

Portable Ultrasonic Flow Measurement of Liquids

Features

Transducers

- non-invasive (no contact with the medium, no need for expensive materials)
- wearfree
- no pressure drop (no operational costs)
- low installation costs
- not sensitive to dust or humidity
- advantageous price for large pipe diameters and high pressure stages

Flowmeter

- portable flowmeter with rechargeable battery for service work
- wall thickness measurement (option)
- simple operation due to clearly structured user dialog

Measurement

- stable and reliable measuring results even under difficult conditions
- precise bi-directional flow measurement with high measurement dynamics
- long-term stable measurement results
- high measurement rate, fast response time



FLUXUS ADM 6725



Measurement equipment in transport case



Wall thickness measurement (option)

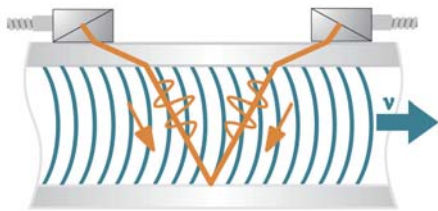
Measuring Principle

For the flow measurement of the medium, ultrasonic signals are used, employing the transit time method. 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.

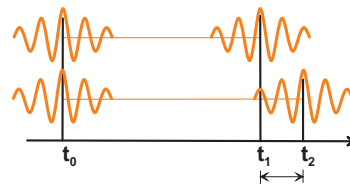
As the medium in which the signals propagate is flowing, the transit time of the ultrasonic signals in flow direction is shorter than against the flow direction.

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

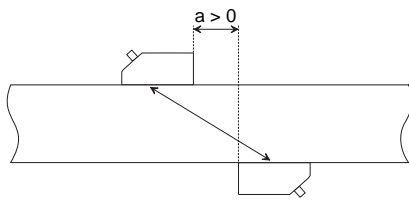
The number of sound paths is the number of transits of the ultrasonic signals through the medium in the pipe.

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

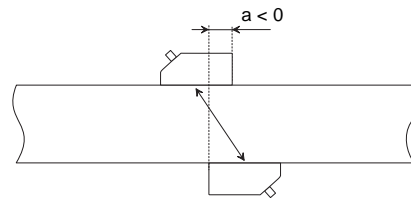
diagonal mode: number of sound paths = odd, the transducers are mounted on opposite sides of the pipe

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.

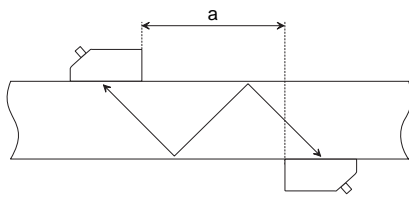
In case of a high signal attenuation by medium, pipe and coatings, diagonal mode with 1 sound path will be used.



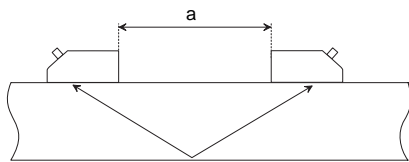
Diagonal mode, 1 sound path



Diagonal mode, 1 sound path, negative transducer distance



Diagonal mode, 3 sound paths




Reflex mode, 2 sound paths

a - transducer distance

Flowmeter

Technical Data

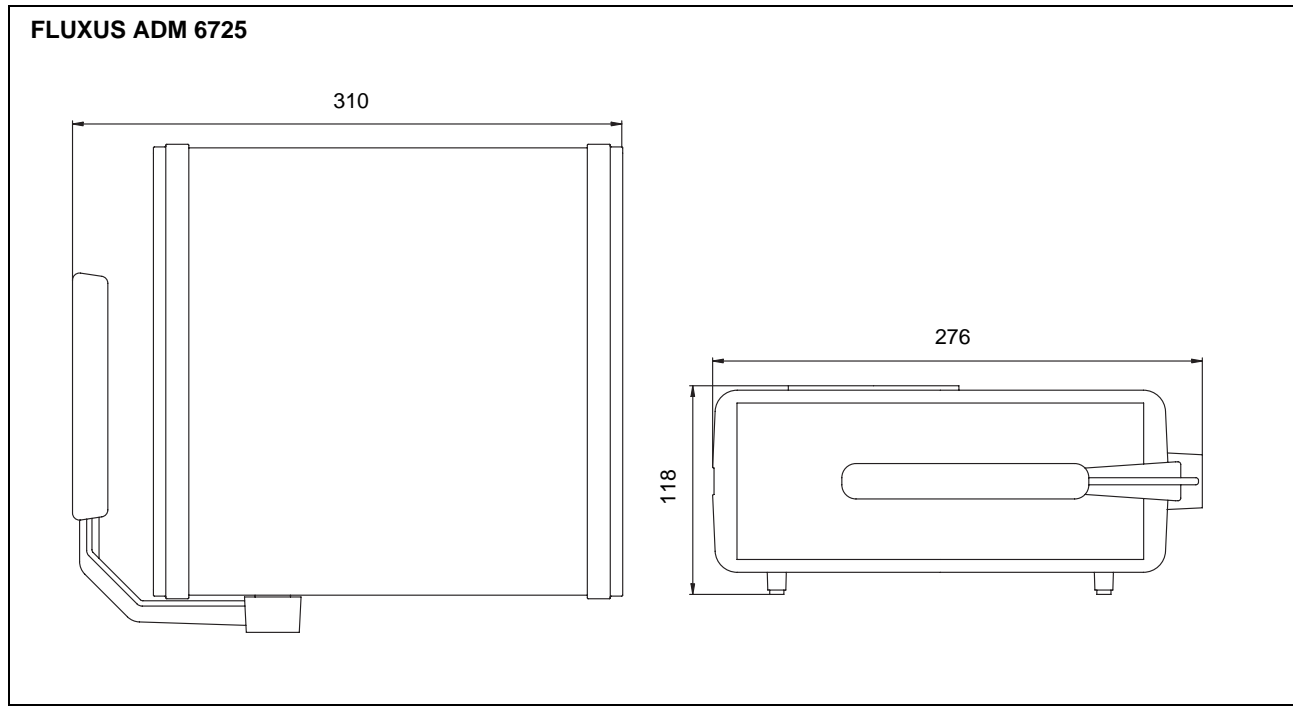
FLUXUS	ADM 6725
design	portable
	
measurement	
measuring principle	transit time difference correlation principle
flow velocity	0.01...25 m/s
repeatability	0.15 % of reading ± 0.01 m/s
accuracy ¹	
with standard calibration	± 1.6 % of reading ± 0.01 m/s
with extended calibration (option)	± 1.2 % of reading ± 0.01 m/s
with field calibration ²	± 0.5 % of reading ± 0.01 m/s
medium	all acoustically conductive liquids with < 10 % gaseous or solid content in volume
flowmeter	
power supply	100...230 V/50...60 Hz or battery
battery	6 V/4 Ah operating time (without outputs, inputs and backlight): > 10 h
power consumption	< 15 W
flow 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	aluminum, powder coated
degree of protection according to EN 60529	IP 54
dimensions	see dimensional drawing
weight	3.9 kg
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
calculation functions	average, difference, sum
data logger	
loggable values	all physical quantities and totalized values
capacity	> 100 000 measured values
communication	
interface	RS232
serial data kit (option)	
software (all Windows™ versions)	- FluxData: download of measured data, graphical presentation, conversion to other formats - FluxKoeff: creating medium data sets
cable	RS232
adapter	RS232 to USB

¹ under reference conditions and with $v > 0.15$ m/s

² reference uncertainty < 0.2 %

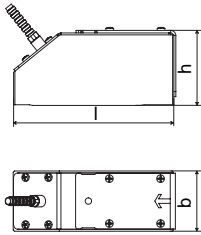
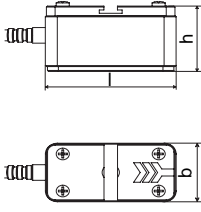
FLUXUS	ADM 6725
outputs (option)	
	The outputs are galvanically isolated from the main device.
number	on request
current output	
range	0/4...20 mA
accuracy	0.1 % of reading $\pm 15 \mu\text{A}$
active output	$R_{\text{ext}} < 500 \Omega$
passive output	$U_{\text{ext}} < 24 \text{ V}$, $R_{\text{ext}} < 1 \text{ k}\Omega$
voltage output	
range	0...1 V or 0...10 V
accuracy	0...1 V: 0.1 % of reading $\pm 1 \text{ mV}$ 0...10 V: 0.1 % of reading $\pm 10 \text{ mV}$
internal resistance	$R_i = 500 \Omega$
frequency output	
range	0...1 kHz or 0...10 kHz
open collector	24 V/4 mA
binary output	
Reed relay	48 V/0.25 A
open collector (OC)	24 V/4 mA
binary output as limit detector	
- function as state output	limit, sign change or error
binary output (OC) as pulse output	
- value	0.01...1000 units
- width	80...1000 ms
inputs (option)	
	The inputs are galvanically isolated from the main device.
number	max. 4, on request
temperature input	
designation	Pt100
design	4-wire
range	-50...+400 °C
resolution	0.1 K
accuracy	$\pm 0.1 \%$ of reading $\pm 0.2 \text{ K}$
current input	
accuracy	0.1 % of reading $\pm 10 \mu\text{A}$
range	active : 0...20 mA passive : -20...+20 mA
active input	$U_i = 15 \text{ V}$, $R_i = 50 \Omega$, $P_i < 0.5 \text{ W}$, not short circuit proof
passive input	$R_i = 50 \Omega$, $P_i < 0.3 \text{ W}$
voltage input	
range	0...1 V or 0...10 V
accuracy	0...1 V: 0.1 % of reading $\pm 1 \text{ mV}$ 0...10 V: 0.1 % of reading $\pm 10 \text{ mV}$
internal resistance	$R_i = 1 \text{ M}\Omega$

Dimensions (in mm)

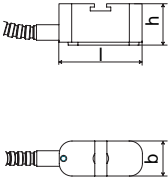
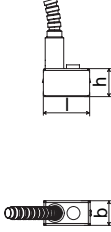


Transducers

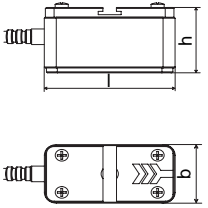
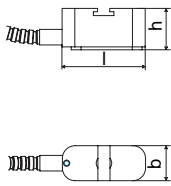
Shear Wave Transducers

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
pipe wall thickness				
min.	mm	-	-	-
max.	mm	-	-	-
material				
housing		PEEK with stainless steel	PEEK with stainless steel	stainless steel
contact surface		cap PEEK	cap 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
depth 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
explosion protection				
ATEX zone		-	-	-
marking		-	-	-
certification		-	-	-
type of protection		-	-	-
FM marking		-	-	-
type of protection		-	-	-

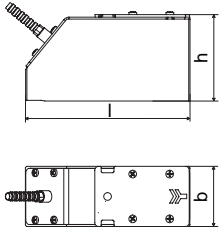
Shear Wave Transducers

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
pipe wall thickness			
min.	mm	-	-
max.	mm	-	-
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
depth b	mm	18	13
height h	mm	21.5	17
dimensional drawing			
operating temperature			
min.	°C	-30	-30
max.	°C	+130	+130
explosion protection			
ATEX zone marking		-	-
certification		-	-
type of protection		-	-
FM marking		-	-
type of protection		-	-

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
pipe wall thickness			
min.	mm	-	-
max.	mm	-	-
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
depth b	mm	30	18
height h	mm	33.5	21.5
dimensional drawing			
operating temperature			
min.	°C	-30	-30
max.	°C	+200	+200
explosion protection			
ATEX zone		-	-
marking		-	-
certification		-	-
type of protection		-	-
FM marking		-	-
type of protection		-	-

Lamb Wave Transducers

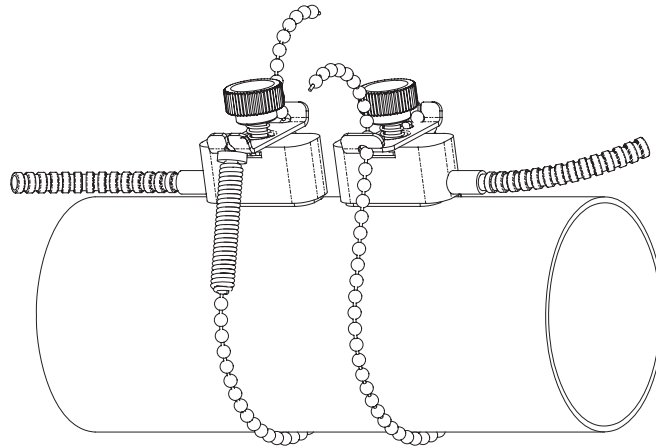
technical type		CRG1NC3	CRH1NC3	CRK1NC3
order code		FLG-NNNNL	FLH-NNNNL	FLK-NNNNL
transducer frequency	MHz	0.2	0.3	0.5
outer pipe diameter				
min. extended	mm	500	400	220
min. recommended	mm	600	450	250
max. recommended	mm	5000	3500	2100
max. extended	mm	6500	5000	4500
pipe wall thickness				
min.	mm	14	9	5
max.	mm	27	18	11
material				
housing		PPSU with stainless steel cap	PPSU with stainless steel cap	PPSU with stainless steel cap
contact surface		PPSU	PPSU	PPSU
degree of protection according to EN 60529		IP 65	IP 65	IP 65
dimensions				
length l	mm	128.5	128.5	128.5
depth b	mm	47	47	47
height h	mm	69.9	69.9	69.9
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+170	+170	+170
explosion protection				
ATEX zone		-	-	-
marking		-	-	-
certification		-	-	-
type of protection		-	-	-
FM marking		-	-	-
type of protection		-	-	-

Order Code Key for Transducers

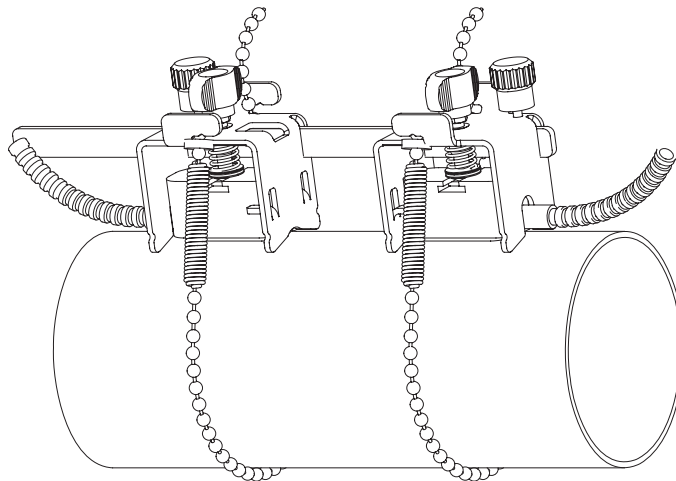
transducer model	frequency	-	temperature	explosion protection	connection system	-	extension cable	description
FL								set of ultrasonic flow transducers for liquids measurement, Lamb wave
FS								set of ultrasonic flow transducers for liquids measurement, shear wave
	G							0.2 MHz
	H							0.3 MHz (Lamb wave only)
	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 13
example								
FS	G	-	N	NN	NL	-	030	shear wave transducer 0.2 MHz, normal temperature range, connection system NL with 30 m extension cable and Lemo connector
		-				-		

Transducer Pipe Mounting Fixtures

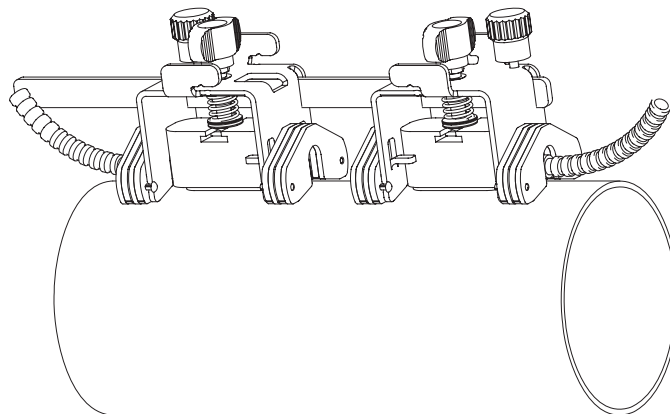
Chains



Fastening Shoes and Chains



Fastening Shoes and Magnets (option)



Connection Systems

Connection System NL

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

x, y - transducer cable length
 l - max. length of extension cable



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