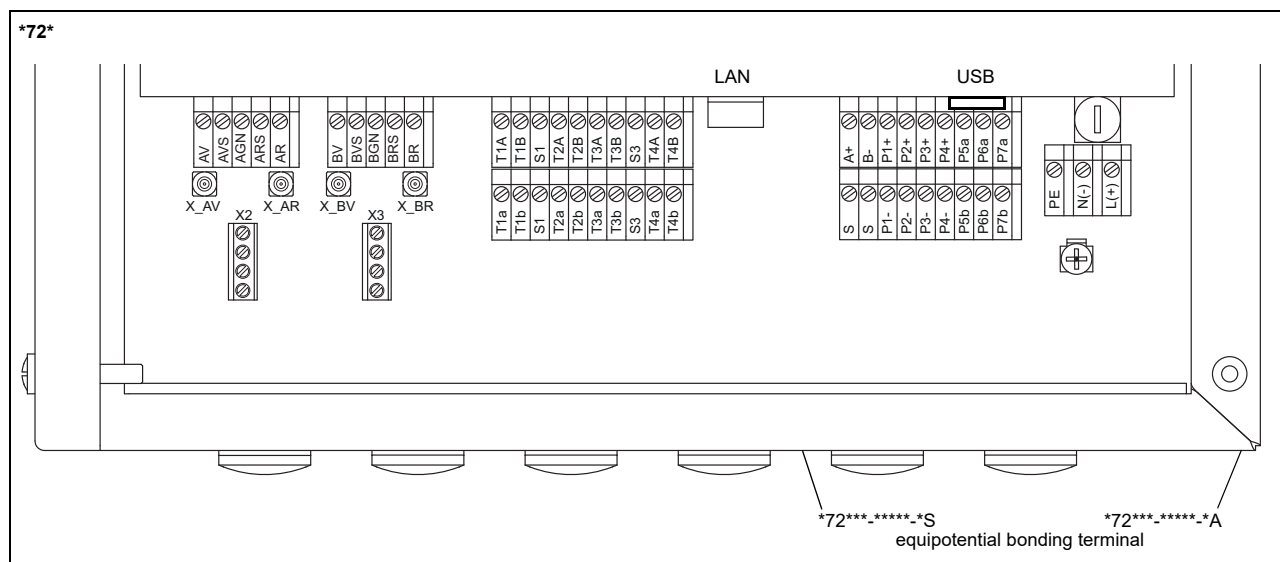


item number: 721110-4

Storage

- do not store outdoors
- store within the original package
- store in a dry and dust-free place
- protect against sunlight
- keep all openings closed
- storing temperature: -4...+140 °F

Terminal assignment



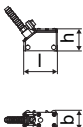
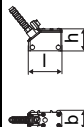

power supply ¹							
terminal		connection (AC)			connection (DC)		
PE		protective conductor			protective conductor		
N(-)		neutral conductor			-		
L(+)		outer conductor			+		
transducers							
transducer cable (transducers *****8*), extension cable					transducer cable (transducers *****52)		
measuring channel A		measuring channel B			measuring chan- nel A	measuring chan- nel 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, 2}							
terminal		connection		terminal	connection	communication inter- face	
P1+ to P4+ P1- to P4-		current output, voltage output, frequency output, HART (P1)		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		digital output		S	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, 2}							
terminal		temperature probe		passive sensor		active sensor	
		direct connection	connection with extension cable	connection		connection	
T1a to T4a		red	red/white	not connected		not connected	
T1A to T4A		red/blue	gray/black	-		+	
T1b to T4b		white/blue	blue/red	+		not connected	
T1B to T4B		white	white/green	not connected		-	
S1, S3		shield	shield	not connected		not connected	
binary inputs ^{1, 2}							
terminal							
P1+ to P2+, P1- to P2-							

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

² The number, type and terminal assignment are customized.

Transducers

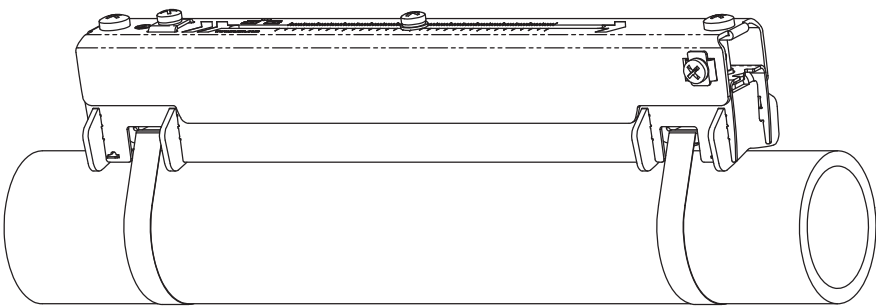
Technical data

order code		FSQ-N***.TS	FSQ-N*1*.T1
technical type		C(DL)Q2N52	C(DL)Q2N81
transducer frequency	MHz	4	4
inner pipe diameter d¹			
min. extended	inch	0.39	0.39
min. recommended	inch	0.98	0.98
max. recommended	inch	5.9	5.9
max. extended	inch	9.4	9.4
pipe wall thickness			
min.	inch	0.02	0.02
material			
housing		PEEK with stainless steel cover 316L	PEEK with stainless steel cover 316L
contact surface		PEEK	PEEK
degree of protection		IP66/IP67	IP66/IP67
transducer cable			
type		1699	1699
length	ft	9	9
dimensions			
length l	inch	1.57	1.57
width b	inch	0.87	0.87
height h	inch	1	1
dimensional drawing			
weight (without cable)	lb	0.04	0.04
pipe surface temperature	°F	-40 to +266	-40 to +266
ambient temperature	°F	-40 to +266	-40 to +266
temperature compensation		x	x
explosion protection			
• ATEX/IECEx			
order code		FSQ-NA2N-.TS	FSQ-NA1N-.T1
pipe surface temperature (Ex)	°C	gas: -55 to +190 dust: -55 to +180	-55 to +180
marking		CE 0637 Ex II 3G II 2D Ex nA IIC T6...T3 Gc Ex tb IIIC T80 °C...T185 °C Db	CE 0637 Ex II 2G II 2D Ex q IIC T6...T3 Gb Ex tb IIIC T80 °C...T185 °C Db
certification		IBExU10ATEX1163 X, IECEx IBE 12.0005X	IBExU07ATEX1168 X, IECEx IBE 08.0007X
• FM			
order code		FSQ-NF2N-.TS	-
pipe surface temperature (Ex)	°F	-40 to +374	-
degree of protection		IP66	-
marking		 NI/Cl. I, II, III/Div. 2 / GP A, B, C, D, E, F, G/ Temp. Codes dwg 3860	-

¹ inner pipe diameter > 2 inch:

If necessary, a smaller number of sound paths has to be used. This may result in an increase of the measurement uncertainty.

Transducer mounting fixture

<p>PermaRail (VLQ-DS-S)</p> 	<p>material: stainless steel 316Ti, 316L, 17-7PH inner length: 6.9 inch dimensions: 9.72 x 1.69 x 1.85 inch</p>
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Coupling materials for transducers

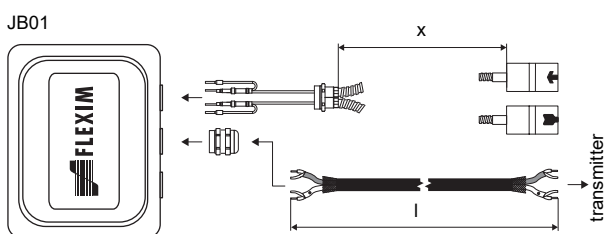
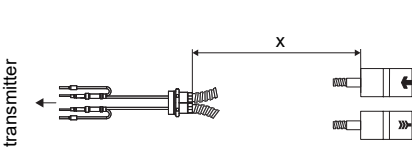
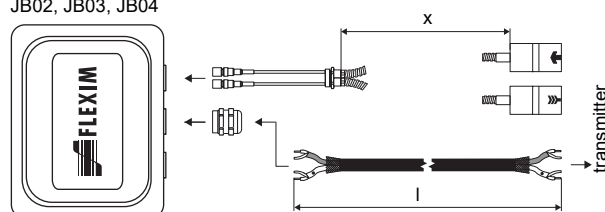
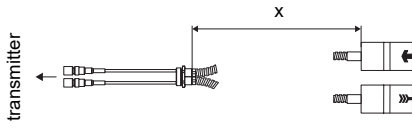
	< 212 °F	< 338 °F	< 302 °F	< 392 °F
< 24 h	coupling compound type N or coupling pad type VT	coupling compound type E or coupling pad type VT	coupling compound type E or coupling pad type VT	coupling compound type E or H or coupling pad type VT
long time measurement	coupling pad type VT	coupling pad type VT	coupling pad type VT	coupling pad type VT

type VT: fluid temperature 392 °F: min. 2 years

Technical data

type	ambient temperature °F
coupling compound type N	-22 to +266
coupling compound type E	-22 to +392
coupling compound type H	-22 to +482
coupling pad type VT	14 to +392

Connection systems

connection system T1		
connection with extension cable	direct connection	transducers technical type
		****8*
connection system TS		
		****52

Cable

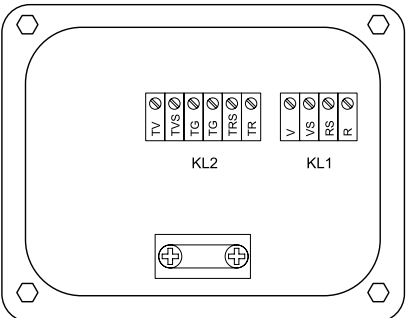
transducer cable			
type		1699	6111
weight	lb/ft	0.06	0.06
ambient temperature	°F	-67 to +392	-148 to +437
cable jacket			
material		PTFE	PFA
outer diameter	inch	0.11	0.11
thickness	inch	0.01	0.02
color		brown	white
shield		x	x
sheath			
material		stainless steel 316Ti	stainless steel 316Ti
outer diameter	inch	0.31	0.31
extension cable			
type		2615	5245
max. length	ft	295	295
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

Junction box

Technical data

JB01S4E3M, JBP2, JBP3		
weight	lb	2.6 lb
fixation		wall mounting optional: 2" pipe mounting
material		
housing		stainless steel 316L
gasket		silicone
degree of protection		IP66/IP67
ambient temperature °F		-40 to +176
explosion protection		
• ATEX/IECEX (zone 1)		
junction box		JB01S4E3M
marking		CE0637 Ex II2G II2D Ex eb mb IIC T6...T4 Gb Ex tb IIIC T100 °C Db Ta -40...+70/80 °C
certification		IBExU06ATEX1161, IECEX IBE 08.0006
type of protection		gas: increased safety decoupling network: encapsulation dust: protection by enclosure
• ATEX (zone 2)		
junction box		JBP2
marking		CE UK CA Ex II3G Ex nA IIC T6...T4 Gc II3D Ex tc IIIC T 100 °C Dc -40 ≤ Ta ≤ +70 °C/+80 °C

Connection



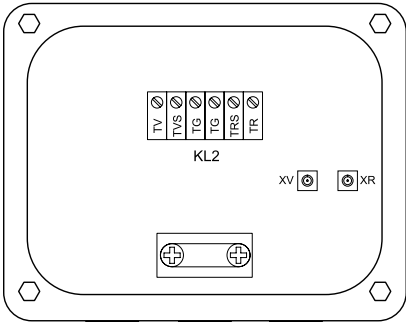
terminal strip	terminal	connection	transducer
KL1	V	signal	↑
	VS	internal shield	
	RS	internal shield	⌋
	R	signal	

Extension cable

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

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		JB02, JB03: IP66/IP67 JB04: Type 4X, IP66
ambient temperature		
min.	°F	-40
max.	°F	+176
explosion protection		
• ATEX		
junction box		JB02
marking		CE UK CA Ex II3G Ex nA IIC T6...T4 Gc II3D Ex tc IIIC T 100 °C Dc -40 ≤ Ta ≤ +70 °C/+80 °C
• FM		
junction box		JB04
marking		FMI APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ T6 Ta = -40...+60 °C

Connection

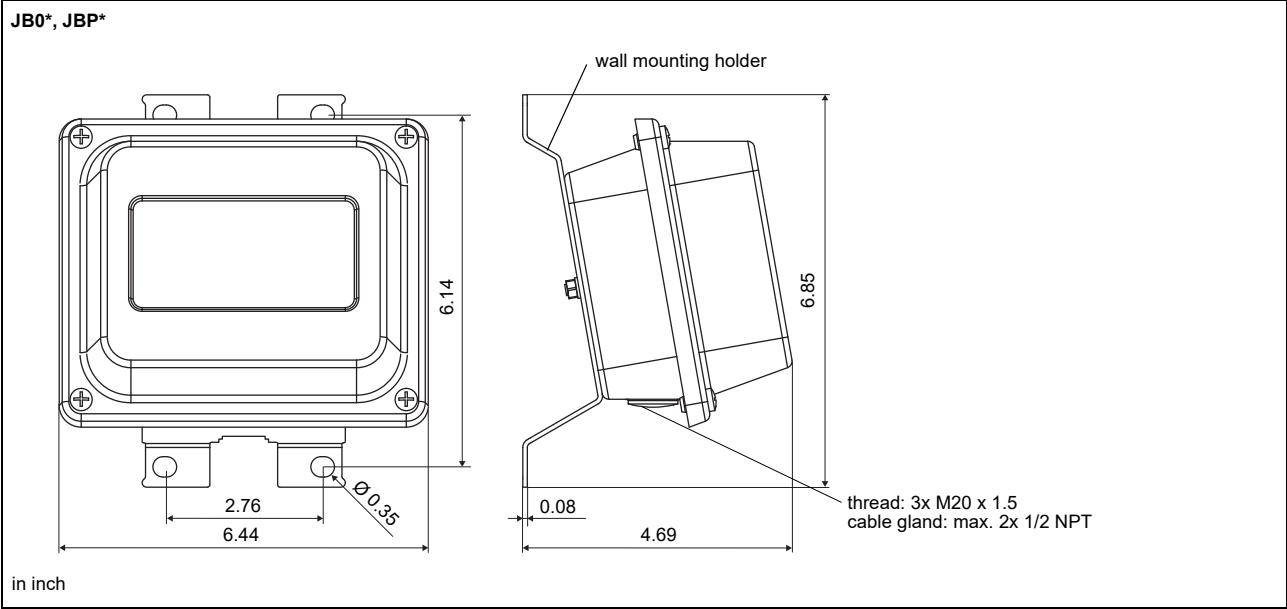


	terminal	connection	transducer
	XV	SMB connector	↑
	XR	SMB connector	⌋

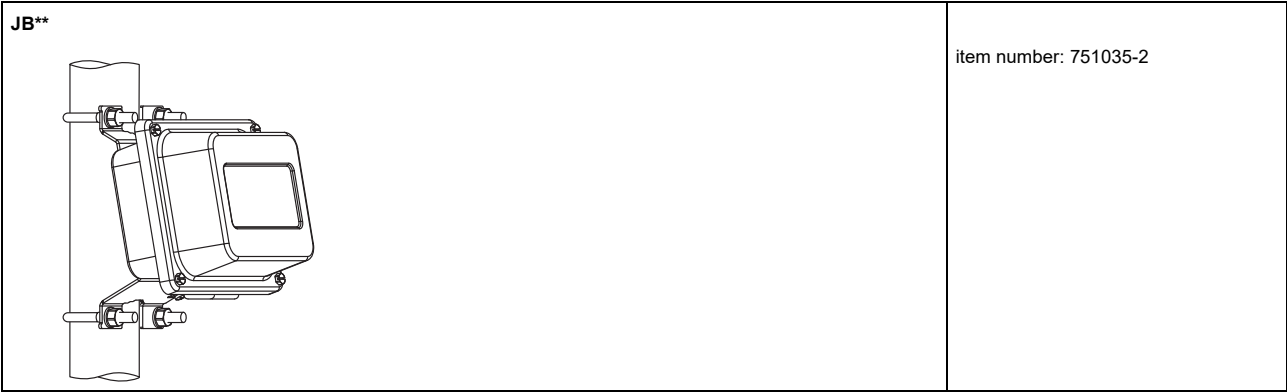
Extension cable

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

Dimensions

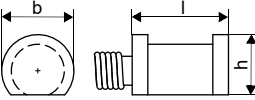
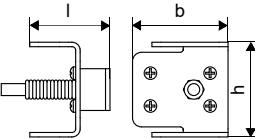
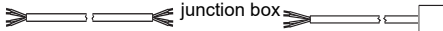

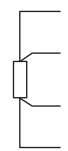


2" pipe mounting kit

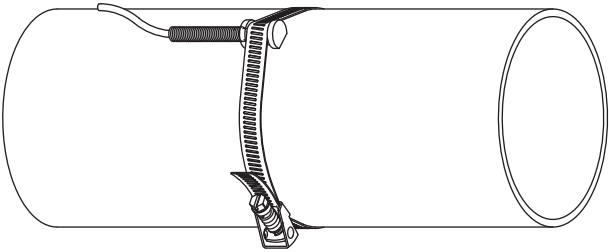
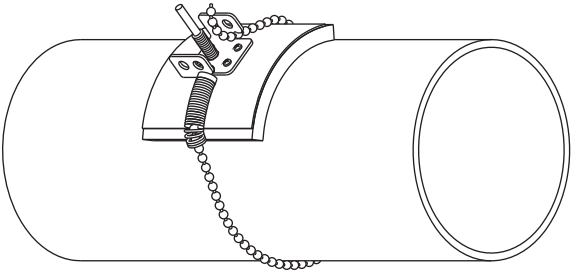


Clamp-on temperature probe (optional)

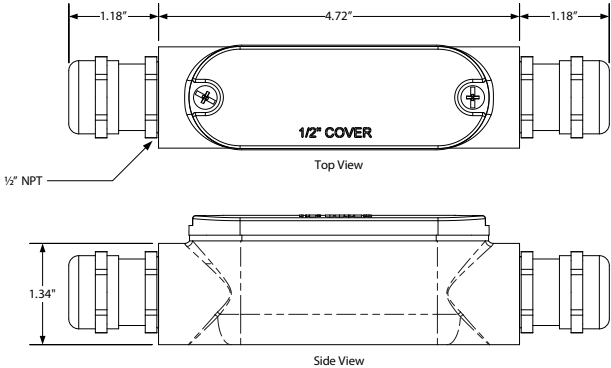
Technical data

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	
PT13F			
design		clamp-on short response time	
type		Pt1000	
connection		4-wire	
measuring range	°F	-58 to +482	
accuracy T		±(0.27 °F + 2 · 10 ⁻³ · (T [°F] - 32 °F)) class A	
response time	s	8 (t50, T1 = 25 °C, T2 = 60 °C)	
housing		PEEK, stainless steel 304, copper	
degree of protection		IP54	
dimensions			
length l	inch	0.55	
width b	inch	1.18	
height h	inch	1.06	
dimensional drawing			
weight	lb	0.7	
accessories			
thermal conductivity paste 392 °F		x	
thermal conductivity foil 482 °F		x	
plastic protection plate, insulation foam		x	
Connection system			
connection with extension cable		direct connection	
extension cable 			
Connection			
	temperature probe		
	red		
	red/blue		
	white/blue		
	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>
<p>ball chain PT13F</p> 	<p>material: stainless steel 316L length: 3 ft</p>

Junction box

 <p>Top View</p> <p>Side View</p>	<p>Connection</p> <table><tr><th>temperature probe</th><th>extension cable</th></tr><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></table>	temperature probe	extension cable	red	white	red	black	white	green	white	red
temperature probe	extension cable										
red	white										
red	black										
white	green										
white	red										

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Subject to change without prior notice.

Errors excepted.

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