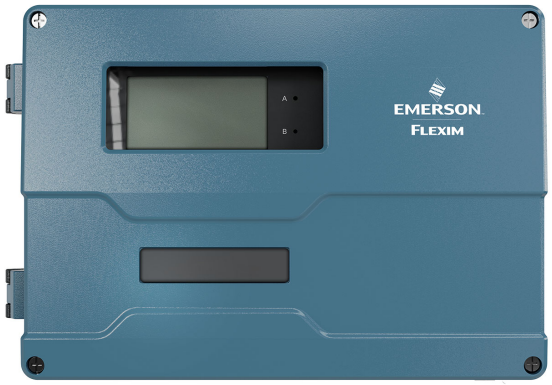
Flexim FLUXUS F731WD
Ultrasonic Flowmeter



Non-invasive Ultrasonic Flow and Temperature Measurement

Features

- Highly accurate non-invasive flow and temperature measurement irrespective of the flow direction (bidirectional), with outstanding measurement dynamics, excellent zero-point stability and high repeatability of the measurement results
- Submersible ultrasonic transducers (IP68) provide a reliable and durable solution for flow measurement on buried pipes or for applications where the measuring point can be overflowed
- Simple retrofitting on existing water networks without interruption of supply and disposal and without the need for shaft construction and pipe intrusion, thus saving time and cost

Applications

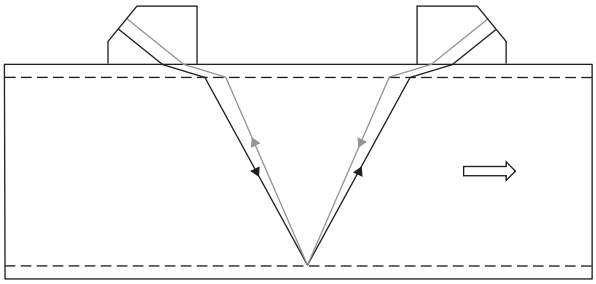
- Flow and temperature measurement on buried water and wastewater pipes
- Flow and temperature measurement on water and wastewater pipes which can be overflowed

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



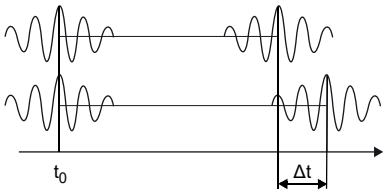
Transit time difference principle

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



HybridTrek

If the gaseous or solid content in the fluid increases occasionally during measurement, a measurement with the transit time difference principle is no longer possible. NoiseTrek mode will then be selected by the flowmeter. This measurement method allows the flowmeter to achieve a stable measurement even with high gaseous or solid content.

The transmitter automatically toggles between the TransitTime and the NoiseTrek mode without having to change the measuring setup.

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

Calculation of sound speed and fluid temperature

The fluid sound speed can be determined from the transit times in the fluid and the geometry of the measuring point. The sound speed is fluid specific and temperature dependent. This curve is stored in the fluid data set for water. Thus, the fluid temperature can be determined from the sound speed.

Number of sound paths

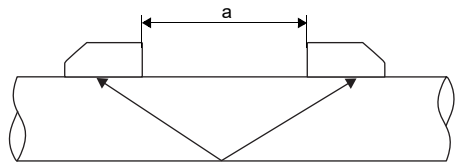
The number of sound paths is the number of transits of the ultrasonic signal through the fluid in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **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 case of high signal attenuation by the fluid or pipe, diagonal arrangement with 1 sound path is used.

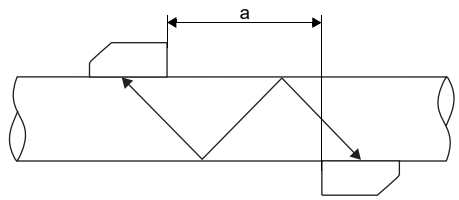
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

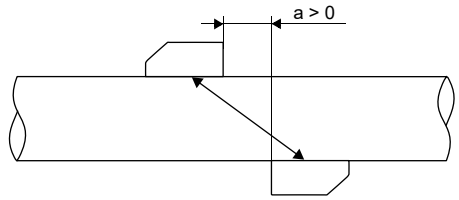
Reflection arrangement, number of sound paths: 2



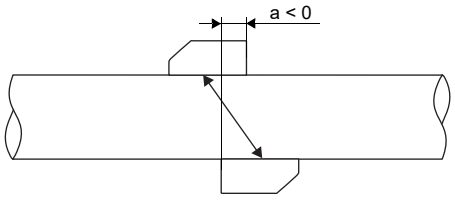
Diagonal arrangement, number of sound paths: 3



Diagonal arrangement, number of sound paths: 1



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



a - transducer distance

Transmitter

Technical data

		FLUXUS F731WD	FLUXUS F731WD Dual Channel
design		DE7-F731WD-NNN**-1AL... (aluminum housing) DE7-F731WD-NNN**-1ST... (stainless steel housing)	DE7-F731WD-NNN**-2AL... (aluminum housing) DE7-F731WD-NNN**-2ST... (stainless steel housing)
		 	
application		flow measurement on 1 water pipe	flow measurement on 1 or 2 water pipes
measurement			
measurement principle		transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content	
flow direction		bidirectional	
synchronised channel averaging		-	x
flow velocity	m/s	0.01...25	
repeatability		0.15 % MV ±0.005 m/s	
fluid		water	
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	
measurement uncertainty (temperature from sound speed)			
measurement uncertainty at the measuring point[2]		±0.2 K (fluid temperature: 0...30 °C, inner pipe diameter: min. 200 mm)	
transmitter			
power supply		• 100...240 V ±10 %/50...60 Hz or • 11...32 V DC	
power consumption	W	< 15	
number of measuring channels		1	2
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 or stainless steel 316L (1.4404)	
degree of protection		IP66	
dimensions	mm	see dimensional drawing	
weight	kg	aluminum housing: 4.5 stainless steel housing: 5.8	
fixation		wall mounting, optional: 2" pipe mounting	
ambient temperature	°C	-40*...+60 aluminum housing and 240 V: -40*...+65 * < -20 without operation of the display	
display		240 x 128 pixels, backlight	
menu language		English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian, Chinese	
measuring functions			
physical quantities		volumetric flow rate, mass flow rate, flow velocity	
totaliser		volume, mass	
calculation functions		average, difference, sum (2 measuring channels necessary)	
diagnostic functions		sound speed, fluid temperature, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times	
communication interfaces			
service interfaces		measured value transmission, parametrisation of the transmitter: • USB • LAN	
process interfaces		max. 1 option: • Modbus RTU • BACnet MS/TP • M-Bus • HART • Profibus PA • FF H1 • Modbus TCP • BACnet IP	

[1] with aperture calibration of the transducers

[2] for transit time difference principle and reference conditions

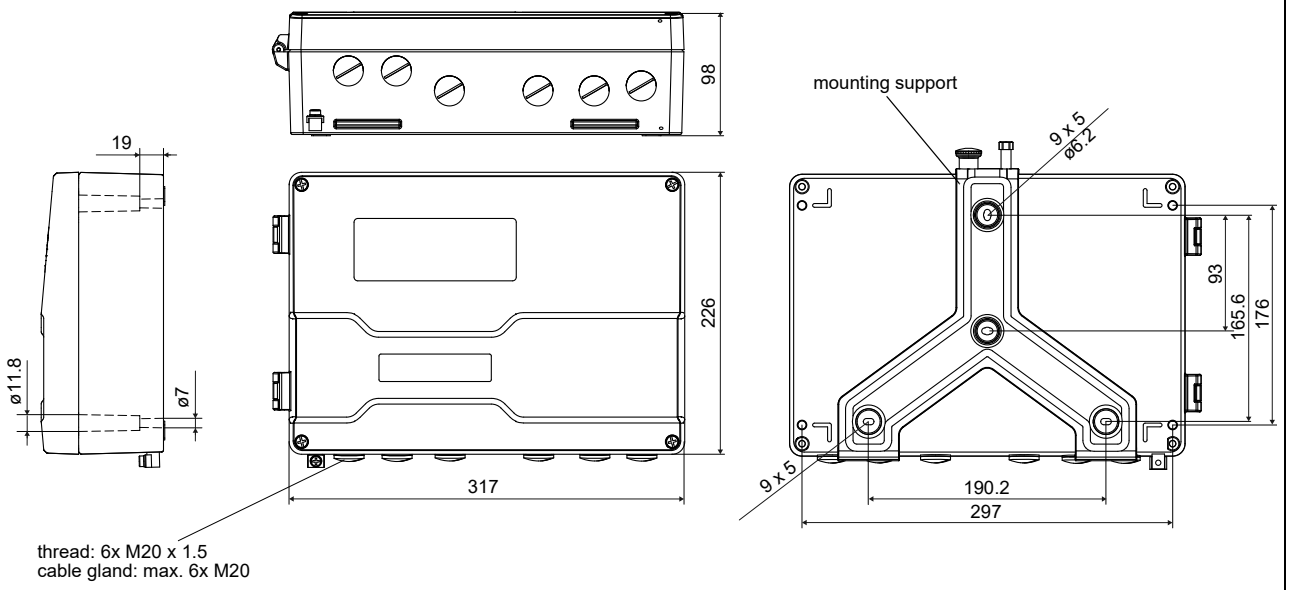
		FLUXUS F731WD	FLUXUS F731WD Dual Channel
accessories			
data transmission kit		USB cable	
software		• FluxDiag Reader: reading of measured values and parameters, graphical representation • FluxDiag (optional): reading of measurement data, graphical representation, report generation, parametrisation of 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		current inputs and outputs: max. 4	
• switchable current output			
		configurable according to NAMUR NE 43 All switchable current outputs are jointly switched to active or passive.	
number		0 or 2	max. 4
range	mA	4...20 (alarm current: 3.2...3.99, 20.01...24, hardware fault current: 3.2)	
uncertainty		0.04 % MV ±3 µA	
active output		R_{ext} = 250...530 Ω, $U_{opencircuit}$ = 28 V DC	
passive output		U_{ext} = 9...30 V DC, depending on R_{ext} (R_{ext} < 458 Ω at 20 V)	
current output in HART mode		option	
• range	mA	4...20 (alarm current: 3.5...3.99, 20.01...22, hardware fault current: 3.2)	
• active output		R_{ext} = 250...530 Ω, $U_{opencircuit}$ = 28 V DC	
• passive output		U_{ext} = 9...30 V DC, depending on R_{ext} (R_{ext} = 250...458 Ω at 20 V)	
• digital output			
number		max. 4	
functions		• frequency output • binary output • pulse output	
type		open collector (passive)	
operating parameters		**OC30V/100mA** 5...30 V, I_{max} = 100 mA, R_{int} = 20 Ω Low: U < 2 V at I_{loop} = 2 mA (R_{ext} = 12 kΩ at U_{ext} = 24 V) High: U > 15 V (R_{ext} = 12 kΩ at U_{ext} = 24 V)	
frequency output			
• range	kHz	0.002...10	
• damping	s	0...999.9 (adjustable)	
• pulse-to-pause ratio		1:1	
binary output			
• binary output as alarm output		limit, change of flow direction or error	
pulse output			
• pulse value	units	0.01...1000	
• pulse width	ms	0.05...1000	
• pulse rate		max. 10 000 pulses	
inputs			
		The inputs are galvanically isolated from the transmitter.	
		current inputs and outputs: max. 4	
• switchable current input			
		All switchable current inputs are jointly switched to active or passive.	
number		max. 2	
accuracy		±0.1 % MV ±0.01 mA at 18...28 °C ±0.1 % MV ±0.01 mA ±0.005 %/K at <18 °C/>28 °C	
resolution	µA	0.1	
active input		R_{int} = 75 Ω, I_{max} ≤ 30 mA $U_{opencircuit}$ = 28 V (open circuit) U_{min} = 21.4 V at 20 mA	
• range	mA	0...20	
passive input		U_{ext} = 24 V, R_{int} = 35 Ω, I_{max} ≤ 24 mA	
• range	mA	0...20	

[1] with aperture calibration of the transducers

[2] for transit time difference principle and reference conditions

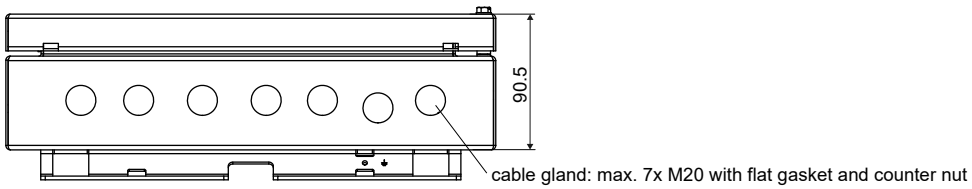
Dimensions

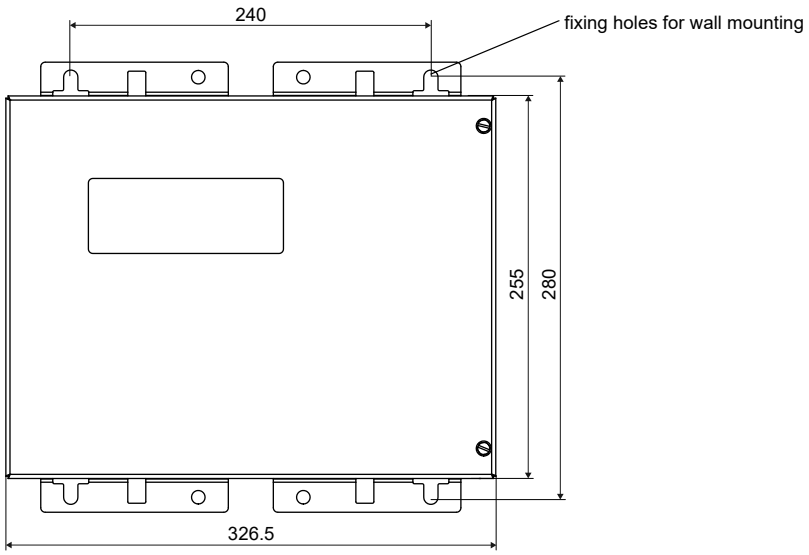
***731 (aluminum housing)**



in mm

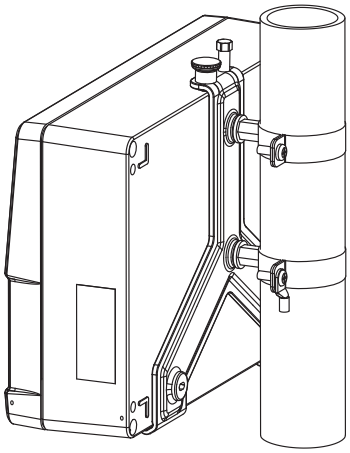
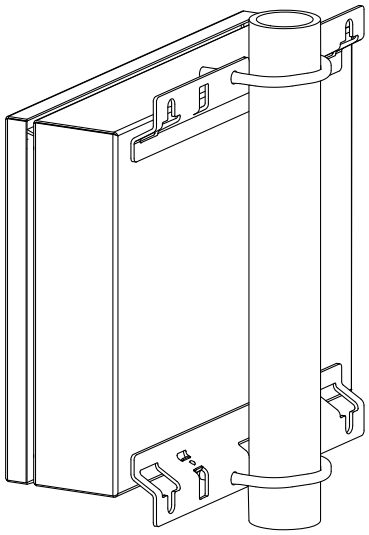
***731 (stainless steel housing)**





in mm

2" pipe mounting kit

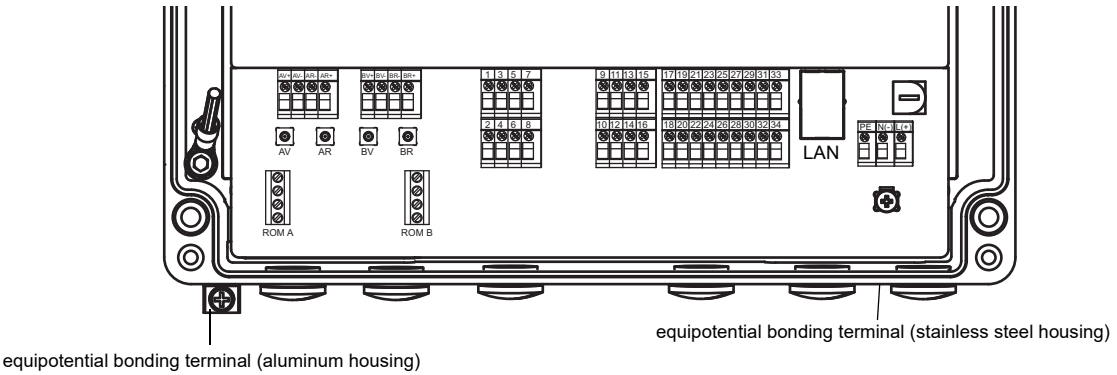
***731 (aluminum housing)** 	item number: 731037-1
***731 (stainless steel housing)** 	item number: 721110-4

Storage

- do not store outdoors
- store within the original package
- store in a dry and dust-free place
- protect against sunlight
- keep all openings closed
- storing temperature: -40...+60 °C

Terminal assignment

***731**



power supply[1]			
AC		**DC**	
terminal	**connection**	**terminal**	**connection**
L	line conductor	(+)	+
N	neutral conductor	(-)	-
PE	protective conductor	PE	protective conductor

transducers							
transducer cable (transducers *****53, ****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 or AV+	signal	BV or BV+	signal		X_AV	X_BV	SMB connector
AVS or AV-	shield	BVS or BV-	shield				
ARS or AR-	shield	BRS or BR-	shield		X_AR	X_BR	SMB connector
AR or AR+	signal	BR or BR+	signal				

outputs, inputs[1, 2]	
terminal	**connection**
depending on configuration	current output, digital output, current input
29+, 30-	passive current output/HART
29-, 30+	active current output/HART
29, 30	Modbus RTU, BACnet MS/TP, M-Bus, Profibus PA, FF H1

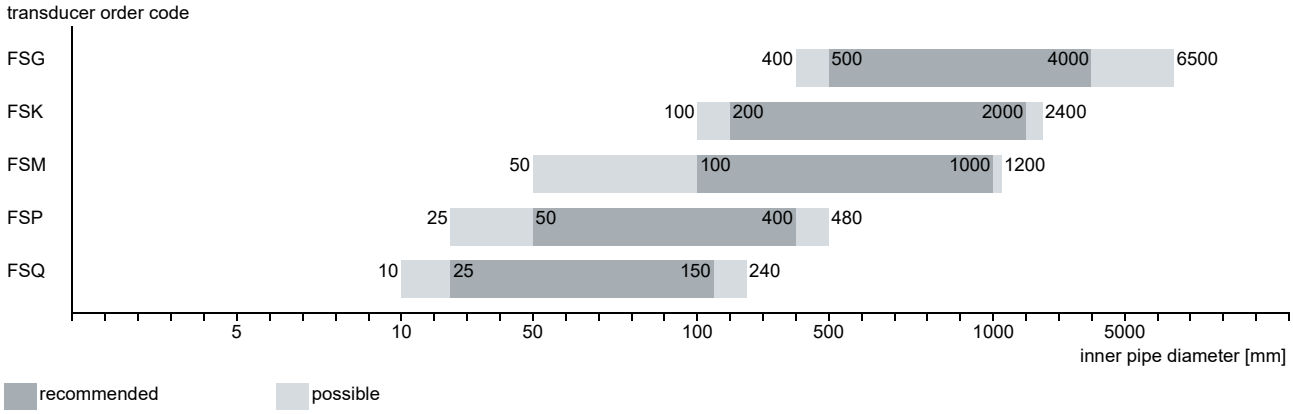
USB	type C Hi-Speed USB 2.0 Device	service (FluxDiag/FluxDiagReader)
LAN	RJ45 10/100 Mbps Ethernet	• service (FluxDiag/FluxDiagReader) • Modbus TCP • BACnet IP

[1] cable (by customer): e.g. flexible wires, with insulated wire ferrules, wire cross-section: 0.25...2.5 mm^2

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

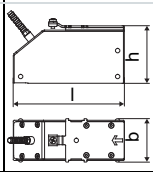
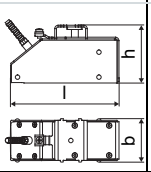
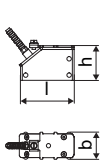
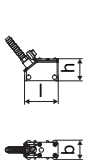
Transducers

Transducer selection

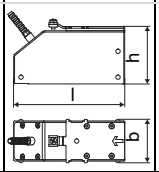
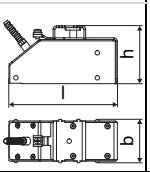
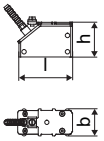
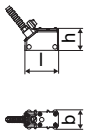


Technical data

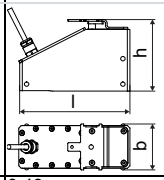
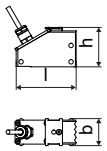
Shear wave transducers

order code		FSG-NNNN-**TS	FSK-NNNN-**TS	FSM-NNNN-**TS	FSP-NNNN-**TS	FSQ-NNNN-**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 cover 316L (1.4404)				
contact surface		PEEK				
degree of protection		IP66		IP66/IP67		
transducer cable						
type		1699				
length	m	5		4		3
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	°C	-40...+130				
ambient temperature	°C	-40...+130				
temperature compensation		x				

Shear wave transducers

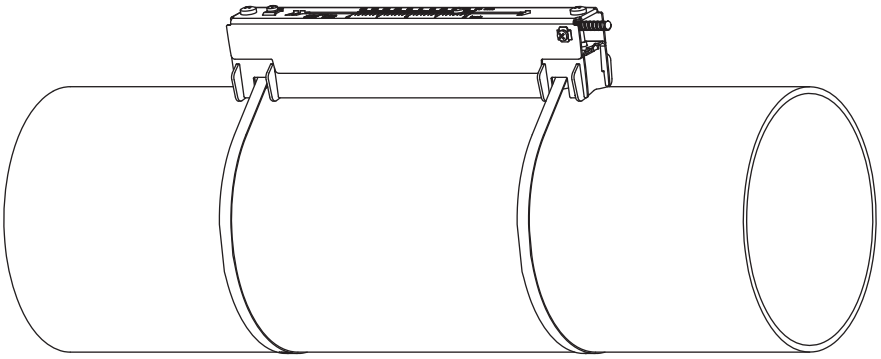
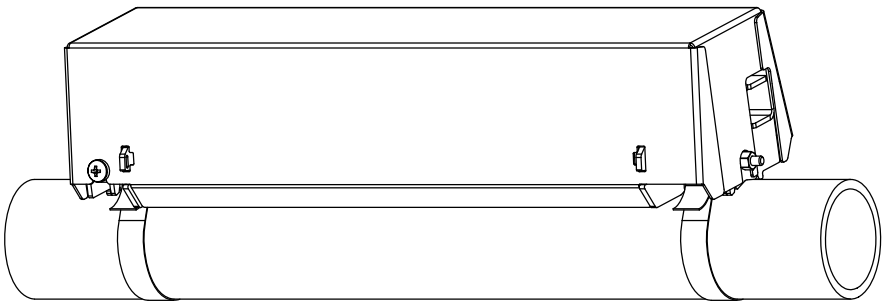
order code		FSG-NNNN-**T1	FSK-NNNN-**T1	FSM-NNNN-**T1	FSP-NNNN-**T1	FSQ-NNNN-**T1
technical type		C(DL)G1N53	C(DL)K1N53	C(DL)M2N53	C(DL)P2N53	C(DL)Q2N53
transducer frequency	MHz	0.2	0.5	1	2	4
inner pipe diameter d						
min. extended	mm	400	100	50	25	10
min. recommended	mm	500	200	100	50	25
max. recommended	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 316L (1.4404)				
contact surface		PEEK				
degree of protection		IP66		IP66/IP67		
transducer cable						
type		1699				
length	m	5		4		3
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	°C	-40...+130				
ambient temperature	°C	-40...+130				
temperature compensation		x				

Shear wave transducers (IP68)

order code		FSG-LNNN-**T1/ H68	FSK-LNNN-**T1/ H68	FSM-LNNN-**T1/ H68
technical type		CDG1LI8	CDK1LI8	CDM2LI8
transducer frequency	MHz	0.2	0.5	1
inner pipe diameter d				
min. extended	mm	400	100	50
min. recommended	mm	500	200	100
max. recommended	mm	4000	2000	1000
max. extended	mm	6500	2400	1200
pipe wall thickness				
min.	mm	11	5	2.5
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	°C	-40...+100		
ambient temperature	°C	-40...+100		
temperature compensation		x		

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

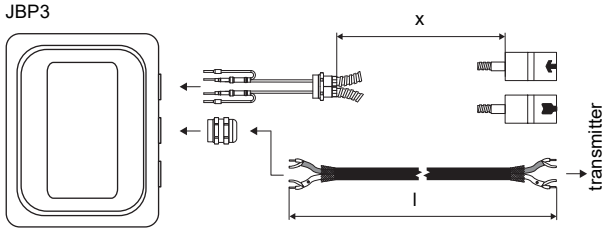
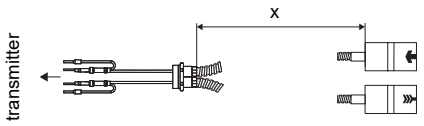
Transducer mounting fixture

Variofix L (VL) 	material: stainless steel 316Ti (1.4571), 316L (1.4404), 17-7PH (1.4568) inner length: **VL(GK)**: 348 mm, option H68: 368 mm **VL(MP)**: 234 mm dimensions: **VL(GK)**: 423 x 90 x 93 mm option H68: 443 x 94 x 105 mm **VL(MP)**: 309 x 57 x 63 mm
Variofix C (VC) 	material: stainless steel 316Ti (1.4571) inner length: **VC(GK)-*S**: 350 mm **VC(MP)**: 400 mm dimensions: **VC(GK)-*S**: 410 x 126 x 125 mm **VC(MP)**: 460 x 96 x 82 mm

Coupling materials for transducers

type	ambient temperature °C
coupling foil type VT	-10...+200

Connection systems

<table>
<tr><td colspan="3">connection system T1</td></tr>
<tr><td>connection with extension cable</td><td>direct connection</td><td>transducers
technical type</td></tr>
<tr><td>JBP3
 
</td><td> 
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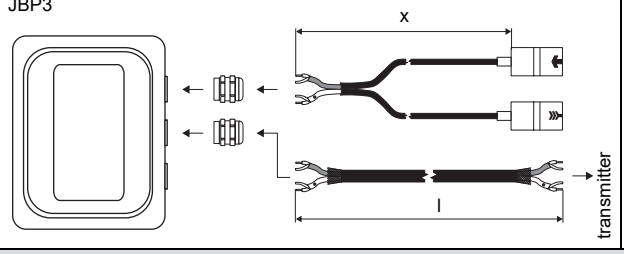
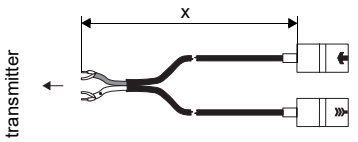
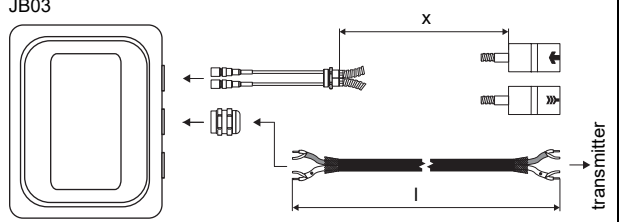
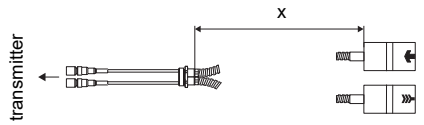
 
</td><td> 
</td><td>****LI*</td></tr>
<tr><td colspan="3">connection system TS</td></tr>
<tr><td>connection with extension cable</td><td>direct connection</td><td>transducers
technical type</td></tr>
<tr><td>JB03
 
</td><td> 
</td><td>*****52</td></tr>
</table>

Cable

transducer cable			
type		**1699**	**2550**
weight	kg/m	0.094	0.035
ambient temperature	°C	-55...+200	-40...+100
properties			longitudinal watertight
cable jacket			
material		PTFE	PUR
outer diameter	mm	2.9	5.2 ±0.2
thickness	mm	0.3	0.9
colour		brown	grey
shield		x	x
sheath			
material		stainless steel 316Ti (1.4571)	-
outer diameter	mm	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	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

Cable length

transducer frequency		**G, K**		**M, P**		**Q**	
transducers technical type		x	l	x	l	x	l
*D***5*	m	5	≤ 300	4	≤ 300	3	≤ 90
*L***5*	m	9	≤ 300	9	≤ 300	9	≤ 90
****Ll*	m	12	≤ 300	12	≤ 300	-	-

x - transducer cable length

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

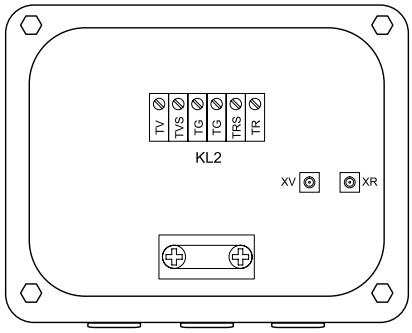
Junction box

Technical data

JB03

weight	kg	1.2 kg
fixation		wall mounting optional: 2" pipe mounting
material		
housing		stainless steel 316L (1.4404)
gasket		silicone
degree of protection		IP66/IP67
ambient temperature	°C	-40...+80

Connection



Transducers

	terminal	connection	transducer
	XV	SMB connector	
	XR	SMB connector	

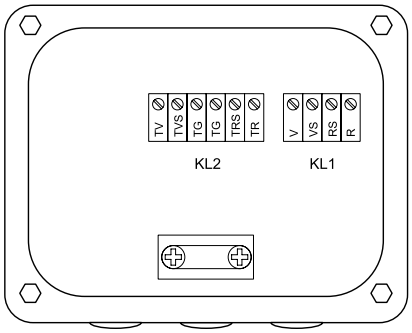
Extension cable

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

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		IP66/IP67
ambient temperature	°C	-40...+80

Connection



Transducers

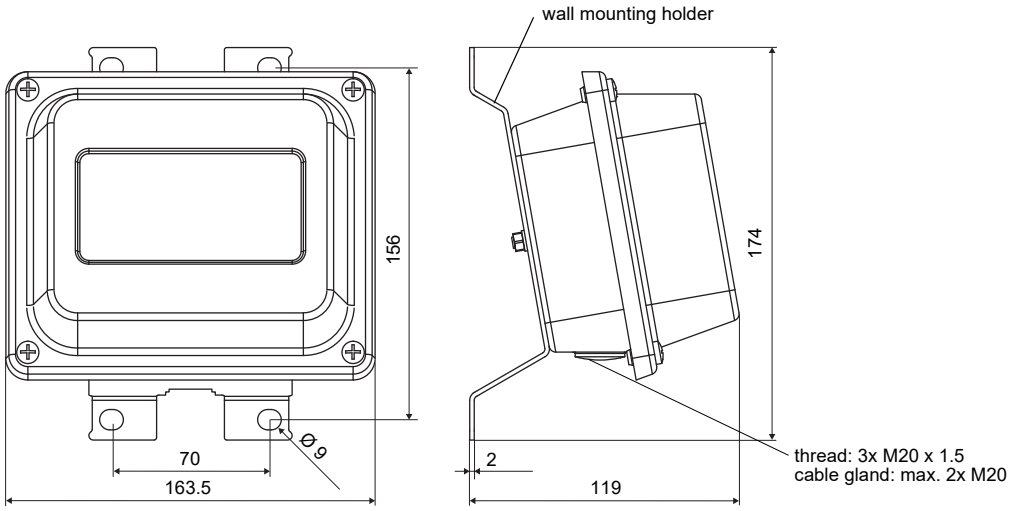
terminal strip	terminal	connection	transducer
KL1	V	signal	
	VS	internal shield	
	RS	internal shield	
	R	signal	

Extension cable

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

Dimensions

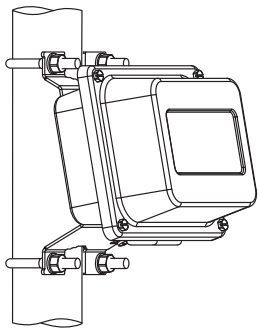
JB0*, JBP*



in mm

2" pipe mounting kit

JB**



item number: 751035-2

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