

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

- Non-invasive transit time measurement for the determination of concentration, density and density-related physical quantities
- Simultaneous bidirectional, highly dynamic flow measurement
- No fluid contact, no need of special materials
- Ideal for aggressive, toxic or abrasive fluids
- Explosion-proof transducers for hazardous areas available
- Maintenance-free and drift-free measurement
- Transducers available for a wide range of inner pipe diameters and fluid temperatures

Applications

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



PIOX S721**-****A



PIOX S721**-****S



Variofix C

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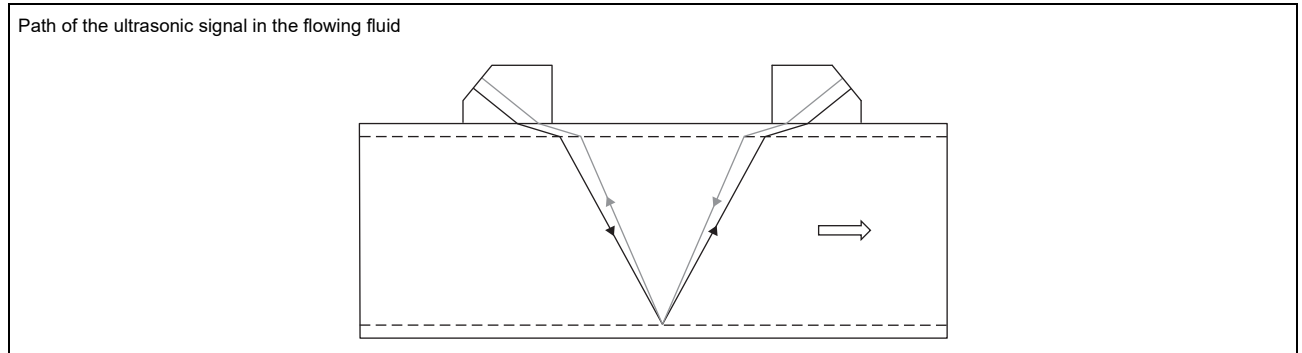
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Function

Measurement principle

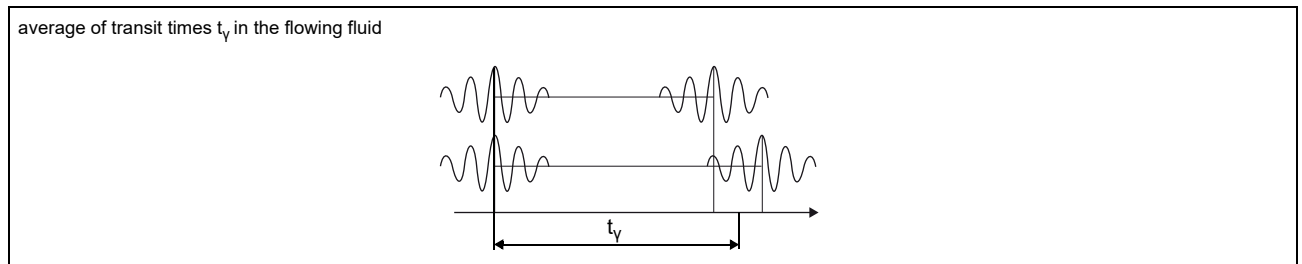
The transducers are mounted on the pipe which is completely filled with the fluid. The ultrasonic signals are emitted alternately by a transducer and received by the other. The physical quantities are determined from the transit times of the ultrasonic signals.



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

Transit time measurement

The average of the transit times of both ultrasonic signals in the fluid and the length of the sound paths in the fluid are used for the calculation of the sound speed. By using the average, the sound speed is independent of the flow velocity of the fluid. The physical quantities of analysis are determined from the sound speed.



Calculation of sound speed

$$c_V = \frac{l_V}{t_V}$$

where

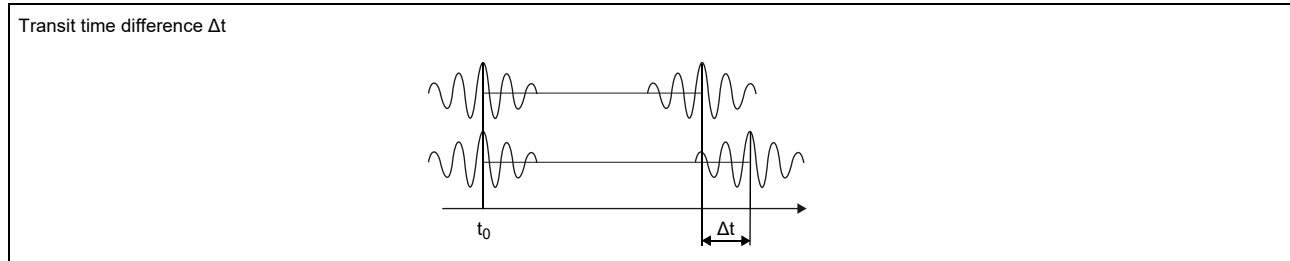
- c_V - sound speed in the fluid
- l_V - sound path in the fluid
- t_V - average of transit times in the fluid

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

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:

- **reflection arrangement**

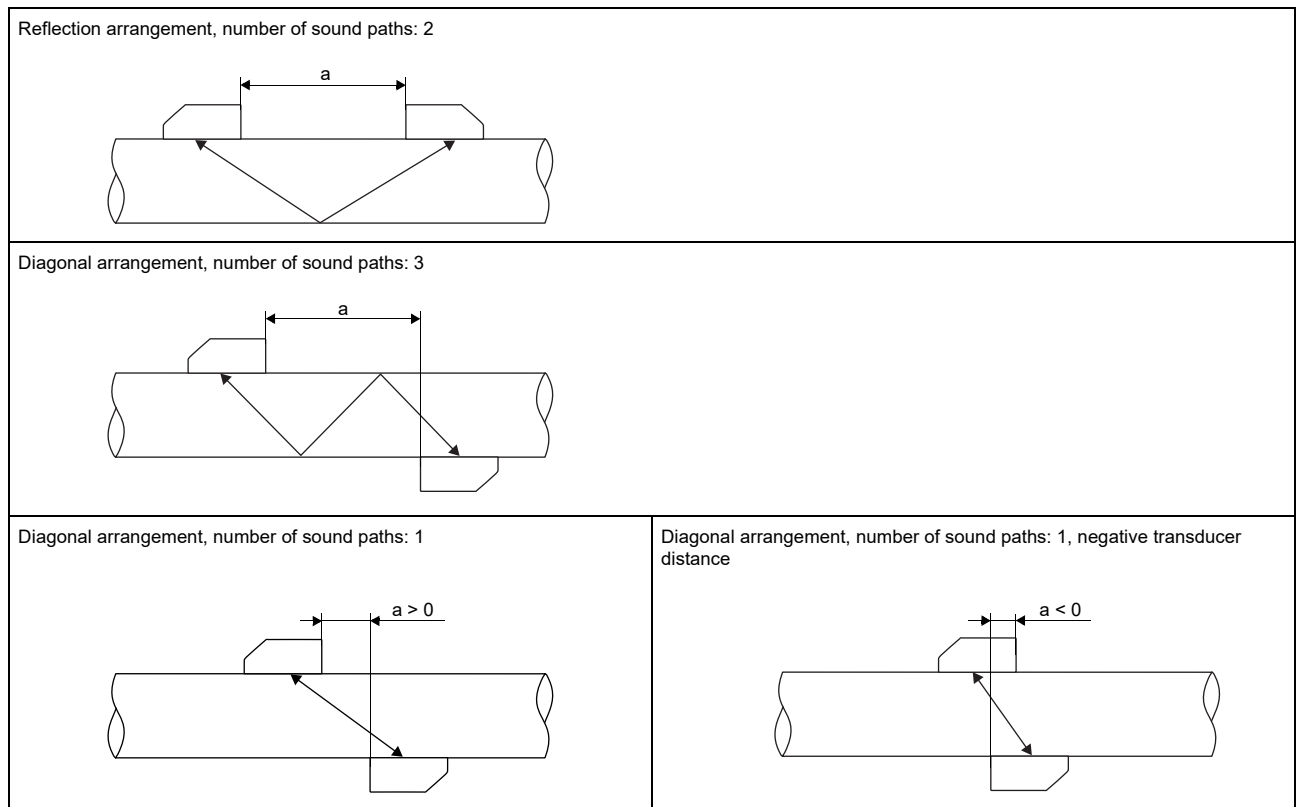
The number of sound paths is even. The transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easier.

- **diagonal arrangement**

The number of sound paths is odd. The transducers are mounted on opposite sides of the pipe. In the case of a high signal attenuation by the fluid, pipe and coatings, diagonal arrangement with 1 sound path will be used.

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 reflection arrangement or diagonal arrangement, the number of sound paths can be adjusted optimally for the application.



a - transducer distance

Transmitter

Technical data


	PIOX S721**-NN0*A	PIOX S721**-NN0*S	PIOX S721**-A20*S	PIOX S721**-F20*S
				
design	standard field device nonEx	field device with stainless steel housing nonEx	field device with stainless steel housing zone 2	field device with stainless steel housing 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: $20 \text{ ns} \pm 10^{-4} \cdot t$, absolute: $200 \text{ ns} \pm 10^{-4} \cdot t$ 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	m/s	0.01...25		
repeatability	0.15 % of reading ± 0.005 m/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 measuring system ¹	± 0.3 % of reading ± 0.005 m/s			
measurement uncertainty at the measuring point ²	± 1 % of reading ± 0.005 m/s			
transmitter				
power supply	<ul style="list-style-type: none"> • 100...230 V/50...60 Hz or • 20...32 V DC or • 11...16 V DC 			
power consumption	W	< 15		
number of measuring channels	1, optional: 2			
damping	s	0...100 (adjustable)		
measuring cycle	Hz	100...1000 (1 channel)		
response time	s	1 (1 channel)		
housing material	aluminum, powder coated	stainless steel 316L (1.4404)		
degree of protection	IP66	IP66	IP66	IP65
dimensions	mm	see dimensional drawing		
weight	kg	5.4	5.1	
fixation	wall mounting, optional: 2" pipe mounting			
ambient temperature °C	-40...+60 (< -20 °C without operation of the display)	-40...+60 (< -20 °C without operation of the display)	-40...+60 (< -20 °C without operation of the display)	-20...+55/60
display	128 x 64 dots, backlight			
menu language	English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian			
explosion protection				
• ATEX/IECEx				
marking	-	-	CE 0637  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	-

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside of explosive atmosphere (housing cover open)

⁴ with inputs and including parametrization of the transmitter

	PIOX S721**-NN0*A	PIOX S721**-NN0*S	PIOX S721**-A20*S	PIOX S721**-F20*S
• FM				
marking	-	-	-	F703Z2**1, F703Z2**2:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 Ta = 60 °C F703Z2**9:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A Ta = 55 °C
measuring functions				
physical quantities	<ul style="list-style-type: none"> analysis: concentration of analyte in matrix, concentration of matrix in analyte, mass fraction, volume fraction, mole fraction, density, normalized density, normalized sound speed flow: volumetric flow rate, flow velocity, sound speed, mass flow rate 			
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: <ul style="list-style-type: none"> • USB³ • LAN³ 			
process interfaces	max. 1 option: <ul style="list-style-type: none"> • RS485 (ASCII sender) • Modbus RTU⁴ • BACnet MS/TP • HART⁴ • Profibus PA⁴ • FF H1⁴ • Modbus TCP⁴ • BACnet IP 			
accessories				
serial data kit	USB cable			
software	<ul style="list-style-type: none"> • FluxDiagReader: download of measured values and parameters, graphical presentation • FluxDiag (optional): download of measurement data, graphical presentation, report generation, parametrization of the transmitter 			
data logger				
loggable values	all physical quantities, totalized values and diagnostic values			
capacity	max. 800 000 measured values			
outputs				
	The outputs are galvanically isolated from the transmitter.			
number	on request			
• switchable current output				
	The switchable current outputs are menu selectable all together as passive or active.			
range	mA	4...20 (3.2...22)		
accuracy		0.04 % of reading ±3 µA		
active output		R _{ext} < 350 Ω		
passive output		U _{ext} = 8...30 V, depending on R _{ext} (R _{ext} < 1 kΩ at 30 V)		
• HART				
range	mA	4...20		
accuracy		0.1 % of reading ±15 µA		
active output		U _{int} = 24 V, R _{ext} < 500 Ω		
passive output		U _{ext} = 10...24 V DC, depending on R _{ext} (R _{ext} < 1 kΩ at 24 V)		
• voltage output				
range	V	0...1 or 0...10		
accuracy		0...1 V: 0.1 % of reading ±1 mV 0...10 V: 0.1 % of reading ±10 mV		
internal resistance		R _{int} = 500 Ω		
• frequency output				
range	kHz	0...5		
optorelay		24 V/4 mA, R _{int} = 66.5 Ω		
• binary output				
optorelay		26 V/100 mA		
Reed relay		48 V/100 mA, R _{int} = 22 Ω		
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...1000		
• pulse width	ms	optorelay: 1...1000 Reed relay: 80...1000		

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside of explosive atmosphere (housing cover open)

⁴ with inputs and including parametrization of the transmitter

	PIOX S721**-NN0*A	PIOX S721**-NN0*S	PIOX S721**-A20*S	PIOX S721**-F20*S
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	°C	-150...+560		
resolution	K	0.01		
accuracy	±0.01 % of reading ±0.03 K			
• current input				
accuracy	0.1 % of reading ±10 µA			
active input	U _{int} = 24 V, R _{int} = 50 Ω, P _{int} < 0.5 W, not short-circuit proof			
• range	mA	0...20		
passive input	R _{int} = 50 Ω, P _{int} < 0.3 W			
• range	mA	-20...+20		
• voltage input				
range	V	0...1		
accuracy	0.1 % of reading ±1 mV			
internal resistance	R _{int} = 1 MΩ			
• binary input				
switching signal	5...30 V, 1 mA			5...26 V, 1 mA
functions	<ul style="list-style-type: none"> • resetting the measured values • resetting the totalizers • stopping the totalizers • activation of the measuring mode for highly dynamic flows 			

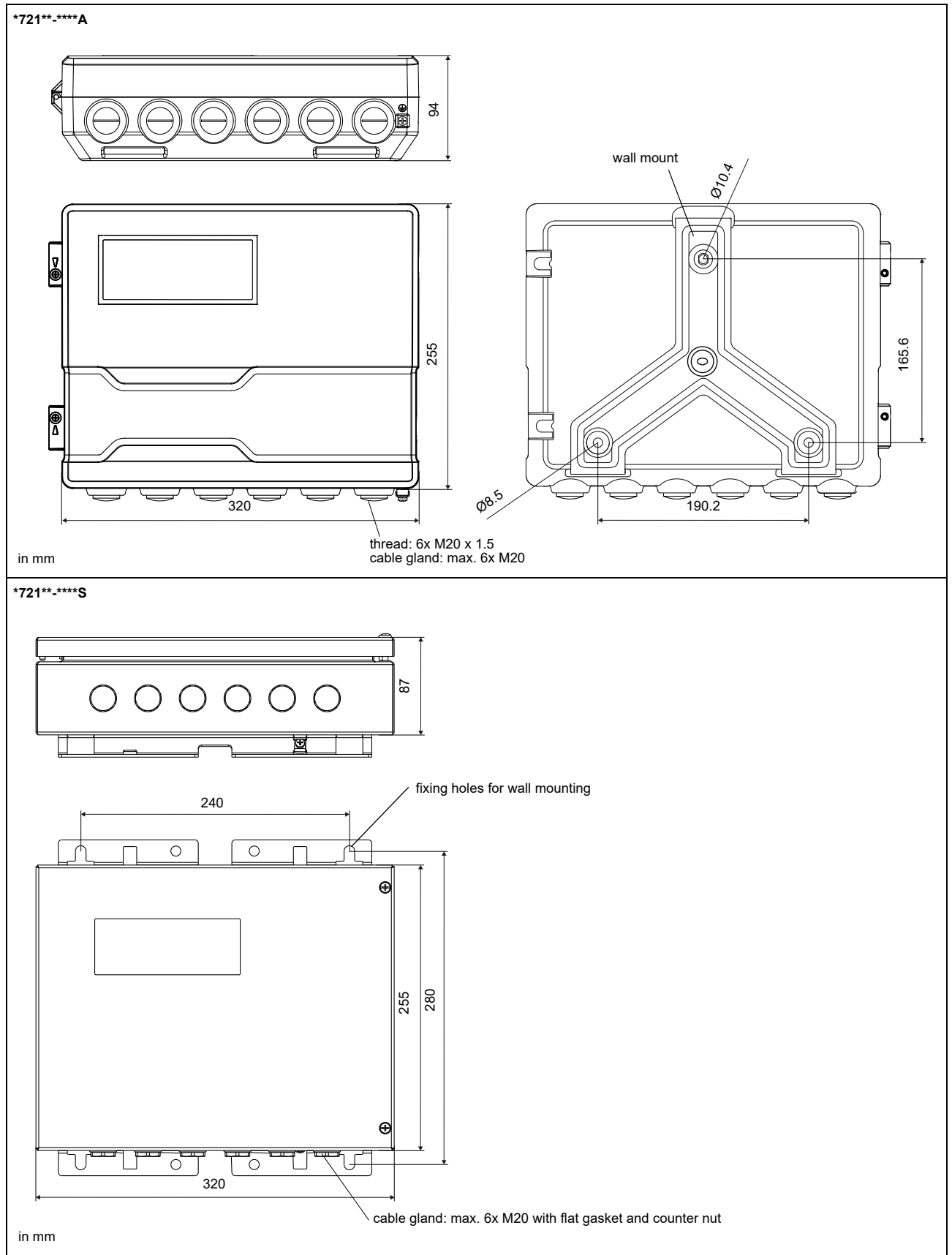
¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside of explosive atmosphere (housing cover open)

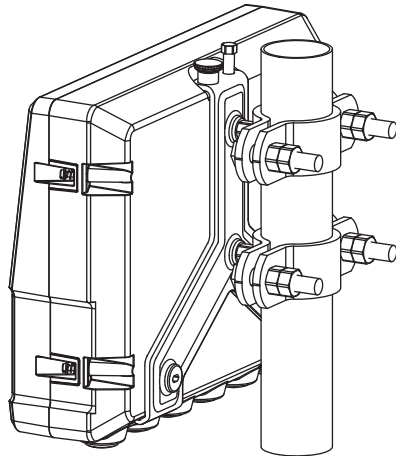
⁴ with inputs and including parametrization of the transmitter

Dimensions

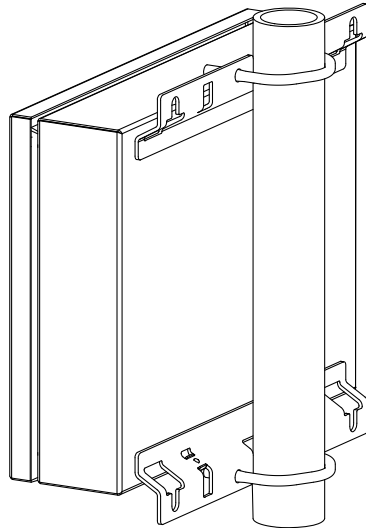


2" pipe mounting kit

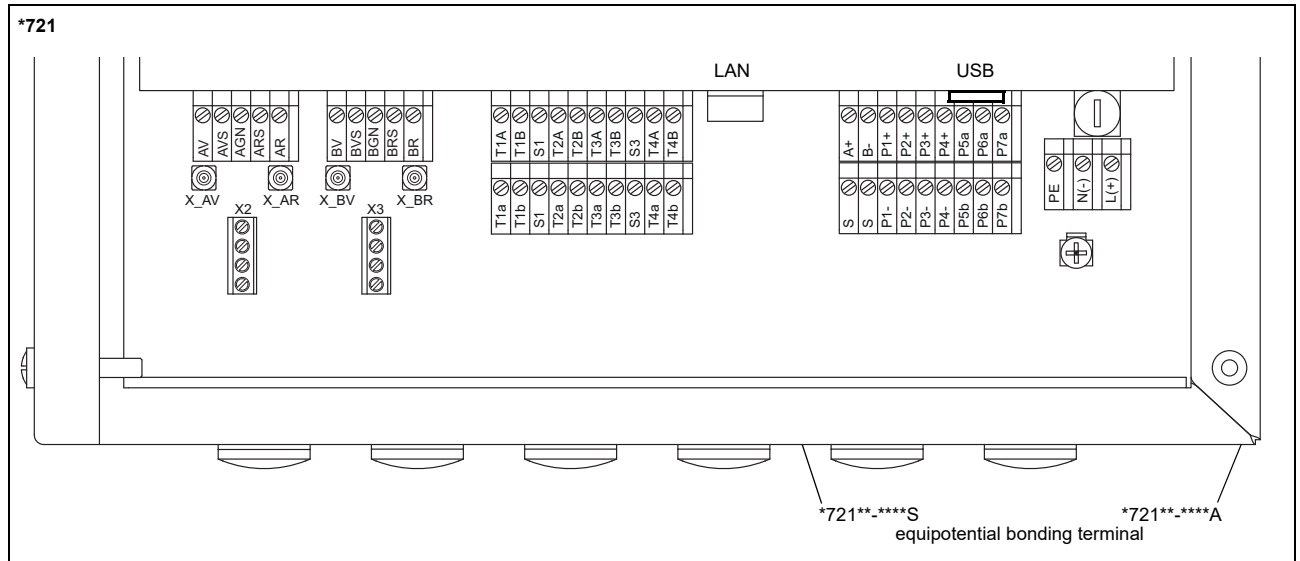
*721**_****A



*721**_****S



Terminal assignment



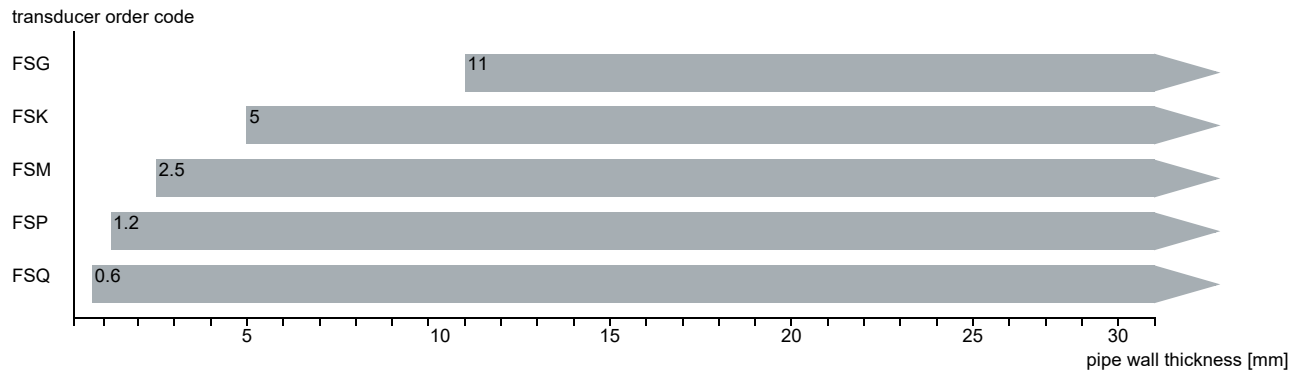
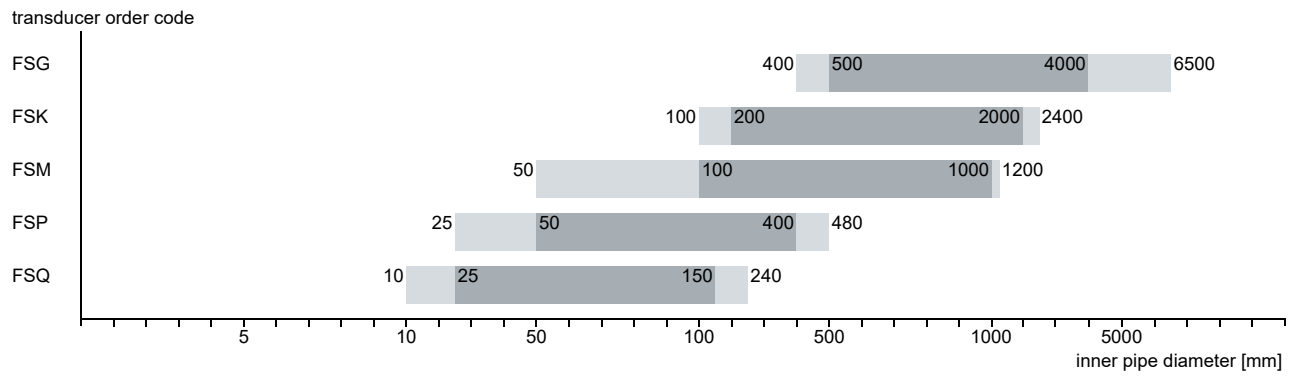
power supply ¹							
terminal		connection (AC)			connection (DC)		
PE		earth			earth		
N(-)		neutral			-		
L(+)		phase			+		
transducers							
transducer cable (transducers ****8*, ****L1*), extension cable				transducer cable (transducers ****52)			
measuring channel A		measuring channel B			measuring channel A	measuring channel B	
terminal	connection	terminal	connection	transducer	terminal	terminal	connection
AV	signal	BV	signal	↑	X_AV	X_BV	SMB connector
AVS	shield	BVS	shield				
ARS	shield	BRS	shield	⌵	X_AR	X_BR	SMB connector
AR	signal	BR	signal				
outputs ^{1, 2}							
terminal	connection	terminal	connection	communication interface			
P1+...P4+ P1-...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 			
		B-	signal -				
P5a...P7a P5b...P7b	binary output (optorelay)	S	shield				
		USB	type B	<ul style="list-style-type: none"> • service (FluxDiag/FluxDiagReader) • service (FluxDiag/FluxDiagReader) • BACnet IP • Modbus TCP 			
		LAN	RJ45				
analog inputs ^{1, 2}							
terminal	temperature probe		passive sensor	active sensor			
	direct connection	connection with extension cable	connection	connection			
T1a...T4a	red	red	not connected	not connected			
T1A...T4A	red/blue	grey	-	+			
T1b...T4b	white/blue	blue	+	not connected			
T1B...T4B	white	white	not connected	-			
S1, S3	shield	shield	not connected	not connected			
binary inputs ^{1, 2}							
terminal							
P1+...P2+, P1-...P2-							

¹ cable (by customer):
 - e.g. flexible leads, with insulated wire end ferrules, lead cross sectional area: 0.25...2.5 mm²
 - outer diameter of the cable (*721**-*52S with ferrite nut): max. 7.6 mm

² The number, type and terminal assignment will be customized.

Transducers

Transducer selection



recommended
 possible

Transducer order code

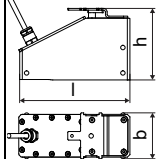
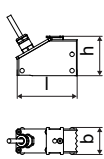
1, 2	3	4	5, 6	7, 8	9...11	no. of character				
transducer	transducer frequency	-	ambient temperature	explosion protection	connection system	-	extension cable	/	option	description
FS										set of ultrasonic flow transducers for liquids measurement, shear wave
	G									0.2 MHz
	K									0.5 MHz
	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						direct connection or connection via junction box
					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/**	FSQL-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	mm	400	100	50	25	10
min. recommended	mm	500	200	100	50	25
max. recommended	mm	4000	2000	1000	400	150
max. extended	mm	6500	2400	1200	480	240
pipe wall thickness						
min.	mm	11	5	2.5	1.2	0.6
material						
housing		PEEK with stainless steel cap 304 (1.4301), ***-*****/OS: 316L (1.4404)				
contact surface		PEEK				
degree of protection		IP67				
transducer cable						
type		1699				
length	m	5		4		3
length (**-*****/LC)	m	9				
dimensions						
length l	mm	129.5	126.5	64		40
width b	mm	51	51	32		22
height h	mm	67	67.5	40.5		25.5
dimensional drawing						
weight (without cable)	kg	0.47	0.36	0.066		0.016
pipe surface temperature						
min.	°C	-40				
max.	°C	+130				
ambient temperature						
min.	°C	-40				
max.	°C	+130				
temperature compensation		x				
explosion protection						
• ATEX/IECEx						
order code		FSG-NA2TS/**	FSK-NA2TS/**	FSM-NA2TS/**	FSP-NA2TS/**	FSQL-NA2TS/**
pipe surface temperature (Ex)		• min. °C -55 • max. °C gas: +190, dust: +180				
marking		CE 0637 Ex II 3G II 2D Ex nA IIC T6...T2 Gc Ex tb IIIC TX Db				
certification ATEX		IBExU10ATEX1163 X				
certification IECEx		IECEx IBE 12.0005X				
• FM						
order code		FSG-NF2TS/**	FSK-NF2TS/**	FSM-NF2TS/**	FSP-NF2TS/**	FSQL-NF2TS/**
pipe surface temperature (Ex)		• min. °C -40 • max. °C +125				
degree of protection		IP66			IP66	
marking		NI/CI. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860			NI/CI. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	

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

order code	FSG-N**TS/IP68	FSK-N**TS/IP68	FSM-N**TS/IP68	FSP-N**TS/IP68
technical type	CDG1LI8	CDK1LI8	CDM2LI8	CDP2LI8
transducer frequency	MHz 0.2	0.5	1	2
inner pipe diameter d				
min. extended	mm 400	100	50	25
min. recommended	mm 500	200	100	50
max. recommended	mm 4000	2000	1000	400
max. extended	mm 6500	2400	1200	480
pipe wall thickness				
min.	mm 11	5	2.5	1.2
material				
housing	PEEK with stainless steel cap 316Ti (1.4571)			
contact surface	PEEK			
degree of protection	IP68 ¹			
transducer cable				
type	2550			
length	m 12			
dimensions				
length l	mm 130			72
width b	mm 54			32
height h	mm 83.5			46
dimensional drawing				
weight (without cable)	kg 0.43			0.085
pipe surface temperature				
min.	°C -40			
max.	°C +100			
ambient temperature				
min.	°C -40			
max.	°C +100			
temperature compensation	x			
explosion protection				
• ATEX/IECEX				
order code	FSG-NA2TS/IP68	FSK-NA2TS/IP68	FSM-NA2TS/IP68	FSP-NA2TS/IP68
pipe surface temperature (Ex)	• min. °C -40 • max. °C gas: +90, dust: +80			
marking	CE 0637 Ex II3G II2D Ex nA IIC T6...T2 Gc Ex tb IIIC TX Db			
certification ATEX	IBExU10ATEX1163 X			
certification IECEX	IECEX IBE 12.0005X			

¹ test conditions: 3 months/2 bar (20 m)/20 °C

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

order code		FSM-E**TS/**	FSP-E**TS/**	FSQ-E**TS/**
technical type		C(DL)M2E52	C(DL)P2E52	C(DL)Q2E52
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recommended	mm	100	50	25
max. recommended	mm	1000	400	150
max. extended	mm	1200	480	240
pipe wall thickness				
min.	mm	2.5	1.2	0.6
material				
housing		PI with stainless steel cap 304 (1.4301), ***-****/OS: 316L (1.4404)		
contact surface		PI		
degree of protection		IP56		
transducer cable				
type		6111		
length	m	4		3
length (**-****/LC)	m	9		
dimensions				
length l	mm	64		40
width b	mm	32		22
height h	mm	40.5		25.5
dimensional drawing				
weight (without cable)	kg	0.066		0.017
pipe surface temperature				
min.	°C	-30		-30
max.	°C	+240 ¹		+200
ambient temperature				
min.	°C	-30		-30
max.	°C	+40 +60 ² +200 ³		+200
temperature compensation		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		CE 0637 Ex II 3G II 2D Ex nA IIC T6...T2 Gc Ex tb IIIA TX Db		
certification ATEX		IBExU10ATEX1163 X		
certification IECEx		IECEx IBE 12.0005X		
• FM				
order code		FSM-EF2TS/**	FSP-EF2TS/**	FSQ-EF2TS/**
pipe surface temperature (Ex)		• min. °C -40 • max. °C +235 ¹		
degree of protection		IP66		
marking		 NI/CI. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860		

¹ > +200 °C:

Variofix L or Variofix C
 observe the insulation instruction
 Ex: ambient temperature max. +40 °C

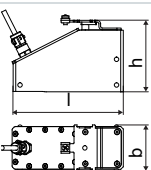
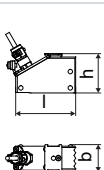
² pipe surface temperature +200...+240 °C: Variofix C without cover

³ pipe surface temperature max. +200 °C

Shear wave transducers (zone 1, TS)

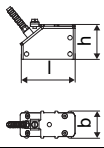
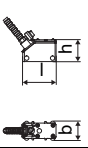
order code	FSG-N*1TS/**	FSK-N*1TS/**	FSM-N*1TS/**	FSP-N*1TS/**	FSQ-N*1TS/**
technical type	C(DL)G1N81	C(DL)K1N81	C(DL)M2N81	C(DL)P2N81	C(DL)Q2N81
transducer frequency	MHz 0.2	0.5	1	2	4
inner pipe diameter d					
min. extended	mm 400	100	50	25	10
min. recommended	mm 500	200	100	50	25
max. recommended	mm 4000	2000	1000	400	150
max. extended	mm 6500	2400	1200	480	240
pipe wall thickness					
min.	mm 11	5	2.5	1.2	0.6
material					
housing	PEEK with stainless steel cap 304 (1.4301), ***-****/OS: 316L (1.4404)				
contact surface	PEEK				
degree of protection	IP65	IP66			IP65
transducer cable					
type	1699				
length	m 5		4		3
length (**-****/LC)	m 9				
dimensions					
length l	mm 129.5	126.5	64		40
width b	mm 51	51	32		22
height h	mm 67	67.5	40.5		25.5
dimensional drawing					
weight (without cable)	kg 0.47	0.36	0.066		0.016
pipe surface temperature					
min.	°C -40				
max.	°C +130				
ambient temperature					
min.	°C -40				
max.	°C +130				
temperature compensation	x				
explosion protection					
• ATEX/IECEX					
order code	FSG-NA1TS/**	FSK-NA1TS/**	FSM-NA1TS/**	FSP-NA1TS/**	FSQ-NA1TS/**
pipe surface temperature (Ex)	• min. °C -55 • max. °C +180				
marking	CE 0637 (E) II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db				
certification ATEX	IBExU07ATEX1168 X				
certification IECEX	IECEX IBE 08.0007X				

Shear wave transducers (zone 1, TS, IP68)

order code		FSG-N*1TS/IP68	FSK-N*1TS/IP68	FSM-N*1TS/IP68	FSP-N*1TS/IP68
technical type		CDG1L11	CDK1L11	CDM2L11	CDP2L11
transducer frequency	MHz	0.2	0.5	1	2
inner pipe diameter d					
min. extended	mm	400	100	50	25
min. recommended	mm	500	200	100	50
max. recommended	mm	4000	2000	1000	400
max. extended	mm	6500	2400	1200	480
pipe wall thickness					
min.	mm	11	5	2.5	1.2
material					
housing		PEEK with stainless steel cap 316Ti (1.4571)			
contact surface		PEEK			
degree of protection		IP68 ¹			
transducer cable					
type		2550			
length	m	12			
dimensions					
length l	mm	130		72	
width b	mm	54		32	
height h	mm	83.5		46	
dimensional drawing					
weight (without cable)	kg	0.43		0.085	
pipe surface temperature					
min.	°C	-40			
max.	°C	+100			
ambient temperature					
min.	°C	-40			
max.	°C	+100			
temperature compensation		x			
explosion protection					
• ATEX/IECEX					
order code		FSG-NA1TS/IP68	FSK-NA1TS/IP68	FSM-NA1TS/IP68	FSP-NA1TS/IP68
pipe surface temperature (Ex)					
• min.	°C	-55			
• max.	°C	+80			
marking		CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db			
certification ATEX		IBExU07ATEX1168 X			
certification IECEX		IECEX IBE 08.0007X			

¹ test conditions: 3 months/2 bar (20 m)/20 °C

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

order code		FSM-E*1TS/**	FSP-E*1TS/**	FSQ-E*1TS/**
technical type		C(DL)M2E85	C(DL)P2E85	C(DL)Q2E85
transducer frequency	MHz	1	2	4
inner pipe diameter d				
min. extended	mm	50	25	10
min. recommended	mm	100	50	25
max. recommended	mm	1000	400	150
max. extended	mm	1200	480	240
pipe wall thickness				
min.	mm	2.5	1.2	0.6
material				
housing		PI with stainless steel cap 304 (1.4301), ***-****/OS: 316L (1.4404)		
contact surface		PI		
degree of protection		IP66		IP56
transducer cable				
type		6111		
length	m	4	3	
length (***-*****/LC)	m	9		
dimensions				
length l	mm	64		40
width b	mm	32		22
height h	mm	40.5		25.5
dimensional drawing				
weight (without cable)	kg	0.066		0.017
pipe surface temperature				
min.	°C	-30		-30
max.	°C	+240 ¹		+200
ambient temperature				
min.	°C	-30		-30
max.	°C	+40 +200 ²		+200
temperature compensation		x		
explosion protection				
• ATEX/IECEx				
order code		FSM-EA1TS/**	FSP-EA1TS/**	FSQ-EA1TS/**
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 TX Db		
certification ATEX		IBExU07ATEX1168 X		
certification IECEx		IECEx IBE 08.0007X		

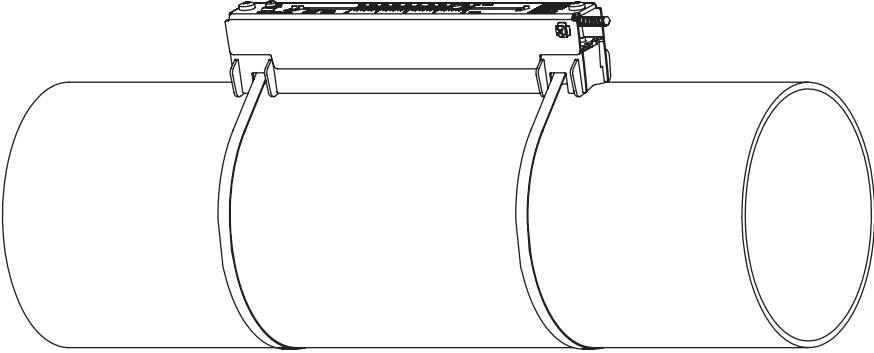
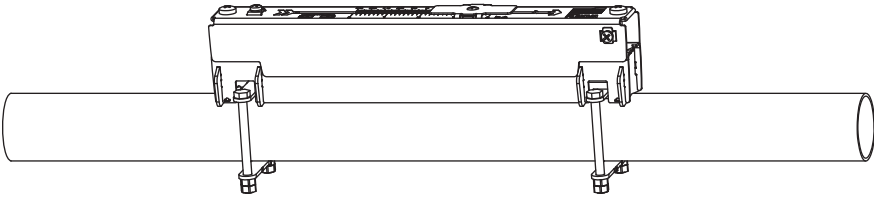
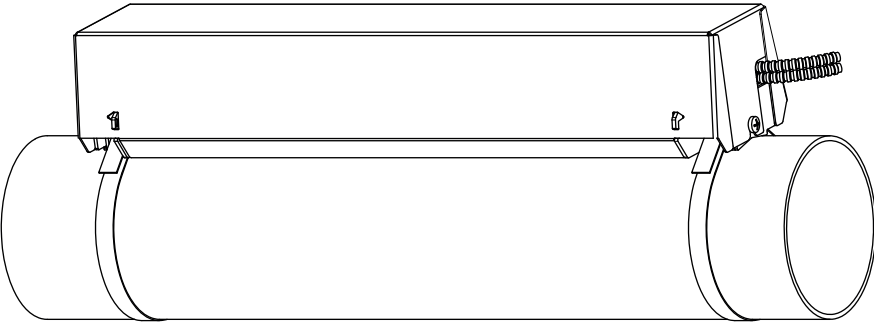
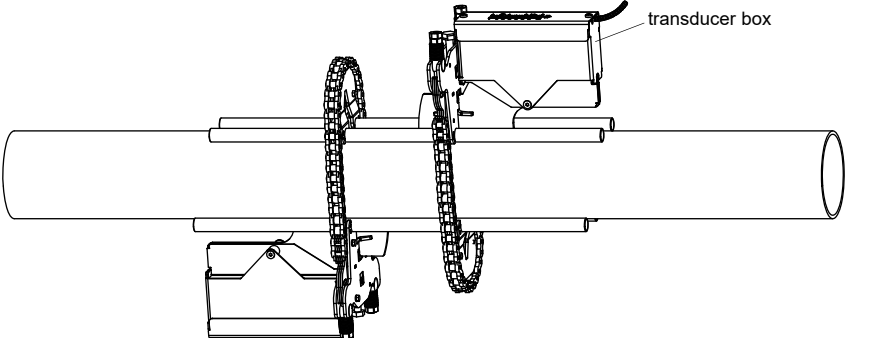
¹ > +200 °C:
 Variofix L or Variofix C
 observe the insulation instruction
 ambient temperature max. +40 °C

² pipe surface temperature max. +200 °C

Transducer mounting fixture

Order code

1, 2	3	4	5	6	7...9	no. of character
transducer mounting fixture	transducer	measurement arrangement	size	fixation	outer pipe diameter	option
VL						Variofix L
VC						Variofix C
WI						transducer box for WaveInjector
	K					transducers with transducer frequency G, K
	M					transducers with transducer frequency M, P
	Q					transducers with transducer frequency Q
		D				reflection arrangement or diagonal arrangement
		R				reflection arrangement
			S			small
			M			medium
			L			large
				B		bolts
				S		tension straps
				W		welding
				N		without fixation
					002	10...20 mm
					004	20...40 mm
					T36	40...360 mm
					013	10...130 mm
					036	130...360 mm
					092	360...920 mm
					200	920...2000 mm
					450	2000...4500 mm
					940	4500...9400 mm
					NDR	any
						IP68 for transducers with degree of protection IP68
						OS housing with stainless steel 316
						Z special design

<p>Variofix L (VLK, VLM, VLQ)</p> 	<p>material: stainless steel 304 (1.4301), 301 (1.4310), 410 (1.4006) option OS: 316Ti (1.4571), 316L (1.4404), 17-7PH (1.4568) inner length: VLK: 348 mm, option IP68: 368 mm VLM: 234 mm VLQ: 176 mm dimensions: VLK: 423 x 90 x 93 mm option IP68: 443 x 94 x 105 mm VLM: 309 x 57 x 63 mm VLQ: 247 x 43 x 47 mm</p>
<p>Variofix L with bolt mounting plates (VL**--B)</p> 	<p>material: stainless steel 304 (1.4301), 301 (1.4310), 410 (1.4006) option OS: 316Ti (1.4571), 316L (1.4404), 17-7PH (1.4568) inner length: VLM: 234 mm VLQ: 176 mm dimensions: VLM: 309 x 57 x 63 mm VLQ: 247 x 43 x 47 mm outer pipe diameter: max. 48 mm</p>
<p>Variofix C (VC)</p> 	<p>material: stainless steel 304 (1.4301), 301 (1.4310) option OS: 316Ti (1.4571) inner length: VCK-*L: 500 mm VCK-*S: 350 mm VCM: 400 mm VCQ: 250 mm dimensions: VCK-*L: 560 x 122 x 102 mm, option IP68: 560 x 126 x 120 mm VCK-*S: 410 x 122 x 102 mm, option IP68: 410 x 126 x 120 mm VCM: 460 x 96 x 80 mm VCQ: 310 x 85 x 62 mm</p>
<p>transducer box WI for Wavelnjector</p> 	<p>see Technical specification TSWavelnjectorVx-x</p>

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	
	< 100 °C	< 170 °C	< 150 °C	< 200 °C	200...240 °C	< 280 °C	280...400 °C
< 24 h	coupling compound type N or coupling foil type VT	coupling compound type E or coupling foil type VT	coupling compound type E or coupling foil type VT	coupling compound type E or H or coupling foil type VT	coupling foil type TF	coupling foil type A and coupling foil type VT	coupling foil type B and coupling foil type VT
long time measurement	coupling foil type VT ¹	coupling foil type VT ²	coupling foil type VT ¹	coupling foil type VT ²	coupling foil type TF	coupling foil type A and coupling foil type VT	coupling foil type B and coupling foil type VT

¹ < 5 years

² < 6 months

Technical data

type	ambient temperature °C
coupling compound type N	-30...+130
coupling compound type E	-30...+200
coupling compound type H	-30...+250
coupling foil type A	max. 280
coupling foil type B	280...400
coupling foil type VT	-10...+200
coupling foil type TF	200...240

Connection systems

connection system TS		
connection with extension cable	direct connection	transducers technical type
<p>JB01</p>		<p>****8*</p>
<p>JB01, JBP2, JBP3</p>		<p>****L1*</p>
<p>JB02, JB03, JB04</p>		<p>****52</p>

Cable

transducer cable				
type		1699	2550	6111
weight	kg/m	0.094	0.035	0.092
ambient temperature	°C	-55...+200	-40...+100	-100...+225
properties			longitudinal watertight	
cable jacket				
material		PTFE	PUR	PFA
outer diameter	mm	2.9	5.2 ±0.2	2.7
thickness	mm	0.3	0.9	0.5
colour		brown	grey	white
shield		x	x	x
sheath				
material		stainless steel 304 (1.4301) option OS: 316Ti (1.4571)	-	stainless steel 304 (1.4301) option OS: 316Ti (1.4571)
outer diameter	mm	8	-	8

extension cable			
type		2615	5245
weight	kg/m	0.18	0.38
ambient temperature	°C	-30...+70	-30...+70
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	mm	12	12
thickness	mm	2	2
colour		black	black
shield		x	x
sheath			
material		-	steel wire braid with copolymer sheath
outer diameter	mm	-	15.6

Cable length

transducer frequency		F, G, H, K	M, P	Q	S				
connection system TS									
transducers technical type		x	l	x	l	x	l	x	l
*(DR)***8*	m	5	≤ 300	4	≤ 300	3	≤ 90	-	-
option LC: *(LT)***8*	m	9	≤ 300	9	≤ 300	9	≤ 90	-	-
*(DR)***5*	m	5	≤ 300	4	≤ 300	3	≤ 90	2	≤ 40
option LC: *(LT)***5*	m	9	≤ 300	9	≤ 300	9	≤ 90	-	-
option IP68: ****Ll*	m	12	≤ 300	12	≤ 300	-	-	-	-

x - transducer cable length

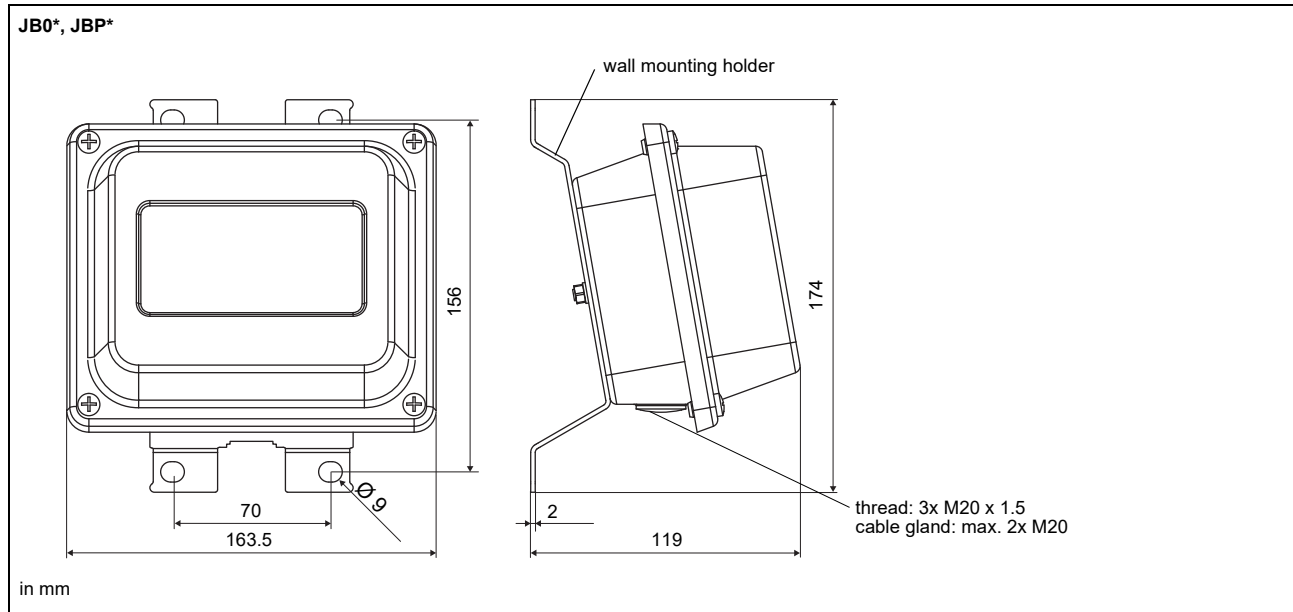
l - max. length of extension cable (depending on application)

Junction box

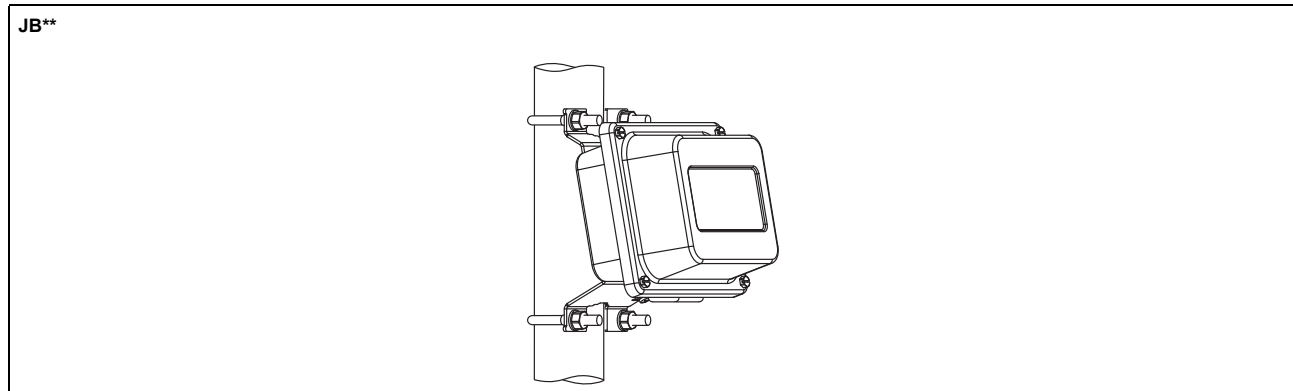
Technical data

JB01S4E3M, JBP2, JBP3			
weight	kg	1.2 kg	
fixation		wall mounting optional: 2" pipe mounting	
material			
housing		stainless steel 316L (1.4404)	
gasket		silicone	
degree of protection		IP67	
ambient temperature			
min.	°C	-40	
max.	°C	+80	
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		JBP2	
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	
	TVS	internal shield	
	TRS	internal shield	
	TR	signal	
JB02, JB03, JB04			
weight	kg	1.2 kg	
fixation		wall mounting optional: 2" pipe mounting	
material			
housing		stainless steel 316L (1.4404)	
gasket		silicone	
degree of protection		IP67	
ambient temperature			
min.	°C	-40	
max.	°C	+80	
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		NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ T6 Ta = -40...+60 °C	
connection			
transducers			
terminal strip	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

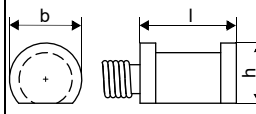
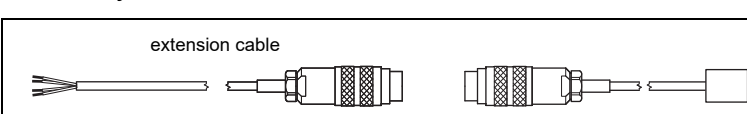
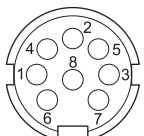
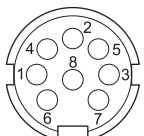
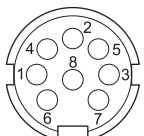
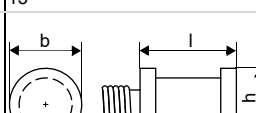

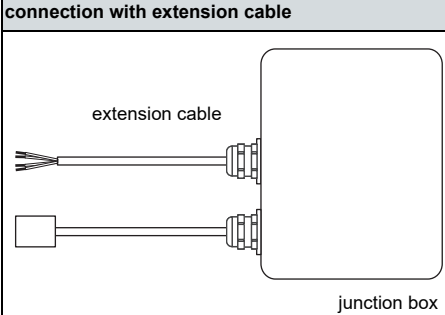
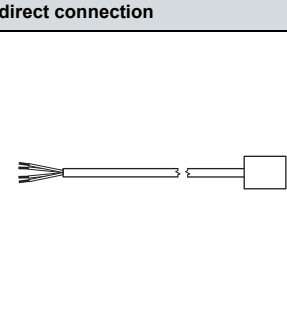
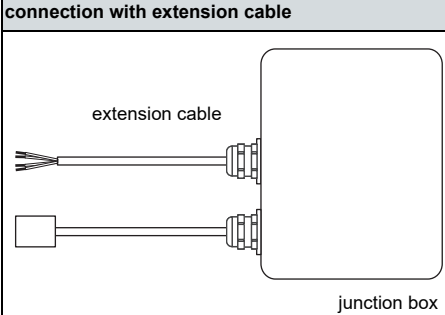
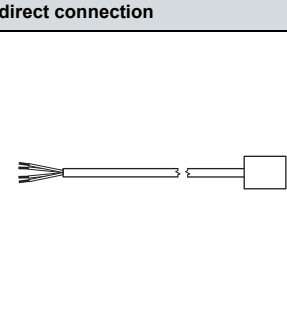
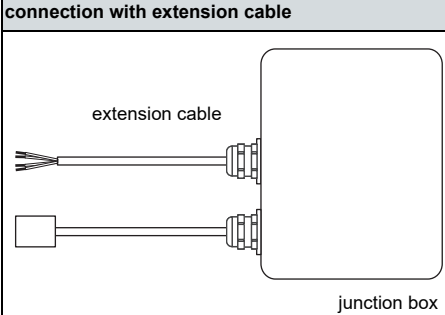
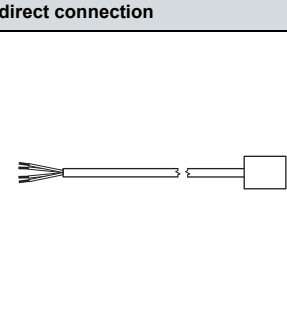


2" pipe mounting kit

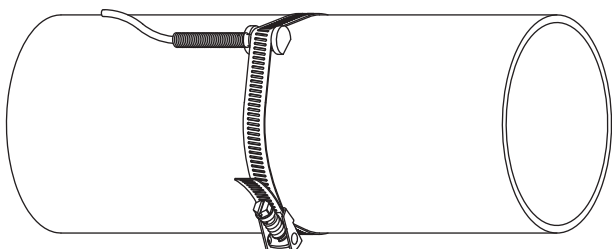


Clamp-on temperature probe (optional)


Technical data

PT12N																				
design	clamp-on with connector																			
type	Pt100																			
connection	4-wire																			
measuring range	°C -30...+250																			
accuracy T	$\pm(0.15 \text{ °C} + 2 \cdot 10^{-3} \cdot T \text{ [°C] })$ class A																			
accuracy ΔT (2x Pt matched according to EN 1434-1)	$\leq 0.1 \text{ K}$ ($3 \text{ K} < \Delta T < 6 \text{ K}$), more corresponding to EN 1434-1																			
response time	s 50																			
housing	aluminum																			
degree of protection	IP66																			
dimensions																				
length l	mm 20																			
width b	mm 15																			
height h	mm 13																			
dimensional drawing																				
weight	kg 0.25 (without connector)																			
accessories																				
thermal conductivity paste 200 °C	x																			
thermal conductivity foil 250 °C	x																			
connection system																				
																				
connection																				
	<table border="1"> <thead> <tr> <th rowspan="2">temperature probe</th> <th rowspan="2">extension cable</th> <th colspan="2">connector</th> </tr> <tr> <th>pin</th> <th></th> </tr> </thead> <tbody> <tr> <td>red</td> <td>grey</td> <td>2</td> <td rowspan="4"></td> </tr> <tr> <td>red/blue</td> <td>red</td> <td>6</td> </tr> <tr> <td>white/blue</td> <td>blue</td> <td>1</td> </tr> <tr> <td>white</td> <td>white</td> <td>7</td> </tr> </tbody> </table>	temperature probe	extension cable	connector		pin		red	grey	2		red/blue	red	6	white/blue	blue	1	white	white	7
temperature probe	extension cable			connector																
		pin																		
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cable																				
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	temperature probe	extension cable																		
type	4 x 0.25 mm ² black	LIYCY 8 x 0.14 mm ² grey																		
standard length	m 3	5/10/25																		
max. length	m -	200																		
cable jacket	PTFE	PVC																		
PT12N																				
design	clamp-on nonEx or ATEX																			
type	Pt100																			
connection	4-wire																			
measuring range	°C -30...+250																			
accuracy T	$\pm(0.15 \text{ °C} + 2 \cdot 10^{-3} \cdot T \text{ [°C] })$ class A																			
accuracy ΔT (2x Pt matched according to EN 1434-1)	$\leq 0.1 \text{ K}$ ($3 \text{ K} < \Delta T < 6 \text{ K}$), more corresponding to EN 1434-1																			
response time	s 50																			
housing	aluminum																			
degree of protection	IP66																			
dimensions																				
length l	mm 20																			
width b	mm 15																			
height h	mm 13																			
dimensional drawing																				
weight	kg 0.25																			
accessories																				
thermal conductivity foil 250 °C	x																			
explosion protection (optional)																				
• ATEX																				
marking	 II3G Ex nA IIC T6...T2 Gc Ta -30...+250 °C																			
connection system																				
<table border="1"> <thead> <tr> <th>connection with extension cable</th> <th>direct connection</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> </tr> </tbody> </table>		connection with extension cable	direct connection																	
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	temperature probe	extension cable																		
type	4 x 0.25 mm ² black	LIYCY 8 x 0.14 mm ² grey																		
standard length	m 3	5/10/25																		
max. length	m -	200																		
cable jacket	PTFE	PVC																		

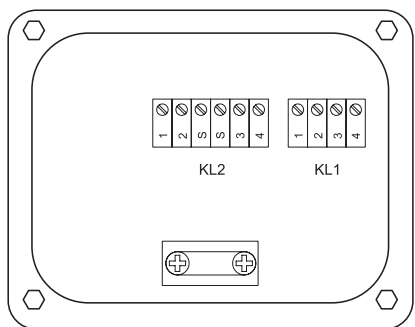
Fixation

<p>tension strap PT12N</p> 	<p>material: stainless steel 301 (1.4310), 410 (1.4006)</p>
---	---

Junction box

JBT2, JBT3		
weight	kg	1.2 kg
fixation		wall mounting optional: 2" pipe mounting
material		
housing		stainless steel 316L (1.4404)
gasket		silicone
degree of protection		IP67
ambient temperature		
min.	°C	-40
max.	°C	+80
explosion protection		
• ATEX		
junction box		JBT2
marking		 II3G Ex nA IIC (T6)...T4 Gc II3D Ex tc IIIC T 100 °C Dc Ta -40...+(70)80 °C

connection



temperature probe

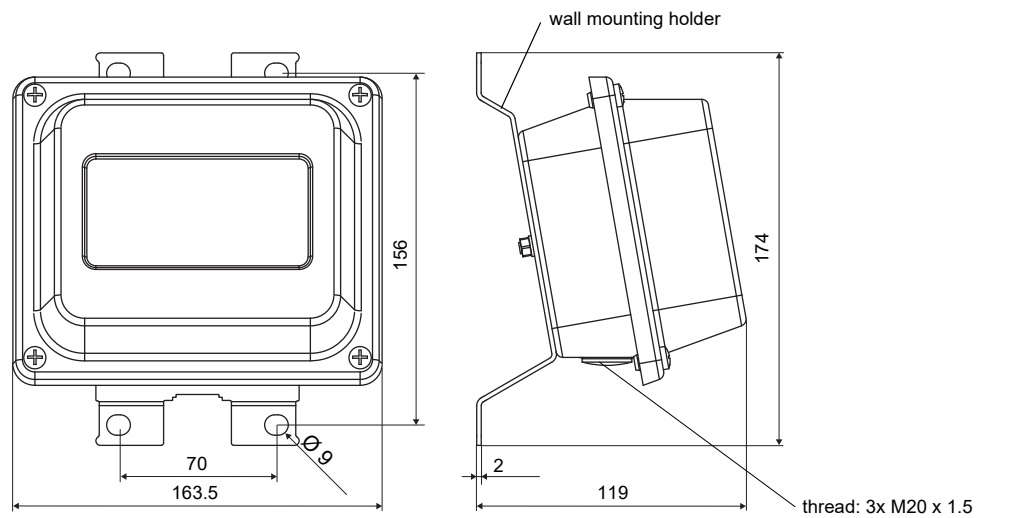
terminal strip	terminal	connection
KL1	1	red
	2	red/blue
	3	white
	4	white/blue

extension cable

terminal strip	terminal	connection
KL2	1	red
	2	grey
	3	white
	4	blue

Dimensions

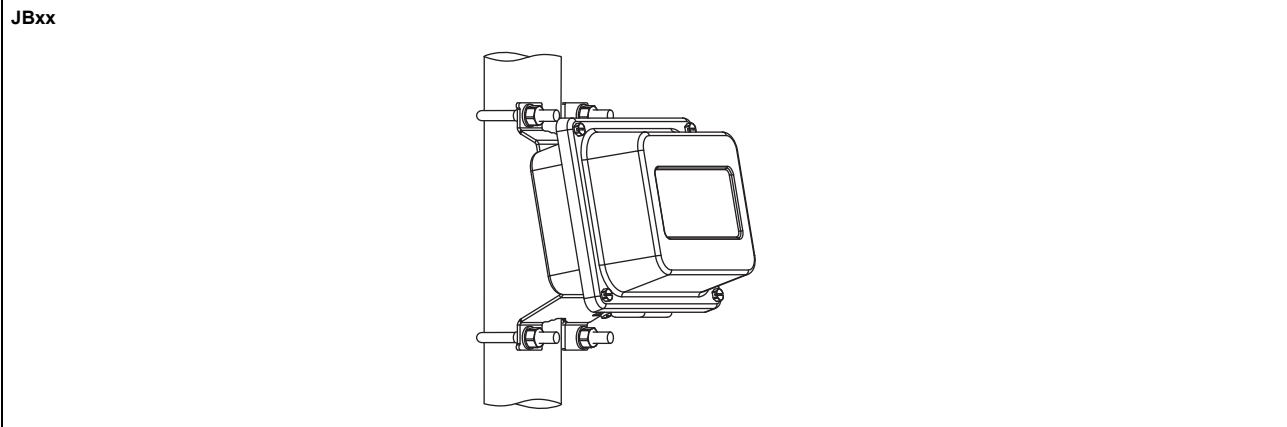
JBTx



wall mounting holder
 156
 174
 70
 163.5
 Ø 9
 2
 119
 thread: 3x M20 x 1.5
 cable gland: max. 2x M12

in mm

2" pipe mounting kit



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