Portable Ultrasonic Flow Measurement of Liquids

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

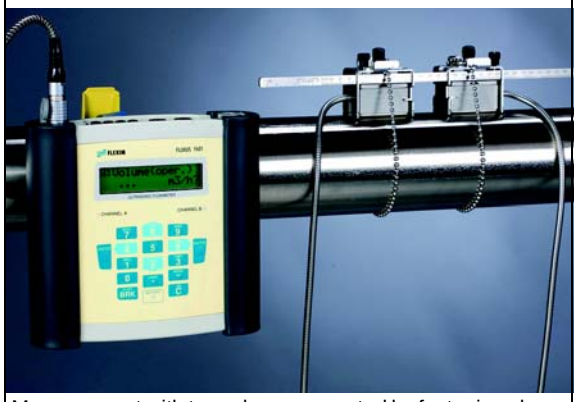
Features

- Non-invasive measurement using a clamp-on method for precise bi-directional, highly dynamic flow measurement
- New portable, easy-to-use flowmeter with 2 flow measurement channels, multiple inputs/outputs, an integrated data logger and a serial interface in the standard version
- Automatic loading of calibration data and transducer detection, reduces set-up times and provides precise, long-term stable results
- Li-Ion battery for 14 hours of measurement operation
- Proven clamp-on method; transducers are available for a wide range of rated diameters from DN 6 to DN 6500 and temperatures from -40...+400 °C; resistant to dust and humidity
- Integrated wall thickness measurement
- Water and dust-tight; resistant against oil, many liquids and dirt
- Robust, water-tight (IP 67) transport case with comprehensive accessories
- HybridTrek: automatic changeover between transit time difference method and NoiseTrek for media with a high proportion of solids or gases
- QuickFix for fast mounting of the flowmeter in difficult conditions

Applications

- Designed for industrial use, in particular for application in
  - chemical industry
  - water and sewage systems
  - cooling systems and air conditioners
  - facility management
  - aviation industry

FLUXUS F601 supported by handle



Measurement with transducers mounted by fastening shoes and flowmeter fixed to the pipe by the QuickFix pipe mounting fixture

Measurement equipment in transport case

Measuring Principle

HybridTrek

The volume flow of the medium is measured by means of the transit time difference principle. If the gaseous or solid content of the medium increases occasionally during measurement, a measurement with this method will be no longer possible. Instead NoiseTrek will be selected, a method achieving a stable measurement even with a high gaseous or solid content.

The flowmeter switches automatically between transit time difference principle and NoiseTrek during measurement, the measurement setup does not need to be changed.

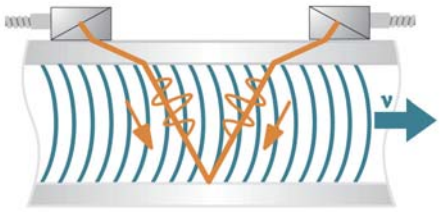
Transit Time Difference Principle

For the flow measurement of the medium, ultrasonic signals are used, employing the transit time difference principle. Ultrasonic signals are emitted by a transducer installed on one side of a pipe, reflected on the opposite side and received by a second transducer. These signals are emitted alternatively in flow direction and against it.

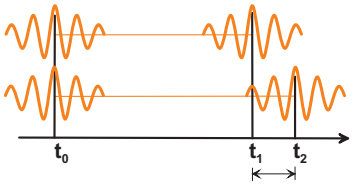
As the medium in which the signals propagate is flowing, the transit time of the ultrasonic signals in flow direction is shorter than against the flow direction.

The transit time difference Δt is measured and allows to determine the average flow velocity on the propagation path of the ultrasonic signals. A flow profile correction is then performed in order to obtain the area average of the flow velocity, which is proportional to the volume flow.

The received ultrasonic signals will be checked for their usefulness for the measurement and the plausibility of the measured values will be evaluated. The complete measuring cycle is controlled by the integrated microprocessors. Disturbance signals will be eliminated.



Path of the ultrasonic signal



Transit time difference Δt

Calculation of the Flow Velocity

$v = k_\alpha \cdot \Delta t/(2 \cdot t_t)$

with:

v - flow velocity
k_α - flowmeter constant
Δt - transit time difference
t_t - transit time of the medium

Number of Sound Paths

The number of sound paths is the number of transits of the ultrasonic signals through the medium in the pipe.

reflection mode: number of sound paths = even, the transducers are mounted on the same side of the pipe, correct positioning of the transducers easier

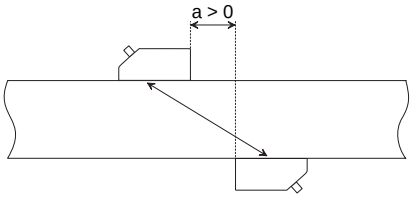
diagonal mode: number of sound paths = odd, the transducers are mounted on opposite sides of the pipe

The mode to be used depends on the application. If the number of sound paths is increased, the accuracy of the measurement will be better, but the signal attenuation is increased.

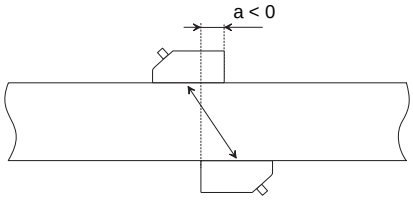
In case of a high signal attenuation by medium, pipe and coatings, diagonal mode with 1 sound path will be used.

The optimum number of sound paths for the parameters of the application will be detemined automatically by the flowmeter

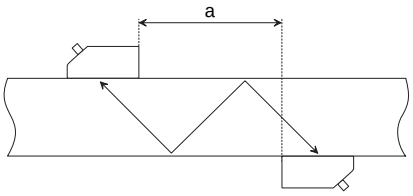
As the transducers can be mounted with the supplied transducer mounting fixture in reflection mode or diagonal mode the number of sound paths can be adjusted optimally to the application.



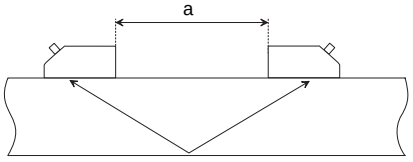
Diagonal mode, 1 sound path



Diagonal mode, 1 sound path, negative transducer distance



Diagonal mode, 3 sound paths



Reflex mode, 2 sound paths

a - transducer distance

Flowmeter

Technical Data

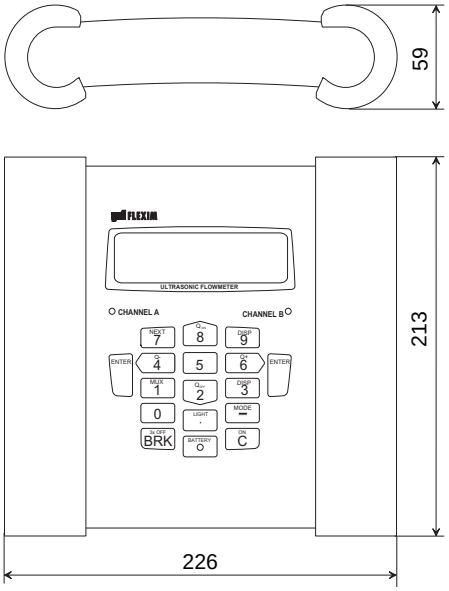
FLUXUS	F601
design	portable
	
measurement	
measuring principle	transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content
flow velocity	0.01...25 m/s
repeatability	0.15 % of reading ±0.01 m/s
accuracy[1]	
with standard calibration with extended calibration (option) with field calibration[2]	±1.6 % of reading ±0.01 m/s ±1.2 % of reading ±0.01 m/s ±0.5 % of reading ±0.01 m/s
medium	all acoustically conductive liquids with < 10 % gaseous or solid content in volume (transit time difference principle)
flowmeter	
power supply	100...230 V/50...60 Hz (power supply), 10.5...15 V DC (socket at flowmeter) or battery
battery	Li-Ion, 7.2 V/4.5 Ah operating time (without outputs, inputs and backlight): > 14 h
power consumption	< 6 W
number of flow measuring channels	2
signal damping	0...100 s, adjustable
measuring cycle (1 channel)	100...1000 Hz
response time	1 s (1 channel), option: 70 ms
material	polyamid
degree of protection according to EN 60529	IP 65
weight	1.9 kg
fixation	QuickFix pipe mounting fixture
operating temperature	-10...+60 °C
display	2 x 16 characters, dot matrix, backlit
menu language	English, German, French, Dutch, Spanish
measuring functions	
physical quantities	volume flow, mass flow, flow velocity, heat flow (if temperature inputs are installed)
totalizers	volume, mass, option: heat quantity
calculation functions	average, difference, sum
data logger	
loggable values	all physical quantities and totalized values
capacity	> 100 000 measured values

[1] for transit time difference principle, reference conditions and v > 0.15 m/s
[2] reference uncertainty < 0.2 %

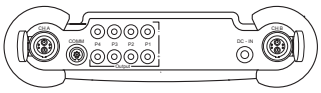
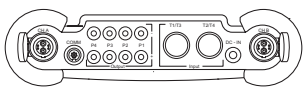
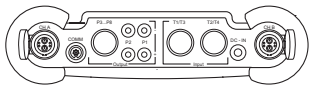
FLUXUS	F601
communication	
interface	RS232/USB
serial data kit	
software (all Windows™ versions)	- FluxData: download of measured data, graphical presentation, conversion to other formats (e.g. for Excel™) - FluxKoeff: creating medium data sets
cable	RS232
adapter	RS232 - USB
outputs	
	The outputs are galvanically isolated from the flowmeter.
number	see standard scopes of supply on page 6, max. on request
accessories	output adapter (if number of outputs > 4)
	current output
range	0/4...20 mA
accuracy	0.1 % of reading ±15 µA
active output	R_{ext} < 200 Ω
passive output	U_{ext} = 4...16 V, dependent on R_{ext} R_{ext} < 500 Ω
	frequency output
range	0...10 kHz
open collector	24 V/4 mA
	binary output
optorelay	32 V/100 mA
binary output as alarm output	
- functions	limit, change of flow direction or error
binary output as pulse output	
- pulse value	0.01...1000 units
- pulse width	1...1000 ms
inputs	
	The inputs are galvanically isolated from the flowmeter.
number	see standard scopes of supply on page 6, max. 4
accessories	input adapter (if number of inputs > 2)
	temperature input
designation	Pt100/Pt1000
connection	4-wire
range	-150...+560 °C
resolution	0.01 K
accuracy	±0.01 % of reading ±0.03 K
	current input
range	passive: -20...+20 mA
accuracy	0.1 % of reading ±10 µA
passive input	R_i = 50 Ω, P_i < 0.3 W
	voltage input
range	0...1 V
accuracy	0.1 % of reading ±1 mV
internal resistance	R_i = 1 MΩ

Dimensions (in mm)

FLUXUS F601



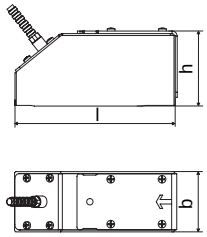
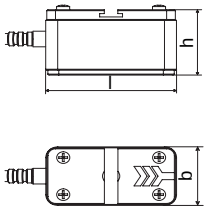
Standard Scopes of Supply

	F601 Standard	F601 Energy	F601 Multifunctional
passive current output	2	2	4
binary output	2	2	2
temperature input	-	2	2
passive current input	-	-	2
application	all flow measurements on liquids	including energy calculator for BTU and heat measurements	for sophisticated measuring tasks, e.g. modeling of pump curves
accessories	- transport case - power supply, power cable - battery - QuickFix pipe mounting fixture for flowmeter - serial data kit - fastening shoes and chains (transducer frequency M, Q) - measuring tape - user manual, Quick Start Guide	- transport case - power supply, power cable - battery - QuickFix pipe mounting fixture for flowmeter - serial data kit - fastening shoes and chains (transducer frequency M, Q) - measuring tape - user manual, Quick Start Guide	- transport case - power supply, power cable - battery - output adapter - input adapter - QuickFix pipe mounting fixture for flowmeter - serial data kit - fastening shoes and chains (transducer frequency M, Q) - measuring tape - user manual, Quick Start Guide
connector board at the upper side of the flowmeter			

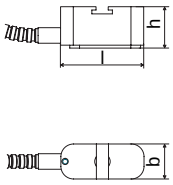
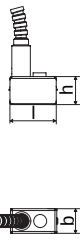
Example for the Equipment of a Transport Case

Transducers

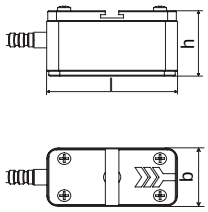
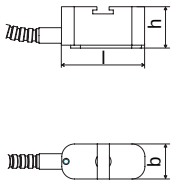
Shear Wave Transducers

technical type		CDG1NZ7	CDK1NZ7	CDM1NZ7
order code		**FSG-NNNNL**	**FSK-NNNNL**	**FSM-NNNNL**
transducer frequency	MHz	0.2	0.5	1
outer pipe diameter				
min. extended	mm	400	100	50
min. recommended	mm	500	200	100
max. recommended	mm	6500	3600	2500
max. extended	mm	6500	4500	3400
material				
housing		PEEK with stainless steel cap	PEEK with stainless steel cap	stainless steel
contact surface		PEEK	PEEK	PEEK
degree of protection according to EN 60529		IP 65	IP 65	IP 65 option: IP 68
dimensions				
length l	mm	129.5	126.5	60
width b	mm	47	47	30
height h	mm	66.4	55.9	33.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+130	+130	+130

Shear Wave Transducers

technical type		CDQ1NZ7	CDS1NZ7
order code		**FSQ-NNNNL**	**FSS-NNNNL**
transducer frequency	MHz	4	8
outer pipe diameter			
min. extended	mm	10	6
min. recommended	mm	25	10
max. recommended	mm	400	70
max. extended	mm	400	70
material			
housing		stainless steel	stainless steel
contact surface		PEEK	PEI
degree of protection according to EN 60529		IP 65	IP 65
dimensions			
length l	mm	42.5	25
width b	mm	18	13
height h	mm	21.5	17
dimensional drawing			
operating temperature			
min.	°C	-40	-30
max.	°C	+130	+130

Shear Wave Transducers (High Temperature)

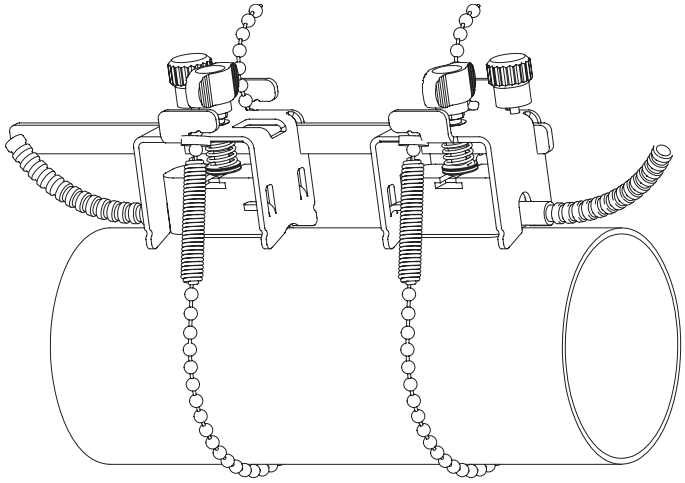
technical type		CDM1EZ7	CDQ1EZ7
order code		**FSM-ENNNL**	**FSQ-ENNNL**
transducer frequency	MHz	1	4
outer pipe diameter			
min. extended	mm	50	10
min. recommended	mm	100	25
max. recommended	mm	2500	400
max. extended	mm	3400	400
material			
housing		stainless steel	stainless steel
contact surface		Sintimid	Sintimid
degree of protection according to EN 60529		IP 65	IP 65
dimensions			
length l	mm	60	42.5
width b	mm	30	18
height h	mm	33.5	21.5
dimensional drawing			
operating temperature			
min.	°C	-30	-30
max.	°C	+200	+200

Order Code Key for Transducers

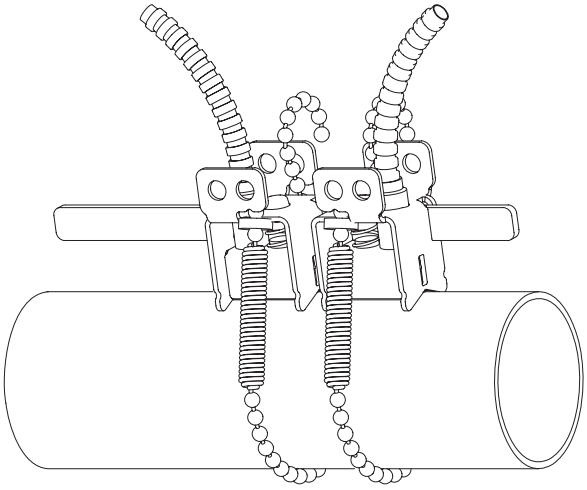
transducer model	frequency	-	temperature	explosion protection	connection system	-	extension cable	description
FS								set of ultrasonic flow transducers for liquids measurement, shear wave
	G							0.2 MHz
	K							0.5 MHz
	M							1 MHz (shear wave only)
	Q							4 MHz (shear wave only)
	S							8 MHz (shear wave only)
			N					normal temperature range
			E					extended temperature range (shear wave transducers with transducer frequency M, Q)
				NN				not explosion proof
					NL			with Lemo connector
							XXX	cable length in m, for max. length of extension cable see page 14
example								
FS	M	-	N	NN	NL	-	030	shear wave transducer 1 MHz, normal temperature range, connection system NL with 30 m extension cable and Lemo connector
		-				-		

Transducer Pipe Mounting Fixtures

Fastening Shoes and Chains

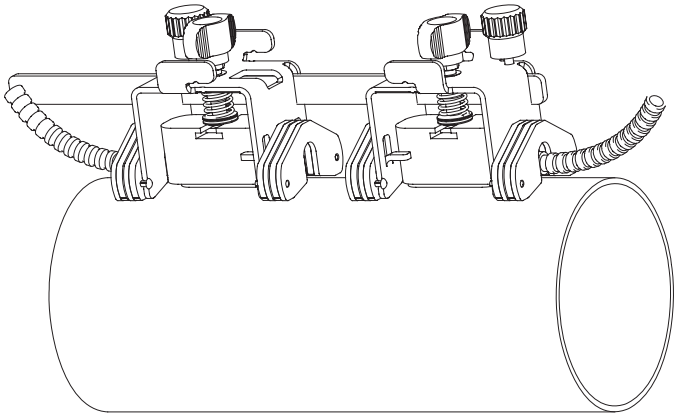


for transducer frequency M, Q

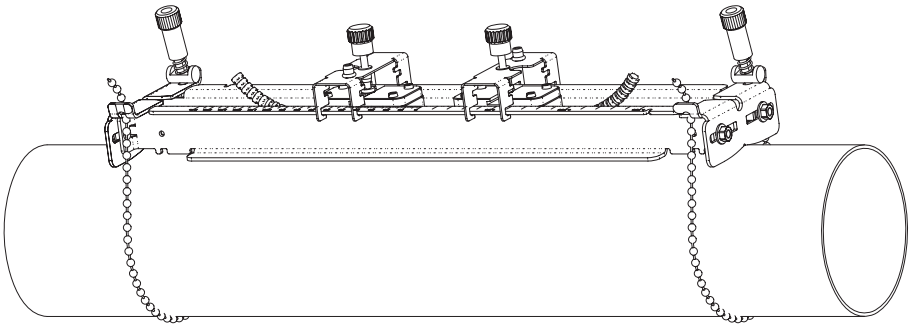


for transducer frequency S

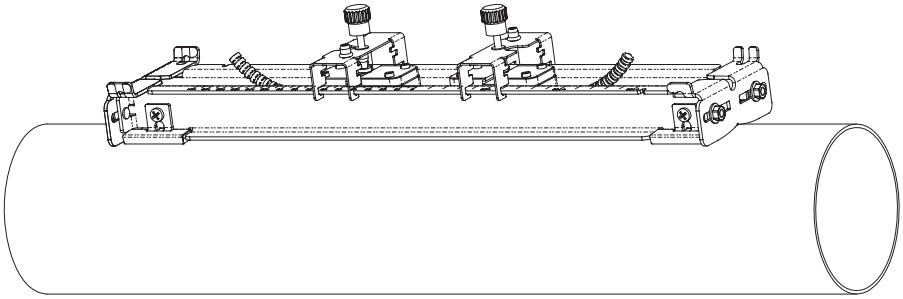
Fastening Shoes and Magnets (option)



Portable Variofix Mounting Fixture PVF and Chain



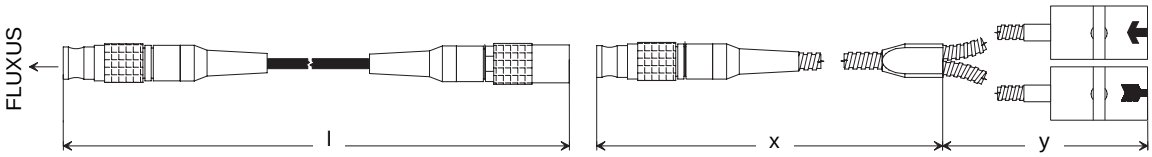
Portable Variofix Mounting Fixture PVF and Magnets (option)



Connection Systems

Connection System NL

transducer frequency		G, H, K			M, P			Q			S		
		x	y	l	x	y	l	x	y	l	x	y	l
cable length	m	2	3	≤ 100	2	2	≤ 100	2	1	≤ 50	1	1	≤ 20



x, y - transducer cable length

l - max. length of extension cable

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

9.7.2008 TSFLUXUS_F601V1-1EN