Ultrasonic Flow Measurement of Liquids in Explosive Atmosphere

Features

Transducers

- non-invasive (no contact with the medium, no need for expensive materials)
- wearfree
- no pressure drop (no operational costs)
- low installation costs
- certified for ATEX zone 1
- not sensitive to dust or humidity
- advantageous price for large pipe diameters and high pressure stages

Flowmeter

- stationary installation
- flameproof housing with degree of protection IP 66
- FLUXUS ADM 8127 with stainless steel housing for offshore application (seawater proof and corrosion proof)
- operation with magnetic pen (housing closed), PC not required
- 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 8027

FLUXUS ADM 8127

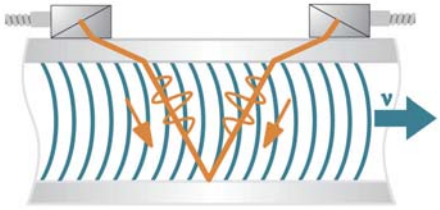
Measurement with explosion proof transducers

Measuring Principle

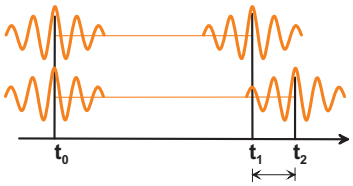
For the flow measurement of the medium, ultrasonic signals are used, employing the transit time method. Ultrasonic signals are emitted by a transducer installed on one side of a pipe, reflected on the opposite side and received by a second transducer. These signals are emitted alternatively in flow direction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

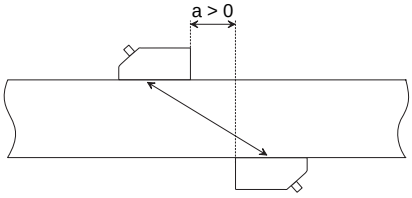
The number of sound paths is the number of transits of the ultrasonic signals through the medium in the pipe.

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

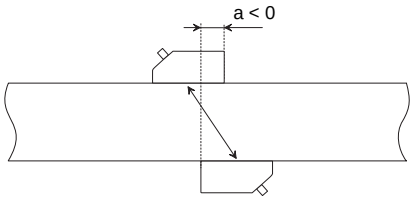
diagonal mode: number of sound paths = odd, the transducers are mounted on opposite sides of the pipe

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.

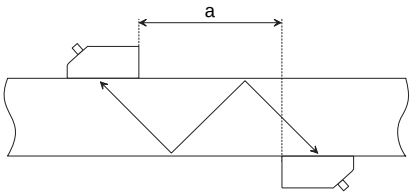
In case of a high signal attenuation by medium, pipe and coatings, diagonal mode with 1 sound path will be used.



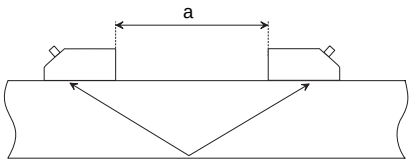
Diagonal mode, 1 sound path



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 8027	ADM 8127
design	explosion proof field device	explosion proof offshore device
		
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 20...32 V DC or on request : 11...16 V DC	
power consumption	< 15 W	
flow channels	1, option: 2	
signal damping	0...100 s, adjustable	
measuring cycle (1 channel)	100...1000 Hz	
response time	1 s (1 channel), option: 70 ms	
material	cast aluminum	stainless steel 316Ti (1.4571)
degree of protection according to EN 60529	IP 66	
dimensions	see dimensional drawing	
weight	6 kg	8.5 kg
installation	wall mounting, 2 " pipe mounting	
operating temperature	-20...+60 °C	-20...+50 °C
display	2 x 16 characters, dot matrix, backlit	
menu language	English, German, French, Dutch, Spanish	
explosion protection		
ATEX zone	1	1
marking	**ADM 8027-***: CE 0044; Ex II 2G Ex de IIC T6 T_a -20...+60 °C **ADM 8027L-***: CE 0044; Ex II 2G Ex de IIB T6 T_a -20...+60 °C **ADM 8027P-***: CE 0044; Ex II 2G Ex de IIC T4 T_a -20...+60 °C **ADM 8027LP-***: CE 0044; Ex II 2G Ex de IIB T4 T_a -20...+60 °C	CE 0044; Ex II 2G Ex de IIC T6 T_a -20...+50 °C
certification	IBExU01ATEX1064	IBExU05ATEX1078
type of protection	electronics enclosure: flameproof enclosure connection enclosure: increased safety	electronics enclosure: flameproof enclosure connection enclosure: increased safety

1 under reference conditions and with v > 0.15 m/s
2 reference uncertainty < 0.2 %

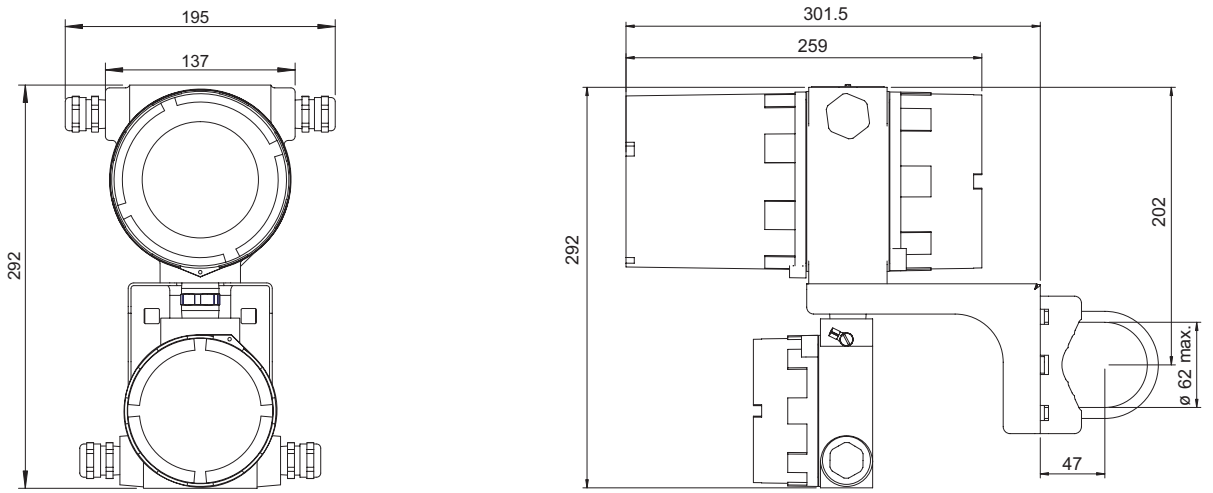
FLUXUS	ADM 8027	ADM 8127
measuring functions		
physical quantities	volume flow, mass flow, flow velocity	
totalizers	volume, mass	
calculation functions	average, difference, sum	

data logger	
loggable values	all physical quantities and totalized values
capacity	> 100 000 measured values
communication	
interface	- process connection: option: RS485 (Modbus, emitter) - diagnosis: RS232 [3]
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[3]
adapter	RS232 to USB[3]
outputs	
	The outputs are galvanically isolated from the main device.
	current output
number	1, option: additionally 1
range	0/4...20 mA
accuracy	0.1 % of reading ±15 µA
active output	R_{ext} < 500 Ω
	binary output
number	1 OC option: additionally 1 OC and max. 2 relay OR max. 3 OC
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	1...1000 ms

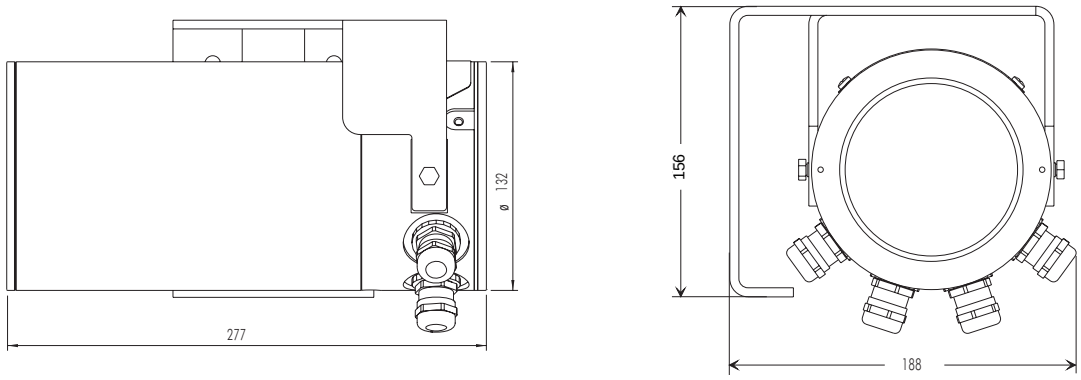
[3] connection of the interface RS232 outside of explosive atmosphere (housing cover open)

Dimensions and Mounting Dimensions (in mm)

FLUXUS ADM 8027



FLUXUS ADM 8127



Wall and 2 " Pipe Mounting Kit

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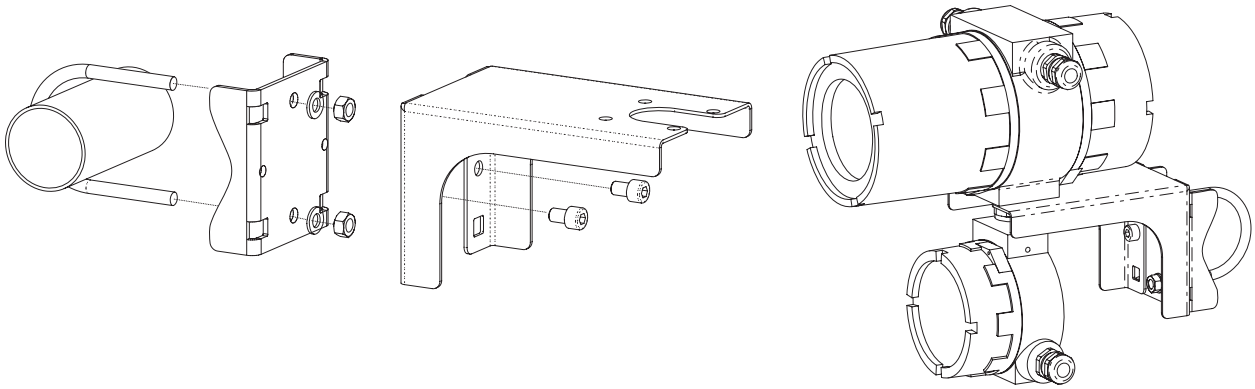
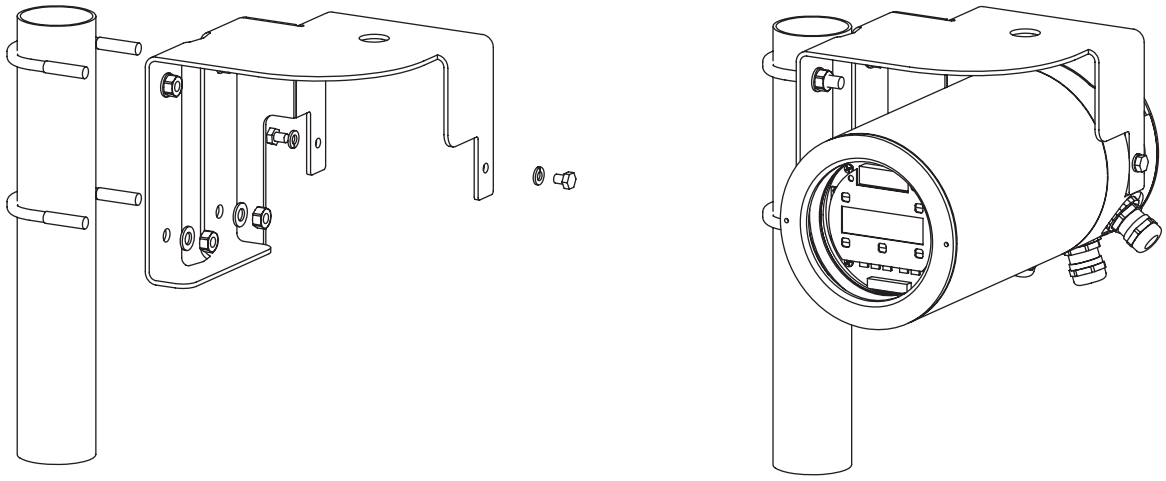
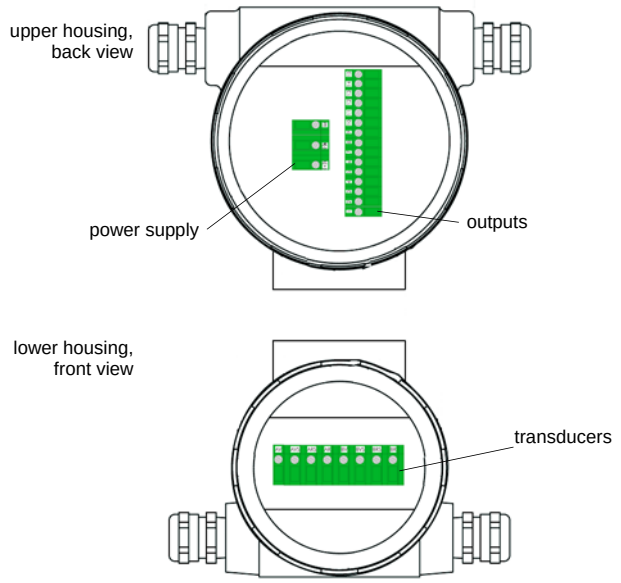


FLUXUS ADM 8127

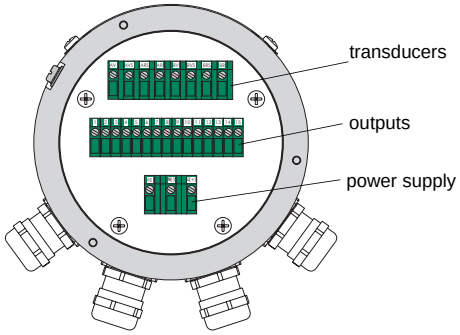


Terminal Assignment

FLUXUS ADM 8027



FLUXUS ADM 8127



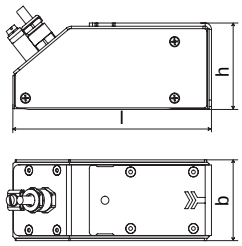
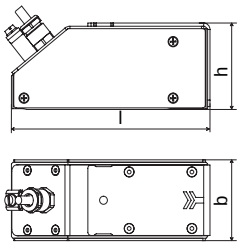
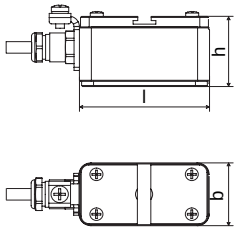
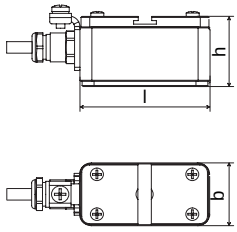
power supply (terminal strip KL1)			
AC		**DC**	
terminal	connection	terminal	connection
PE	earth		
N	neutral	L+	+
L1	phase	L-	-

transducers (terminal strip KL3)			
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

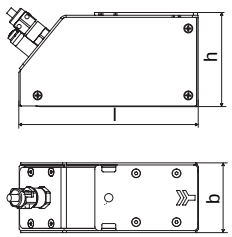
outputs (terminal strip KL2)	
terminal	connection
1(-), 2(+)	current output I1
3(-), 4(+)	current output I2 (option)
5(-), 6(+)	binary output B1 (open collector)
7(-), 8(+)	binary output B2 (open collector, option)
9(a), 10(b)	binary output B2 (Reed relay, option)
11(a), 12(b)	binary output B2 (Reed relay, option)
13(B-), 14(A+)	RS485 (option)

Transducers

Shear Wave Transducers (for ATEX zone 1)

technical type		CDG1N31	CDK1N31	CDM1N31	CDQ1N31
order code		**FSG-NA1TS**	**FSK-NA1TS**	**FSM-NA1TS**	**FSQ-NA1TS**
transducer frequency	MHz	0.2	0.5	1	4
outer pipe diameter					
min. extended	mm	400	100	50	10
min. recommended	mm	500	200	100	25
max. recommended	mm	6500	3600	2500	400
max. extended	mm	6500	4500	3400	400
pipe wall thickness					
min.	mm	-	-	-	-
max.	mm	-	-	-	-
material					
housing		PEEK with stainless steel cap	PEEK with stainless steel cap	stainless steel	stainless steel
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection according to EN 60529		IP 65	IP 65	IP 65	IP 65
dimensions					
length l	mm	129.5	126.5	60	60
depth b	mm	50	50	30	30
height h	mm	64	53.5	33.5	33.5
dimensional drawing					
operating temperature					
min.	°C	-40	-40	-20	-20
max.	°C	+130	+130	+120	+120
explosion protection					
ATEX zone		1	1	1	1
marking		CE 0044; Ex II 2G Ex q II T6...T3 Ta -40...+180 °C Ex II 2D Ex tD A21 IP65 TX	CE 0044; Ex II 2G Ex q II T6...T3 Ta -40...+180 °C Ex II 2D Ex tD A21 IP65 TX	CE 0044; Ex II 2G EEx m II T6...T4 Ta -20...+120 °C	CE 0044; Ex II 2G EEx m II T6...T4 Ta -20...+120 °C
certification		IBExU04ATEX1011 X	IBExU04ATEX1011 X	IBExU98ATEX1012 X	IBExU98ATEX1012 X
type of protection		powder filling	powder filling	encapsulation	encapsulation
FM marking		-	-	-	-
type of protection		-	-	-	-

Lamb Wave Transducers (for ATEX Zone 1)

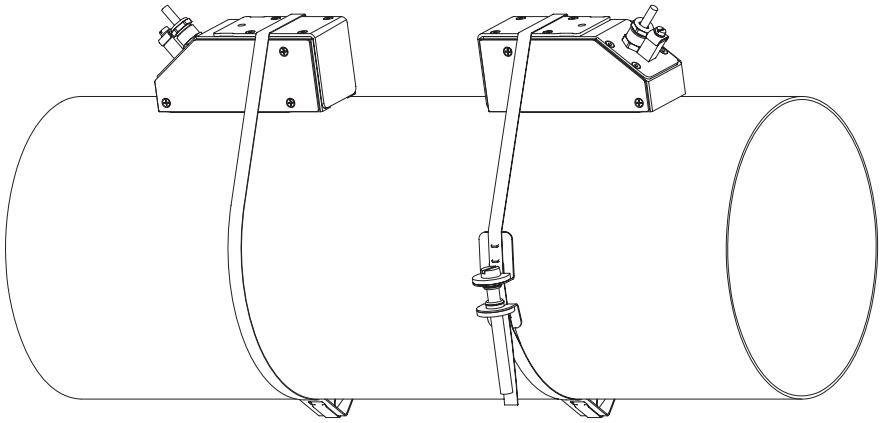
technical type		CRG1N33	CRH1N33	CRK1N33
order code		**FLG-NA1TS**	**FLH-NA1TS**	**FLK-NA1TS**
transducer frequency	MHz	0.2	0.3	0.5
outer pipe diameter				
min. extended	mm	500	400	220
min. recommended	mm	600	450	250
max. recommended	mm	5000	3500	2100
max. extended	mm	6500	5000	4500
pipe wall thickness				
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	50	50	50
height h	mm	67.5	67.5	67.5
dimensional drawing				
operating temperature				
min.	°C	-40	-40	-40
max.	°C	+140	+140	+140
explosion protection				
ATEX zone		1	1	1
marking		CE 0044; Ex II 2G Ex q II T6...T3 Ta -40...+140 °C Ex II 2D Ex tD A21 IP65 TX	CE 0044; Ex II 2G Ex q II T6...T3 Ta -40...+140 °C Ex II 2D Ex tD A21 IP65 TX	CE 0044; Ex II 2G Ex q II T6...T3 Ta -40...+140 °C Ex II 2D Ex tD A21 IP65 TX
certification		IBExU04ATEX1011 X	IBExU04ATEX1011 X	IBExU04ATEX1011 X
type of protection		powder filling	powder filling	powder filling
FM marking		-	-	-
type of protection		-	-	-

Order Code Key for Transducers

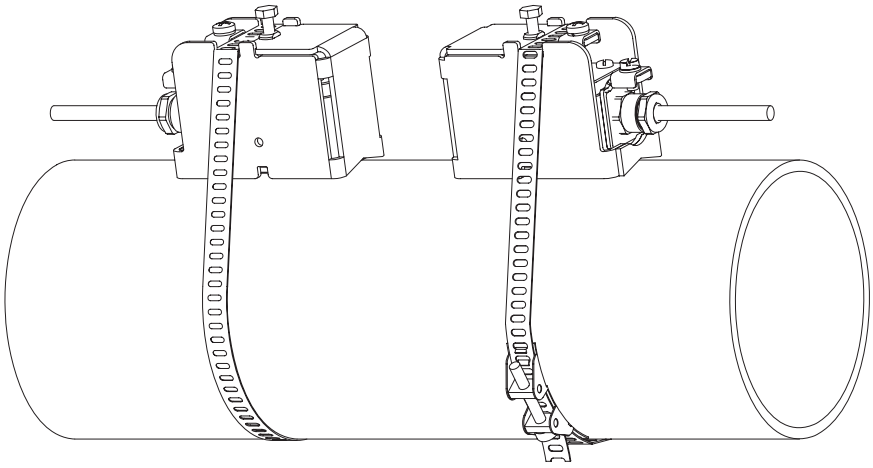
transducer model	frequency	-	temperature	explosion protection	connection system	-	extension cable	description
FL								set of ultrasonic flow transducers for liquids measurement, Lamb wave
FS								set of ultrasonic flow transducers for liquids measurement, shear wave
	G							0.2 MHz
	H							0.3 MHz (Lamb wave only)
	K							0.5 MHz
	M							1 MHz (shear wave only)
	Q							4 MHz (shear wave only)
			N					normal temperature range
				A1				ATEX zone 1 (with connection system TS)
					TS			direct connection or connection via junction box
							XXX	cable length in m, for max. length of extension cable see page 16 connection system TS: 0 m: without junction box > 0 m: with junction box JB01 (ATEX zone 1)
example								
FS	G	-	N	A1	TS	-	030	shear wave transducer 0.2 MHz, normal temperature range, for ATEX zone 1, connection system TS with junction box JB01 and 30 m extension cable
		-				-		

Transducer Pipe Mounting Fixtures

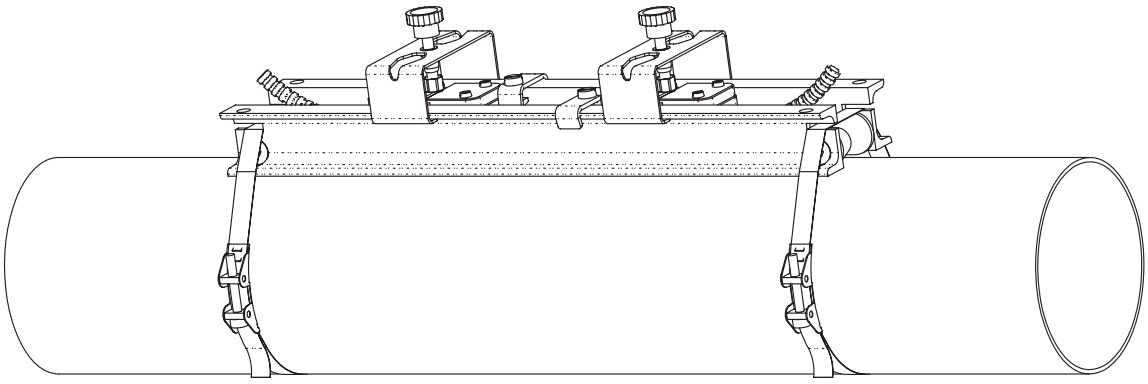
Tension Straps and Clasps



Tension Straps, Clasps and Mounting Shoes



Variofix Mounting Fixture VFX with Tension Straps and Clasps



Connection Systems

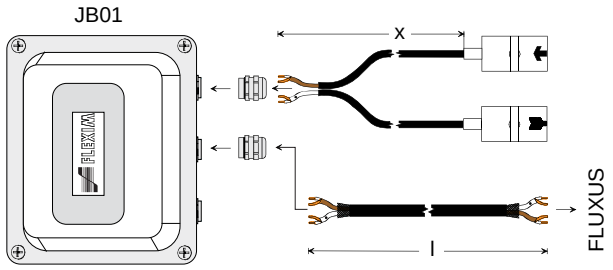
Connection System TS

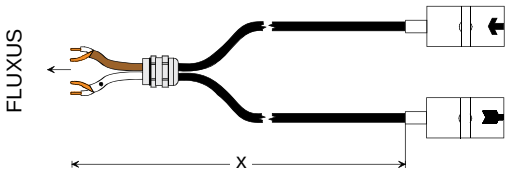
transducer frequency		G, H, K		M, P		Q		S	
		x	l	x	l	x	l	x	l
cable length	m	5	≤ 300	4	≤ 300	3	≤ 90	2	≤ 40

connection via junction box

direct connection

ATEX zone 1





x - transducer cable length

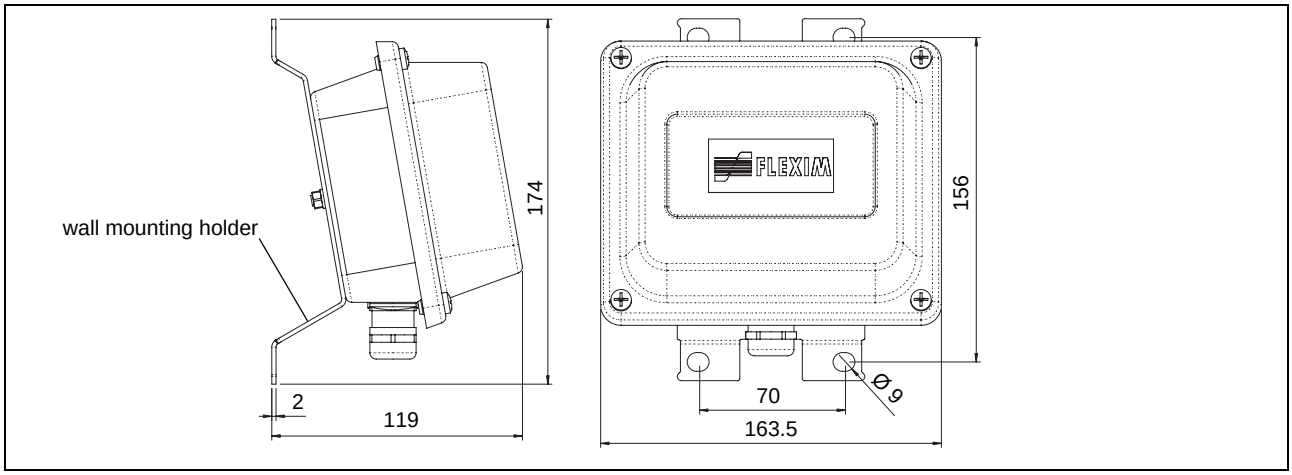
l - max. length of extension cable

Junction Box

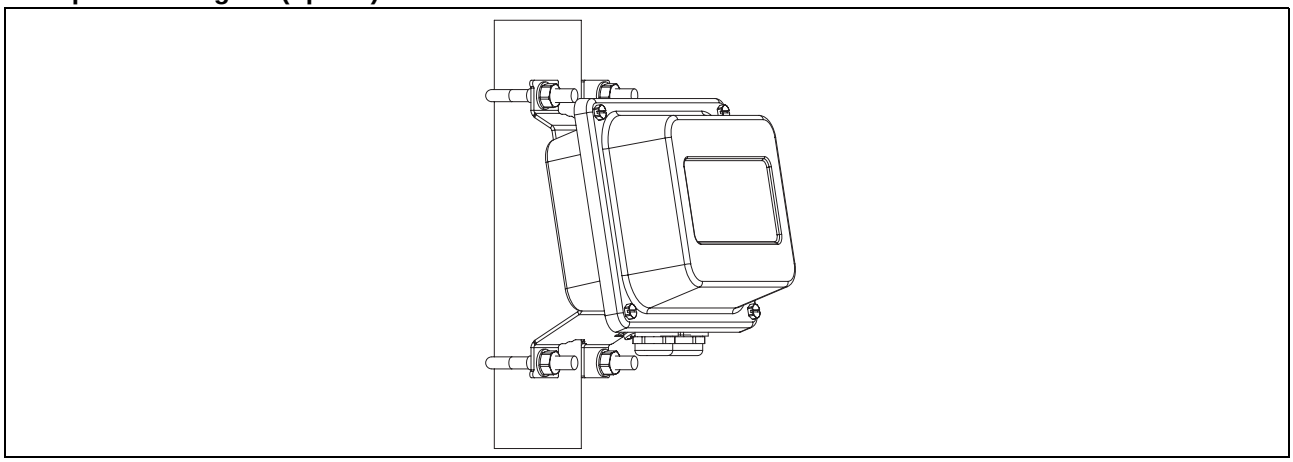
Technical Data

technical type		**JB01S4E3M**
dimensions		see dimensional drawing
installation		wall mounting option: 2 " pipe mounting
material		
housing		stainless steel 316L (1.4404)
gasket		silicone
degree of protection according to EN 60529		IP 67
operating temperature		
min.	°C	-40
max.	°C	+80
explosion protection		
ATEX zone		1
marking		CE 0044 Ex II2G Ex e mb II T6...T4 T_a -40...+80 °C
certification		IBExU06ATEX1161
type of protection		junction box: increased safety decoupled network: encapsulation

Dimensions



2 " Pipe Mounting Kit (option)



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