



FLEXIM

Technical specification

PIOX S721

Process analysis and flow measurement with ultrasound

Non-invasive clamp-on ultrasonic measuring system for continuous monitoring of concentration, density or other process-relevant fluid properties

Features

- Time measurement for the accurate and repeatable determination of concentration, density and density-related physical quantities
- Reliable, maintenance-free and repeatable drift-free measurement
- High measurement accuracy even at very low as well as very high flow rates and independent of the flow direction (bidirectional)
- Installation and start-up do not require any pipe work nor any process interruptions
- Non-invasive: no fluid contact, no need of special materials, ideal for aggressive, toxic or abrasive fluids
- 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
- Transmitter and transducers for use in hazardous areas are available
- Transmitter and transducers are separately calibrated (traceable to national standards)
- Transducers available for a wide range of inner pipe diameters and fluid temperatures

Applications

For a wide range of fluids, e.g., H₂SO₄, HF, HCl, HNO₃, sugar solution (Brix), brine in:

- Chemical industry
- Petrochemical industry
- Oil and gas industry
- Pharmaceutical industry
- Semiconductor industry
- Mechanical and electrical industries
- Food industry



PIOX S721**-****A



PIOX S721**-****S



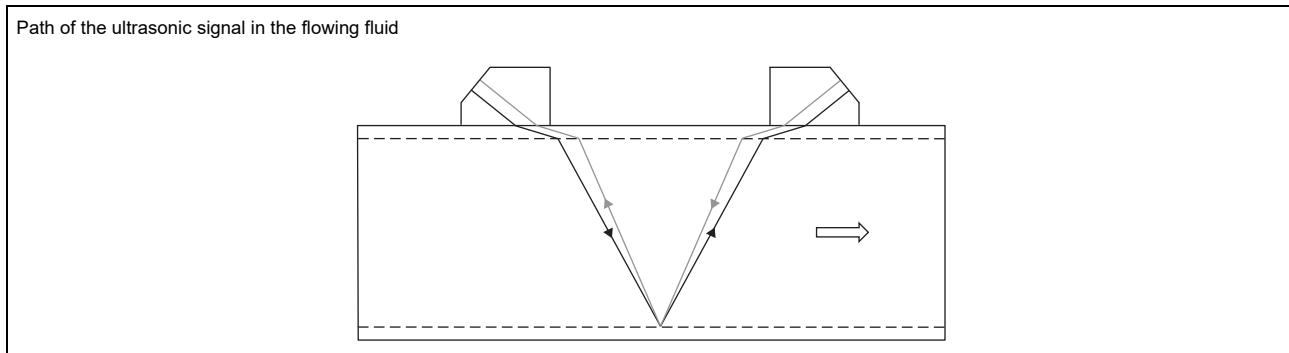
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Function

Measurement principle

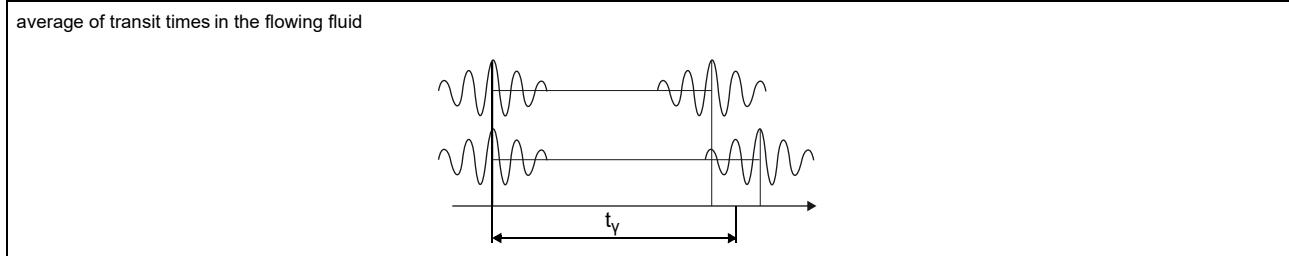
The transducers are mounted on the pipe which is completely filled with the fluid. The ultrasonic signals are emitted alternately by a transducer and received by the other. The physical quantities are determined from the transit times of the ultrasonic signals.



The transmitter determines physical quantities for analysis by using the transit time measurement and physical quantities for flow by means of the transit time difference principle.

Transit time measurement

All physical quantities for analysis are determined from the sound speed. The sound speed is calculated from the average of both ultrasonic signals in the fluid. By using the average, the sound speed is independent of the flow velocity of the fluid.



Calculation of sound speed

The sound speed is the quotient of the path of the ultrasonic signal in the fluid and transit time. The transit time is calculated as average of the transit times of both transducer signals in the fluid, corrected by the transit time in the transducer and in the pipe wall.

$$c_y = \frac{l_y}{t_y}$$

$$t_y = \frac{t_1 + t_2}{2}$$

where

c_y - sound speed in the fluid

l_y - sound path in the fluid

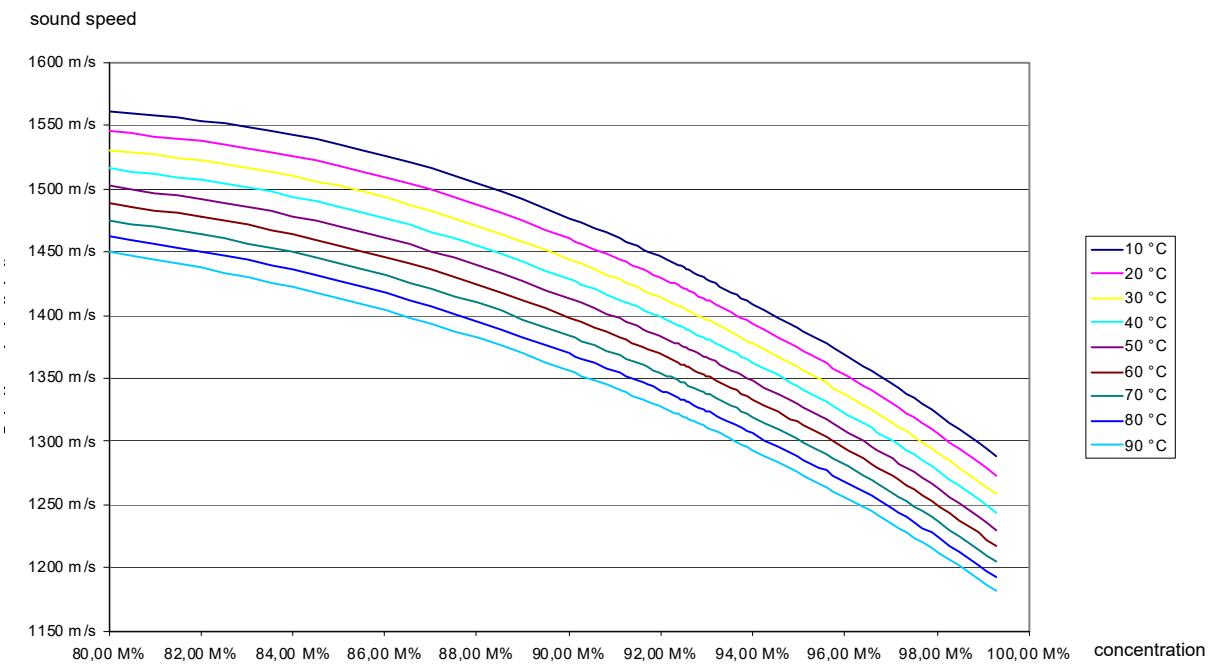
t_y - average of transit times in the fluid

t_1, t_2 - transit time in the fluid

A field calibration is recommended to reduce the influence of the pipe parameters on the accuracy of the measurement.

Further physical quantities, e.g., concentration, density, degree of conversion, can be calculated in dependence on the measured sound speed and fluid temperature in the transmitter. This requires a set of characteristic curves where physical quantity, sound speed and fluid temperature are correlated. The characteristic curves can be prepared by FLEXIM if required.

Example of the dependence of the sound speed of sulfuric acid on concentration and temperature



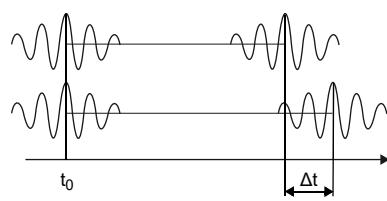
Transit time difference principle

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.

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

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

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

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

where

ρ - operating density

K - concentration

T - 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.

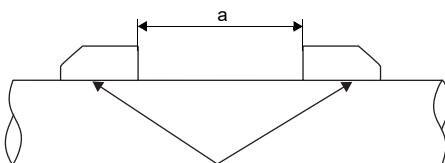
- **direct mode**

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

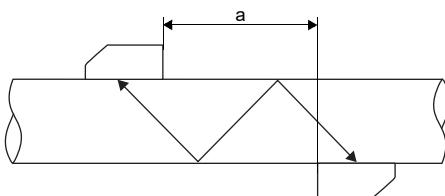
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

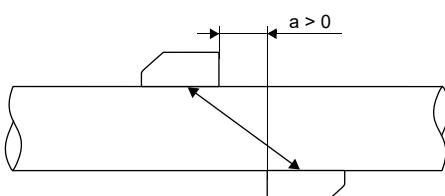
Reflect arrangement, number of sound paths: 2



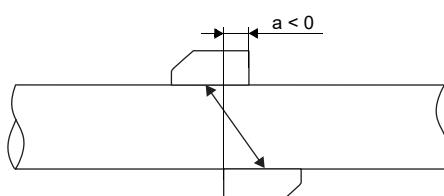
Diagonal arrangement, number of sound paths: 3



Direct mode, number of sound paths: 1



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



a - transducer distance

Transmitter

Technical data

	PIOX S721**-NN0*A S721**-NN0*S	PIOX S721**-A20*A S721**-A20*S	PIOX S721**-F20*A S721**-F20*S					
design	standard field device	standard field device zone 2	standard field device FM Class I Div. 2					
measurement								
• analysis								
transit time (repeatable)	$1/(50 \cdot f_a) \pm 10^{-4} \cdot t$							
transit time (absolute)	$1/(5 \cdot f_a) \pm 10^{-4} \cdot t$							
	f _a - transducer frequency, t - total transit time e.g., for transducers with transducer frequency M (f _a = 1 MHz): repeatable: 20 ns ±10 ⁻⁴ · t, absolute: 200 ns ±10 ⁻⁴ · t The total measurement uncertainty of a physical quantity for analysis is supplied order-related as it depends on the fluid, operating range and installation. For the basis of calculation see document TIPIOX-S_Uncert_analysis.							
• flow								
measurement principle	transit time difference correlation principle							
flow velocity	ft/s	0.03 to 82						
repeatability		0.15 % MV ±0.02 ft/s						
fluid	all acoustically conductive liquids with < 10 % 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 ¹		±0.3 % MV ±0.02 ft/s includes calibration certificate traceable to NIST						
measurement uncertainty at the measuring point ²		±1 % MV ±0.02 ft/s						
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)						
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)						
display	128 x 64 pixels, backlight							
menu language	English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian							
explosion protection								
• ATEX/IECEx								
marking	-	C E 0637 II3G Ex nA nC ic IIC T4 Gc Ex tb IIIC T120 °C Db T _a -40...+60 °C	-					
certification ATEX	-	IIBExU11ATEX1015	-					
certification IECEx	-	IECEx IBE 11.0008	-					

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside the explosive atmosphere (housing cover open)

	PIOX S721**-NN0*A S721**-NN0*S	PIOX S721**-A20*A S721**-A20*S	PIOX S721**-F20*A S721**-F20*S
• FM			
marking	-	-	S721**-F20*S2, S721**-F20*S3:  APPROVED NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5
measuring functions			
physical quantities	see table below		
totalizer	volume, mass		
calculation functions	average, difference, sum (2 measuring channels necessary)		
diagnostic functions	signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times		
communication interfaces			
service interfaces	measured value transmission, parametrization of the transmitter: • USB ³ • LAN ³		
process interfaces	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 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			
number	The outputs are galvanically isolated from the transmitter. on request		
• switchable current output			
range	mA	All switchable current outputs are jointly switched to active or passive.	
accuracy	4 to 20 (3.2 to 22)		
active output	0.04 % MV ±3 µA		
passive output	$R_{ext} < 350 \Omega$		
		$U_{ext} = 8$ to 30 V, depending on R_{ext} ($R_{ext} < 1 \text{ k}\Omega$ at 30 V)	
• HART			
range	mA	4 to 20	
accuracy	0.1 % MV ±15 µA		
active output	$U_{int} = 24$ V, $R_{ext} < 500 \Omega$		
passive output	$U_{ext} = 10$ to 24 V DC, depending on R_{ext} ($R_{ext} < 1 \text{ k}\Omega$ 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	$R_{int} = 500 \Omega$		
• frequency output			
range	kHz	0 to 5	-
optorelay	-	24 V/4 mA, $R_{int} = 66.5 \Omega$	-
• binary output			
optorelay	-	26 V/100 mA	-
Reed relay	-	48 V/100 mA, $R_{int} = 22 \Omega$	-
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 Reed relay: 80 to 1000	-

¹ with aperture calibration of the transducers² for transit time difference principle and reference conditions³ outside the explosive atmosphere (housing cover open)

	PIOX S721**-NN0*A S721**-NN0*S	PIOX S721**-A20*A S721**-A20*S	PIOX S721**-F20*A S721**-F20*S
• digital output			
functions	• frequency output • binary output • pulse output	-	• frequency output • binary output • pulse output
number	3	-	3
operating parameters	5 to 30 V/< 100 mA	-	5 to 30 V/< 100 mA
frequency output			
• range	kHz 0 to 5	-	0 to 5
binary output			
• binary output as alarm output	limit, change of flow direction or error	-	limit, change of flow direction or error
pulse output			
• functions	mainly for totalizing	-	mainly for totalizing
• pulse value	0.01 to 1000	-	0.01 to 1000
• pulse width	ms 0.05 to 1000	-	0.05 to 1000
inputs			
	The inputs are galvanically isolated from the transmitter.		
number	max. 4, on request min. 1 input or process interface with inputs necessary for fluid temperature		
• temperature input			
type	Pt100/Pt1000		
connection	4-wire		
range	°F -238 to +1040		
resolution	K 0.01		
accuracy	±0.01 % MV ±0.03 K		
• 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	• reset of the measured values • reset of the totalizers • stop of the totalizers • activation of the measuring mode for highly dynamic flows		

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside the explosive atmosphere (housing cover open)

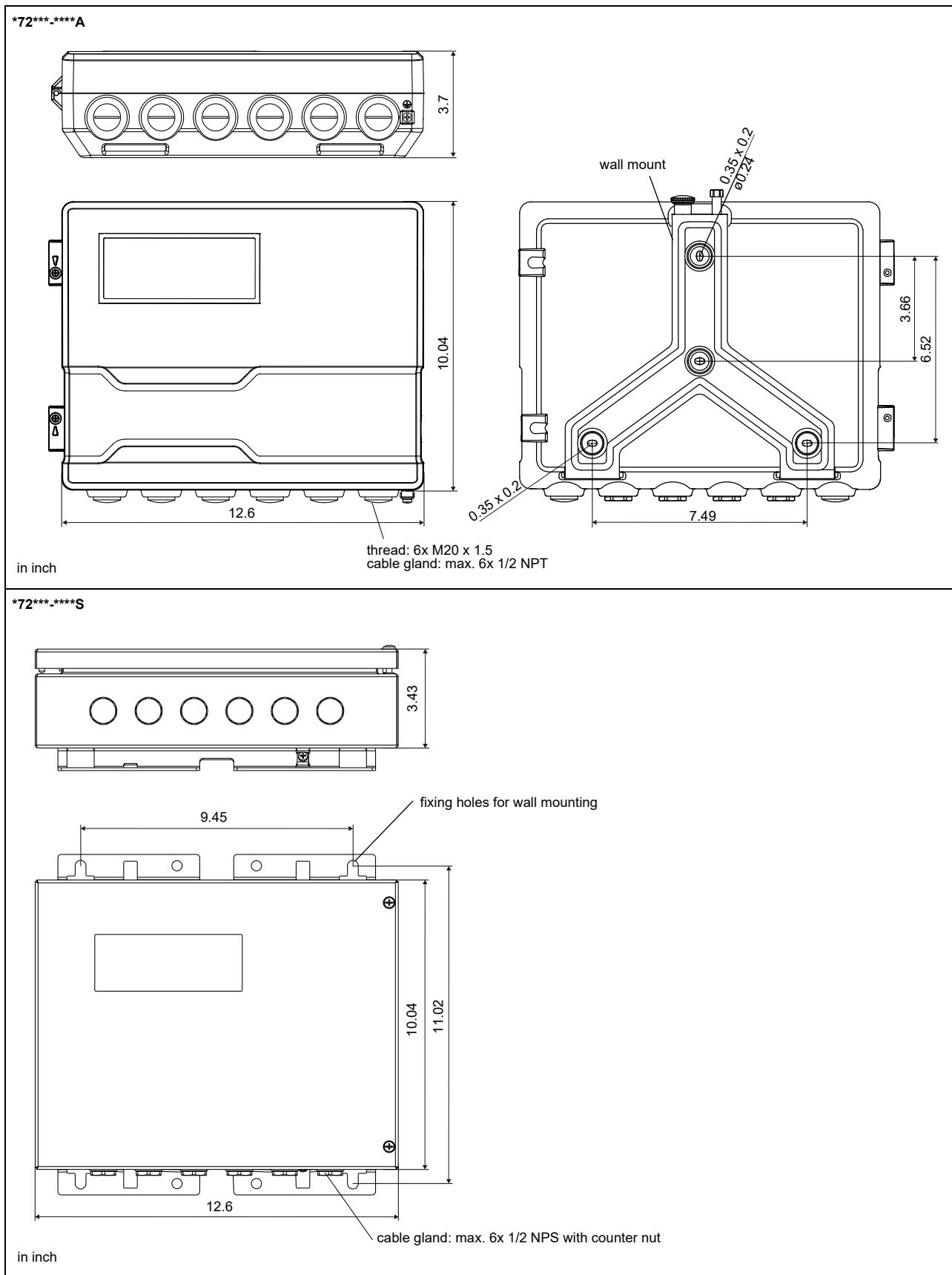
Physical quantities

The available physical quantities depend on the fluid data set in the transmitter.

fluid data set	physical quantities	remark
NN no fluid data set	• sound speed, volumetric flow rate	
MD standard fluid data set	• analysis ¹ : concentration, mass fraction, volume fraction, density, normalized density, normalized sound speed, sound speed • flow: volumetric flow rate, flow velocity, mass flow rate	application-specific fluid data set from FLEXIM database
CU customized fluid data set	• analysis ¹ : concentration, mass fraction, volume fraction, density, normalized density, normalized sound speed, sound speed • flow: volumetric flow rate, flow velocity, mass flow rate • further customized physical quantities ¹	data set developed by FLEXIM in cooperation with the customer

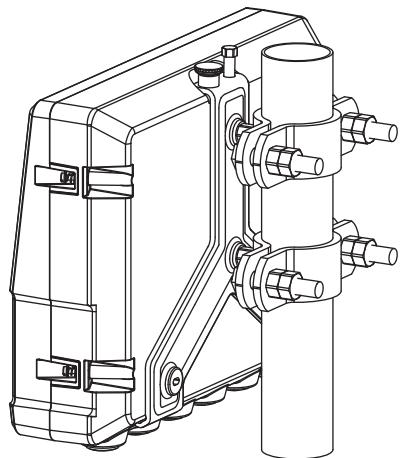
¹ min. 1 input or process interface with inputs necessary for fluid temperature

Dimensions



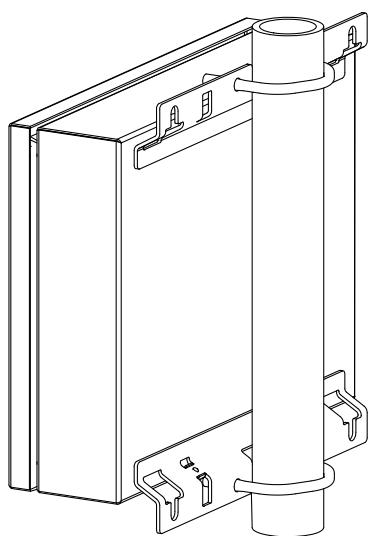
2" pipe mounting kit

*72***-***A



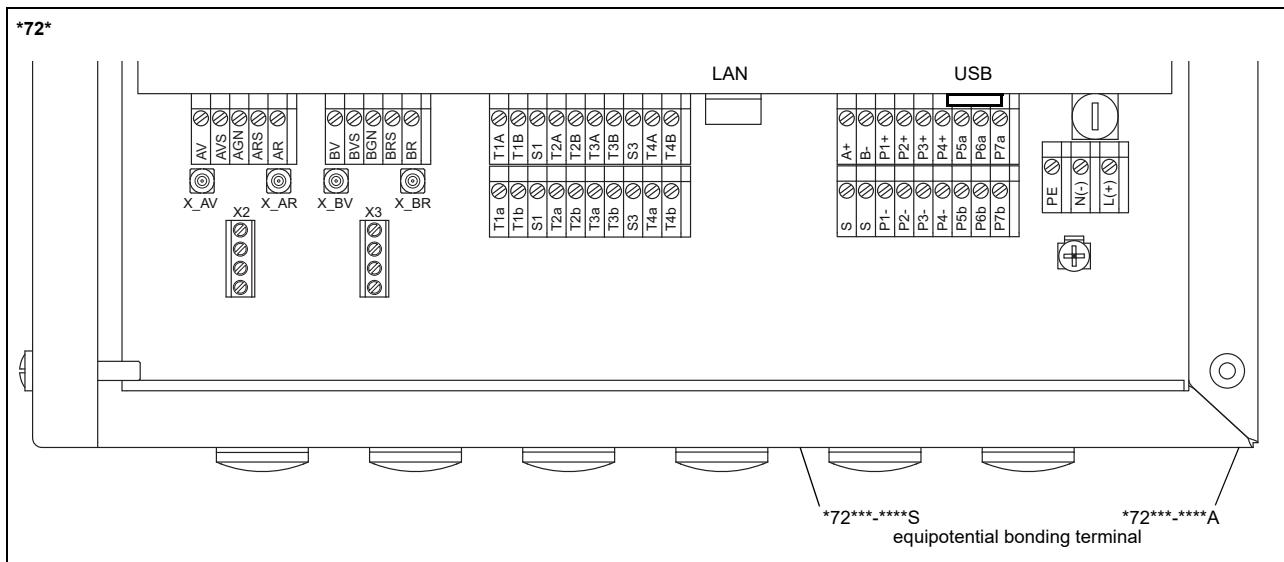
order code:
ACC-PE-*721-/PMK4

*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					transducer cable (transducers ****52)		
transducer cable (transducers ****LI*), extension cable					measuring chan- nel A	measuring chan- nel 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, 2}				
terminal	connection	terminal	connection	communication interface
P1+ to P4+ P1- to P4-	current output, voltage output, frequency output, binary output (Reed relay), HART (P1)	A+	signal +	<ul style="list-style-type: none"> • RS485¹ • Modbus RTU¹ • BACnet MS/TP¹ • Profibus PA¹ • FF H1¹
P5a to P7a P5b to P7b	binary output (optorelay), digital output	B-	signal -	
		S	shield	
		USB	type B Hi-Speed USB 2.0 Device	<ul style="list-style-type: none"> • service (FluxDiag/ FluxDiagReader)
		LAN	RJ45 10/100 Mbps Ethernet	<ul style="list-style-type: none"> • service (FluxDiag/ FluxDiagReader) • BACnet IP • Modbus TCP

analog inputs ^{1, 2}				
	temperature probe		passive sensor	active sensor
terminal	direct connection	connection with extension cable	connection	connection
T1a to T4a	red	white	not connected	not connected
T1A to T4A	red	black	-	+
T1b to T4b	white	red	+	not connected
T1B to T4B	white	green	not connected	-
S1, S3	shield	shield	not connected	not connected

binary inputs ^{1, 2}
terminal
P1+ to P2+, P1- to P2-

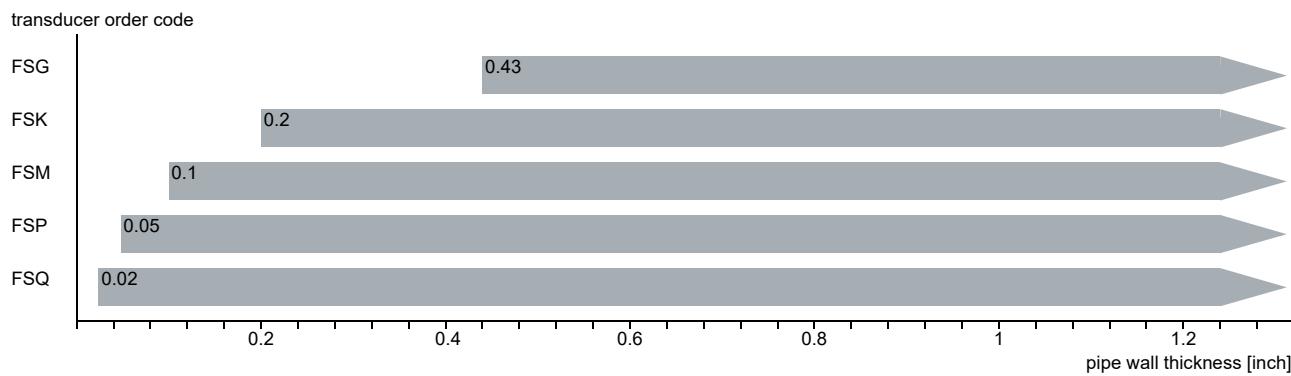
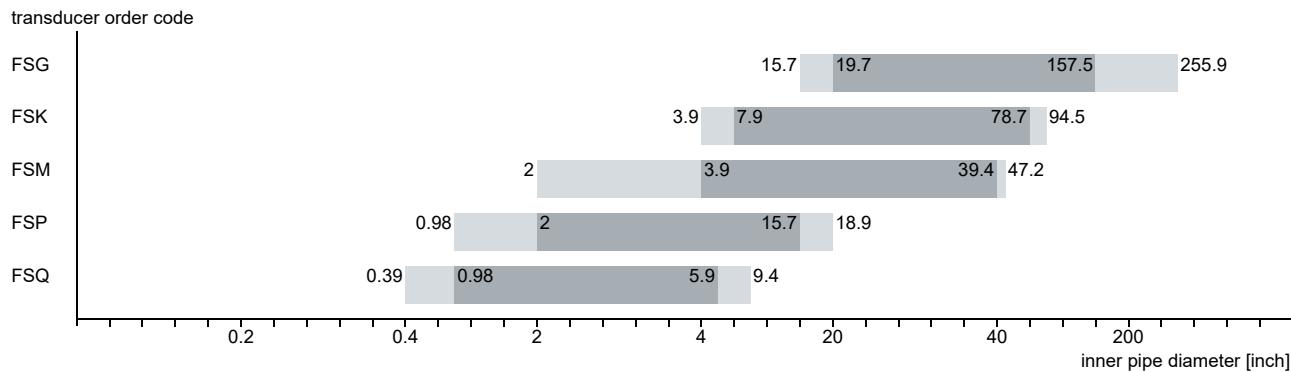
¹ cable (by customer):

- 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

Transducer selection



recommended

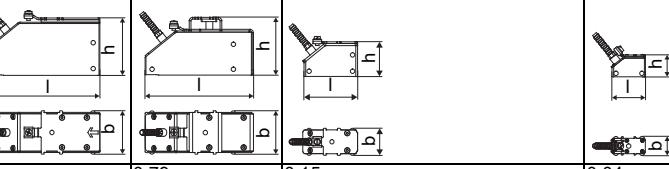
possible

Transducer order code

1, 2 transducer	3 transducer frequency	4 ambient temperature	5, 6 explosion protection	7, 8 connection system	9 to 11 extension cable	no. of character option	description
FS	-			-	/		set of ultrasonic flow transducers for liquids measurement, shear wave
	G						0.2 MHz
	K						0.5 MHz
	M						1 MHz
	P						2 MHz
	Q						4 MHz
	N						normal temperature range
	E						extended temperature range
	NN						not explosion-proof
	A2						ATEX zone 2/IECEx zone 2
	A1						ATEX zone 1/IECEx zone 1
	F2						FM Class I Div. 2
	TS						with SMB connector
	T1						with stripped cable ends
	XXX						0 m: without extension cable > 0 m: with extension cable
	LC						long transducer cable
	IP68						degree of protection IP68
	OS						housing with stainless steel 316

Technical data

Shear wave transducers (zone 2 - FM Class I Div. 2 - nonEx, TS)

order code	FSG-N**TS/**	FSK-N**TS/**	FSM-N**TS/**	FSP-N**TS/**	FSQ-N**TS/**				
technical type	C(DL)G1N52	C(DL)K1N52	C(DL)M2N52	C(DL)P2N52	C(DL)Q2N52				
transducer frequency [MHz]	0.2	0.5	1	2	4				
inner pipe diameter d									
min. extended	inch	15.7	3.9	2	0.39				
min. recommended	inch	19.7	7.9	3.9	0.98				
max. recommended	inch	157.5	78.7	39.4	5.9				
max. extended	inch	255.9	94.5	47.2	9.4				
pipe wall thickness									
min.	inch	0.43	0.2	0.1	0.05				
material									
housing		PEEK with stainless steel cover 304, ***-****/OS: 316L							
contact surface		PEEK							
degree of protection		NEMA 6							
transducer cable									
type		1699							
length	ft	16	13		9				
length (***/****/LC)	ft	29							
dimensions									
length l	inch	5.1	4.98	2.52	1.57				
width b	inch	2.01	2.01	1.26	0.87				
height h	inch	2.64	2.66	1.59	1				
dimensional drawing									
weight (without cable)	lb	1	0.79	0.15	0.04				
pipe surface temperature									
min.	°F	-40							
max.	°F	+266							
ambient temperature									
min.	°F	-40							
max.	°F	+266							
temperature compensation		x							
explosion protection									
• ATEX/IECEx									
order code		FSG-NA2TS/**	FSK-NA2TS/**	FSM-NA2TS/**	FSP-NA2TS/**				
pipe surface temperature (Ex)		FSQ-NA2TS/**							
• min.	°C	-55							
• max.	°C	gas: +190, dust: +180							
marking		 0637  II3G  Ex nA IIC T6...T3 Gc Ex tb IIIC T80 °C...T185 °C Db							
certification ATEX		IBExU10ATEX1163 X							
certification IECEx		IECEx IBE 12.0005X							
• FM									
order code		FSG-NF2TS/**	FSK-NF2TS/**	FSM-NF2TS/**	FSP-NF2TS/**				
pipe surface temperature (Ex)		FSQ-NF2TS/**							
• min.	°F	-40							
• max.	°F	+257	+40	+374					
degree of protection		IP66							
marking		 APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860							
		 APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860							

Shear wave transducers (zone 2 - nonEx, T1, IP68)

order code	FSG-N**T1/IP68	FSK-N**T1/IP68	FSM-N**T1/IP68	FSP-N**T1/IP68				
technical type	CDG1L18	CDK1L18	CDM2L18	CDP2L18				
transducer frequency MHz	0.2	0.5	1	2				
inner pipe diameter d								
min. extended	inch	15.7	3.9	2				
min. recommended	inch	19.7	7.9	3.9				
max. recommended	inch	157.5	78.7	39.4				
max. extended	inch	255.9	94.5	47.2				
pipe wall thickness								
min.	inch	0.43	0.2	0.1				
material								
housing	PEEK with stainless steel cover 316Ti							
contact surface	PEEK							
degree of protection	IP68 ¹							
transducer cable								
type	2550							
length	ft	39						
dimensions								
length l	inch	5.12	2.76					
width b	inch	2.13	1.26					
height h	inch	3.29	1.81					
dimensional drawing								
weight (without cable)	lb	0.95	0.19					
pipe surface temperature								
min.	°F	-40						
max.	°F	+212						
ambient temperature								
min.	°F	-40						
max.	°F	+212						
temperature compensation	x							
explosion protection								
• ATEX/IECEx								
order code	FSG-NA2T1/IP68	FSK-NA2T1/IP68	FSM-NA2T1/IP68	FSP-NA2T1/IP68				
pipe surface temperature (Ex)								
• min.	°C	-40						
• max.	°C	gas: +90, dust: +80						
marking	0637 II3G II2D Ex nA IIC T6...T5 Gc Ex tb IIIC T80 °C...T85 °C Db							
certification ATEX	IBExU10ATEX1163 X							
certification IECEx	IECEx IBE 12.0005X							

¹ test conditions: 3 months/29 psi (65 ft)/36 °F

Shear wave transducers (zone 2 - FM Class I Div. 2 - nonEx, TS, extended temperature range)

order code	FSG-ENNNTS/**	FSK-ENNNTS/**	FSM-E**TS/**	FSP-E**TS/**	FSQ-E**TS/**
technical type	C(DL)G1E52	C(DL)K1E52	C(DL)M2E52	C(DL)P2E52	C(DL)Q2E52
transducer frequency MHz	0.2	0.5	1	2	4
inner pipe diameter d					
min. extended	inch	15.7	3.9	2	0.98
min. recommended	inch	19.7	7.9	3.9	2
max. recommended	inch	157.5	78.7	39.4	15.7
max. extended	inch	255.9	94.5	47.2	18.9
pipe wall thickness					
min.	inch	0.43	0.2	0.1	0.05
material					
housing		PPSU with stainless steel cover 304, ***-****/OS: 316L	PI with stainless steel cover 304, ***-****/OS: 316L		
contact surface		PPSU	PI		
degree of protection		IP65	NEMA 4		
transducer cable					
type		1699	6111		
length	ft	16	13		9
length (**-****/LC)	ft	29	29		
dimensions					
length l	inch	5.1	2.52		1.57
width b	inch	2.01	1.26		0.87
height h	inch	2.64	1.59		1
dimensional drawing					
weight (without cable)	lb	1.8	0.15		0.04
pipe surface temperature					
min.	°F	-40	-22		-22
max.	°F	+356	+450 ¹		+392
ambient temperature					
min.	°F	-40	-22		-22
max.	°F	+356	+104 ² +140 ² +392 ³		+392
temperature compensation		x	x		
explosion protection					
• ATEX/IECEx					
order code	-	-	FSM-EA2TS/**	FSP-EA2TS/**	FSQ-EA2TS/**
pipe surface temperature (Ex)					
• min.	°C	-	-	-45	
• max.	°C	-	-	gas: +235 ¹ , dust: +225 ¹	
marking		-	-	II3G II2D Ex nA IIC T6...T2 Gc Ex tb IIIA T80 °C...230 °C Db	
certification ATEX	-	-	-	IBExU10ATEX1163 X	
certification IECEx	-	-	-	IIECEx IBE 12.0005X	
• FM					
order code	-	-	FSM-EF2TS/**	FSP-EF2TS/**	FSQ-EF2TS/**
pipe surface temperature (Ex)					
• min.	°F	-	-	-40	
• max.	°F	-	-	+455 ¹	
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 > +200 °C/+392 °F:

quick release clasps and tension straps (nonEx) or Variofix L (nonEx, Ex)

observe the insulation instruction

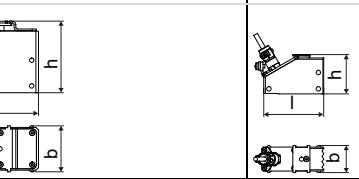
Ex: ambient temperature max. +40 °C/+104 °F

² pipe surface temperature +200 to +232 °C/+392 to +450 °F: quick release clasps and tension straps³ pipe surface temperature max. +200 °C/+392 °F

Shear wave transducers (zone 1, T1)

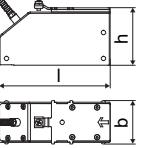
order code	FSG-N*1T1/**	FSK-N*1T1/**	FSM-N*1T1/**	FSP-N*1T1/**	FSQ-N*1T1/**
technical type	C(DL)G1N81	C(DL)K1N81	C(DL)M2N81	C(DL)P2N81	C(DL)Q2N81
transducer frequency MHz	0.2	0.5	1	2	4
inner pipe diameter d					
min. extended	inch 15.7	3.9	2	0.98	0.39
min. recommended	inch 19.7	7.9	3.9	2	0.98
max. recommended	inch 157.5	78.7	39.4	15.7	5.9
max. extended	inch 255.9	94.5	47.2	18.9	9.4
pipe wall thickness					
min.	inch 0.43	0.2	0.1	0.05	0.02
material					
housing	PEEK with stainless steel cover 304 , ***-****/OS: 316L				
contact surface	PEEK				
degree of protection	IP65	IP66			IP65
transducer cable					
type	1699				
length	ft 16		13		9
length (**-****/LC)	ft 29				
dimensions					
length l	inch 5.1	4.98	2.52		1.57
width b	inch 2.01	2.01	1.26		0.87
height h	inch 2.64	2.66	1.59		1
dimensional drawing					
weight (without cable)	lb 1	0.79	0.15		0.04
pipe surface temperature					
min.	°F -40				
max.	°F +266				
ambient temperature					
min.	°F -40				
max.	°F +266				
temperature compensation	x				
explosion protection					
• ATEX/IECEx					
order code	FSG-NA1T1/**	FSK-NA1T1/**	FSM-NA1T1/**	FSP-NA1T1/**	FSQ-NA1T1/**
pipe surface temperature (Ex)					
• min.	°C -55				
• max.	°C +180				
marking	 0637 @ II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC T80 °C...T185 °C Db				
certification ATEX	IBExU07ATEX1168 X				
certification IECEx	IECEx IBE 08.0007X				

Shear wave transducers (zone 1, T1, IP68)

order code	FSG-N*1T1/IP68	FSK-N*1T1/IP68	FSM-N*1T1/IP68	FSP-N*1T1/IP68			
technical type	CDG1LI1	CDK1LI1	CDM2LI1	CDP2LI1			
transducer frequency	MHz	0.2	0.5	1			
inner pipe diameter d							
min. extended	inch	15.7	3.9	2			
min. recommended	inch	19.7	7.9	3.9			
max. recommended	inch	157.5	78.7	39.4			
max. extended	inch	255.9	94.5	47.2			
pipe wall thickness							
min.	inch	0.43	0.2	0.1			
material							
housing		PEEK with stainless steel cover 316Ti					
contact surface		PEEK					
degree of protection		IP68 ¹					
transducer cable							
type		2550					
length	ft	39					
dimensions							
length l	inch	5.12	2.76				
width b	inch	2.13	1.26				
height h	inch	3.29	1.81				
dimensional drawing							
weight (without cable)	lb	0.95	0.19				
pipe surface temperature							
min.	°F	-40					
max.	°F	+212					
ambient temperature							
min.	°F	-40					
max.	°F	+212					
temperature compensation		x					
explosion protection							
• ATEX/IECEx							
order code		FSG-NA1T1/IP68	FSK-NA1T1/IP68	FSM-NA1T1/IP68			
pipe surface temperature (Ex)				FSP-NA1T1/IP68			
• min.	°C	-40					
• max.	°C	+80					
marking		 0637  II2G Ex q IIC T6...T5 Gb Ex tb IIC T80 °C...T85 °C Db					
certification ATEX		IBExU07ATEX1168 X					
certification IECEx		IECEx IBE 08.00007X					

¹ test conditions: 3 months/29 psi (65 ft)/36 °F

Shear wave transducers (zone 1, T1, extended temperature range)

order code		FSG-EA1T1/**	FSK-EA1T1/**
technical type		C(DL)G1E83	C(DL)K1E83
transducer frequency MHz	0.2	0.5	
inner pipe diameter d			
min. extended	inch	15.7	3.9
min. recommended	inch	19.7	7.9
max. recommended	inch	157.5	78.7
max. extended	inch	255.9	94.5
pipe wall thickness			
min.	inch	0.43	0.2
material			
housing		PPSU with stainless steel cover 304, ***-****/OS: 316L	
contact surface		PPSU	
degree of protection		IP65	
transducer cable			
type		1699	
length	ft	16	
length (**-****/LC)	ft	29	
dimensions			
length l	inch	5.1	
width b	inch	2.01	
height h	inch	2.64	
dimensional drawing			
weight (without cable)	lb	1.8	
pipe surface temperature			
min.	°F	-40	
max.	°F	+356	
ambient temperature			
min.	°F	-40	
max.	°F	+356	
temperature compensation		x	
explosion protection			
• ATEX/IECEx			
pipe surface temperature (Ex)			
• min.	°C	-50	
• max.	°C	+155	
marking		CE 0637 II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC T80 °C...T160 °C Db	
certification ATEX		IBExU07ATEX1168 X	
certification IECEx		IECEx IBE 08.0007X	

Shear wave transducers (zone 1, T1, extended temperature range)

order code	FSM-E*1T1/**	FSP-E*1T1/**	FSQ-E*1T1/**
technical type	C(DL)M2E85	C(DL)P2E85	C(DL)Q2E85
transducer frequency MHz	1	2	4
inner pipe diameter d			
min. extended	inch 2	0.98	0.39
min. recommended	inch 3.9	2	0.98
max. recommended	inch 39.4	15.7	5.9
max. extended	inch 47.2	18.9	9.4
pipe wall thickness			
min.	inch 0.1	0.05	0.02
material			
housing	PI with stainless steel cover 304, ***-****/OS: 316L		
contact surface	PI		
degree of protection	IP66		IP56
transducer cable			
type	6111		
length	ft 13		9
length (**-****/LC)	ft 29		
dimensions			
length l	inch 2.52		1.57
width b	inch 1.26		0.87
height h	inch 1.59		1
dimensional drawing			
weight (without cable)	lb 0.15		0.04
pipe surface temperature			
min.	°F -22		-22
max.	°F +450 ¹		+392
ambient temperature			
min.	°F -22		-22
max.	°F +104 +392 ²		+392
temperature compensation	x		
explosion protection			
• ATEX/IECEx			
order code	FSM-EA1T1/**	FSP-EA1T1/**	FSQ-EA1T1/**
pipe surface temperature (Ex)			
• min.	°C -45		
• max.	°C +225 ¹		
marking		CE 0637 Ex II2G II2D Ex q IIC T6...T2 Gb Ex tb IIIA T80 °C...T230 °C Db	
certification ATEX	IBExU07ATEX1168 X		
certification IECEx	IECEx IBE 08.0007X		

¹ > +200 °C/+392 °F:

Variofix L

observe the insulation instruction

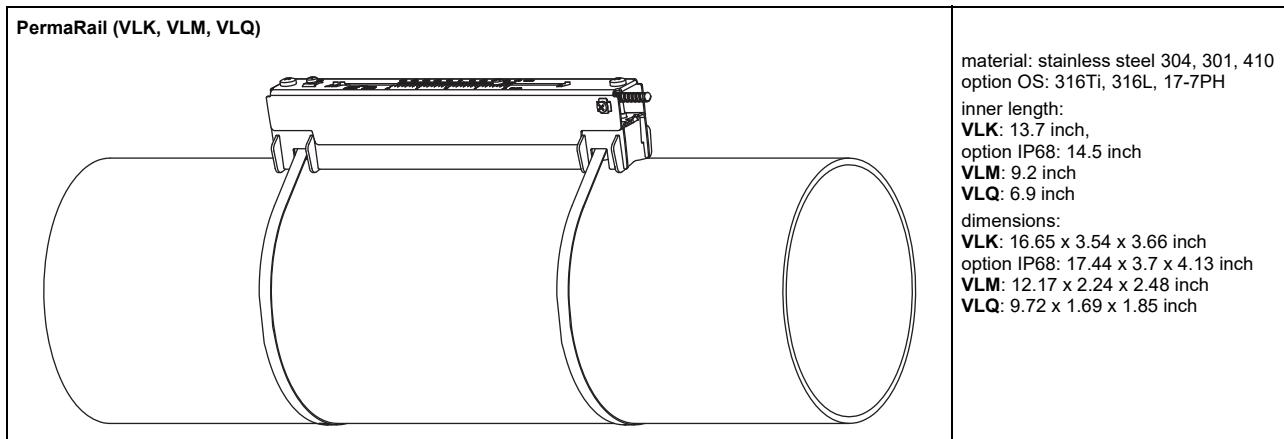
ambient temperature max. +40 °C/+104 °F

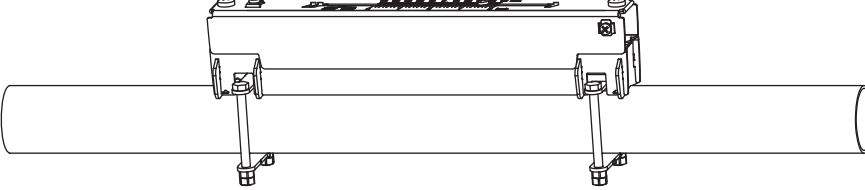
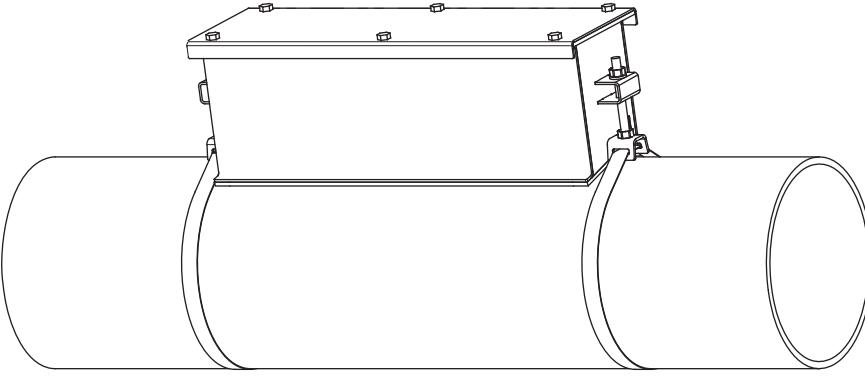
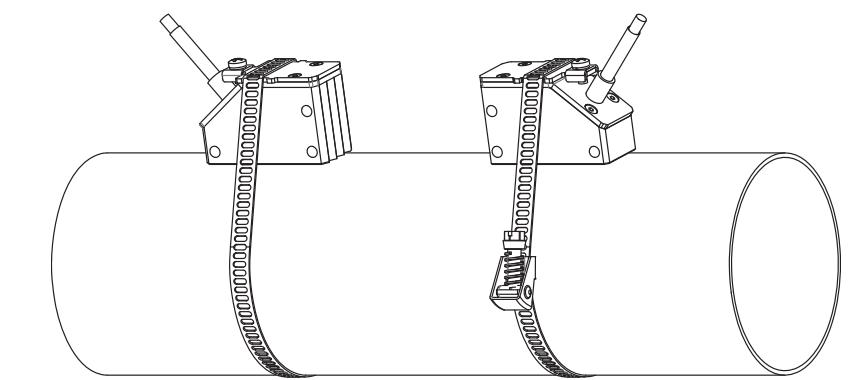
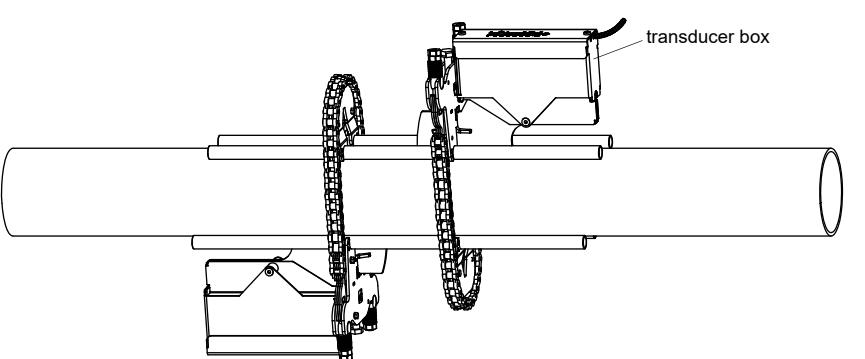
² pipe surface temperature max. +200 °C/+392 °F

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
WI							transducer box for Wavelnjector
	K						transducers with transducer frequency G, K
	M						transducers with transducer frequency M, P
	Q						transducers with transducer frequency Q
	D						reflect arrangement or diagonal arrangement/direct mode
	R						reflect arrangement
	S						small
	M						medium
	L						large
	B						bolts
	S						tension straps
	W						welding
	N						without fixation
		SK1					0.5 to 2.5 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
		SK7					100 to 170 inch
		SK8					170 to 370 inch
		NDR					any
			IP68				for transducers with degree of protection IP68
			OS				housing with stainless steel 316
			Z				special design



PermaRail with bolt mounting plates (VL*-**-B) 	material: stainless steel 304, 301, 410 option OS: 316Ti, 316L, 17-7PH inner length: VLM: 9.2 inch VLQ: 6.9 inch dimensions: VLM: 12.17 x 2.24 x 2.48 inch VLQ: 9.72 x 1.69 x 1.85 inch outer pipe diameter: max. 1.9 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
transducer box WI for WavelInjector 	see Technical specification TSWaveInjectorVx-x

Coupling materials for transducers

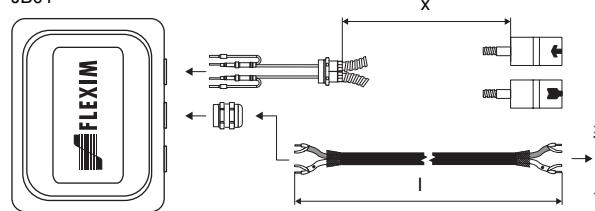
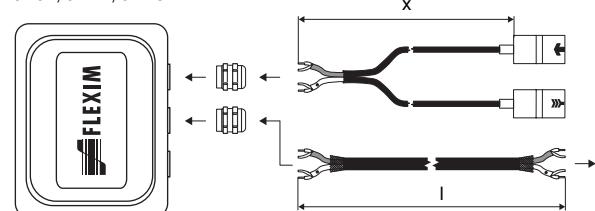
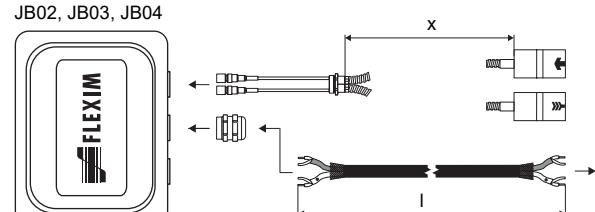
	normal temperature range (4th character of transducer order code = N)		extended temperature range (4th character of transducer order code = E)			WaveInjector WI-400	
	< 212 °F	< 338 °F	< 302 °F	< 392 °F	392 to 464 °F	< 536 °F	536 to 752 °F
< 24 h	coupling com- pound type N or coupling pad type VT	coupling com- pound type E or coupling pad type VT	coupling com- pound type E or H or coupling pad type VT	coupling com- pound type E or H or coupling pad type VT	coupling pad type TF	coupling pad type A and coupling pad type VT	coupling pad type B and coupling pad type VT
long time measure- ment	coupling pad type VT	coupling pad type VT	coupling pad type VT	coupling pad type VT	coupling pad type TF	coupling pad type A and coupling pad type VT	coupling pad type B and 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 A	max. 536
coupling pad type B	536 to 752
coupling pad type VT	14 to +392
coupling pad type TF	392 to 464

Connection systems

connection system T1		
connection with extension cable	direct connection	transducers technical type
JB01	 <p>transmitter</p>	*****8*
JB01, JBP2, JBP3	 <p>transmitter</p>	*****LI*
connection system TS		
connection with extension cable	direct connection	transducers technical type
JB02, JB03, JB04	 <p>transmitter</p>	*****52

Cable

transducer cable			
type	1699	2550	6111
weight	lb/ft	0.06	0.02
ambient temperature	°F	-67 to +392	-40 to +212
properties		longitudinal watertight	
cable jacket			
material	PTFE	PUR	PFA
outer diameter	inch	0.11	0.2 ±0.01
thickness	inch	0.01	0.04
color	brown	gray	white
shield	x	x	x
sheath			
material	stainless steel 304 option OS: 316Ti	-	stainless steel 304 option OS: 316Ti
outer diameter	inch	0.31	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	F, G, H, K	M, P	Q	S
connection system TS				
transducers technical type	x	I	x	I
*(DR)***8*	ft	16	≤ 984	13
option LC:	ft	29	≤ 984	29
*(LT)***8*	ft	16	≤ 984	13
*(DR)***5*	ft	16	≤ 984	9
option LC:	ft	29	≤ 984	29
*(LT)***5*	ft	39	≤ 984	39
option IP68: ****LI*	ft	-	≤ 984	-

x = transducer cable length

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

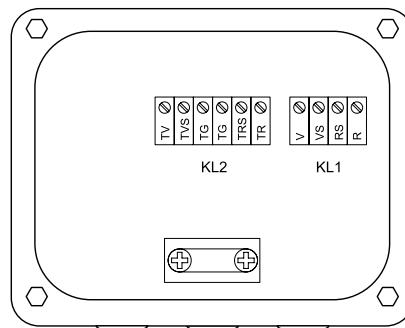
Junction box

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		NEMA 6
ambient temperature		
min.	°F	-40
max.	°F	+176
explosion protection		
• ATEX/IECEx (zone 1)		
junction box		JB01S4E3M
marking		CE 0637 Ex II2G II2D Ex eb mb IIC T6...T4 Gb Ex tb IIIC T100 °C Db Ta -40...+70/80 °C
certification ATEX		IBExU06ATEX1161
certification IECEx		IECEx IBE 08.0006
type of protection		gas: increased safety decoupled network: encapsulation dust: protection by enclosure
• ATEX (zone 2)		
junction box		JPB2
marking		CE Ex II3G Ex nA IIC (T6)...T4 Gc II3D Ex tc IIIC T 100 °C Dc Ta -40...+(70)80 °C

Connection



Transducers

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

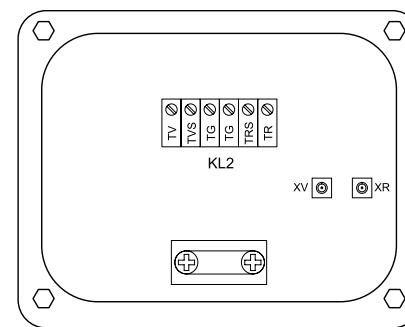
Extension cable

terminal strip	terminal	connection
KL2	TV	signal
	TSV	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		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



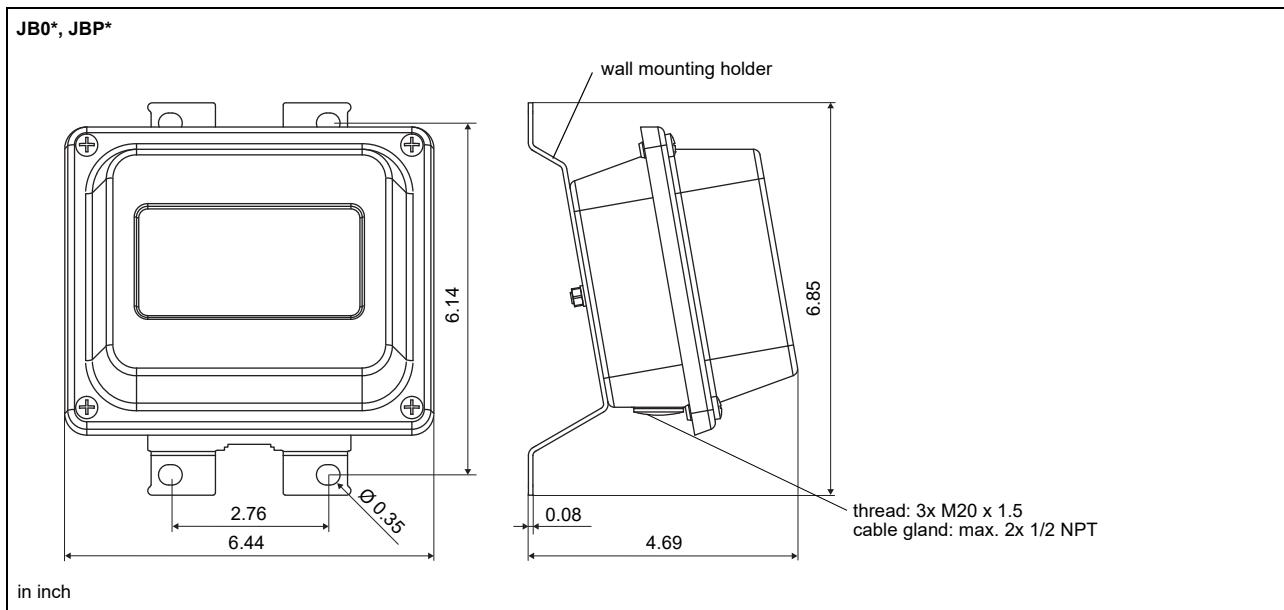
Transducers

terminal	terminal	connection	transducer
XV	SMB connector		↑
	XR	SMB connector	⤻

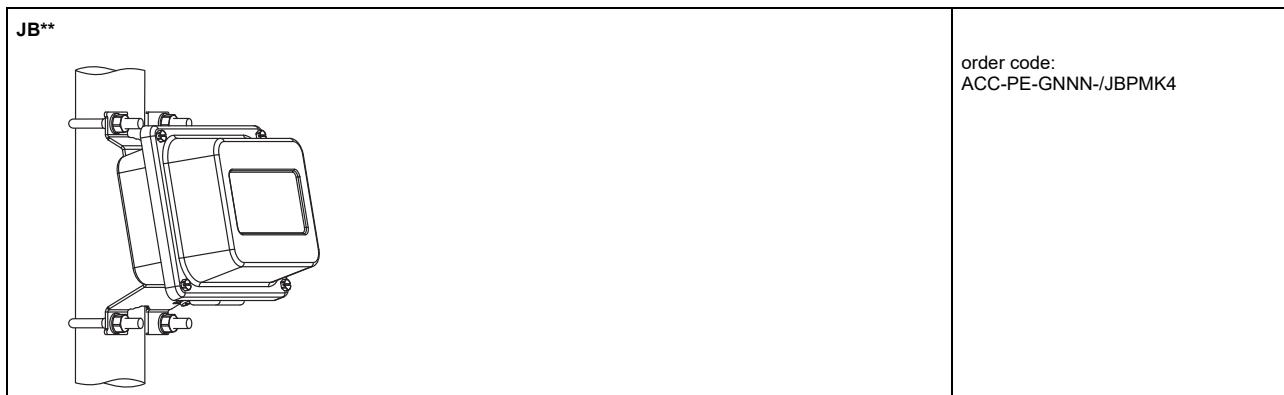
Extension cable

terminal strip	terminal	connection
KL2	TV	signal
	TSV	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	$\pm(0.27^{\circ}\text{F} + 2 \cdot 10^{-3} \cdot (T ^{\circ}\text{F}) - 32^{\circ}\text{F})$ class A	
accuracy ΔT (2x Pt matched according to EN 1434-1)	$\leq 0.03^{\circ}\text{F}$ (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	

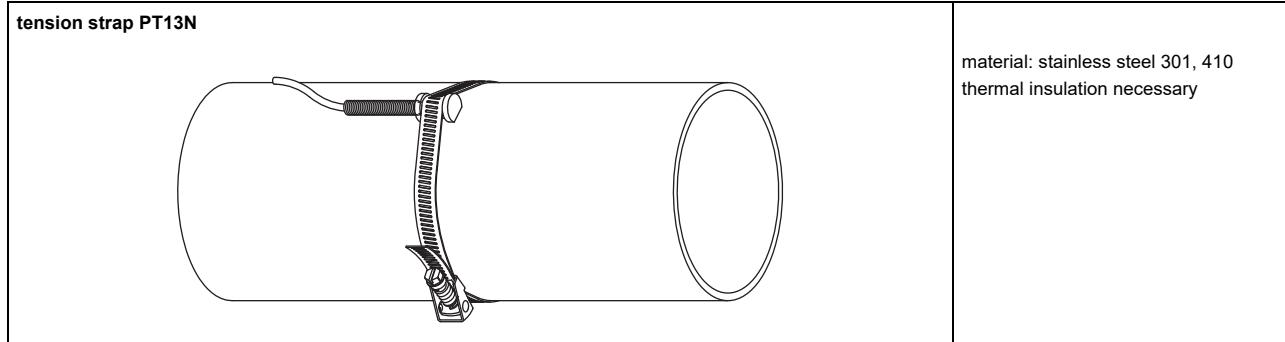
Connection

temperature probe	
red	
red	
white	
white	

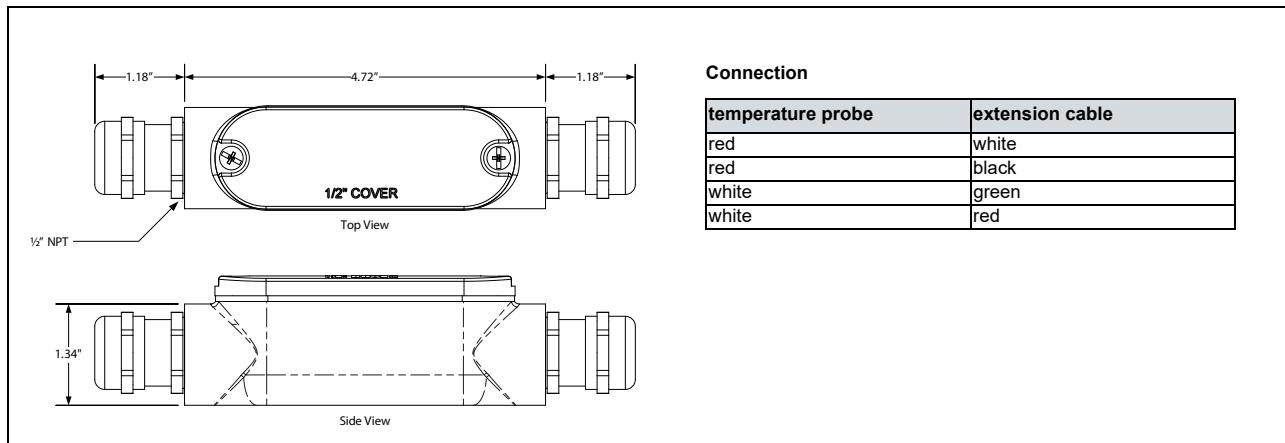
Cable

	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

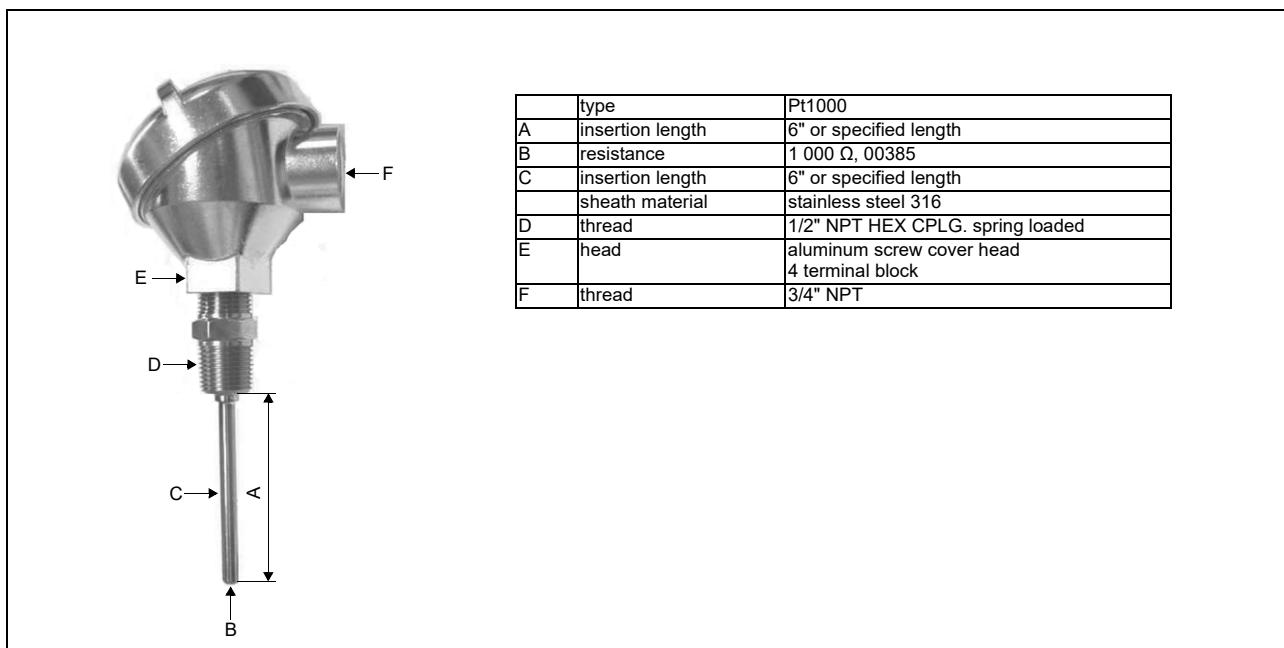
Fixation



Junction box



Inline temperature probe (optional)



FLEXIM AMERICAS Corporation
Edgewood, NY 11717
USA

Tel.: (631) 492-2300
Fax: (631) 492-2117

internet: www.flexim.com
e-mail: usinfo@flexim.com

1-888-852-7473

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