

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

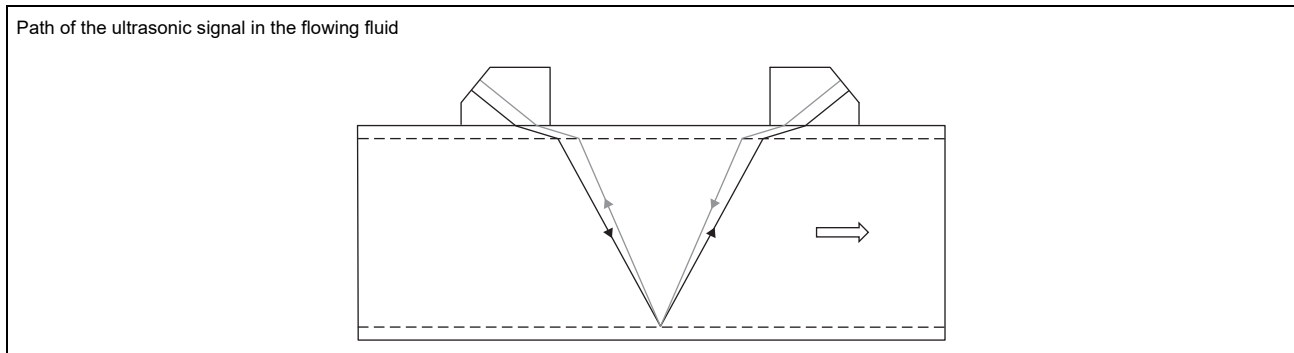
- Flow and temperature measurement on buried water and wastewater pipes
- Flow and temperature measurement on water and wastewater pipes which can be overflowed

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Function

Measurement principle

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

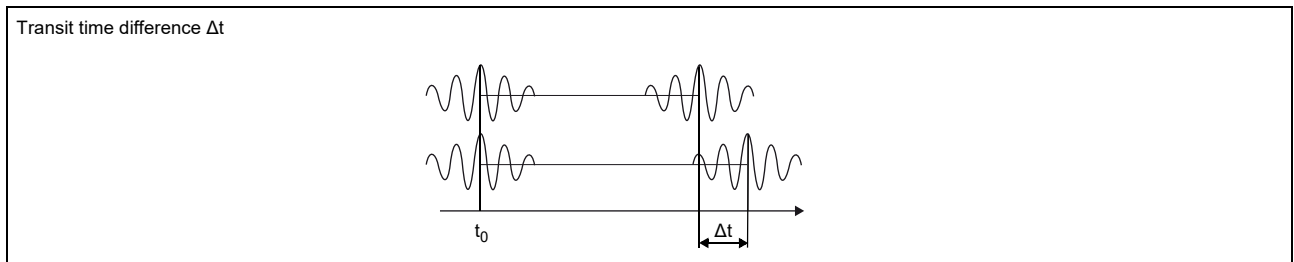


Transit time difference principle

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.



HybridTrek

If the gaseous or solid content in the fluid increases occasionally during measurement, a measurement with the transit time difference principle may no longer be 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

$$\dot{V} = k_{Re} \cdot A \cdot k_a \cdot \frac{\Delta t}{2 \cdot t_y}$$

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_y - 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.

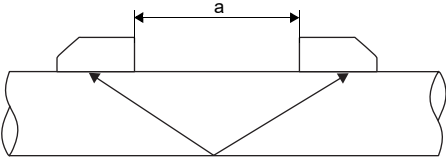
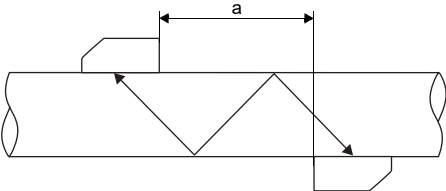
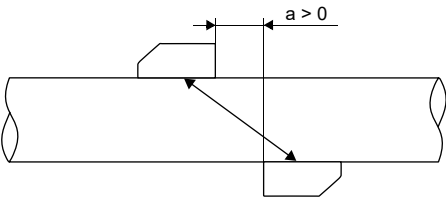
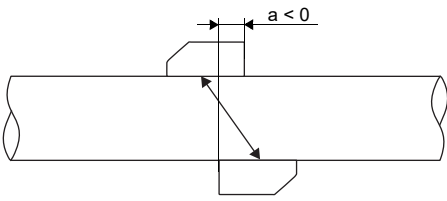
Number of sound paths

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:

- **reflect arrangement**
The number of sound paths is even. The transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easy.
- **diagonal arrangement**
The number of sound paths is odd. The transducers are mounted on opposite sides of the pipe.
- **direct mode**
Diagonal arrangement with 1 sound path. This should be used in the case of a high signal attenuation by the fluid, pipe or coatings.

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

As the transducers can be mounted with the transducer mounting fixture in reflect arrangement or diagonal arrangement, the number of sound paths can be adjusted optimally for the application.

Reflect arrangement, number of sound paths: 2	
	
Diagonal arrangement, number of sound paths: 3	
	
Direct mode, number of sound paths: 1	Direct mode, number of sound paths: 1, negative transducer distance
	

a - transducer distance

Transmitter

Technical data

		FLUXUS F731WD	FLUXUS F731WD Dual Channel
			
design		field device with 1 measuring channel	field device with 2 measuring channels
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	
synchronized channel averaging		-	x
flow velocity	ft/s	0.03 to 82	
repeatability		0.15 % MV ±0.02 ft/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 ±0.02 ft/s includes calibration certificate traceable to NIST	
measurement uncertainty at the measuring point ²		±1 % MV ±0.02 ft/s	
measurement uncertainty (temperature from sound speed)			
measurement uncertainty at the measuring point ²		±0.2 K (fluid temperature: 32 to 86 °F, inner pipe diameter: min. 7.9 inch)	
transmitter			
power supply		• 100 to 240 V ±10 %/50 to 60 Hz or • 11 to 32 V DC	
power consumption	W	< 15	
number of measuring channels		1	2
damping	s	0 to 100 (adjustable)	
measuring cycle	Hz	100 to 1000 (1 channel)	
response time	s	1 (1 channel), option: 0.02	
housing material		aluminum, powder coated or stainless steel 316L	
degree of protection		IP66	
dimensions	inch	see dimensional drawing	
weight	lb	aluminum housing: 9.9 stainless steel housing: 12.8	
fixation		wall mounting, optional: 2" pipe mounting	
ambient temperature	°F	-40 to +140 (< -4 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	
totalizer		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, parametrization of the transmitter: • USB • LAN	
process interfaces		max. 1 option: • Modbus RTU • BACnet MS/TP • HART • Profibus PA • FF H1 • Modbus TCP • BACnet IP	
accessories			
data transmission kit		USB cable	
software		• FluxDiagReader: reading of measured values and parameters, graphical representation • FluxDiag (optional): reading of measurement data, graphical representation, report generation, parametrization of the transmitter	

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

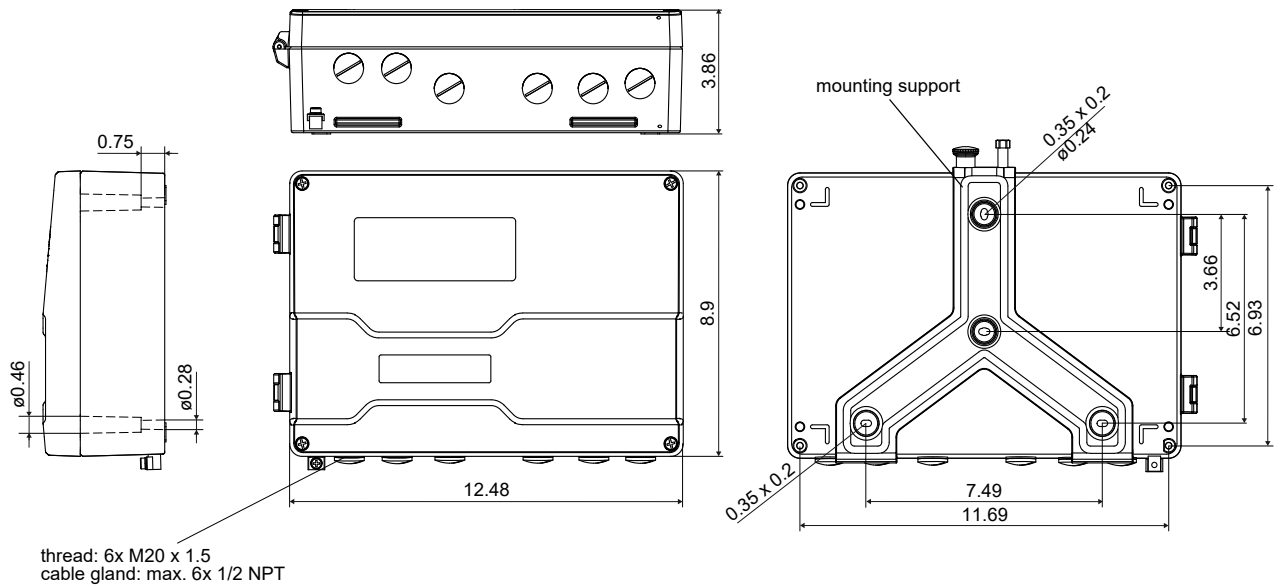
		FLUXUS F731WD	FLUXUS F731WD Dual Channel
data logger			
loggable values		all physical quantities, totalized physical quantities and diagnostic values	
capacity		max. 800 000 measured values	
outputs			
		The outputs are galvanically isolated from the transmitter.	
number		current inputs and outputs: 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 to 20 (alarm current: 3.2 to 3.99, 20.01 to 24, hardware fault current: 3.2)	
uncertainty		0.04 % MV ±3 µA	
active output		R _{ext} = 250 to 530 Ω, U _{opencircuit} = 28 V DC	
passive output		U _{ext} = 9 to 30 V DC, depending on R _{ext} (R _{ext} < 458 Ω at 20 V)	
current output in HART mode		option	
• range	mA	4 to 20 (alarm current: 3.5 to 3.99, 20.01 to 22, hardware fault current: 3.2)	
• active output		R _{ext} = 250 to 530 Ω, U _{opencircuit} = 28 V DC	
• passive output		U _{ext} = 9 to 30 V DC, depending on R _{ext} (R _{ext} = 250 to 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 to 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 to 10	
• damping	s	0 to 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 to 1000	
• pulse width	ms	0.05 to 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 64 to 82 °F ±0.1 % MV ±0.01 mA ±0.005 %/K at <64 °F/>82 °F	
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 to 20	
passive input		U _{ext} = 24 V, R _{int} = 35 Ω, I _{max} ≤ 24 mA	
• range	mA	0 to 20	

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

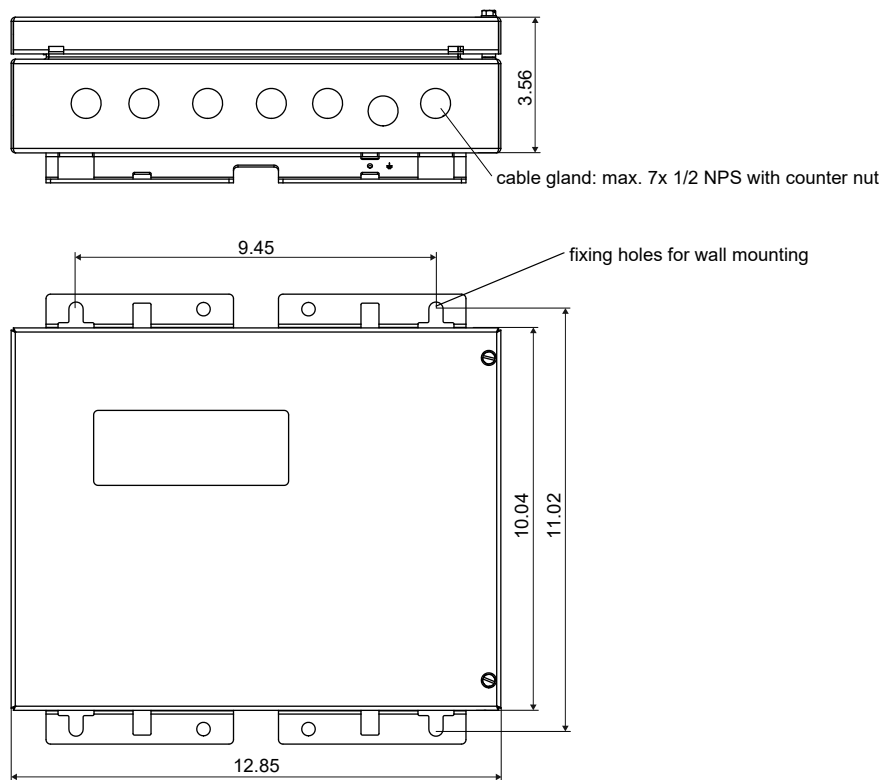
Dimensions

*731**-*****-*AL



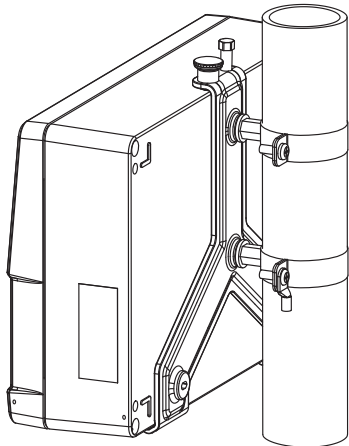
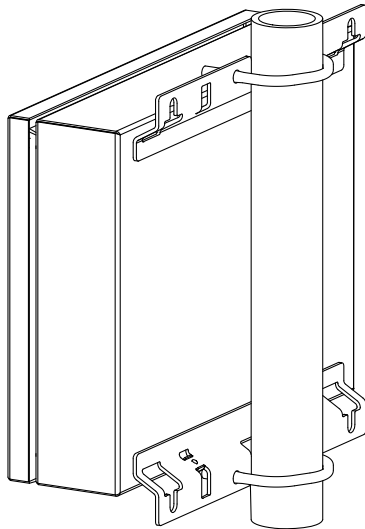
in inch

*731**-*****-*ST



in inch

2" pipe mounting kit

*731**-*****-AL 	item number: 731037-1
*731**-*****-ST 	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...+140 °F

Terminal assignment

*731

equipotential bonding terminal (aluminum housing)

equipotential bonding terminal (stainless steel housing)

power supply¹

AC		DC	
terminal	connection	terminal	connection
L	line conductor	(+)	+
N	neutral conductor	(-)	-
PE	protective conductor	PE	protective conductor

transducers

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

outputs, inputs^{1, 2}

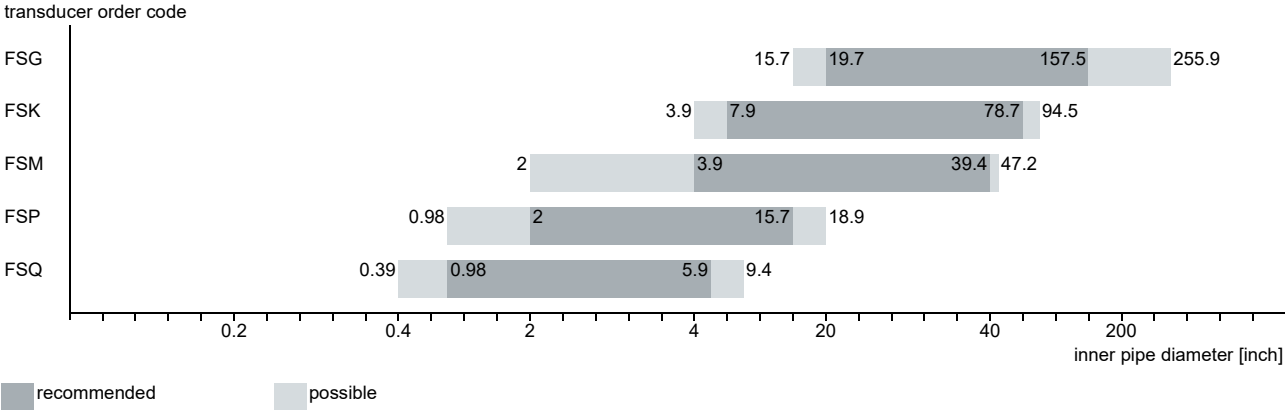
terminal	connection	
depending on configuration	current output, digital output, current input	
29+, 30-	passive current output/HART	
29-, 30+	active current output/HART	
29, 30	Modbus RTU, BACnet MS/TP, Profibus PA, FF H1	
USB	type C Hi-Speed USB 2.0 Device	service (FluxDiag/FluxDiagReader)
LAN	RJ45 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: AWG14 to 24

² The number, type and terminal assignment are customized.

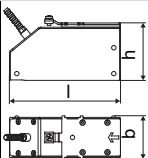
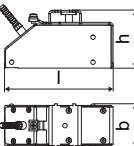
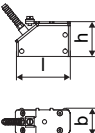
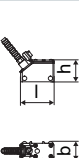
Transducers

Transducer selection

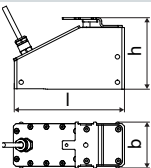
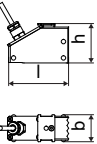


Technical data

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	inch	15.7	3.9	2	0.98	0.39
min. recommended	inch	19.7	7.9	3.9	2	0.98
max. recommended	inch	157.5	78.7	39.4	15.7	5.9
max. extended	inch	255.9	94.5	47.2	18.9	9.4
pipe wall thickness						
min.	inch	0.43	0.2	0.1	0.05	0.02
material						
housing		PEEK with stainless steel cover 316L				
contact surface		PEEK				
degree of protection		IP66		IP66/IP67		
transducer cable						
type		1699				
length	ft	16		13		9
dimensions						
length l	inch	5.1	4.98	2.52	1.57	
width b	inch	2.01	2.01	1.26	0.87	
height h	inch	2.64	2.66	1.59	1	
dimensional drawing						
weight (without cable)	lb	1	0.79	0.15	0.04	
pipe surface temperature	°F	-40 to +266				
ambient temperature	°F	-40 to +266				
temperature compensation		x				

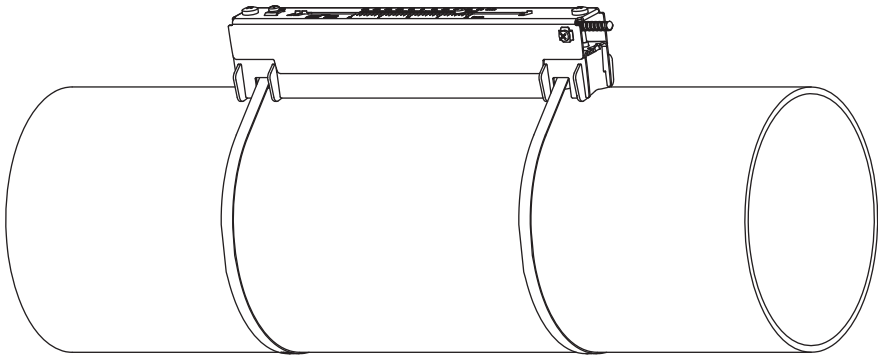
Shear wave transducers (IP68)

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	inch	15.7	3.9	2
min. recommended	inch	19.7	7.9	3.9
max. recommended	inch	157.5	78.7	39.4
max. extended	inch	255.9	94.5	47.2
pipe wall thickness				
min.	inch	0.43	0.2	0.1
material				
housing		PEEK with stainless steel cover 316Ti		
contact surface		PEEK		
degree of protection		IP68 ¹		
transducer cable				
type		2550		
length	ft	39		
dimensions				
length l	inch	5.12		2.76
width b	inch	2.13		1.26
height h	inch	3.29		1.81
dimensional drawing				
weight (without cable)	lb	0.95		0.19
pipe surface temperature	°F	-40 to +212		
ambient temperature	°F	-40 to +212		
temperature compensation		x		

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

Transducer mounting fixture

Variofix L (VL)



material: stainless steel 316Ti, 316L, 17-7PH

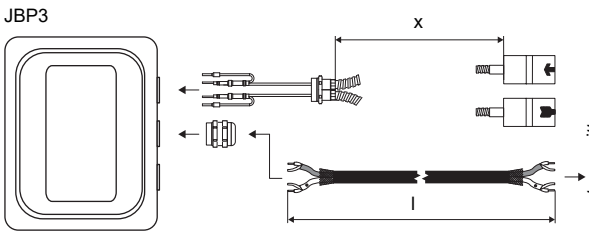
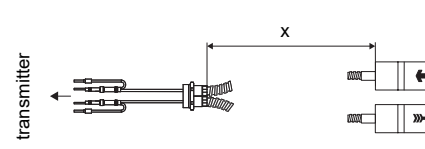
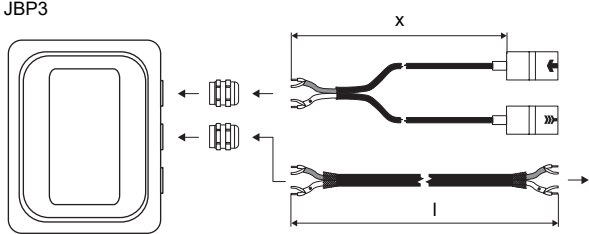
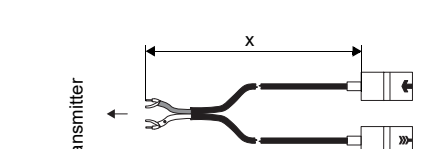
inner length:
VL(GK): 13.7 inch,
option H68: 14.5 inch
VL(MP): 9.2 inch

dimensions:
VL(GK): 16.65 x 3.54 x 3.66 inch
option H68: 17.44 x 3.7 x 4.13 inch
VL(MP): 12.17 x 2.24 x 2.48 inch

Coupling materials for transducers

type	ambient temperature °F
coupling pad type VT	14 to +392

Connection systems

connection system T1		
connection with extension cable	direct connection	transducers technical type
JBP3		****53
JBP3		****L*

Cable

transducer cable			
type		1699	2550
weight	lb/ft	0.06	0.02
ambient temperature	°F	-67 to +392	-40 to +212
properties			longitudinal watertight
cable jacket			
material		PTFE	PUR
outer diameter	inch	0.11	0.2 ±0.01
thickness	inch	0.01	0.04
color		brown	gray
shield		x	x
sheath			
material		stainless steel 316Ti	-
outer diameter	inch	0.31	-

extension cable			
type		2615	5245
weight	lb/ft	0.12	0.26
ambient temperature	°F	-22 to +158	-22 to +158
properties		halogen-free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2	halogen-free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2
cable jacket			
material		PUR	PUR
outer diameter	inch	max. 0.47	max. 0.47
thickness	inch	0.08	0.08
color		black	black
shield		x	x
sheath			
material		-	steel wire braid with copolymer sheath
outer diameter	inch	-	max. 0.61

Cable length

transducer frequency		G, K		M, P		Q	
transducers technical type		x	l	x	l	x	l
*D***5*	ft	16	≤ 984	13	≤ 984	9	≤ 295
*L***5*	ft	29	≤ 984	29	≤ 984	29	≤ 295
****L*	ft	39	≤ 984	39	≤ 984	-	-

x = transducer cable length

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

Junction box

Technical data

JBP3		
weight	lb	2.6 lb
fixation		wall mounting optional: 2" pipe mounting
material		
housing		stainless steel 316L
gasket		silicone
degree of protection		IP66/IP67
ambient temperature	°F	-40 to +176

Connection

The diagram shows a rectangular connection box with four mounting holes at the corners. Inside, there are two terminal strips. The left strip, labeled KL2, has five terminals: TV, TVS, TG, TRS, and TR. The right strip, labeled KL1, has four terminals: V, VS, RS, and R. Below these strips is a battery symbol with two positive (+) terminals.

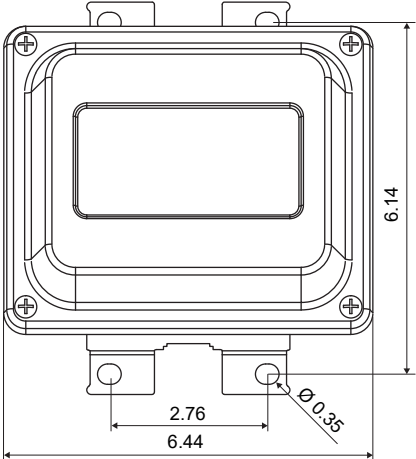
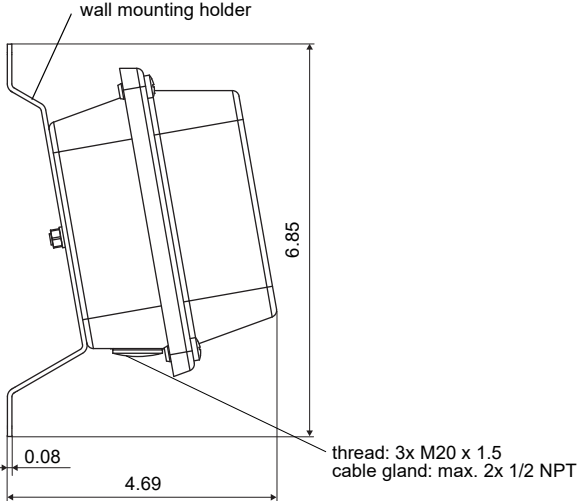
Transducers

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

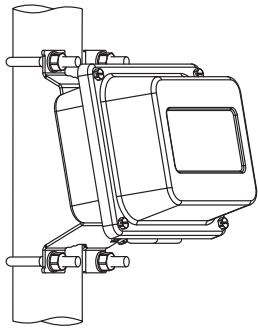
Extension cable

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

Dimensions

JB0*, JBP*	
	
in inch	

2" pipe mounting kit

JB** 	item number: 751035-2
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