

Portable ultrasonic flow measurement of liquids in hazardous areas

Portable instrument for non-invasive, quick ultrasonic flow measurement with clamp-on technology for all types of piping

Features

- Precise bidirectional and highly dynamic flow measurement with the non-invasive clamp-on technology
- Automatic loading of calibration data and transducer detection for a fast and easy set-up (less than 5 min), providing precise and long-term stable results
- High precision at fast and slow flow rates, high temperature and zero point stability
- Portable, easy-to-use flow transmitter with 2 flow channels, multiple inputs, an integrated data logger with a serial interface
- Water tight; resistant against oil, many liquids and dirt
- Extremely resistant carbon fiber housing
- Robust, water-tight (IP67) transport case with comprehensive accessories
- Compact and very lightweight, allowing the measuring system to be easily carried as personal luggage, e.g. for off-shore visits
- Covered by FM Class I Div. 2 certification
- Li-Ion battery provides up to 25 hours of measurement operation
- User-friendly design
- QuickFix for a simple and fast transmitter fixation, e.g. on pipes
- Transducers available for a wide range of inner pipe diameters and fluid temperatures (-200...+600 °C)
- Rugged transducers (FM Class I Div. 2, resistant to rough environments and humidity)
- HybridTrek automatically switches between transit time and NoiseTrek mode of measurement when high particulate flows are encountered
- Measurement is unaffected by fluid density, viscosity and solid content (max. 10 % of volume)

Applications

Designed for the following industries:

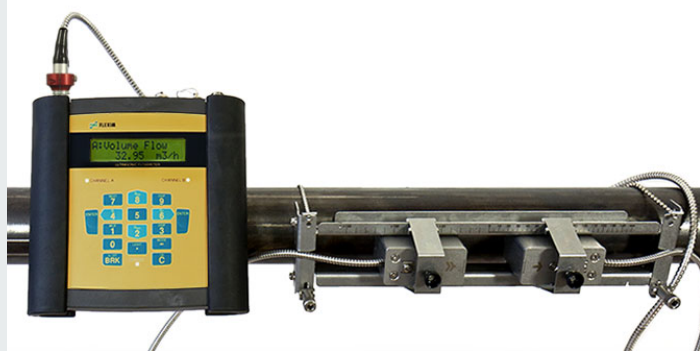
- Upstream (on- and offshore)
- Midstream and downstream (pipelines and refineries)
- Chemical industry
- Energy sector (e.g. HVAC, geothermal, power plants)



FLUXUS F608



Measurement with transducers mounted with the portable Variofix VP



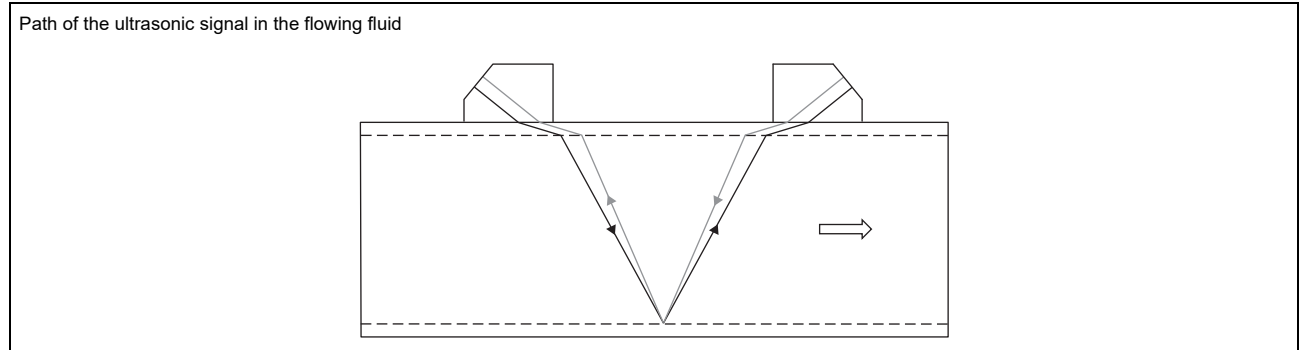
Measurement with the flow transmitter fixed to the pipe with the QuickFix pipe mounting fixture

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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.

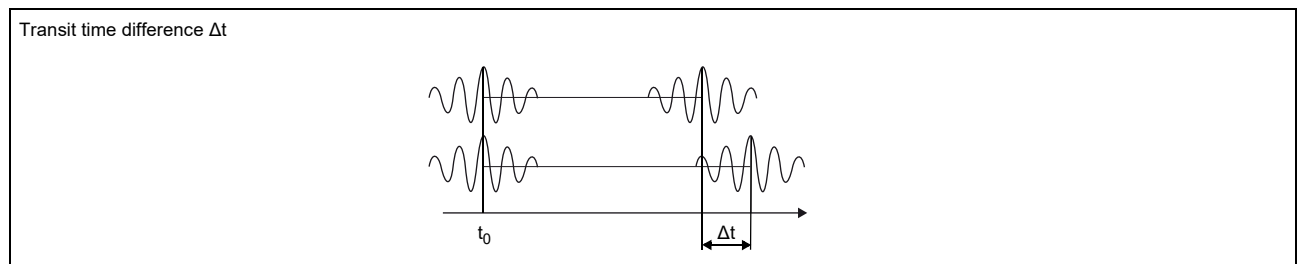


Transit time difference principle

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 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

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

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

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.

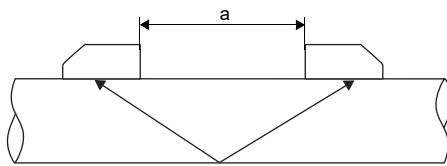
- **diagonal arrangement**

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.

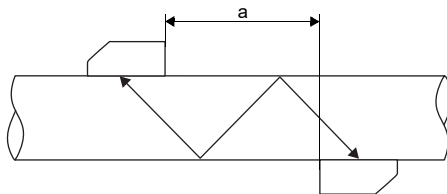
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

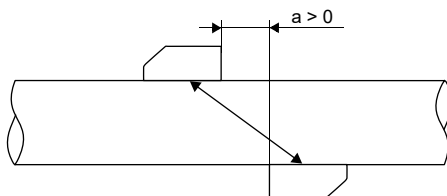
Reflection arrangement, number of sound paths: 2



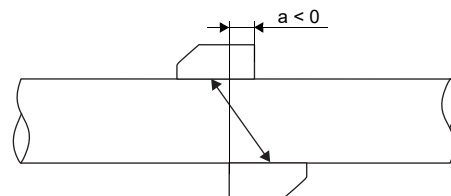
Diagonal arrangement, number of sound paths: 3



Diagonal arrangement, number of sound paths: 1



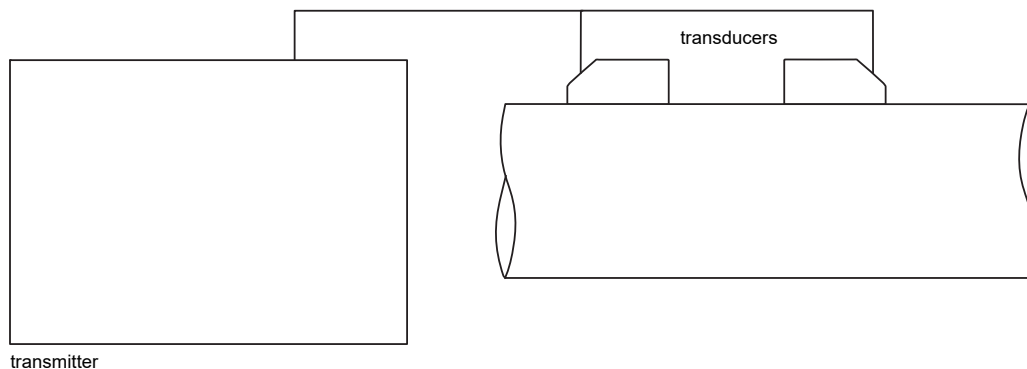
Diagonal arrangement, number of sound paths: 1, negative transducer distance



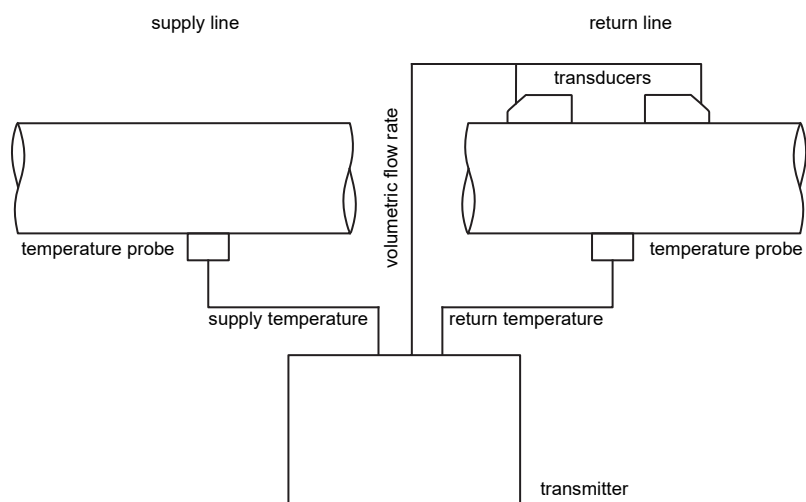
a - transducer distance

Typical measurement setup

Example of a reflection arrangement





Example of a thermal energy rate measurement measuring the volumetric flow rate in the return line



Transmitter

Technical data

		FLUXUS F608**-F2	
			
design		portable, FM Class I Div. 2	
measurement			
measurement principle		transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content	
flow direction		bidirectional	
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	
transmitter			
power supply		<ul style="list-style-type: none">• 100...230 V/50...60 Hz (power supply unit, outside the explosive atmosphere)• 10.5...15 V DC (socket at transmitter)• integrated battery	
integrated battery		Li-Ion, 7.2 V/6.2 Ah, max. 47 Wh	
• operating time	h	> 14 (without inputs and backlight) > 25 (1 measuring channel, ambient temperature > 10 °C, without inputs and backlight)	
power consumption	W	< 6 (with inputs and backlight), charging: 18	
number of measuring channels		2	
damping	s	0...100 (adjustable)	
measuring cycle	Hz	100...1000 (1 channel)	
response time	s	1 (1 channel), option: 0.07	
housing material		PA, TPS, PC, Polyester, stainless steel	
degree of protection		IP65	
dimensions	mm	see dimensional drawing	
weight	kg	2.2	
fixation		QuickFix pipe mounting fixture	
ambient temperature	°C	-10...+60	
display		2 x 16 characters, dot matrix, backlight	
menu language		English, German, French, Dutch, Spanish	
explosion protection			
• FM			
marking			NI/CI. I /Div. 2/ GP. A,B,C,D / T5 Ta = 60 °C
measuring functions			
physical quantities		volumetric flow rate, mass flow rate, flow velocity, thermal energy rate (if temperature inputs are installed)	
totaliser		volume, mass, optional: thermal energy	
calculation functions		average, difference, sum	
diagnostic functions		sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times	
communication interfaces			
service interfaces		<ul style="list-style-type: none">• RS232• USB (with adapter)	
accessories			
data transmission kit			
• cable		RS232	
• adapter		RS232 - USB	
software		<ul style="list-style-type: none">• FluxDiagReader: reading of measured values and parameters, graphical representation• FluxDiag (optional): reading of measurement data, graphical representation, report generation	
adapter		<ul style="list-style-type: none">• input adapter (if number of inputs > 2)	
transport case		dimensions: 500 x 400 x 190 mm	
data logger			
loggable values		all physical quantities, totalised physical quantities and diagnostic values	
capacity		> 100 000 measured values	

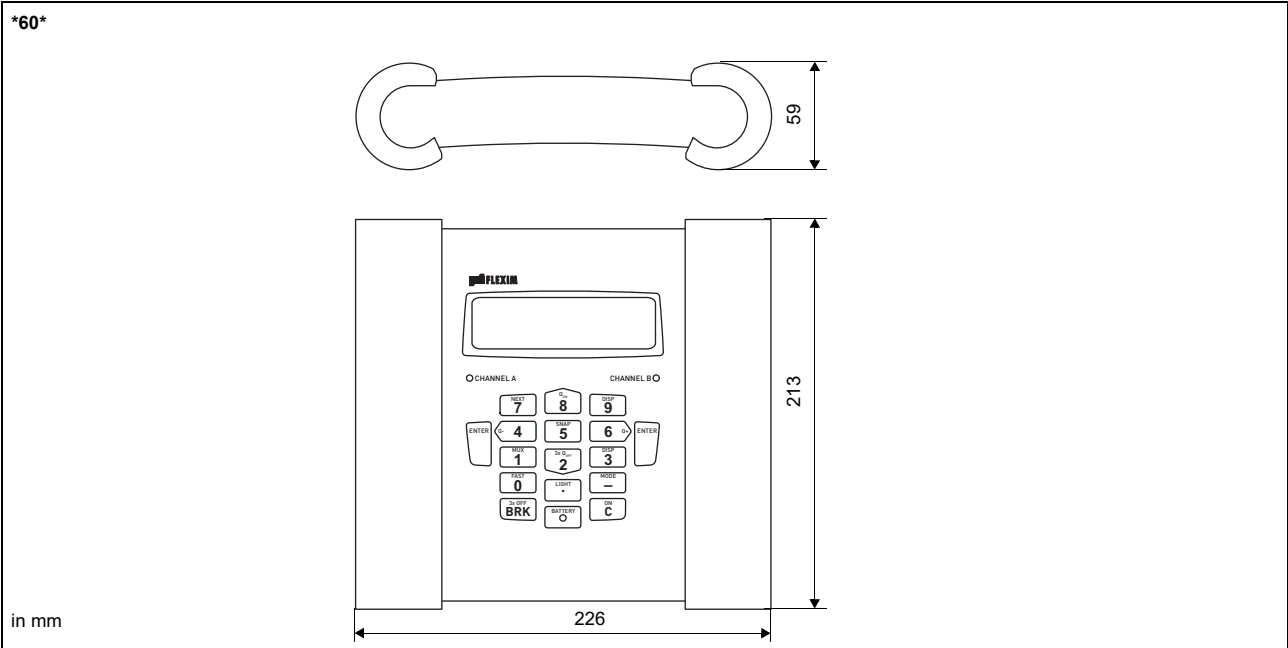
¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

	FLUXUS F608**-F2
inputs	
	The inputs are galvanically isolated from the transmitter.
number	max. 4
• temperature input	
type	Pt100/Pt1000
connection	4-wire
range	°C -150...+560
resolution	K 0.01
accuracy	±0.01 % MV ±0.03 K

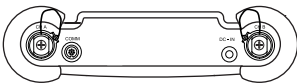
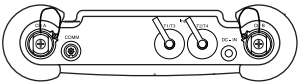
¹ with aperture calibration of the transducers
² for transit time difference principle and reference conditions

Dimensions



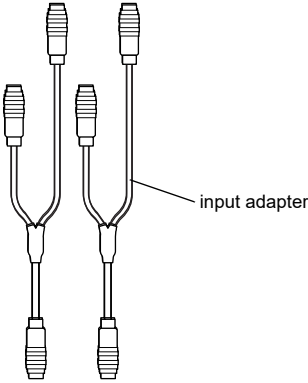
- Storage
- do not store outdoors
 - store within the original package
 - store in a dry and dust-free place
 - protect against sunlight
 - keep all openings closed
 - storing temperature: -10...+60 °C

Standard scope of supply

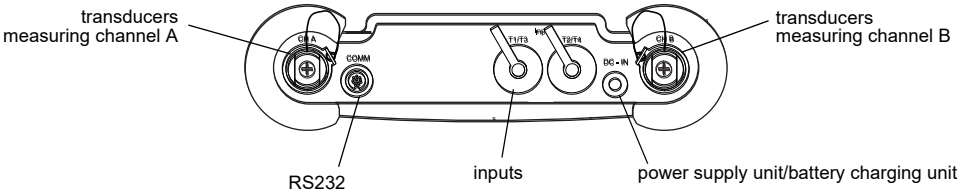
	F608 Standard	F608 Energy
application	flow measurement of liquids	
	2 independent measuring channels	
		temperature-compensated calculation of mass flow rate
		integrated thermal energy computer for monitoring of energy flows
		simultaneous monitoring of flow and energy flow
inputs		
temperature input	-	2
accessories		
transport case	x	x
power supply unit, mains cable	x	x
battery	x	x
input adapter	-	-
QuickFix pipe mounting fixture for transmitter	x	x
data transmission kit	x	x
measuring tape	x	x
operating instruction, safety instructions, Quick start guide	x	x
connector board at the upper side of the transmitter		

Adapters

*608**-F2



input adapter



transducers measuring channel A

transducers measuring channel B

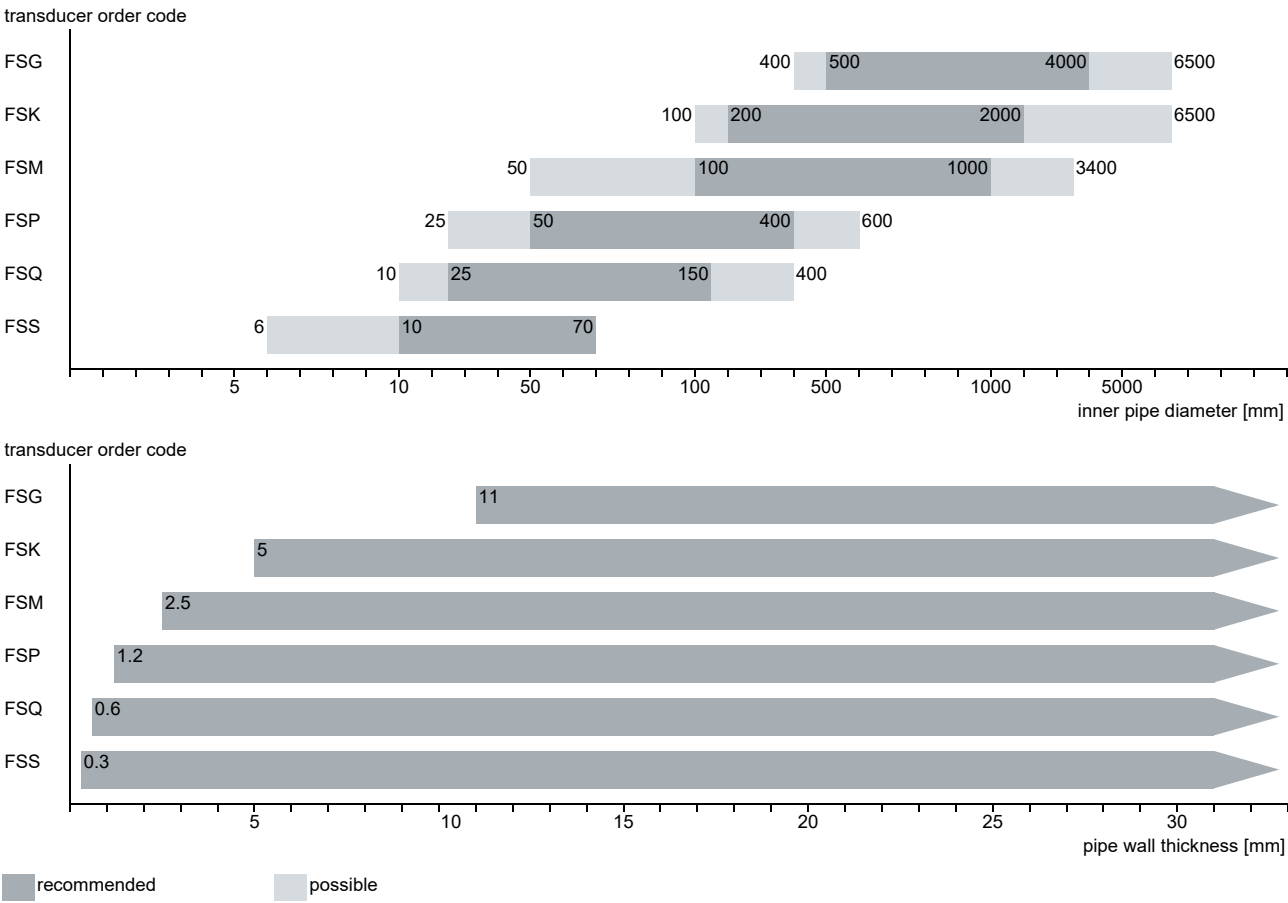
RS232

inputs

power supply unit/battery charging unit

Transducers

Transducer selection

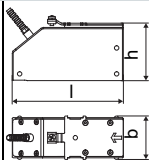
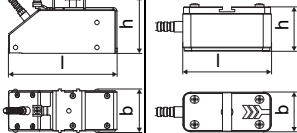
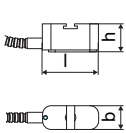
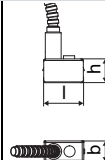



Transducer order code

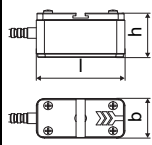
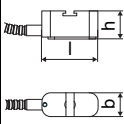

1, 2	3	4	5...7	8, 9	10, 11	12...14	no. of character			
transducer	transducer frequency	-	ambient temperature	explosion protection	-	certification	connection system	-	cable length	description
FS										set of ultrasonic flow transducers for measurement of liquids, shear wave
	G									0.2 MHz
	K									0.5 MHz
	M									1 MHz
	P									2 MHz
	Q									4 MHz
	S									8 MHz
			N							normal temperature range
			E							extended temperature range
				F2N						FM Class I Div. 2
					**					
						NL				with LEMO connector
								***		in m

Technical data

Shear wave transducers (FM Class I Div. 2, NL)

order code		FSG-NF2N-**NL	FSK-NF2N-**NL	FSM-NF2N-**NL	FSP-NF2N-**NL	FSQ-NF2N-**NL	FSS-NF2N-**NL
technical type		C(DL)G1N51	C(DL)K1N51	C(DL)M1N51	C(DL)P1N51	C(DL)Q1N51	CDS1N51
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	6500	3400	600	400	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)		stainless steel 304 (1.4301)		stainless steel 304 (1.4301)	
contact surface		PEEK		PEEK		PEI	
degree of protection		IP66					
transducer cable							
type		1699					
length	m	5		4		3	2
dimensions							
length l	mm	129.5	126.5	60		42.5	25
width b	mm	51	51	30		18	13
height h	mm	67	67.5	33.5		21.5	17
dimensional drawing							
weight (without cable)	kg	0.47	0.36	0.035		0.011	0.004
pipe surface temperature	°C	-40...+130					-30...+130
ambient temperature	°C	-40...+130					-30...+130
temperature compensation		x					-
explosion protection							
• FM							
pipe surface temperature (Ex)	°C	-40...+125					
degree of protection		IP66					
marking		 NI/CI. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860					

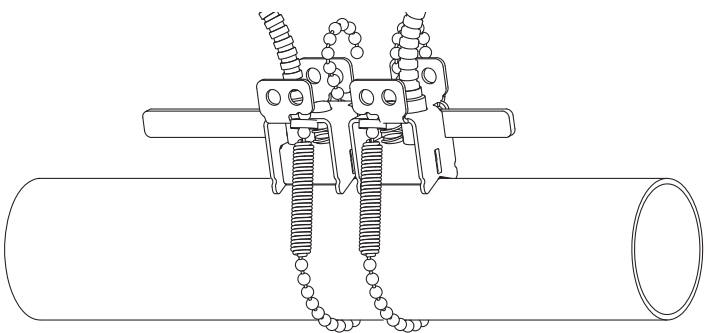
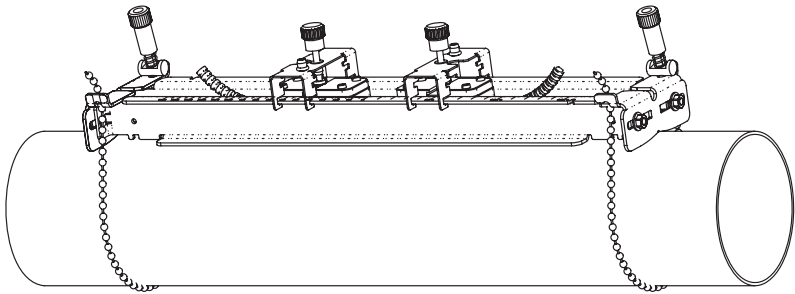
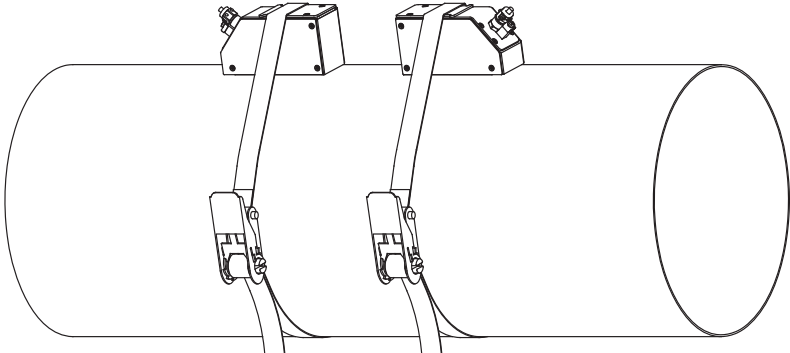
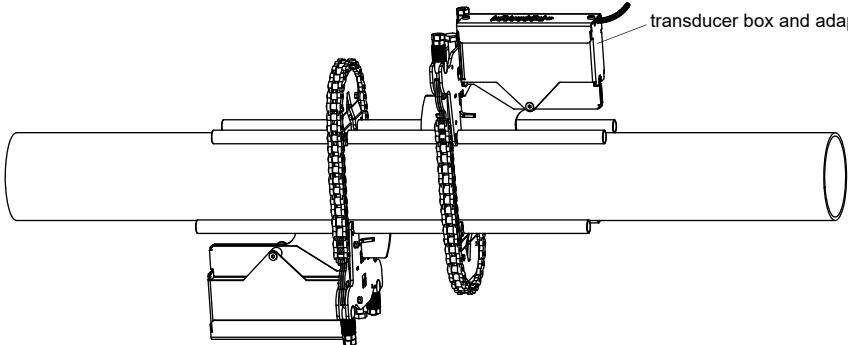
Shear wave transducers (FM Class I Div. 2, NL, extended temperature range)

order code		FSM-EF2N-**NL	FSP-EF2N-**NL	FSQ-EF2N-**NL
technical type		C(DL)M1E51	C(DL)P1E51	C(DL)Q1E51
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	3400	600	400
pipe wall thickness				
min.	mm	2.5	1.2	0.6
material				
housing		stainless steel 304 (1.4301)		
contact surface		Sintimid		
degree of protection		IP66		
transducer cable				
type		1699		
length	m	4		3
dimensions				
length l	mm	60		42.5
width b	mm	30		18
height h	mm	33.5		21.5
dimensional drawing				
weight (without cable)	kg	0.042		0.011
pipe surface temperature	°C	-30...+200		
ambient temperature	°C	-30...+200		
temperature compensation		x		
explosion protection				
• FM				
pipe surface temperature (Ex)	°C	-40...+190		
degree of protection		IP66		
marking		 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860		

Transducer mounting fixture

Order code

1, 2	3	4	5	6	7...10	no. of character		
transducer mounting fixture	transducer	-	measurement arrangement	size	-	fixation	outer pipe diameter	description
FS								fastening shoes (transducers with transducer frequency S)
VP								portable Variofix
TB								tension belts
WL								transducer box for WaveInjector
	A							all transducers
	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
					C			chains
					N			without fixation
						0100		10...100 mm
						0250		10...250 mm
						0550		10...550 mm
						1500		50...1500 mm
						2100		50...2100 mm

<p>fastening shoes FS and chains</p> 	<p>transducer frequency: S</p> <p>material: stainless steel 304 (1.4301), 301 (1.4310), 303 (1.4305)</p> <p>dimensions: 210 x 32 x 44 mm</p> <p>chain length: 0.5 m</p> <p>outer pipe diameter: max. 150 mm</p>
<p>portable Variofix VP and chains</p> 	<p>material: stainless steel 304 (1.4301), 301 (1.4310), 303 (1.4305)</p> <p>dimensions: 414 x 94 x 76 mm</p> <p>chain length: 2 m</p>
<p>tension belts TB</p> 	<p>material: steel, powder coated and textile tension belt</p> <p>length: 5/7 m</p> <p>ambient temperature: max. 60 °C</p> <p>outer pipe diameter: max. 1500/2100 mm</p>
<p>transducer box WL for WaveInjector</p>  <p>transducer box and adapter</p>	<p>see Technical specification TSWaveInjectorVx-x</p>

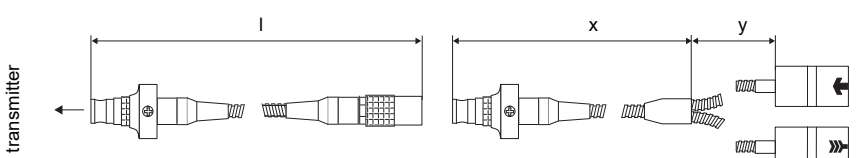
Coupling materials for transducers

normal temperature range (4th character of transducer order code = N)		extended temperature range (4th character of transducer order code = E)		WaveInjector	
< 100 °C	< 170 °C	< 150 °C	< 200 °C	< 280 °C	280...630 °C
coupling compound type N	coupling compound type E	coupling compound type E	coupling compound type E or H	coupling foil type A and coupling foil type VT	coupling foil type B and coupling foil type VT

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...630
coupling foil type VT	-10...+200

Connection systems

connection system NL	
direct connection/connection with extension cable	transducers technical type
	****51

Cable

transducer cable		
type		1699
weight	kg/ m	0.094
ambient temperature	°C	-55...+200
cable jacket		
material		PTFE
outer diameter	mm	2.9
thickness	mm	0.3
colour		brown
shield		x
sheath		
material		stainless steel 304 (1.4301)
outer diameter	mm	8

extension cable		
type		1750
standard length	m	5 10
weight	kg/ m	0.12
ambient temperature	°C	< 80
cable jacket		
material		PE
outer diameter	mm	6
thickness	mm	0.5
colour		black
shield		x
sheath		
material		stainless steel 304 (1.4301)
outer diameter	mm	9

Cable length

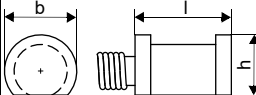
transducer frequency		F, G, H, K			M, P			Q			S		
connection system NL													
transducers technical type		x	y	l	x	y	l	x	y	l	x	y	l
*(DR)***51	m	2	3	≤ 10	2	2	≤ 10	2	1	≤ 10	1	1	≤ 10
*(LT)***51	m	2	7	≤ 10	7	2	≤ 10	8	1	≤ 10	-	-	-

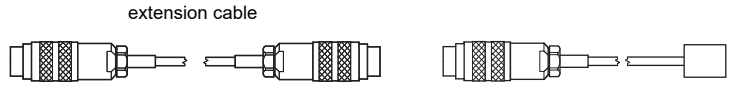
x, y - transducer cable length

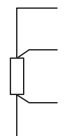
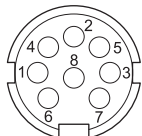
l - max. length of extension cable

Clamp-on temperature probe (optional)

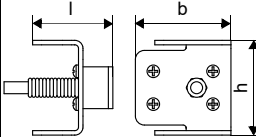
Technical data

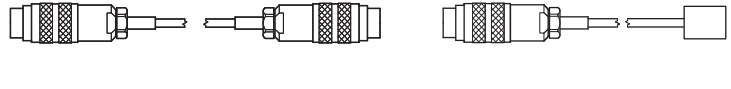
PT12N			
item number		• 670415-1 • 670414-1 (matched)	
design		clamp-on with connector	
type		Pt100	
connection		4-wire	
measuring range	°C	-30...+250	
accuracy T		±(0.15 °C + 2 · 10 ⁻³ · T [°C]) class A	
accuracy ΔT (2x Pt matched according to EN 1434-1)		≤ 0.1 K (3 K < ΔT < 6 K), more corresponding to EN 1434-1	
response time	s	50 (t ₅₀ , T ₁ = 25 °C, T ₂ = 60 °C)	
housing material		aluminum	
degree of protection		IP54	
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	

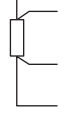
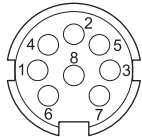
Connection system			
direct connection/connection with extension cable			
			

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

Cable			
	temperature probe	extension cable	
type		4 x 0.22 mm ² LIYCY 8 x 0.14 mm ²	
standard length	m	3	
max. length	m	-	
ambient temperature	°C	-30...+250	
min. bend radius	mm	27	
cable jacket			
material		PFA	PVC
outer diameter	mm	3.8 ±0.15	4.8 ±2
colour		black	grey

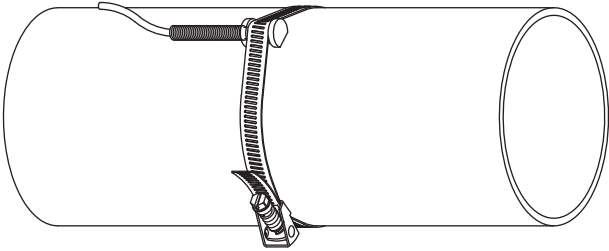
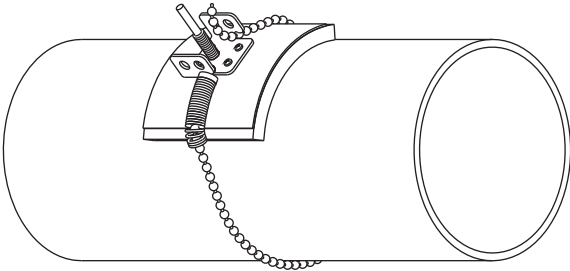
PT12F			
item number		• 670415-2 • 670414-2 (matched)	
design		clamp-on short response time, with connector	
type		Pt100	
connection		4-wire	
measuring range	°C	-50...+250	
accuracy T		±(0.15 °C + 2 · 10 ⁻³ · T [°C]) class A	
accuracy ΔT (2x Pt matched according to EN 1434-1)		≤ 0.1 K (3 K < ΔT < 6 K), more corresponding to EN 1434-1	
response time	s	8 (t ₅₀ , T ₁ = 25 °C, T ₂ = 60 °C)	
housing material		PEEK, stainless steel 304 (1.4301), copper	
degree of protection		IP54	
dimensions			
length l	mm	14	
width b	mm	30	
height h	mm	27	
dimensional drawing			
weight	kg	0.32 (without connector)	
accessories			
thermal conductivity paste 200 °C		x	
thermal conductivity foil 250 °C		x	
plastic protection plate, insulation foam		x	

Connection system			
direct connection/connection with extension cable			
			

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

Cable			
	temperature probe	extension cable	
type		4 x 0.22 mm ² LIYCY 8 x 0.14 mm ²	
standard length	m	3	
max. length	m	-	
ambient temperature	°C	-50...+250	
min. bend radius	mm	27	
cable jacket			
material		PFA	PVC
outer diameter	mm	3.8 ±0.15	4.8 ±2
colour		black	grey

Fixation

<div><div>tension strap PT12N</div><div></div></div>	<div><div>material: stainless steel 301 (1.4310), 410 (1.4006)</div><div>thermal insulation necessary</div></div>
<div><div>ball chain PT12F</div><div></div></div>	<div><div>material: stainless steel 316L (1.4404)</div><div>length: 1 m</div></div>

Wall thickness measurement (optional)

The pipe wall thickness is an important pipe parameter which has to be determined exactly for a good measurement. However, the pipe wall thickness often is unknown.

The wall thickness probe can be connected to the transmitter instead of the flow transducers and the wall thickness measurement mode is activated automatically.

Acoustic coupling compound is applied to the wall thickness probe which then is placed firmly on the pipe. The wall thickness is displayed and can be stored directly in the transmitter.

Technical data

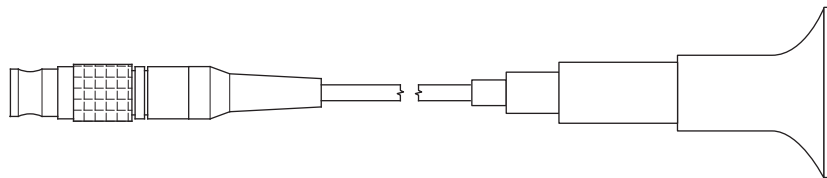
DWR1NZ7		
item number		600522-0
measuring range ¹	mm	1...250
resolution	mm	0.01
accuracy		1 % ±0.1 mm
fluid temperature	°C	-20...+200, short-time peak max. 500
explosion protection		-
cable		
type		2616
length	m	1.5

¹ The measuring range depends on the attenuation of the ultrasonic signal in the pipe. For strongly attenuating plastics (e.g. PFA, PTFE, PP) the measuring range is smaller.

Cable

2616		
ambient temperature	°C	<200
cable jacket		
material		FEP
outer diameter	mm	5.1
colour		black
shield		x

DWR1NZ7



FLEXIM GmbH
Boxberger Str. 4
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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Errors excepted.

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