FLEXIM

Technical specification

FLUXUS H721

Ultrasonic process monitoring and flow measurement of hydrocarbons

Features

- Exact and highly reliable bidirectional clamp-on flow measurement of operational and mass flow rate
- Measurement of standard volumetric flow rate according to ASTM and API determination
- Installation and start-up do not require any pipe work nor any process interruptions
- Transducers for use in hazardous areas are available
- Maintenance-free and drift-free measurement
- Transducers available for a wide range of inner pipe diameters and fluid temperatures
- Fluid data sets for all classes of hydrocarbons integrated in the transmitter
- Guided application adaptation

Applications

Applications in single and multiproduct pipelines:

- Leakage detection
- Check metering
- Fluid detection, batch/interface detection
- Fluid quality monitoring

FLUXUS H721**-****A

FLUXUS H721**-****S

Variofix C

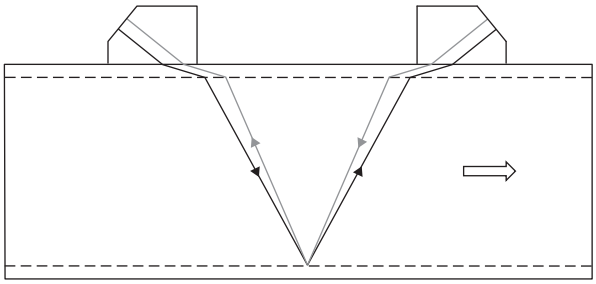
TSFLUXUS_H721V2-5EN_Leu, 2020-11-01

Function

Measurement principle

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

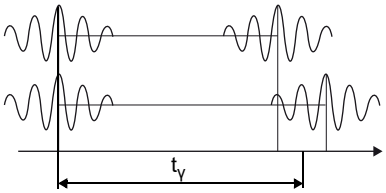
Path of the ultrasonic signal in the flowing fluid



Transit time measurement

All HPI physical quantities are determined from the sound speed. The sound speed is calculated by using 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.

average of transit times in the flowing 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.

$$c_\gamma = \frac{l_\gamma}{t_\gamma}$$

$$t_\gamma = \frac{t_1 + t_2}{2}$$

where

c_γ - sound speed in the fluid

l_γ - sound path in the fluid

t_γ - 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.

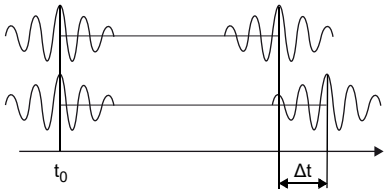
Transit time difference principle

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 standard volumetric flow rate

The standard volumetric flow rate can be selected as physical quantity. It is calculated with the following formula:

$$\dot{V}_N = \dot{V} \cdot VCF$$

where

$$VCF = CTL \cdot CPL = \frac{\rho}{\rho_N}$$

$\dot{V}_N$ - standard volumetric flow rate

$\dot{V}$ - operating volumetric flow rate

VCF - volume correction factor

CTL - correction for the effect of temperature on liquid

CPL - correction for the effect of pressure on liquid

ρ_N - normalised density

ρ - operating density

according to ASTM D 1250-04, IP200/04

Calculation of mass flow rate

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

$\rho = f(API, T)$

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

API - API gravity

T - temperature

$\dot{m}$ - mass flow rate

$\dot{V}$ - volumetric flow rate

Number of sound paths

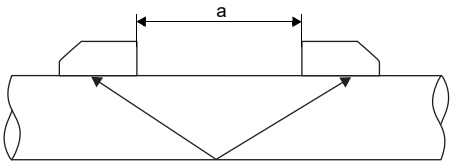
The number of sound paths is the number of transits of the ultrasonic signal through the fluid in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **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 easy.
- **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.

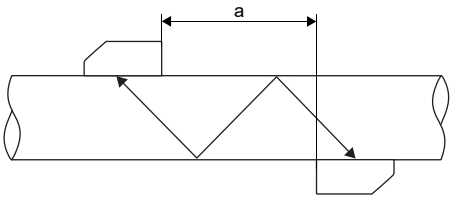
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

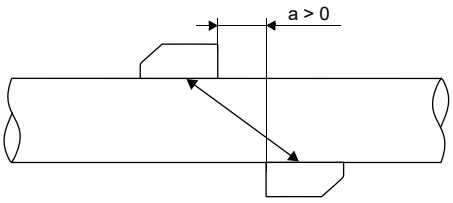
Reflection arrangement, number of sound paths: 2



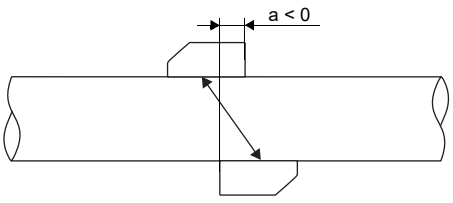
Diagonal arrangement, number of sound paths: 3



Diagonal arrangement, number of sound paths: 1



Diagonal arrangement, number of sound paths: 1, negative transducer distance



a - transducer distance

Transmitter

Technical data

		FLUXUS H721**-NN0*A	FLUXUS H721**-NN0*S	FLUXUS H721**-A20*S	FLUXUS H721**-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					
• flow					
measurement principle		transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content			
flow velocity	m/s	0.01...25			
repeatability		0.15 % MV ±0.005 m/s			
fluid		all acoustically conductive liquids with < 10 % gaseous or solid content in volume (transit time difference principle)			
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 ±0.005 m/s			
measurement uncertainty at the measuring point[2]		±1 % MV ±0.005 m/s			
• HPI					
transit time (repeatable)		$1/(50 \cdot f_\alpha) \pm 10^{-4} \cdot t$			
transit time (absolute)		$1/(5 \cdot f_\alpha) \pm 10^{-4} \cdot t$			
		f_α - transducer frequency, t - total transit time e.g. for transducers with transducer frequency M (f_α = 1 MHz): repeatable: 20 ns $\pm 10^{-4} \cdot t$, absolute: 200 ns $\pm 10^{-4} \cdot t$			
transmitter					
power supply		• 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 (1 measuring point)			
damping	s	0...100 (adjustable)			
measuring cycle	Hz	100...1000 (1 channel)			
response time	s	1 (1 channel), option: 0.02			
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 Ex II3G II2D Ex nA nC ic IIC T4 Gc Ex tb IIIC T120 °C Db T_a -40...+60 °C	-
certification ATEX		-	-	IBExU11ATEX1015	-
certification IECEx		-	-	IECEx IBE 11.0008	-

[1] with aperture calibration of the transducers

[2] for transit time difference principle and reference conditions

[3] outside the explosive atmosphere (housing cover open)

[4] with inputs and including parametrisation of the transmitter

		FLUXUS H721**-NN0*A	FLUXUS H721**-NN0*S	FLUXUS H721**-A20*S	FLUXUS H721**-F20*S
• FM					
marking		-	-	-	H721**-F20*S2, H721**-F20*S3: NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 H721**-F20*S1: NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A
measuring functions					
physical quantities		• flow: operating volumetric flow rate, standard volumetric flow rate according to ASTM 1250/TP25/4311, flow velocity, mass flow rate • HPI: API gravity, density, normalised density • interface detection: slope of the HPI physical quantities • fluid detection: according to fluid table			
totaliser		volume, mass			
calculation functions		average, difference, sum (2 measuring channels necessary)			
diagnostic functions		sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times			
communication interfaces					
service interfaces		measured value transmission, parametrisation of the transmitter: • USB[3] • LAN[3]			
process interfaces		max. 1 option: • Modbus RTU[4] • HART[4] • Profibus PA[4] • FF H1[4] • Modbus TCP[4]			
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, parametrisation of the transmitter			
data logger					
loggable values		all physical quantities, totalised 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...20 (3.2...22)			
accuracy		0.04 % MV ±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 % MV ±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 % MV ±1 mV 0...10 V: 0.1 % MV ±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 totalising			
• 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 the explosive atmosphere (housing cover open)

[4] with inputs and including parametrisation of the transmitter

		FLUXUS H721**-NN0*A	FLUXUS H721**-NN0*S	FLUXUS H721**-A20*S	FLUXUS H721**-F20*S
inputs					
		The inputs are galvanically isolated from the transmitter.			
number		max. 4, on request			
• **temperature input**					
type		Pt100/Pt1000			
connection		4-wire			
range	°C	-150...+560			
resolution	K	0.01			
accuracy		±0.01 % MV ±0.03 K			
• **current input**					
accuracy		0.1 % MV ±10 µA			
active input • range	 mA	U_{int} = 24 V, R_{int} = 50 Ω, P_{int} < 0.5 W, not short-circuit proof 0...20			
passive input • range	 mA	R_{int} = 50 Ω, P_{int} < 0.3 W -20...+20			
• **voltage input**					
range	V	0...1			
accuracy		0.1 % MV ±1 mV			
internal resistance		R_{int} = 1 MΩ			
• **binary input**					
switching signal		5...30 V, 1 mA			5...26 V, 1 mA
functions		• reset of the measured values • reset of the totalisers • stop of the totalisers • activation of the measuring mode for highly dynamic flows			

[1] with aperture calibration of the transducers

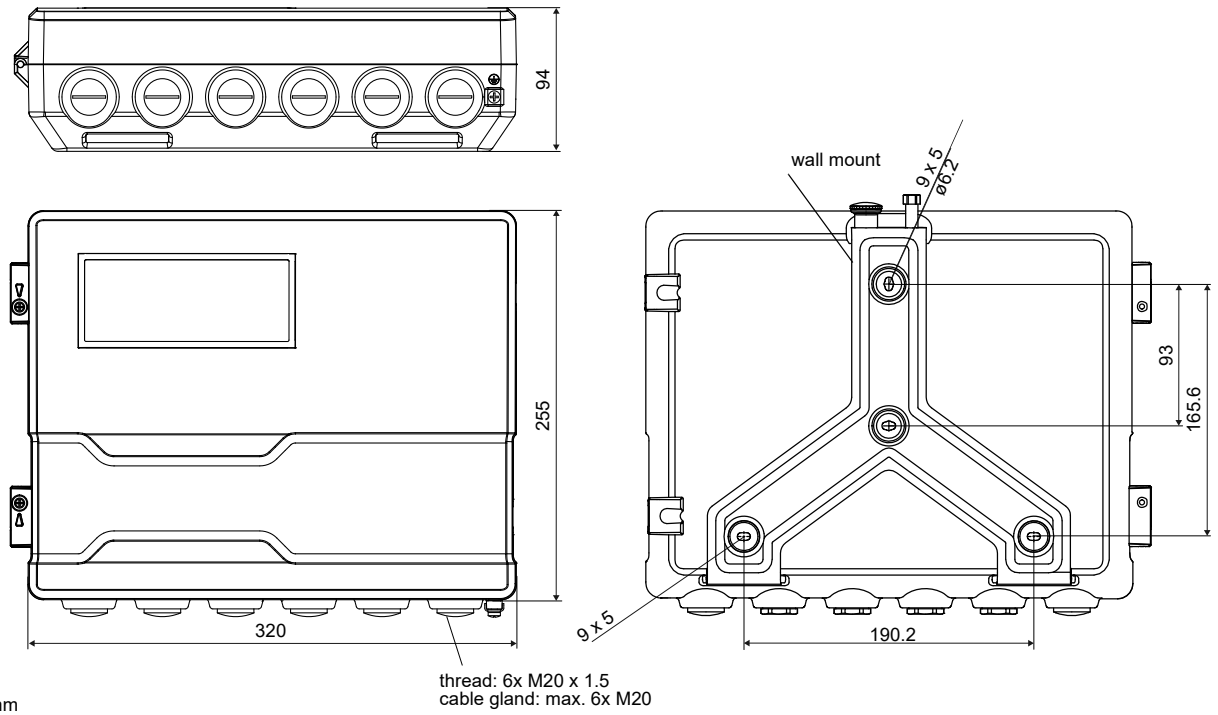
[2] for transit time difference principle and reference conditions

[3] outside the explosive atmosphere (housing cover open)

[4] with inputs and including parametrisation of the transmitter

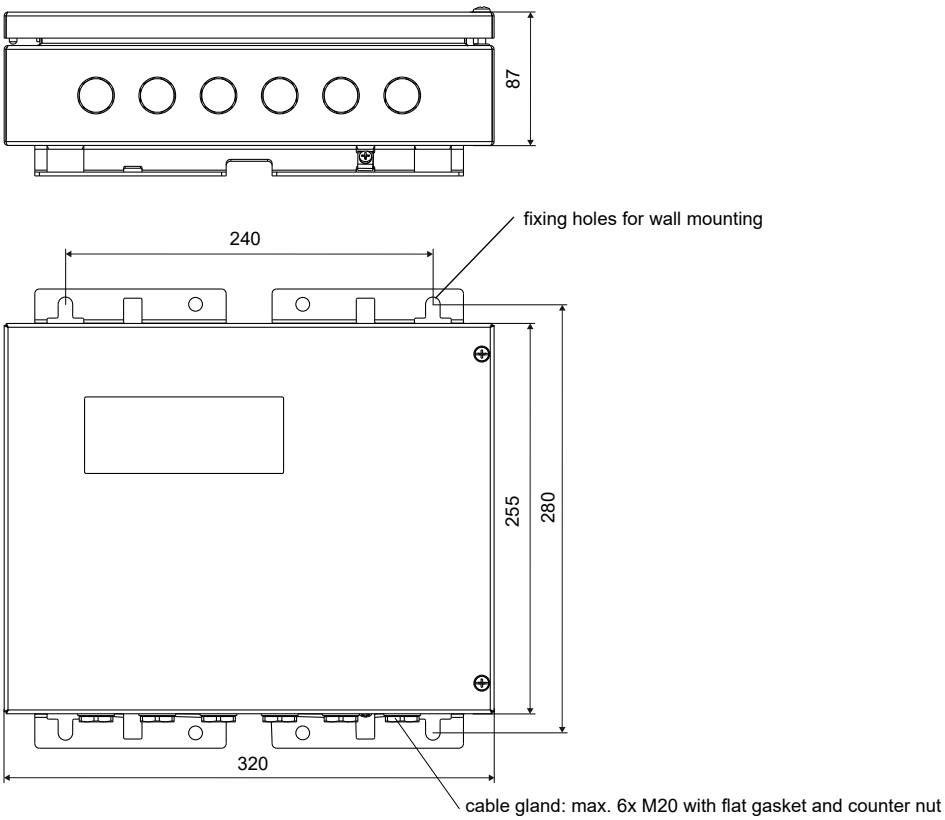
Dimensions

72-****A**



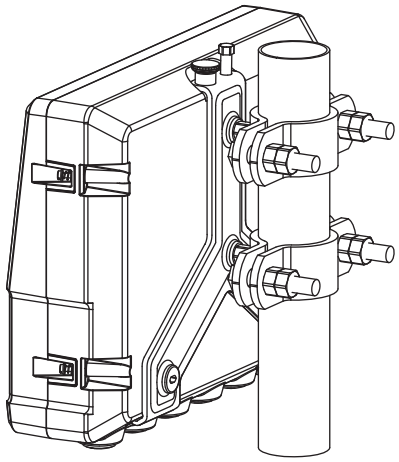
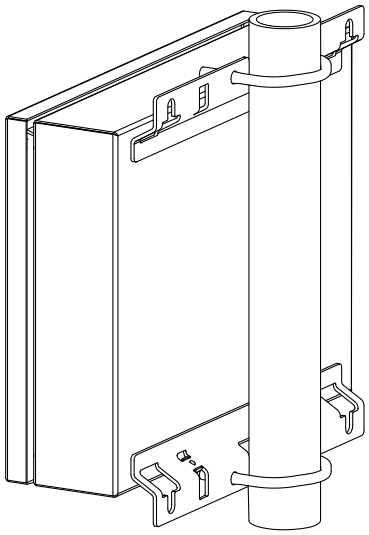
in mm

72-****S**

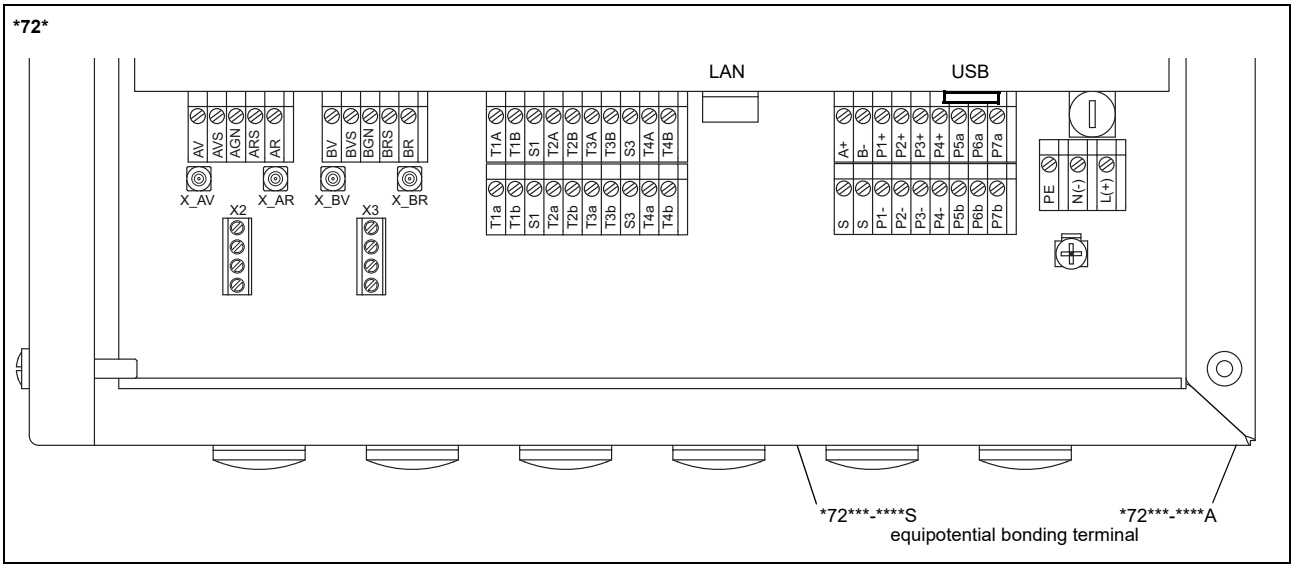


in mm

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 *****8*, ****LI*), extension cable					transducer cable (transducers *****52)		
measuring channel A		**measuring channel B**			**measuring channel A**	**measuring channel B**	
terminal	**connection**	**terminal**	**connection**	**transducer**	**terminal**		**connection**
AV	signal	BV	signal		X_AV	X_BV	SMB connector
AVS	shield	BVS	shield				
ARS	shield	BRS	shield		X_AR	X_BR	SMB connector
AR	signal	BR	signal				

outputs[1]

terminal	**connection**
P1+...P4+ P1-...P4-	current output, voltage output, frequency output, binary output (Reed relay), HART (P1)
P5a...P7a P5b...P7b	binary output

terminal	**connection**	**communication interface**
A+	signal +	• Modbus RTU[1] • Profibus PA[1] • FF H1[1]
B-	signal -	
101	shield	
USB	type B Hi-Speed USB 2.0 Device	• service (FluxDiag/ FluxDiagReader)
LAN	RJ45 10/100 Mbps Ethernet	• service (FluxDiag/ FluxDiagReader) • Modbus TCP

analog inputs[1, 2]

	temperature probe		**passive sensor**	**active sensor**
terminal	**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]

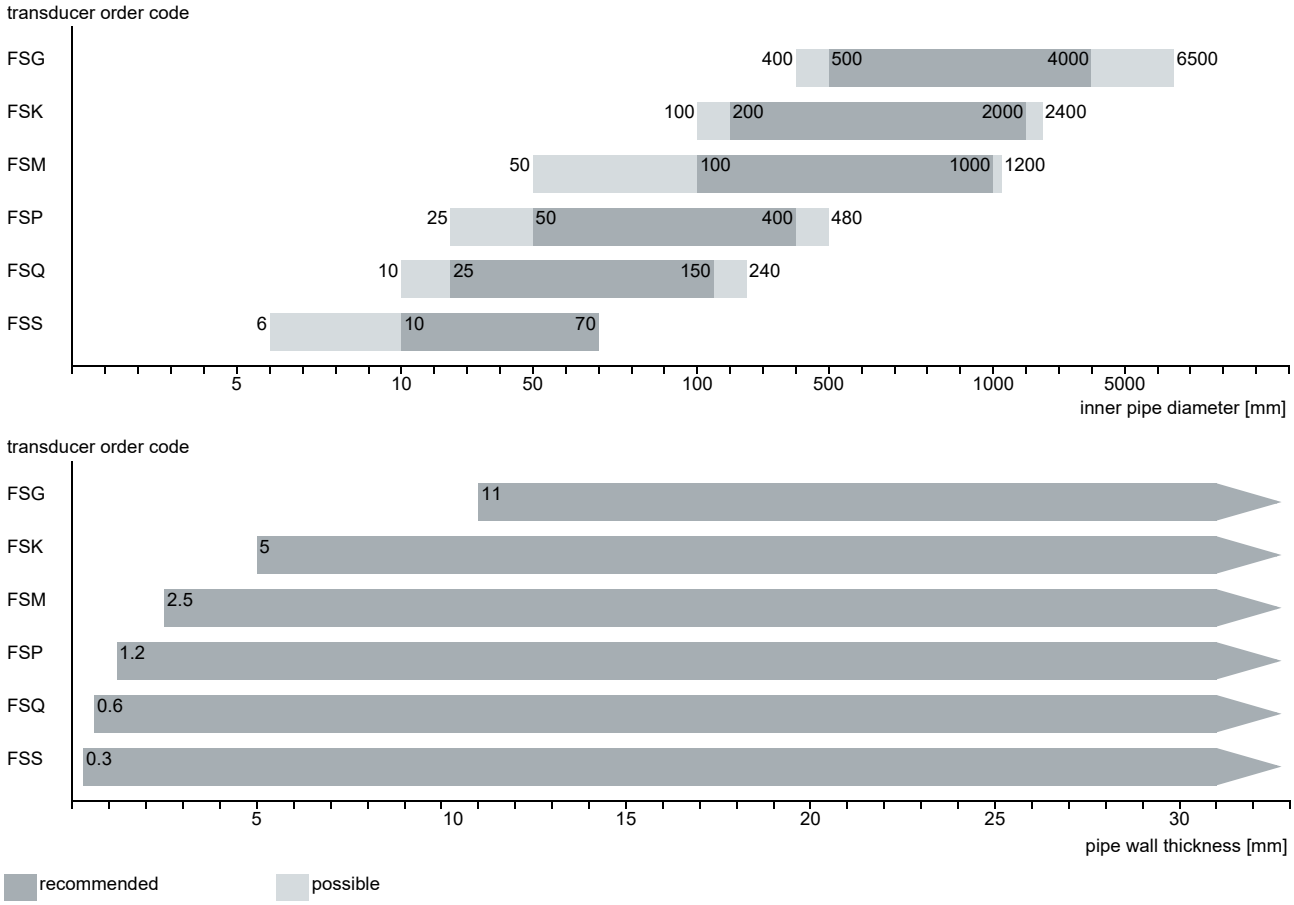
terminal
P1+...P2+, P1-...P2-

[1] cable (by customer):
- e.g. flexible wires, with insulated wire ferrules, wire cross-section: 0.25...2.5 mm^2
- outer diameter of the cable (*721**-****S with ferrite nut): max. 7.6 mm

[2] The number, type and terminal assignment are customised.

Transducers

Transducer selection

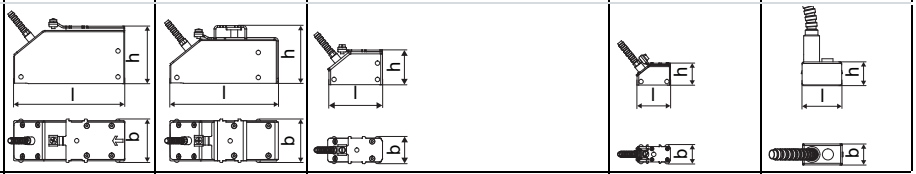


Transducer order code

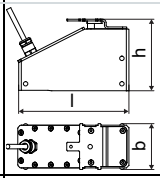
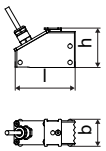
1, 2	3		4	5, 6	7, 8		9...11			no. of character
transducer	**transducer frequency**	**-**	**ambient temperature**	**explosion protection**	**connection system**	**-**	**extension cable**	**/**	**option**	**description**
FS										set of ultrasonic flow transducers for liquids measurement, shear wave
	G									0.2 MHz
	K									0.5 MHz
	M									1 MHz
	P									2 MHz
	Q									4 MHz
	S									8 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)

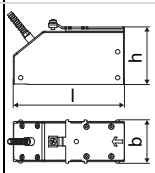
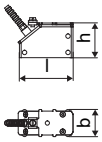
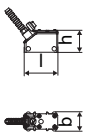
order code		FSG-N**TS/**	FSK-N**TS/**	FSM-N**TS/**	FSP-N**TS/**	FSQ-N**TS/**	FSS-N**TS/**
technical type		C(DL)G1N52	C(DL)K1N52	C(DL)M2N52	C(DL)P2N52	C(DL)Q2N52	CDS1N52
transducer frequency	MHz	0.2	0.5	1	2	4	8
inner pipe diameter d							
min. extended	mm	400	100	50	25	10	6
min. recommended	mm	500	200	100	50	25	10
max. recommended	mm	4000	2000	1000	400	150	70
max. extended	mm	6500	2400	1200	480	240	70
pipe wall thickness							
min.	mm	11	5	2.5	1.2	0.6	0.3
material							
housing		PEEK with stainless steel cover 304 (1.4301), ***-*****/OS: 316L (1.4404)					stainless steel 304 (1.4301)
contact surface		PEEK					PEI
degree of protection		IP67					IP65
transducer cable							
type		1699					
length	m	5		4		3	2
length (***-*****/LC)	m	9					-
dimensions							
length l	mm	129.5	126.5	64		40	25
width b	mm	51	51	32		22	13
height h	mm	67	67.5	40.5		25.5	17
dimensional drawing							
weight (without cable)	kg	0.47	0.36	0.066		0.016	0.004
pipe surface temperature							
min.	°C	-40					-30
max.	°C	+130					+130
ambient temperature							
min.	°C	-40					-30
max.	°C	+130					+130
temperature compensation		x					-
explosion protection							
• ATEX/IECEx							
order code		FSG-NA2TS/**	FSK-NA2TS/**	FSM-NA2TS/**	FSP-NA2TS/**	FSQ-NA2TS/**	-
pipe surface temperature (Ex)							
• min.	°C	-55					-
• max.	°C	gas: +190, dust: +180					-
marking		CE 0637 Ex II3G II2D 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/**	FSQ-NF2TS/**	FSS-NF2TS/**
pipe surface temperature (Ex)							
• min.	°C	-40					
• max.	°C	+125		+190			+125
degree of protection		IP66					
marking		FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860					

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 cover 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...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/2 bar (20 m)/20 °C

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

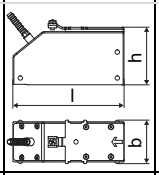
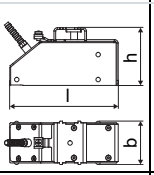
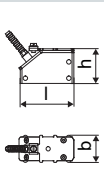
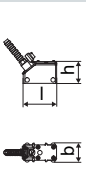
order code		FSG-ENNTS/**	FSK-ENNTS/**	FSM-E**TS/**	FSP-E**TS/**	FSQ-E**TS/**
technical type		C(DL)G1E52	C(DL)K1E52	C(DL)M2E52	C(DL)P2E52	C(DL)Q2E52
transducer frequency	MHz	0.2	0.5	1	2	4
inner pipe diameter d						
min. extended	mm	400	100	50	25	10
min. recommended	mm	500	200	100	50	25
max. recommended	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		PPSU with stainless steel cover 304 (1.4301), ***-*****/OS: 316L (1.4404)		PI with stainless steel cover 304 (1.4301), ***-*****/OS: 316L (1.4404)		
contact surface		PPSU		PI		
degree of protection		IP65		IP56		
transducer cable						
type		1699		6111		
length	m	5		4		3
length (***-*****/LC)	m	9		9		
dimensions						
length l	mm	129.5		64		40
width b	mm	51		32		22
height h	mm	67		40.5		25.5
dimensional drawing						
weight (without cable)	kg	0.82		0.066		0.017
pipe surface temperature						
min.	°C	-40		-30		-30
max.	°C	+170		+240[1]		+200
ambient temperature						
min.	°C	-40		-30		-30
max.	°C	+170		+40 +60[2] +200[3]		+200
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		-	-	CE 0637 Ex II3G II2D Ex nA IIC T6...T2 Gc Ex tb IIIA T80 °C...230 °C 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		-	-	APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860		

[1] > +200 °C:
Variofix C without cover or Variofix L
observe the insulation instruction
Ex: ambient temperature max. +40 °C

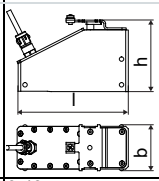
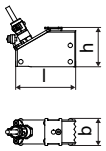
[2] pipe surface temperature +200...+240 °C: Variofix C without cover

[3] pipe surface temperature max. +200 °C

Shear wave transducers (zone 1, TS)

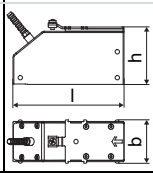
order code		FSG-N*1TS/**	FSK-N*1TS/**	FSM-N*1TS/**	FSP-N*1TS/**	FSQ-N*1TS/**
technical type		C(DL)G1N81	C(DL)K1N81	C(DL)M2N81	C(DL)P2N81	C(DL)Q2N81
transducer frequency	MHz	0.2	0.5	1	2	4
inner pipe diameter d						
min. extended	mm	400	100	50	25	10
min. recommended	mm	500	200	100	50	25
max. recommended	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 cover 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 Ex 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, TS, IP68)

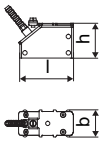
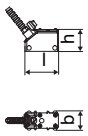
order code		FSG-N*1TS/IP68	FSK-N*1TS/IP68	FSM-N*1TS/IP68	FSP-N*1TS/IP68
technical type		CDG1LI1	CDK1LI1	CDM2LI1	CDP2LI1
transducer frequency	MHz	0.2	0.5	1	2
inner pipe diameter d					
min. extended	mm	400	100	50	25
min. recommended	mm	500	200	100	50
max. recommended	mm	4000	2000	1000	400
max. extended	mm	6500	2400	1200	480
pipe wall thickness					
min.	mm	11	5	2.5	1.2
material					
housing		PEEK with stainless steel cover 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 com-pensation		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	-40			
• max.	°C	+80			
marking		CE 0637 Ex II2G II2D Ex q IIC T6...T5 Gb Ex tb IIIC T80 °C...T85 °C 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		FSG-E*1TS/**	FSK-E*1TS/**
technical type		C(DL)G1E83	C(DL)K1E83
transducer frequency	MHz	0.2	0.5
inner pipe diameter d			
min. extended	mm	400	100
min. recommended	mm	500	200
max. recommended	mm	4000	2000
max. extended	mm	6500	2400
pipe wall thickness			
min.	mm	11	5
material			
housing		PPSU with stainless steel cover 304 (1.4301), ***-*****/OS: 316L (1.4404)	
contact surface		PPSU	
degree of protection		IP65	
transducer cable			
type		1699	
length	m	5	
length (***-*****/LC)	m	9	
dimensions			
length l	mm	129.5	
width b	mm	51	
height h	mm	67	
dimensional drawing			
weight (without cable)	kg	0.82	
pipe surface temperature			
min.	°C	-40	
max.	°C	+170	
ambient temperature			
min.	°C	-40	
max.	°C	+170	
temperature compensation		x	
explosion protection			
• **ATEX/IECEx**			
order code		FSG-EA1TS/**	FSK-EA1TS/**
pipe surface temperature (Ex)			
• min.	°C	-50	
• max.	°C	+155	
marking		CE 0637 Ex 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, 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 cover 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 T80 °C...T230 °C 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

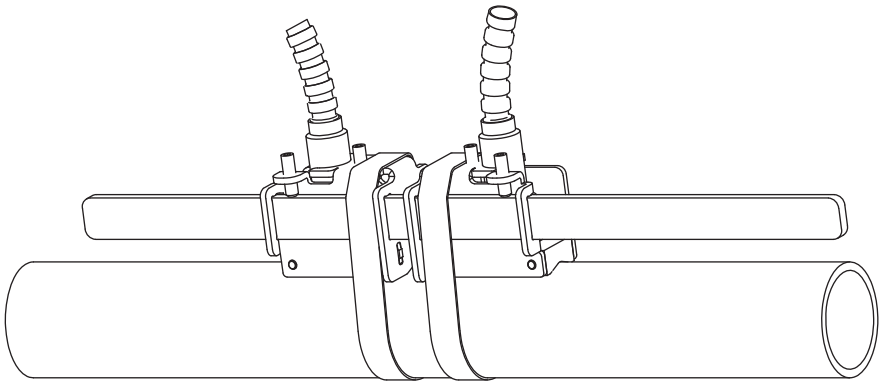
[2] pipe surface temperature max. +200 °C

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**	**description**
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
	S									transducers with transducer frequency S
			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

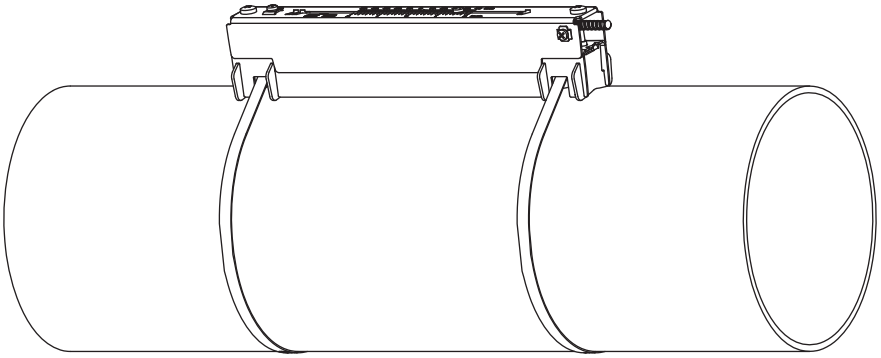
Variofix L (VLS)



transducer frequency: S

material: stainless steel 304 (1.4301), 303 (1.4305)

Variofix L (VLK, VLM, VLQ)

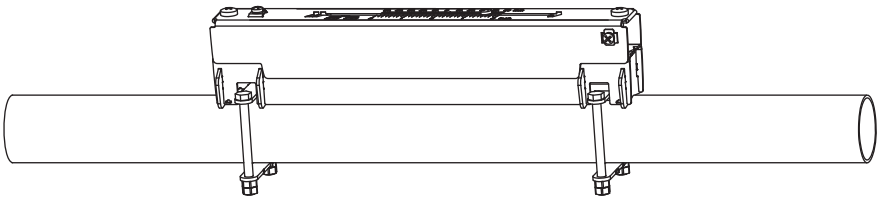


material: stainless steel 304 (1.4301), 301 (1.4310), 410 (1.4006)
option OS: 316Ti (1.4571), 316L (1.4404), 17-7PH (1.4568)

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

Variofix L with bolt mounting plates (VL*--B)**



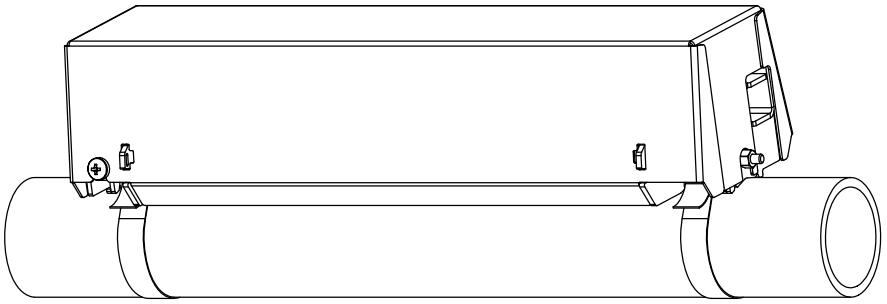
material: stainless steel 304 (1.4301), 301 (1.4310), 410 (1.4006)
option OS: 316Ti (1.4571), 316L (1.4404), 17-7PH (1.4568)

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

Variofix C (VC)

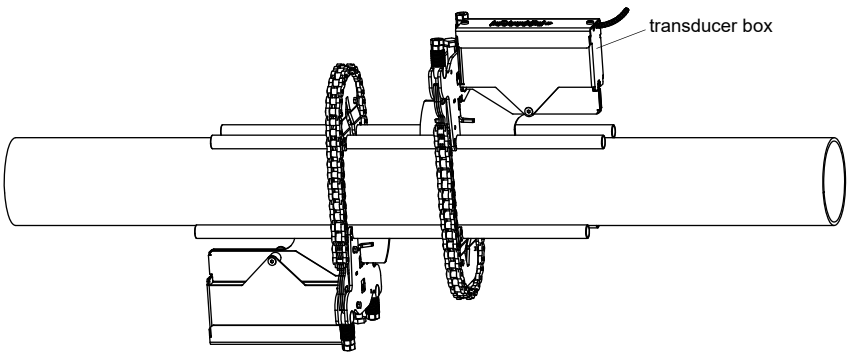


material: stainless steel 316Ti (1.4571)

inner length:
VCK-*L: 500 mm
VCK-*S: 350 mm
VCM: 400 mm
VCQ: 250 mm

dimensions:
VCK-*L: 560 x 126 x 125 mm
VCK-*S: 410 x 126 x 125 mm
VCM: 460 x 96 x 82 mm
VCQ: 310 x 85 x 71 mm

transducer box WI for WaveInjector



see Technical specification TSWaveInjectorVx-x

Coupling materials for transducers

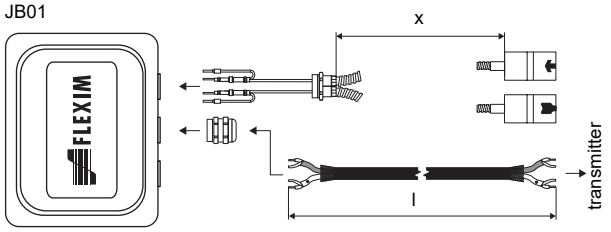
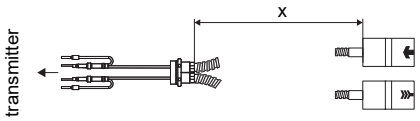
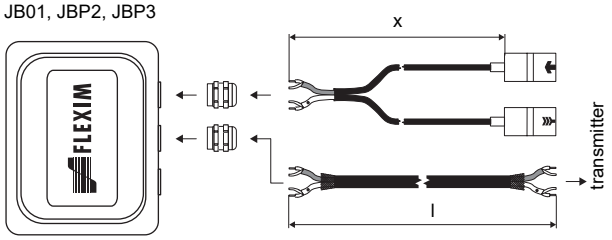
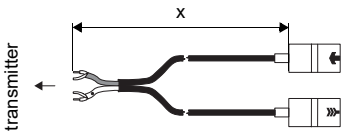
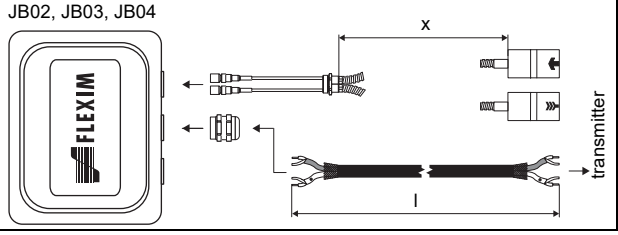
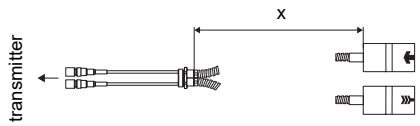
	normal temperature range (4th character of transducer order code = N)		**extended temperature range (4th character of transducer order code = E)**			**WaveInjector WI-400**	
	< 100 °C	< 170 °C	< 150 °C	< 200 °C	200...240 °C	< 280 °C	280...400 °C
< 24 h	coupling compound type N or coupling foil type VT	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	coupling foil type VT	coupling foil type VT	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

type VT: fluid temperature 200 °C: min. 2 years

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
JB01 		*****8*
JB01, JBP2, JBP3 		****LI*
JB02, JB03, JB04 		*****52

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**
order code		ACC-PE- GNNN-/EXEXXXX	ACC-PE- GNNN-/EXA1XXX
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	max. 12	max. 12
thickness	mm	2	2
colour		black	black
shield		x	x
sheath			
material		-	steel wire braid with copolymer sheath
outer diameter	mm	-	max. 15.5

XXX - cable length inch m

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: ****LI*	m	12	≤ 300	12	≤ 300	-	-	-	-

x - transducer cable length

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

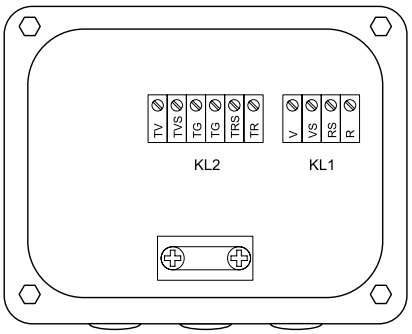
Junction box

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	

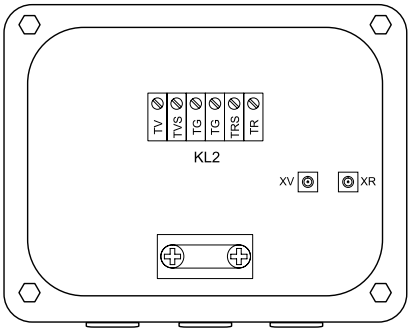
Extension cable

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		FM APPROVED NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ T6 Ta = -40...+60 °C

Connection



Transducers

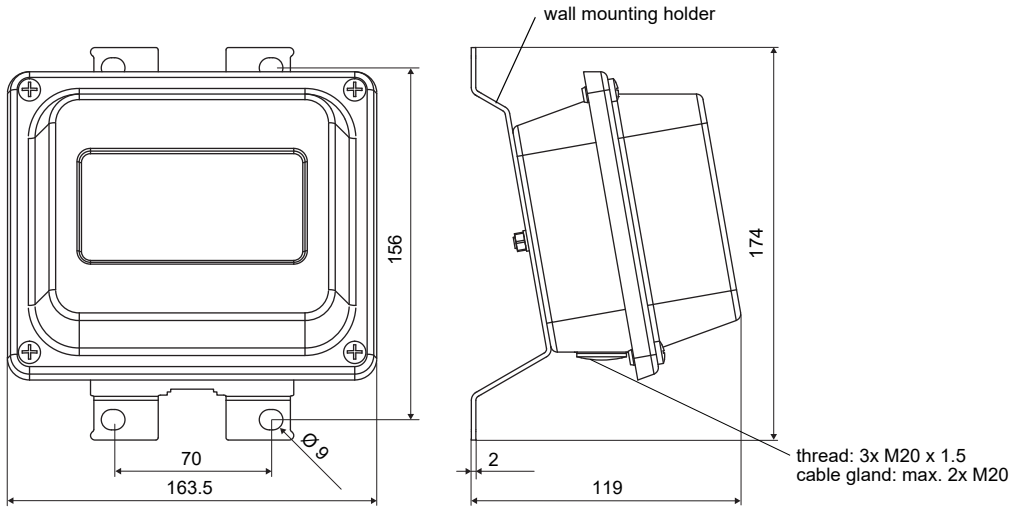
	terminal	connection	transducer
	XV	SMB connector	
	XR	SMB connector	

Extension cable

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

Dimensions

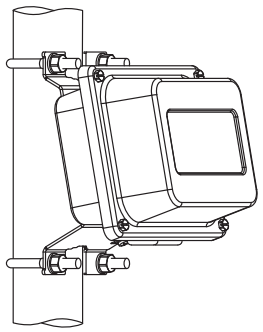
JB0*, JBP*



in mm

2" pipe mounting kit

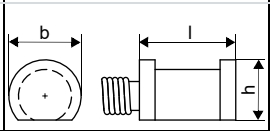
JB**



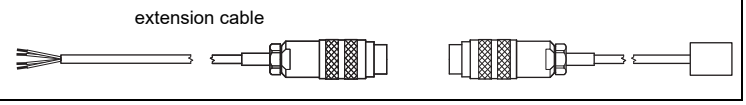
order code:
ACC-PE-GNNN-/JBPMK4

Clamp-on temperature probe (optional)

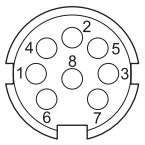
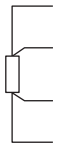
Technical data

PT12N		
design		clamp-on with connector
type		Pt100
connection		4-wire
measuring range	°C	-30...+250
accuracy T		±(0.15 °C + 2 · 10^{-3} · |T [°C]|) class A
accuracy ΔT (2x Pt matched according to EN 1434-1)		≤ 0.1 K (3 K < ΔT < 6 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

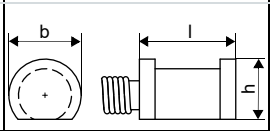
direct connection/connection with extension cable


Connection

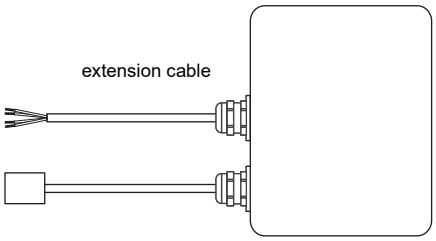
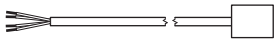
	temperature probe	extension cable	connector	
			pin	
	red	grey	2	
	red/blue	red	6	
	white/blue	blue	1	
	white	white	7	

Cable

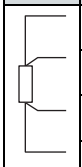
		temperature probe	extension cable
type		4 x 0.25 mm² black	LIYCY 8 x 0.14 mm² grey
standard length	m	3	5/10/25
max. length	m	-	200
cable jacket		PTFE	PVC

PT12N		
design		clamp-on nonEx or ATEX
type		Pt100
connection		4-wire
measuring range	°C	-30...+250
accuracy T		±(0.15 °C + 2 · 10^{-3} · |T [°C]|) class A
accuracy ΔT (2x Pt matched according to EN 1434-1)		≤ 0.1 K (3 K < ΔT < 6 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		CE Ex II3G Ex nA IIC T6...T2 Gc Ta -30...+250 °C

Connection system

connection with extension cable	direct connection
	

Connection

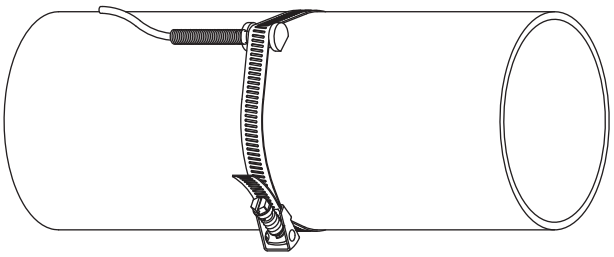
	temperature probe
	red
	red/blue
	white/blue
	white

Cable

		temperature probe	extension cable
type		4 x 0.25 mm² black	LIYCY 8 x 0.14 mm² grey
standard length	m	3	5/10/25
max. length	m	-	200
cable jacket		PTFE	PVC

Fixation

tension strap PT12N



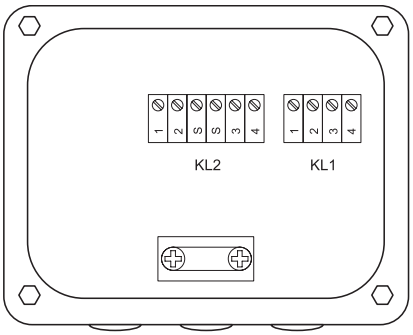
material: stainless steel 301 (1.4310), 410 (1.4006)

thermal insulation necessary

Junction box

JBT2, JBT3		
order code		• JBT2: ACC-PE-GNNN-/JB4 • JBT3: ACC-PE-GNNN-/JB6
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		CE Ex II3G Ex nA IIC (T6)...T4 Gc II3D Ex tc IIIC T 100 °C Dc Ta -40...+(70)80 °C

Connection



Temperature probe

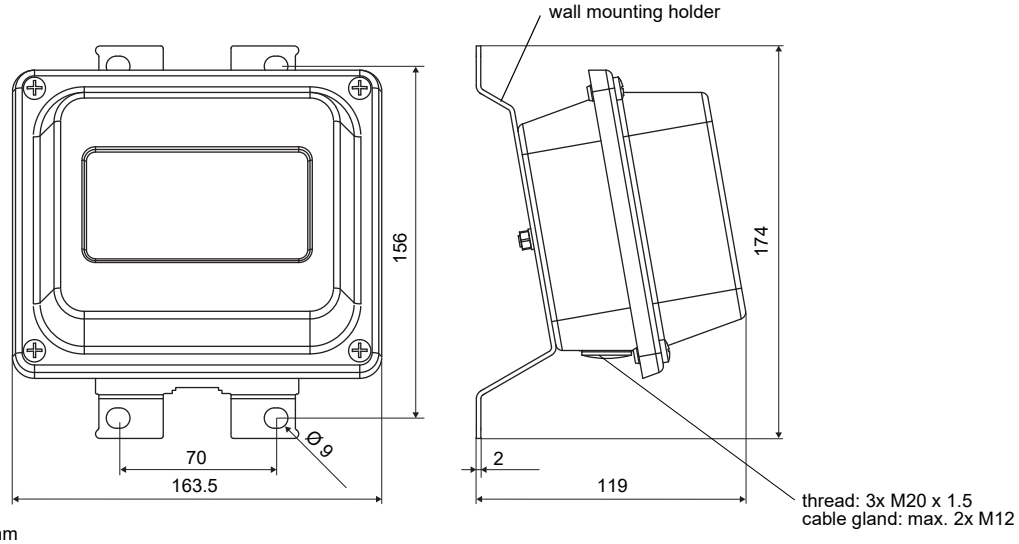
terminal strip	terminal	connection
KL1	1	red
	2	red/blue
	3	white
	4	white/blue

Extension cable

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

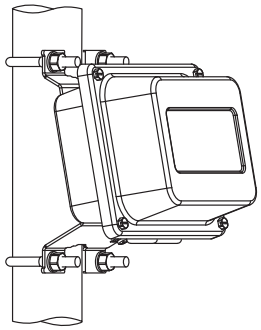
Dimensions

JBT*



in mm

2" pipe mounting kit

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