

Non-invasive ultrasonic flow measurement on buried pipes

Permanently installed clamp-on ultrasonic flow measurement system for buried water and wastewater pipes

Features

- Highly accurate non-invasive flow 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), additionally protected by the very robust transducer mounting fixture made of stainless steel (316Ti) Variofix C, 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 measurement on buried water and wastewater pipes
- Flow measurement on water and wastewater pipes which can be overflowed



FLUXUS WD100, WD200



FLUXUS WD400, WD1200, WD6500



Measurement with transducers mounted with Variofix C

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Function

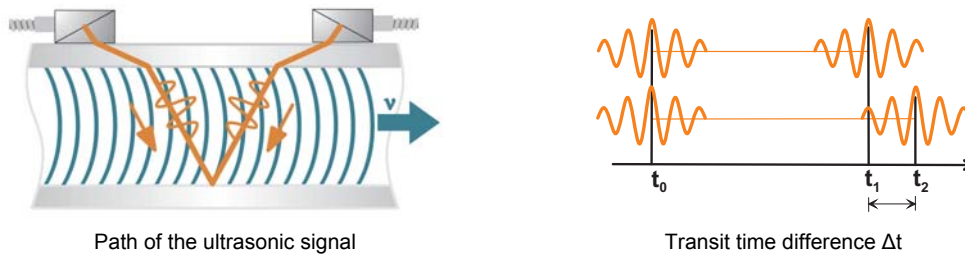
Measurement principle

In order to measure the flow of a fluid in a pipe, ultrasonic signals are used, employing the transit time difference principle. Ultrasonic signals are emitted by a transducer installed on the pipe and received by a second transducer. These signals are emitted alternately in the flow direction and against it.

As the fluid in which the signals propagate is flowing, the transit time of the ultrasonic signals in the flow direction is shorter than 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.

Two integrated microprocessors control the entire measuring process. This allows the flowmeter to remove disturbance signals, and to check each received ultrasonic wave for its validity which reduces noise.



Calculation of volumetric flow rate

$$\dot{V} = k_{Re} \cdot A \cdot k_a \cdot \Delta t / (2 \cdot t_{fl})$$

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_{fl} - transit time 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**

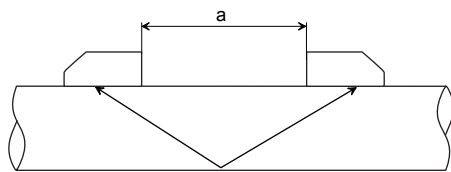
The number of sound paths is even. Both of the transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easier.

- **diagonal arrangement**

The number of sound paths is odd. Both of 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.

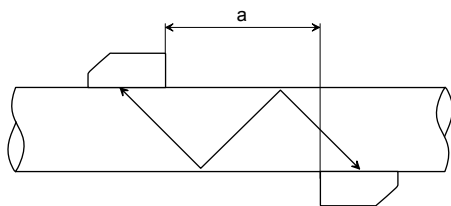
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

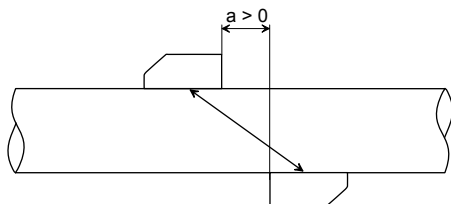


a - transducer distance

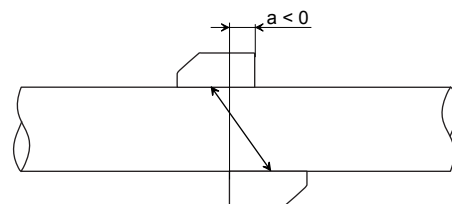
Reflection arrangement, number of sound paths: 2



Diagonal arrangement, number of sound paths: 3



Diagonal arrangement, number of sound paths: 1



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

Flow transmitter

Technical data

FLUXUS	WD6500	WD1200	WD400	WD200	WD100
design	flow measurement at fresh water pipes				
transducers	CDG1LI8	CDK1LI8	CDM2LI8	CDM2LI8	CDP2LI8
inner pipe diameter	1200...6500 mm	400...1200 mm	200...400 mm	100...200 mm	50...100 mm
					
measurement					
measurement principle	transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content			transit time difference correlation principle	
flow velocity	0.01...25 m/s				
repeatability	0.15 % of reading ±0.01 m/s			0.25 % of reading ±0.01 m/s	
fluid	water				
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5.1-2011			-	
accuracy ¹	±1.2 % of reading ±0.01 m/s ±0.5 % of reading ±0.01 m/s (with field calibration) ²			±1.5 % of reading ±0.01 m/s -	
flow transmitter					
power supply	100...230 V/50...60 Hz or 20...32 V DC or 11...16 V DC			100...230 V/50...60 Hz or 20...32 V DC or 11...16 V DC	
power consumption	< 15 W			< 10 W	
number of flow measuring channels	1, optional: 2			1	
damping	0...100 s, adjustable				
measuring cycle (1 channel)	100...1000 Hz			10 Hz	
response time	1 s (1 channel), option: 20 ms			1 s	
housing material	aluminum, powder coated or stainless steel 316L (1.4404)			aluminum, powder coated	
degree of protection according to IEC/EN 60529	IP66				
dimensions	see dimensional drawing				
weight	aluminum housing: 5.4 kg stainless steel housing: 5.1 kg			1.5 kg	
fixation	wall mounting, optional: 2" pipe mounting				
ambient temperature	-40...+60 °C (< -20 °C without operation of the display)			-10...+60 °C	
display	128 x 64 dots, backlight			2 x 16 characters, dot matrix	
menu language	English, German, French, Dutch, Spanish, Russian, Polish			English, German, French, Dutch, Spanish	
measuring functions					
physical quantities	volumetric flow rate, mass flow rate, flow velocity				
totalizer	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			-	
data logger					
loggable values	all physical quantities, totalized values and diagnostic values			all physical quantities and totalized values	
capacity	max. 800 000 measured values			> 100 000 measured values	

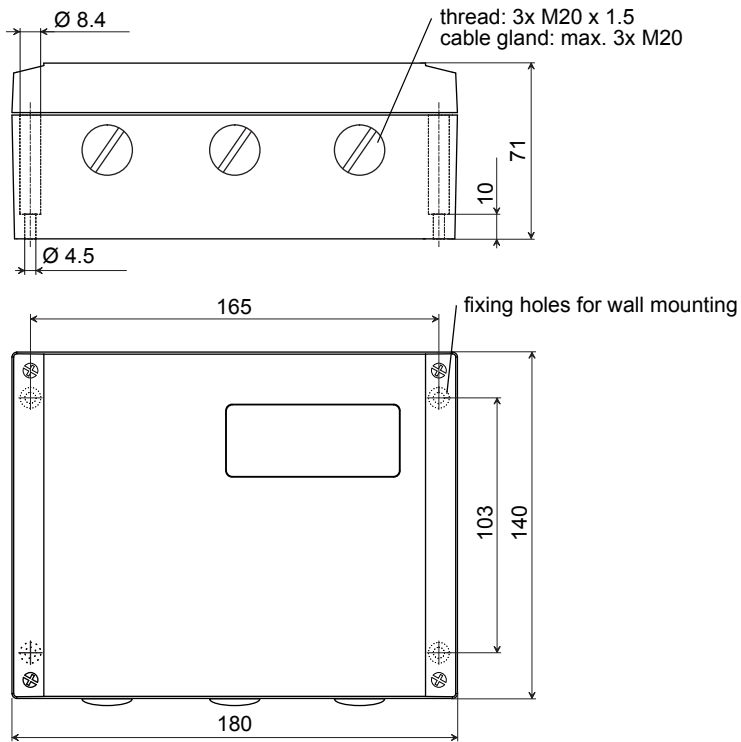
¹ for transit time difference principle, reference conditions and $v > 0.15$ m/s

² reference uncertainty < 0.2 %

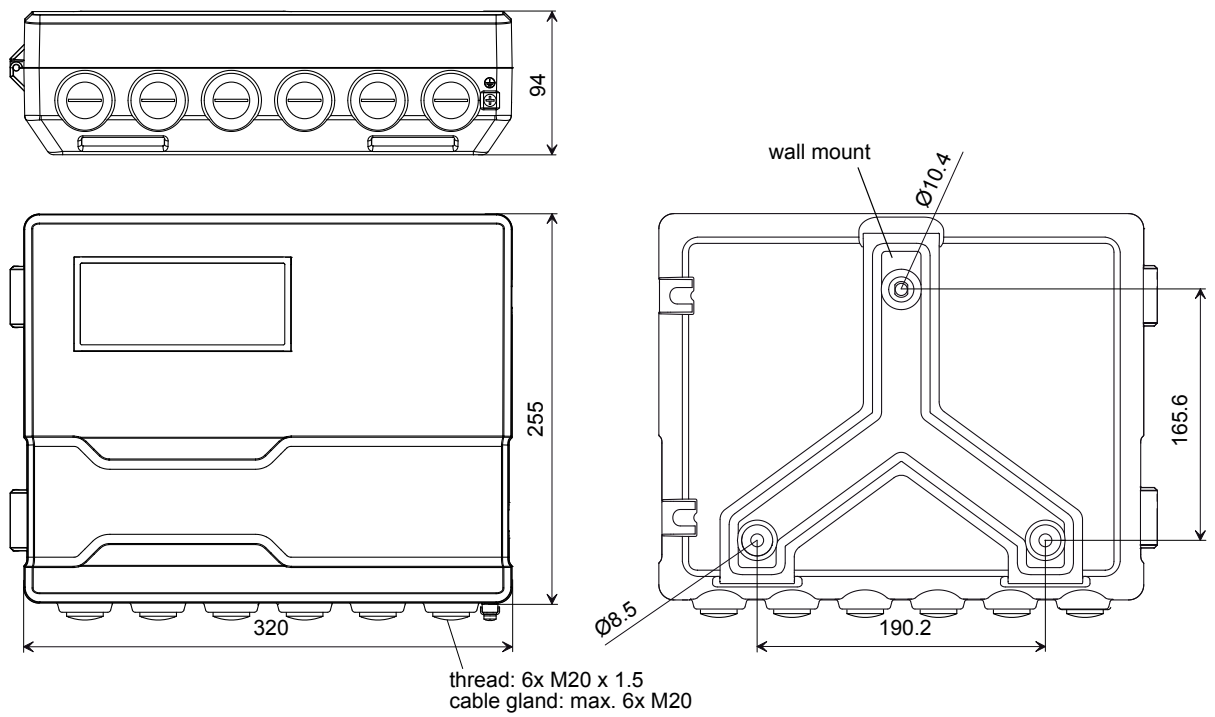
FLUXUS	WD6500	WD1200	WD400	WD200	WD100
communication					
service/diagnosis	measured value transmission, parametrization of the transmitter: - USB - Ethernet			measured value transmission: - RS232	
process integration (max. 1 optional)	- BACnet MS/TP - BACnet IP - M-Bus - RS485 (ASCII sender) including parametrization of the transmitter: - Modbus RTU - Modbus TCP - HART - Profibus PA - FF H1			- RS485 (sender) - Modbus RTU - BACnet MS/TP - M-Bus	
serial data kit (optional)					
software	FluxDiag: - download of measurement data - graphical presentation - report generation - parametrization of the transmitter			FluxDiag: - download of measurement data - graphical presentation - report generation	
cable	USB cable			RS232	
adapter	-			RS232 - USB	
outputs					
The outputs are galvanically isolated from the transmitter.					
number	current output: 1 and binary output: 2			current output: 1 and binary output: 2	
current output					
current output - range - accuracy - active output	0/4...20 mA 0.1 % of reading $\pm 15 \mu\text{A}$ $R_{\text{ext}} < 500 \Omega$			0/4...20 mA 0.1 % of reading $\pm 15 \mu\text{A}$ $R_{\text{ext}} < 500 \Omega$	
current output I1 in HART mode - range - active output	4...20 mA $U_{\text{int}} = 24 \text{ V}$			- -	
binary output					
optorelay	26 V/100 mA			28 V/100 mA	
binary output as alarm output - functions	limit, change of flow direction or error			limit, change of flow direction or error	
binary output as pulse output - pulse value - pulse width	mainly for totalizing 0.01...1000 units 1...1000 ms			mainly for totalizing 0.01...1000 units 80...1000 ms	

Dimensions

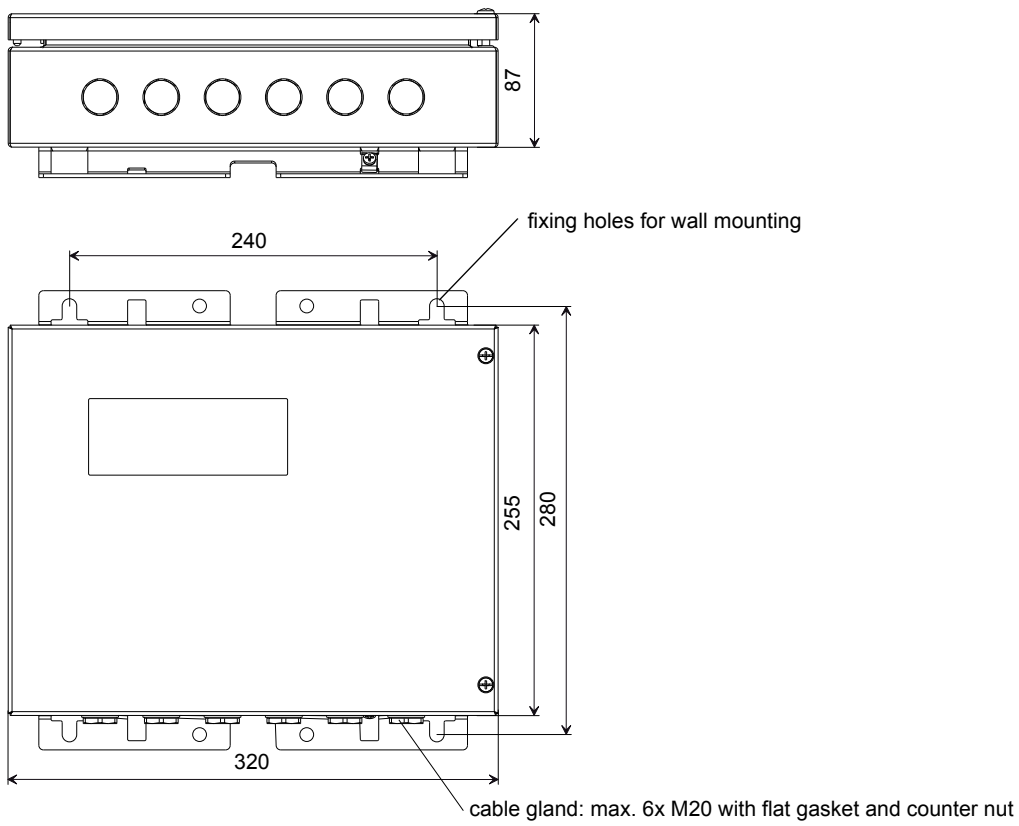
FLUXUS WD100, WD200



FLUXUS WD400, WD1200, WD6500 (aluminum housing)



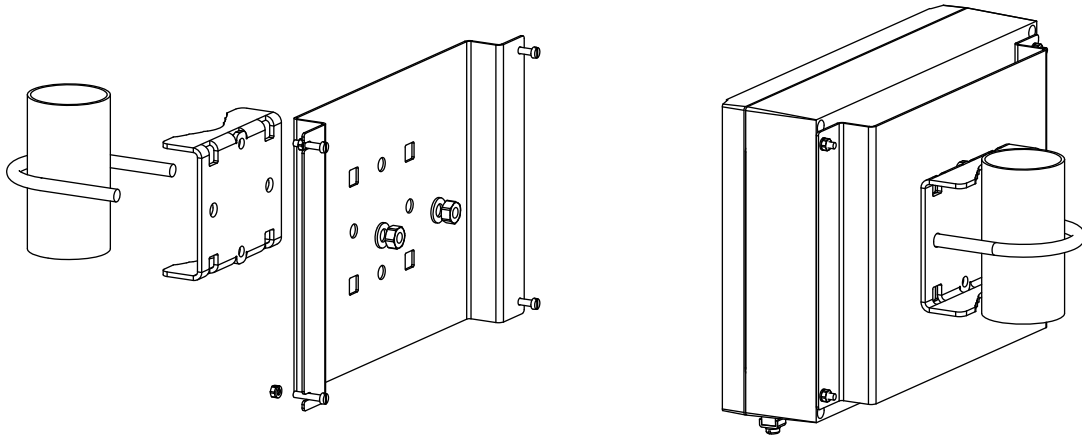
FLUXUS WD400, WD1200, WD6500 (stainless steel housing)



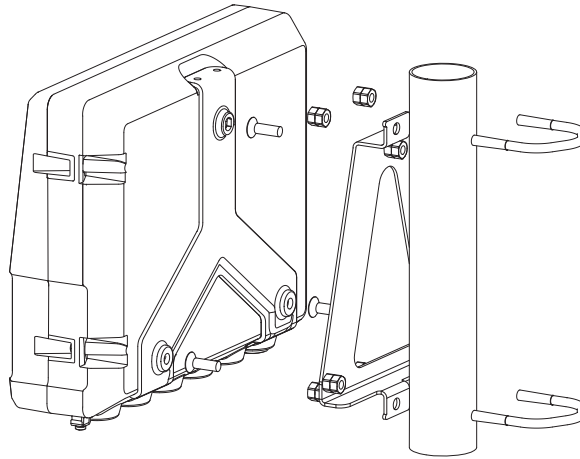
in mm

2 " pipe mounting kit (optional)

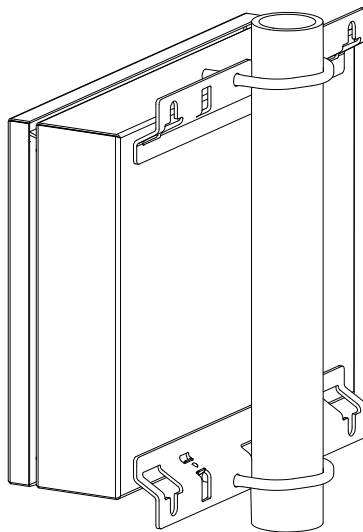
FLUXUS WD100, WD200



FLUXUS WD400, WD1200, WD6500 (aluminum housing)

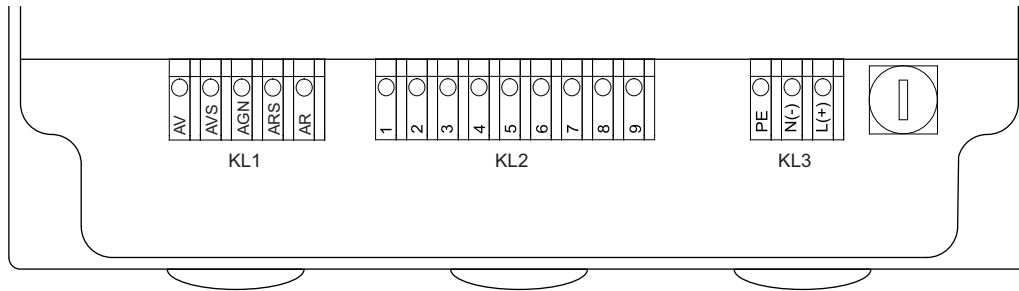


FLUXUS WD400, WD1200, WD6500 (stainless steel housing)



Terminal assignment

FLUXUS WD100, WD200



power supply

terminal strip KL3

terminal	connection (AC)	connection (DC)
PE	earth	earth
N(-)	neutral	-
L(+)	phase	+

transducers

terminal strip KL1

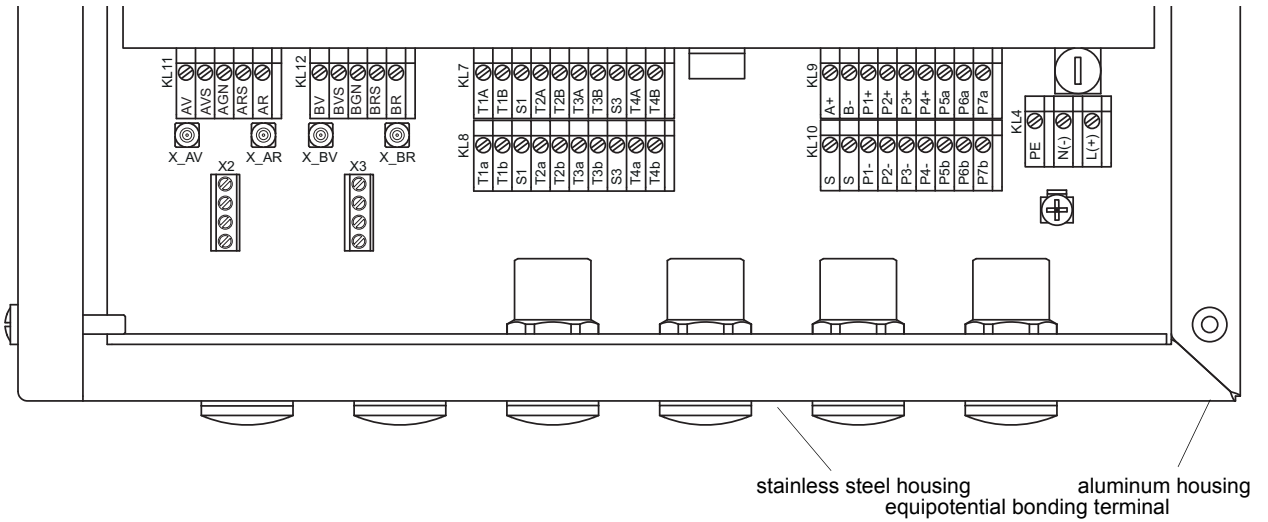
extension cable, transducer cable	
measuring channel A	
terminal	connection
AV	transducer ↗, signal
AVS	transducer ↗, internal shield
ARS	transducer ↘, internal shield
AR	transducer ↘, signal
cable gland	external shield

outputs

terminal strip KL2

terminal	connection
1(-), 2(+)	binary output B1
3(-), 4(+)	binary output B2
5(-), 6(+)	current output I1
7(-), 8(+), 9 (shield)	communication interface

FLUXUS WD400, WD1200, WD6500



power supply

terminal strip KL4

terminal	connection (AC)	connection (DC)
PE	earth	earth
N(-)	neutral	-
L(+)	phase	+

transducers

terminal strip KL11, KL12

extension cable transducer cable			
measuring channel A		measuring channel B	
terminal	connection	terminal	connection
AV	signal	BV	signal
AVS	shield	BVS	shield
ARS	shield	BRS	shield
AR	signal	BR	signal

outputs

terminal strip KL9, KL10

terminal	connection
P1+, P1-	current output
P5a...P6a, P5b...P6b	binary output

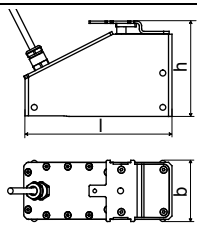
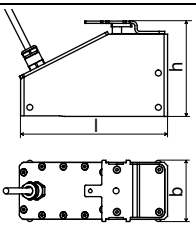
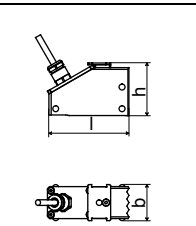
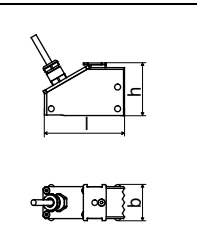
**RS485, Modbus RTU, BACnet MS/
TP, Profibus, FF (optional)**

terminal strip KL9, KL10

terminal	connection
A+	signal +
B-	signal -
S	shield

Transducers

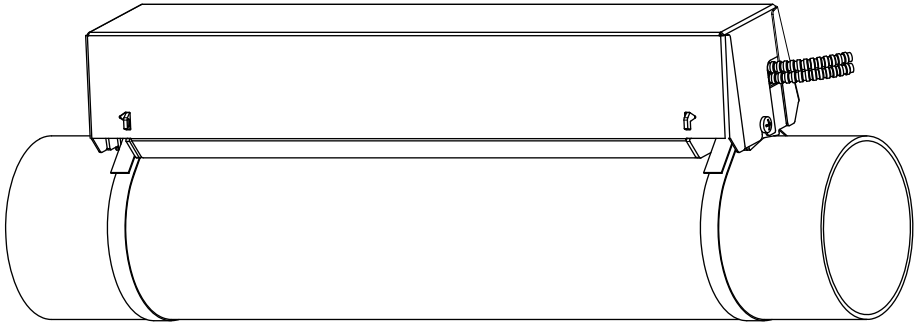
Technical data

technical type		CDG1LI8	CDK1LI8	CDM2LI8	CDP2LI8
transducer frequency	MHz	0.2	0.5	1	2
pipe wall thickness					
min.	mm	11	5	2	1
material					
housing		PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)	PEEK with stainless steel cap 316Ti (1.4571)
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection according to IEC/EN 60529		IP68 ¹	IP68 ¹	IP68 ¹	IP68 ¹
transducer cable					
type		2550	2550	2550	2550
length	m	12	12	12	12
dimensions					
length l	mm	130	130	72	72
width b	mm	54	54	32	32
height h	mm	83.5	83.5	46	46
dimensional drawing					
ambient temperature					
min.	°C	-40	-40	-40	-40
max.	°C	+100	+100	+100	+100
temperature compensation		x	x	x	x

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

Transducer mounting fixture

Variofix C (VC)



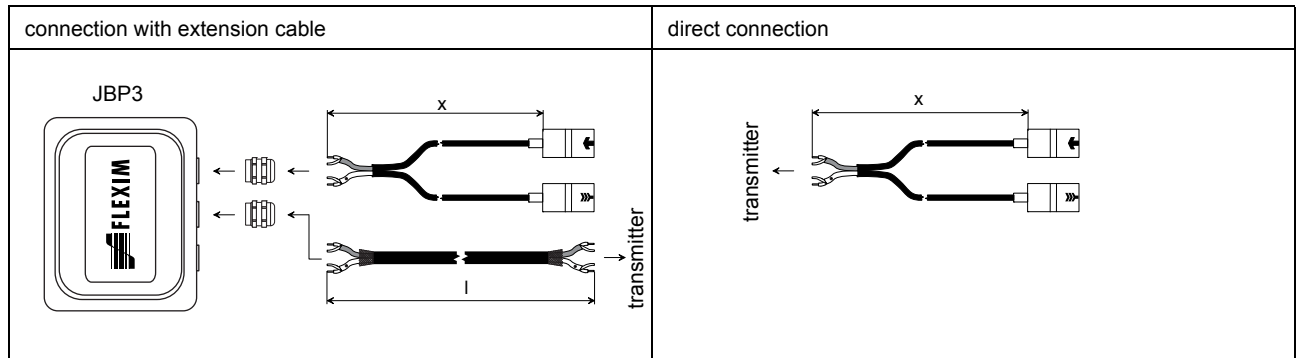
material: stainless steel 316 (1.4571)
 inner length:
VCK-*S: 350 mm
VCM: 400 mm
 dimensions:
VCK-*S: 410 x 126 x 120 mm
VCM: 460 x 96 x 80 mm

Coupling materials for transducers

Technical data

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

Connection systems



x - transducer cable length

Transducer cable

Technical data

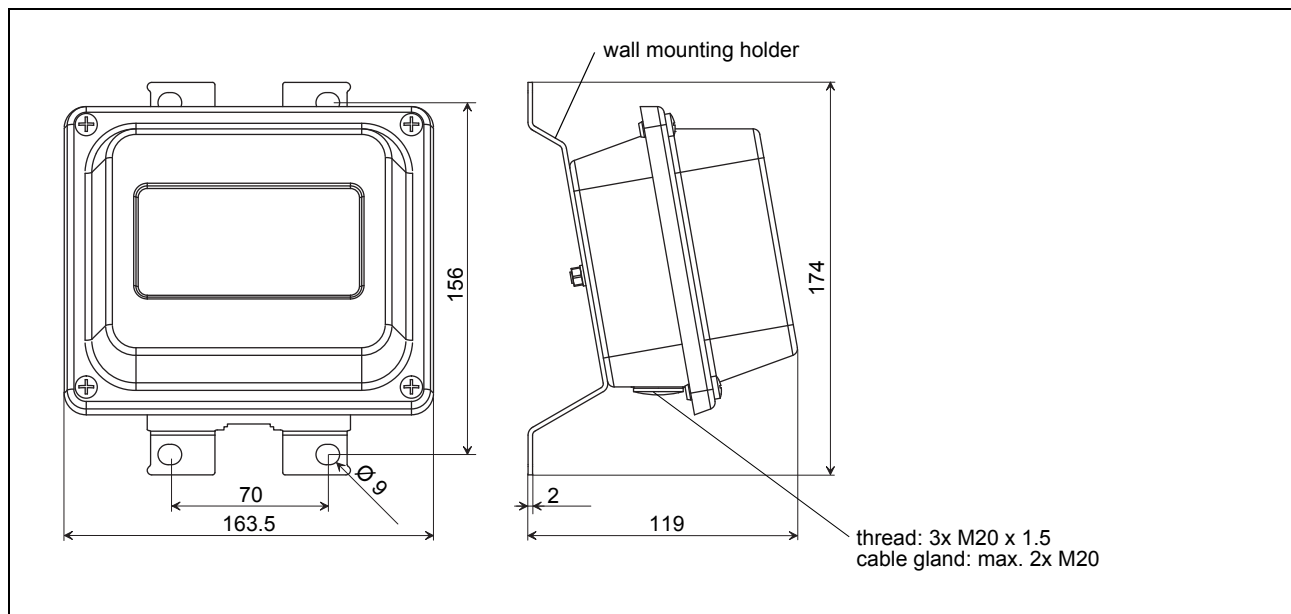
		transducer cable		extension cable	
type		2550		2615	5245
standard length	m	12		-	-
max. length	m	-		≤ 300	≤ 300
ambient temperature	°C	-40...+100		-40...+70	-30...+70
properties		longitudinal water tight		halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2	halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2
cable jacket					
material		PUR		PUR	PUR
outer diameter	mm	5.2 ±0.2		12	12
thickness	mm	0.9		2	2
colour		grey		black	black
shield		x		x	x
sheath					
material		-		-	steel wire braid with copolymer sheath
outer diameter	mm	-		-	15.6

Junction box (optional)

Technical data

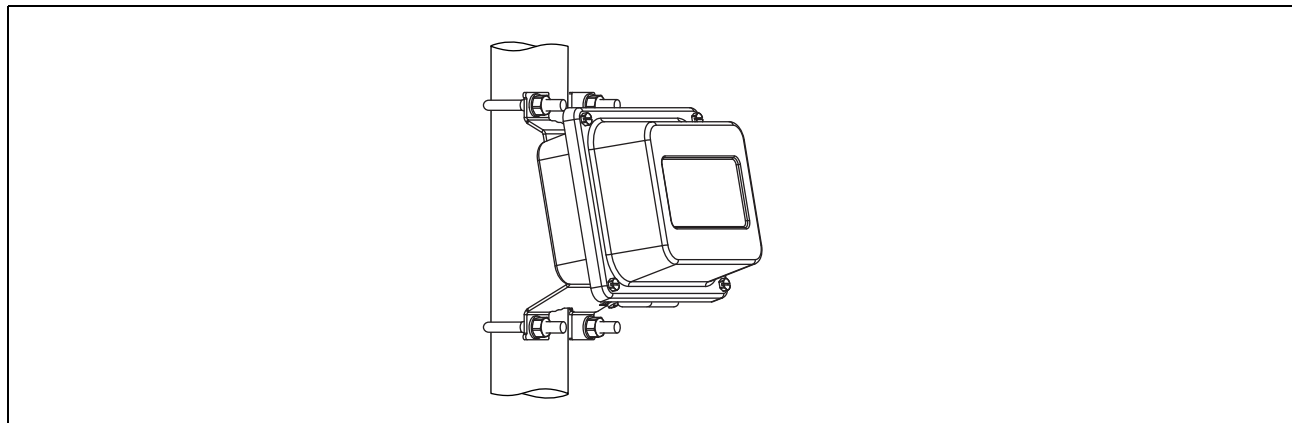
technical type		JBP3
dimensions		see dimensional drawing
weight	kg	1.2 kg
fixation		wall mounting, optional: 2 " pipe mounting
material		
housing		stainless steel 316L (1.4404)
gasket		silicone
degree of protection according to IEC/ EN 60529		IP67
ambient temperature		
min.	°C	-40
max.	°C	+80

Dimensions



in mm

2 " pipe mounting kit (optional)



Terminal assignment

JBP3

terminal strip KL1

terminal	connection
TV	transducer ↑, signal
TVS	transducer ↑, internal shield
TRS	transducer ↕, internal shield
TR	transducer ↕, signal
cable gland	external shield

terminal strip KL2

terminal	connection
TV	signal
TVS	internal shield
TRS	internal shield
TR	signal
shield terminal	external shield

shield terminal

equipotential bonding terminal
(at wall mounting holder)



FLEXIM GmbH
Wolfener Str. 36
12681 Berlin
Germany
Tel.: +49 (30) 93 66 76 60
Fax: +49 (30) 93 66 76 80

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

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TSFLUXUS_WDV2-1EN_Leu, 2016-08-01