

### Steam ultrasonic flowmeter for permanent installation

Transmitter for permanent outdoor wall or pipe mounting

#### Features

- Exact and highly reliable measurement of saturated and superheated steam for temperatures up to max. 155 °C by means of the clamp-on principle
- Synchronized channel averaging to reduce turbulence-related fluctuations of the measured value
- Physical quantities volumetric flow rate and mass flow rate available in a transmitter without additional steam calculator
- Installation and start-up do not require any pipe work and are carried out without any process interruptions and cooling down of the steam system
- Non-invasive, wear-free and pressure constant measurement
- Maintenance-free acoustic coupling using permanent coupling foil
- High measurement accuracy even at very low as well and high flow rates and independent of the flow direction (bidirectional)
- Automatic loading of calibration data and transducer recognition
- Advanced self-diagnosis and possibilities for event-based triggering of data recording for the supervision and control of critical processes
- Transmitter and transducers for use in hazardous areas
- Transmitter and transducers are separately calibrated (traceable to national standards)
- The measurement is zero point stable and drift free

#### Applications

- Food and beverage industry
- Pharmaceutical industry
- Chemical industry
- Manufacturing industries



FLUXUS G831ST-LT



Variofix L

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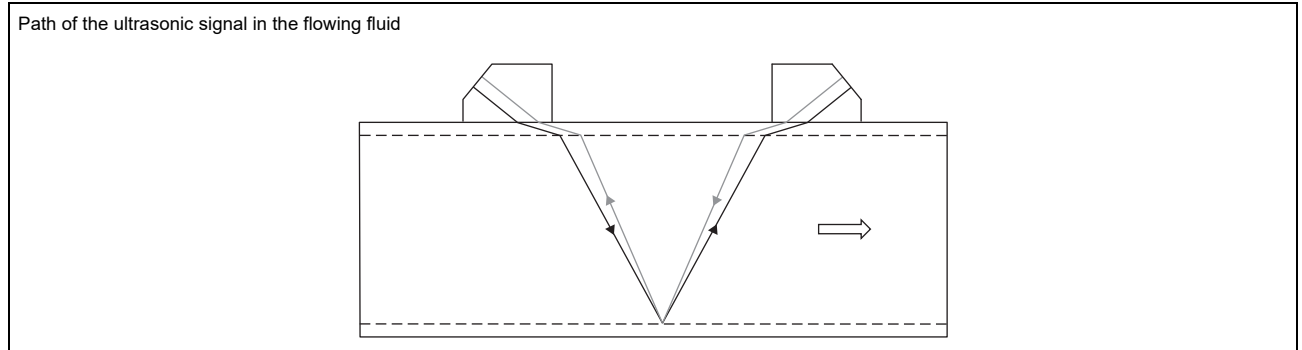
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## Function

### Measurement principle

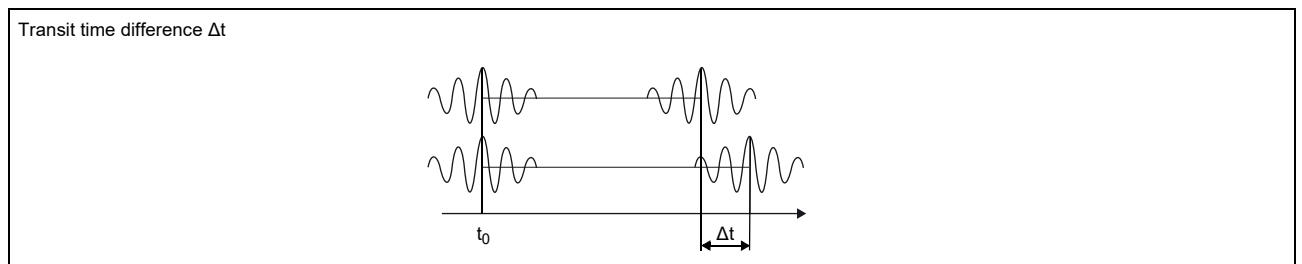
The transducers are mounted on the pipe which is completely filled with the fluid. The ultrasonic signals are emitted alternately by a transducer and received by the other. The physical quantities are determined from the transit times of the ultrasonic signals.



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  $\Delta t$  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.



### Calculation of volumetric flow rate

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

where

- $\dot{V}$  - volumetric flow rate
- $k_{Re}$  - fluid mechanics calibration factor
- $A$  - cross-sectional pipe area
- $k_a$  - acoustical calibration factor
- $\Delta t$  - transit time difference
- $t_{\gamma}$  - average of transit times in the fluid

### Calculation of mass flow rate

The mass flow rate is calculated from the operating density and the volumetric flow rate:

$$\dot{m} = \rho \cdot \dot{V}$$

The operating density of the fluid is calculated as the function of pressure and temperature of the fluid:

$$\rho = f(p, T)$$

where

- $\rho$  - operating density
- $p$  - fluid pressure
- $T$  - fluid temperature
- $\dot{m}$  - mass flow rate
- $\dot{V}$  - volumetric flow rate

### 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**

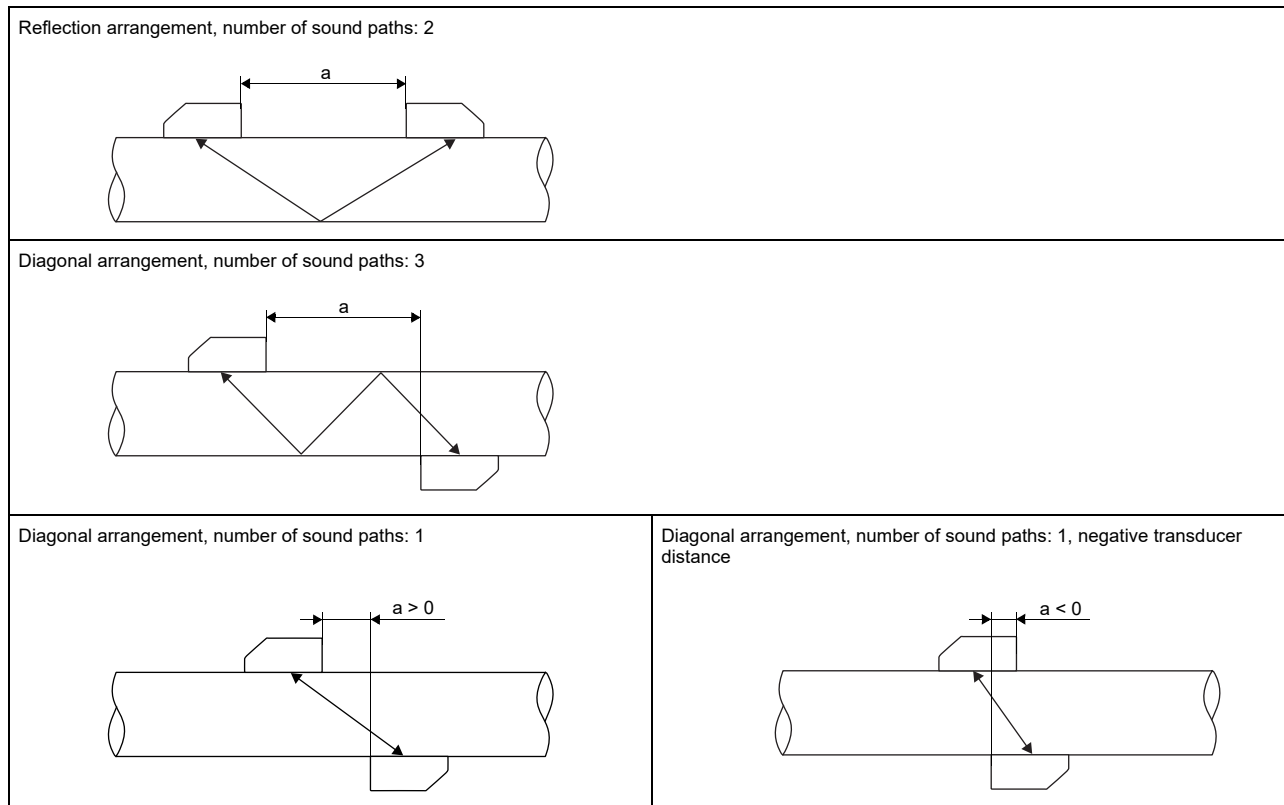
The number of sound paths is even. The transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easy.

• **diagonal arrangement**

The number of sound paths is odd. The transducers are mounted on opposite sides of the pipe. In the case of a high signal attenuation by the fluid, pipe and coatings, diagonal arrangement with 1 sound path will be used.

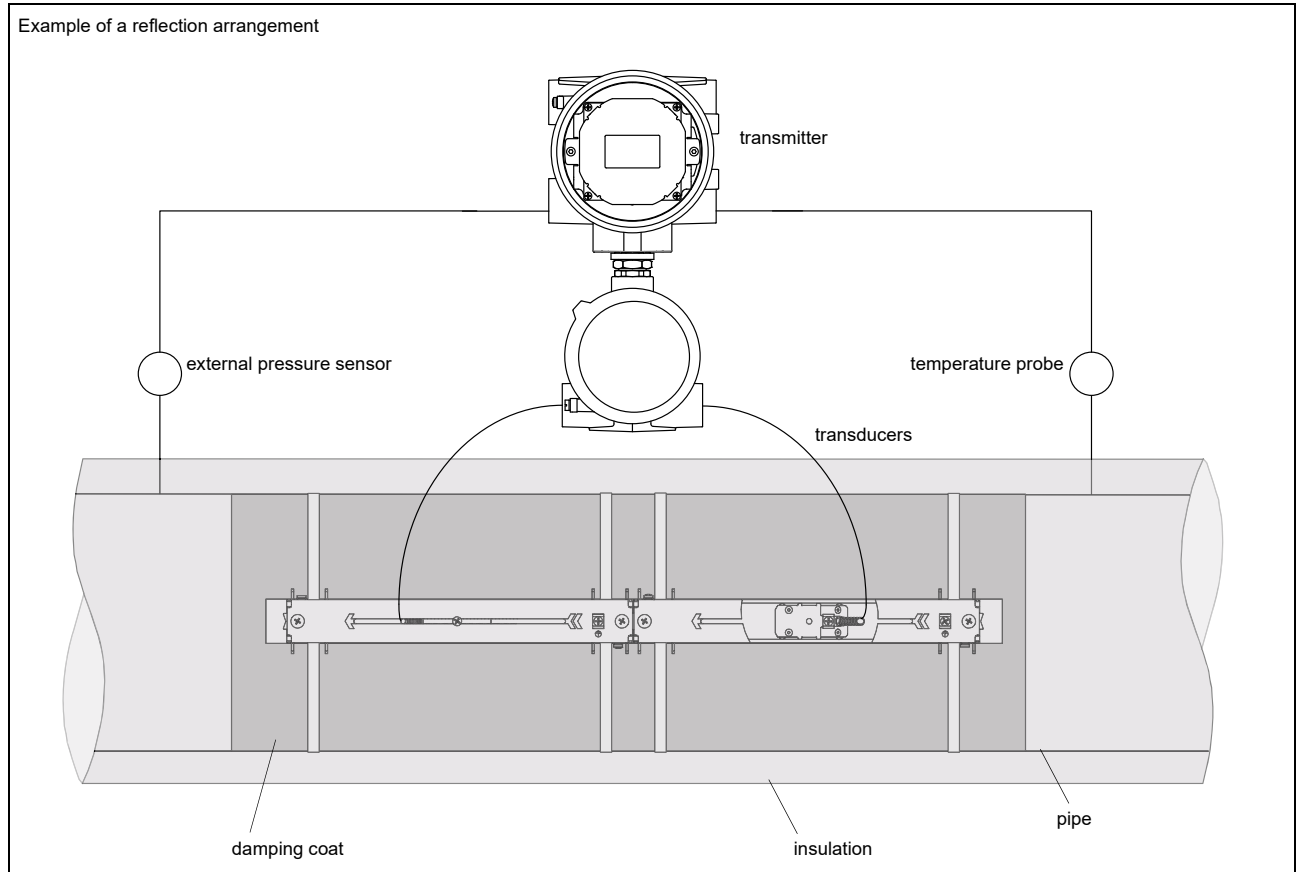
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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






a - transducer distance

### Typical measurement setup



# Transmitter

## Technical data

	FLUXUS G831ST-LT (831-AA1)	FLUXUS G831ST-LT (831-AA2)
		
design	explosion-proof field device zone 1 (intrinsic safety: HART)	explosion-proof field device zone 1 (intrinsic safety: inputs, HART)
application	steam measurement <sup>2</sup>	
<b>measurement</b>		
measurement principle	transit time difference correlation principle	
synchronised channel averaging	x (2 measuring channels necessary)	
flow velocity	m/s depending on pipe diameter and transducer, see diagrams	
repeatability	0.15 % MV ±0.005 m/s	
fluid	saturated steam, superheated steam	
fluid pressure	bar (a) 3...5.4	
fluid temperature	°C 135...155	
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5.1-2011	
<b>measurement uncertainty (volumetric flow rate)</b>		
measurement uncertainty of the measuring system <sup>1</sup>	±0.3 % MV ±0.005 m/s	
measurement uncertainty at the measuring point	±1...3 % MV ±0.005 m/s, depending on the application	
<b>transmitter</b>		
power supply	20...32 V DC, U <sub>m</sub> = 120 V	
power consumption	W < 4	
number of measuring channels	1, optional: 2	
damping	s 0...100 (adjustable)	
measuring cycle	Hz 100...1000 (1 channel)	
response time	s 1 (1 channel), option: 0.02	
housing material	cast aluminum, special heavy-duty coating	
degree of protection	IP66	
dimensions	mm see dimensional drawing	
weight	kg 6.5	
fixation	wall mounting, 2" pipe mounting	
ambient temperature	°C -40...+60 (< -20 without operation of the display)	
display	128 x 64 pixels, backlight	
menu language	English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian	
<b>explosion protection</b>		
<b>• ATEX/IECEX</b>		
marking	CE 0637  II 2G II 2D Ex db eb ia IIC T6 Gb Ex tb ia IIC T100 °C Db T <sub>a</sub> -40...+60 °C	CE 0637  II (1) 2G II (1) 2D Ex db eb ia [ia] IIC T6 Gb Ex tb ia [ia] IIC T100 °C Db T <sub>a</sub> -40...+60 °C
certification ATEX	IBExU20ATEX1103 X	IBExU20ATEX1103 X
certification IECEX	IECEX IBE 20.0015X	IECEX IBE 20.0015X
<b>measuring functions</b>		
physical quantities	operating volumetric flow rate, mass flow rate, flow velocity	
totaliser	volume, mass	
calculation functions	average, difference, sum (2 measuring channels necessary)	
diagnostic functions	sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times	
<b>communication interfaces</b>		
service interfaces	measured value transmission, parametrisation of the transmitter: USB	
process interfaces	HART (intrinsic safety, optional)	
<b>accessories</b>		
data transmission kit	USB cable	
software	<ul style="list-style-type: none"> <li>FluxDiagReader: reading of measured values and parameters, graphical presentation</li> <li>FluxDiag (optional): reading of measurement data, graphical presentation, report generation, parametrisation of the transmitter</li> </ul>	
<b>data logger</b>		
loggable values	all physical quantities, totalised physical quantities and diagnostic values	
capacity	max. 800 000 measured values	

<sup>1</sup> with aperture calibration of the transducers

<sup>2</sup> test measurement to validate the application required in advance

<sup>3</sup> outside the explosive atmosphere (housing cover open)

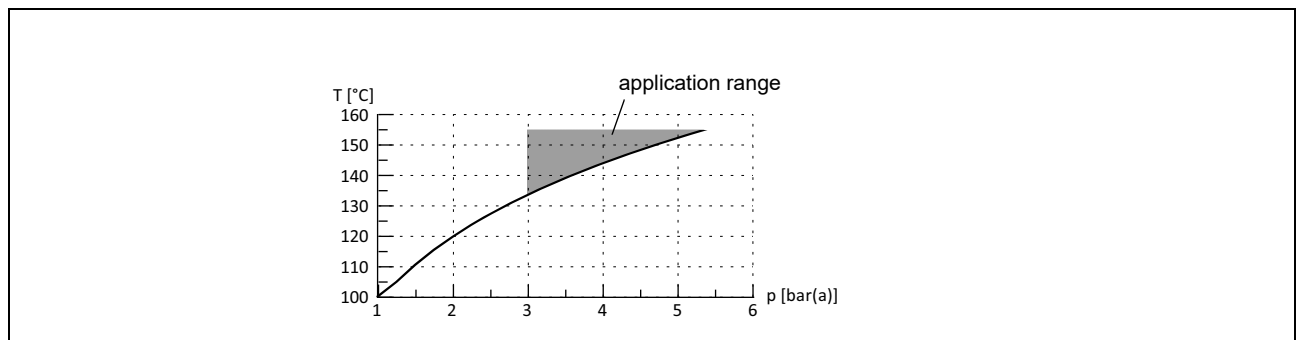
		FLUXUS G831ST-LT (831-AA1)	FLUXUS G831ST-LT (831-AA2)
<b>outputs</b>			
		The outputs are galvanically isolated from the transmitter.	
<b>• current output</b>			
number		1	
range	mA	4...20 (3.2...24)	
accuracy		0.04 % MV ±3 µA	
passive output		U <sub>ext</sub> ≤ 29 V DC, depending on R <sub>ext</sub> (R <sub>ext</sub> < 830 Ω at 29 V)	
current output in HART mode			
• range	mA	4...20 (3.5...22)	
• passive output		U <sub>ext</sub> = 9...29 V DC	
intrinsic safety parameters		U <sub>i</sub> = 29 V I <sub>i</sub> = 100 mA P <sub>i</sub> = 0.725 W C <sub>i</sub> = 1 nF L <sub>i</sub> = 50 nH	
<b>inputs</b>			
<b>• temperature input</b>			
number		-	max. 1
type		-	Pt100/Pt1000
connection		-	4-wire
range	°C	-	-150...+560
resolution	K	-	0.01
accuracy			
intrinsic safety parameters		-	U <sub>o</sub> = 9.2 V I <sub>o</sub> = 25 mA P <sub>o</sub> = 0.057 W C <sub>o</sub> = 4283 nF L <sub>o</sub> = 57 mH
<b>• current input</b>			
number		-	max. 1
accuracy		-	±0.1 % MV ±0.01 mA
active input		-	U <sub>int</sub> < 20 V, R <sub>int</sub> = 360 Ω
• range	mA	-	0...20
intrinsic safety parameters		-	U <sub>o</sub> = 29.2 V I <sub>o</sub> = 88 mA P <sub>o</sub> = 0.64 W C <sub>o</sub> = 73 nF L <sub>o</sub> = 4.1 mH

<sup>1</sup> with aperture calibration of the transducers

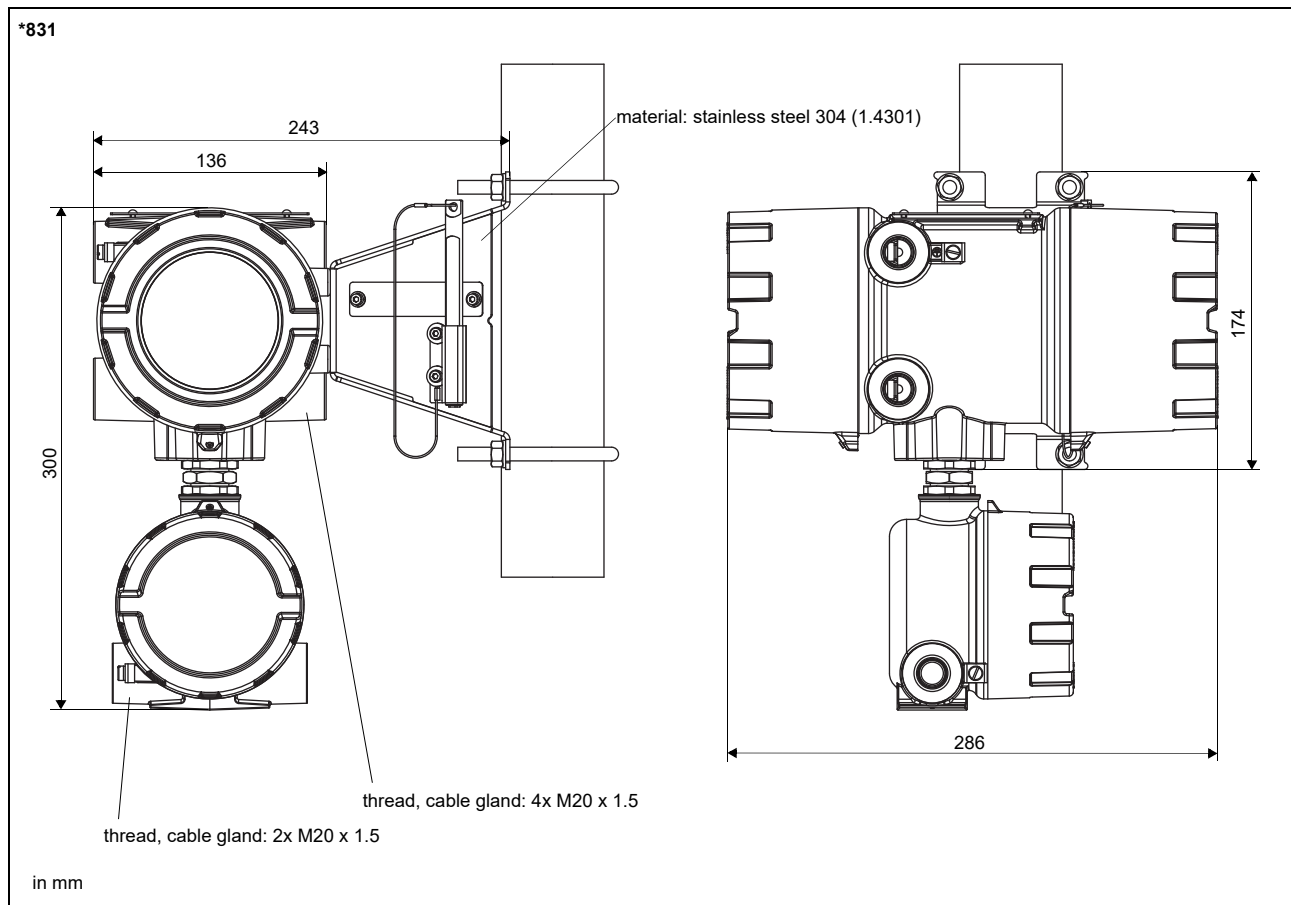
<sup>2</sup> test measurement to validate the application required in advance

<sup>3</sup> outside the explosive atmosphere (housing cover open)

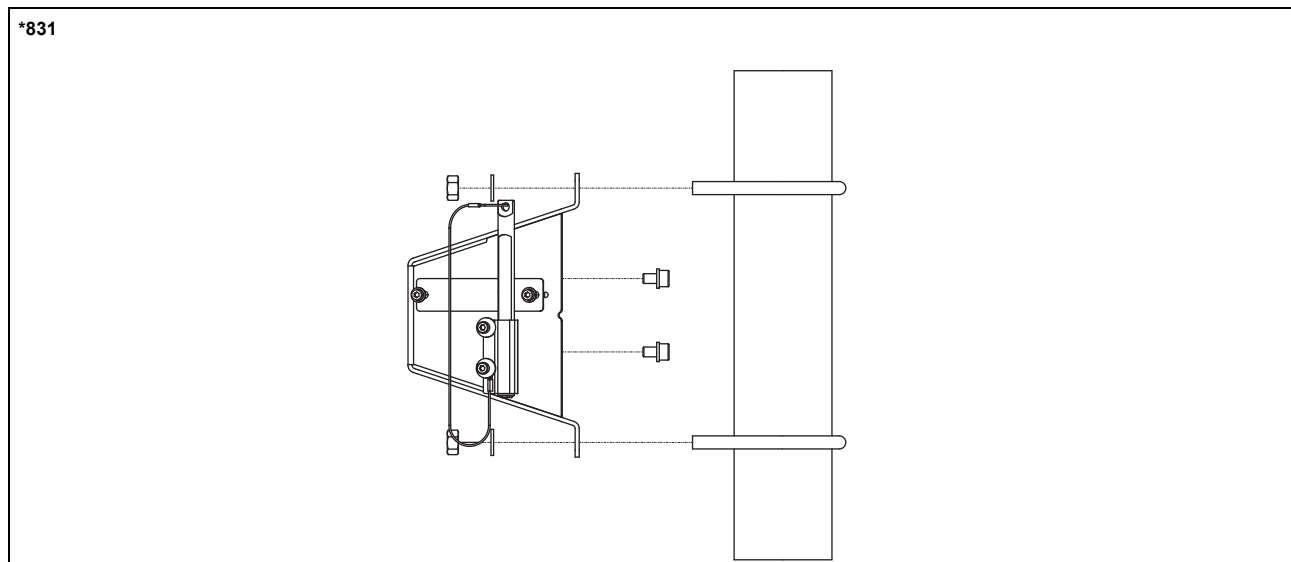
### Saturated steam pressure curve



### Dimensions



### 2" pipe mounting kit

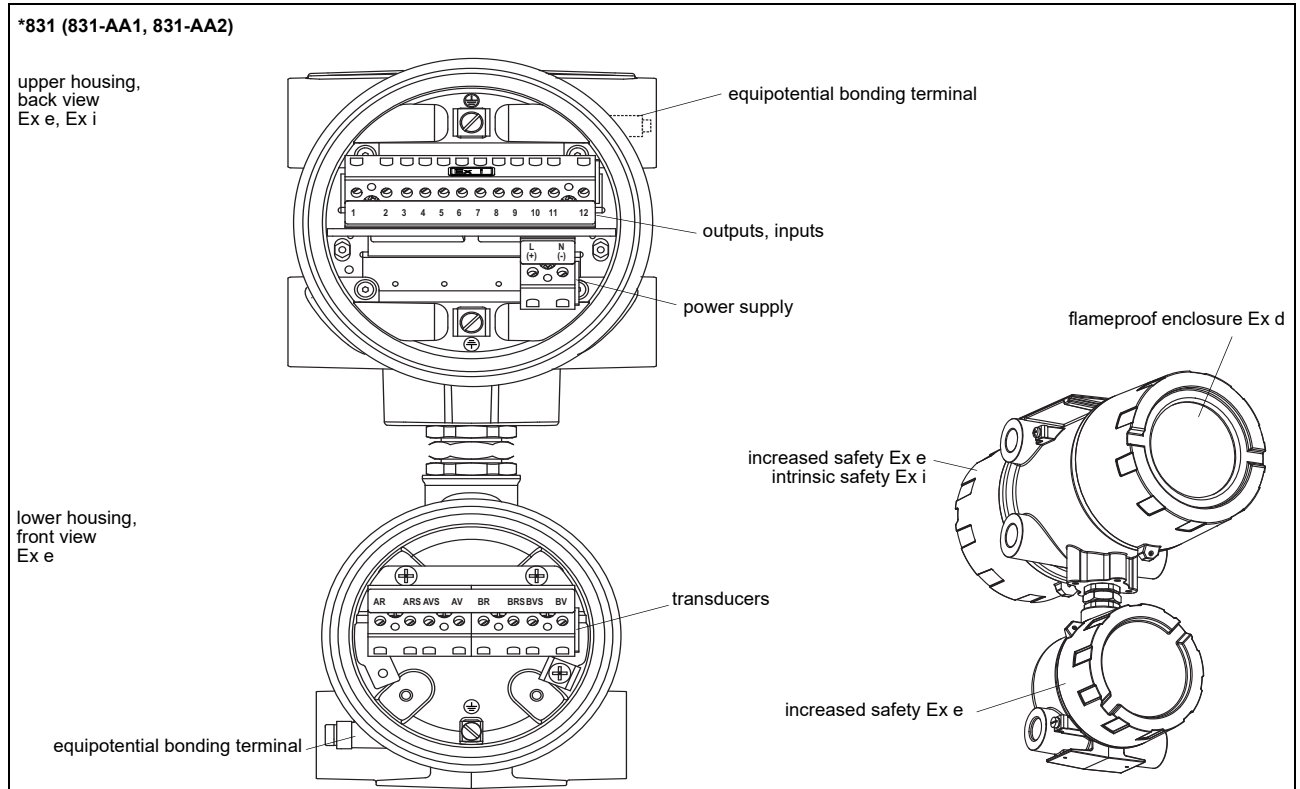


### Storage

- store within the original package
- keep all openings closed
- protect against sunlight
- store in a dry and dust-free place
- do not store outdoors
- storing temperature: -40...+60 °C



### Terminal assignment



power supply <sup>1</sup>				
<b>DC</b>				
<b>terminal</b>	<b>connection</b>			
(+)	+			
(-)	-			
transducers, extension cable				
measuring channel A		measuring channel B		transducer
terminal	connection	terminal	connection	
AV	signal	BV	signal	↑
AVS	internal shield	BVS	internal shield	↑
ARS	internal shield	BRS	internal shield	↑
AR	signal	BR	signal	↑
cable gland	external shield	cable gland	external shield	↑ ↑
outputs <sup>1, 2</sup>				
<b>terminal</b>	<b>connection</b>			
11+, 12-	current output, HART			
USB	type C Hi-Speed USB 2.0 Device	service (FluxDiag/FluxDiagReader)		
inputs <sup>2</sup>				
temperature probe				
<b>terminal</b>	<b>direct connection</b>	<b>connection with extension cable</b>		
3	red	red		
4	red/blue	blue		
5	white/blue	grey		
6	white	white		
current input <sup>1</sup>				
<b>terminal</b>	<b>connection</b>			
1	-			
2	+			

<sup>1</sup> cable (by customer): e.g. flexible wires, with insulated wire ferrules, wire cross-section: 0.25...2.5 mm<sup>2</sup>

<sup>2</sup> The number, type and terminal assignment are customised.

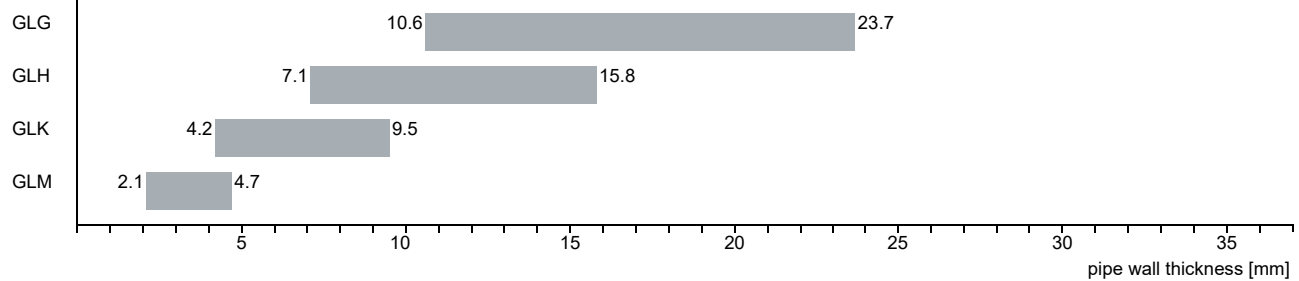
# Transducers

## Transducer selection

### Step 1

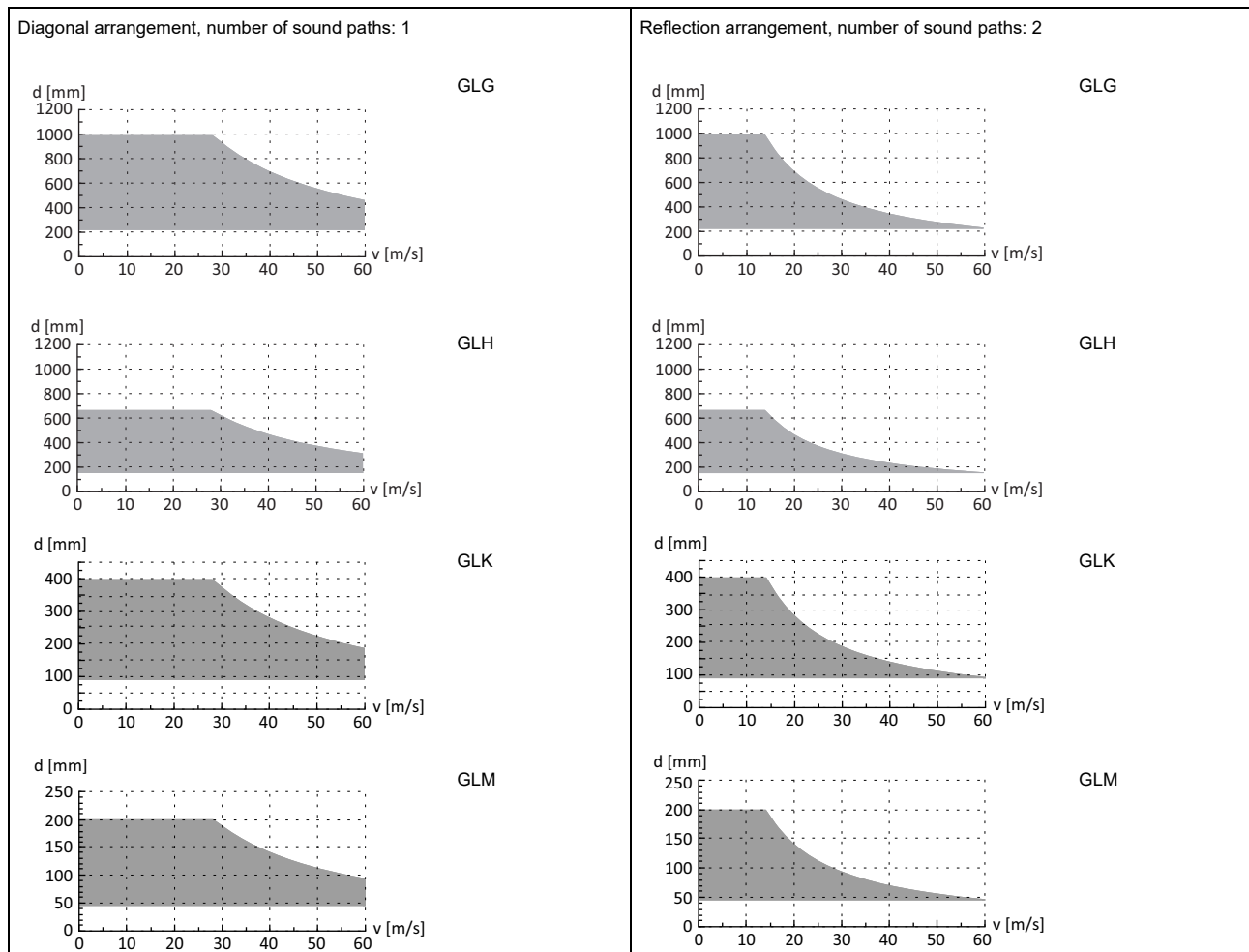
pipe wall thickness

transducer order code



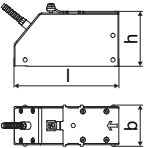
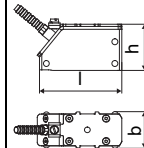
### Step 2

inner pipe diameter  $d$  dependent on the flow velocity  $v$  of the fluid in the pipe



inner pipe diameter and max. flow velocity for a steam application

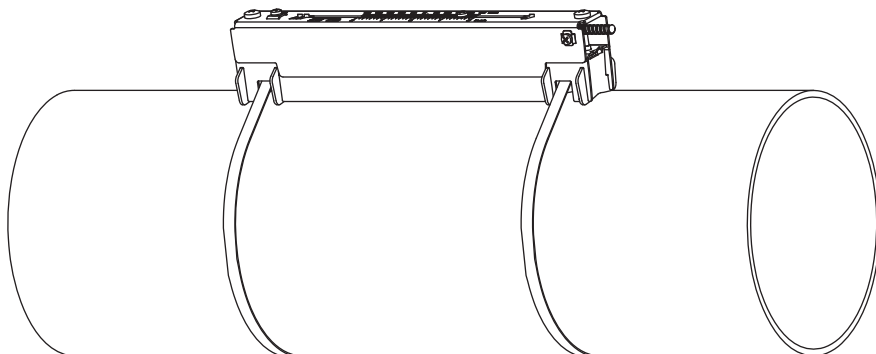
**Lamb wave transducers (zone 1, steam measurement, T1)**

order code		GLG-SA1T1/**	GLH-SA1T1/**	GLK-SA1T1/**	GLM-SA1T1/**
technical type		G(RT)G1S83	G(RT)H1S83	G(RT)K1S83	G(RT)M1S83
transducer frequency	MHz	0.2	0.3	0.5	1
fluid pressure		see saturated steam pressure curve			
<b>inner pipe diameter d</b>					
min.	mm	225	150	90	45
max.	mm	1000	667	400	200
<b>pipe wall thickness</b>					
min.	mm	10.6	7.1	4.2	2.1
max.	mm	23.7	15.8	9.5	4.7
<b>material</b>					
housing		PPSU with stainless steel cover 316Ti (1.4571)			
contact surface		PPSU			
degree of protection		IP65			
<b>transducer cable</b>					
type		1699			
length	m	5			4
length (***_***/LC)	m	9			9
<b>dimensions</b>					
length l	mm	128.5			74
width b	mm	51			32
height h	mm	67.5			40.5
dimensional drawing					
weight (without cable)	kg	0.8			0.16
<b>storing temperature</b>					
min.	°C	-40			
max.	°C	+180			
<b>operating temperature</b>					
min.	°C	100			
max.	°C	155			
warm-up time	h	3			1
temperature compensation		x			
<b>explosion protection</b>					
<b>• ATEX/IECEX</b>					
order code		GLG-SA1T1/**	GLH-SA1T1/**	GLK-SA1T1/**	GLM-SA1T1/**
pipe surface temperature (Ex)					
• min.	°C	-50			
• max.	°C	+155			
marking		CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC T80 °C...T160 °C Db			
certification ATEX		IBExU07ATEX1168 X			
certification IECEX		IECEX IBE 08.0007X			

completely thermally insulated transducer installation necessary

## Transducer mounting fixture

Variofix L (VLK, VLM)



material: stainless steel 304 (1.4301),  
301 (1.4310), 410 (1.4006)  
option OS: 316Ti (1.4571), 316L  
(1.4404), 17-7PH (1.4568)

inner length:

**VLK:** 348 mm,

**VLM:** 234 mm

dimensions:

**VLK:** 423 x 90 x 93 mm

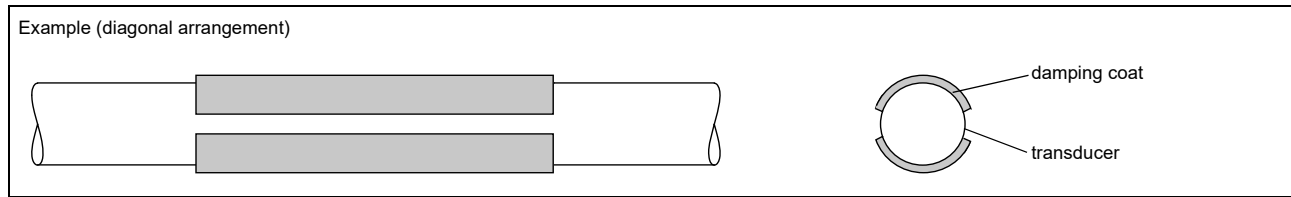
**VLM:** 309 x 57 x 63 mm

## Coupling materials for transducers

type	ambient temperature °C
coupling foil type VT	-10...+200

## Damping coat

The damping coat will be used to reduce acoustic noise influences on the measurement.



## Technical data

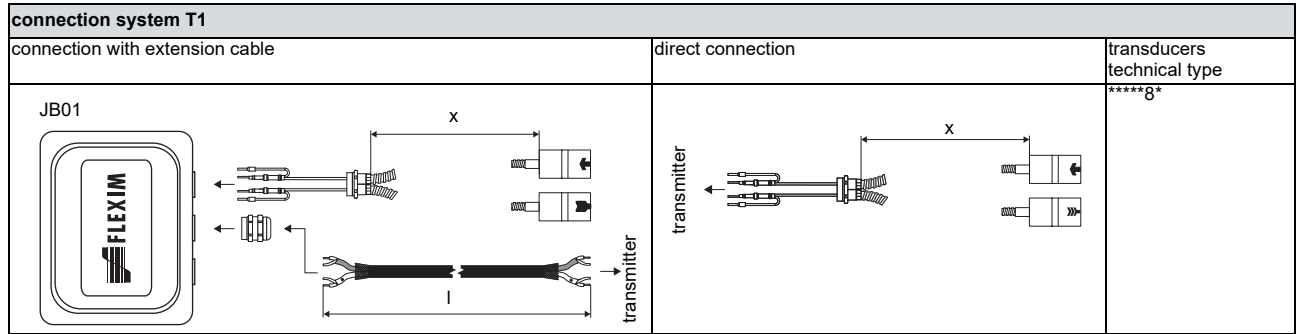
order code		ACC-PE-GNNN-/DPL1
material		multipolymeric matrix/inorganic ceramic coating
packing drum	I	1
properties		heat resistant, inert
fluid temperature when applying	°C	10...200
drying time (example)		approx. 3 h at 20 °C approx. 15 min at 150 °C
temperature resistance in dry state	°C	max. 650
durability of the packing drum (unopened)		2 years

Observe installation instructions (TI\_DampingCoat).

## Dimensioning

transducer frequency	number of packing drums		
	outer pipe diameter		
	≤300 mm	≤500	≤700
G	2	3	4
H	2	2	3
K	2	2	-
M	2	-	-

## Connection systems



### 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
material	stainless steel 304 (1.4301) option OS: 316Ti (1.4571)
outer diameter	mm 8

extension cable		
type	2615	5245
order code	ACC-PE- GNNN-/EXEXXXX	ACC-PE- GNNN-/EXA1XXX
weight	kg/m 0.18	0.38
ambient temperature	°C -30...+70	-30...+70
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	mm max. 12	max. 12
thickness	mm 2	2
colour	black	black
shield	x	x
sheath		
material	-	steel wire braid with copolymer sheath
outer diameter	mm -	max. 15.5

XXX - cable length in m

### Cable length


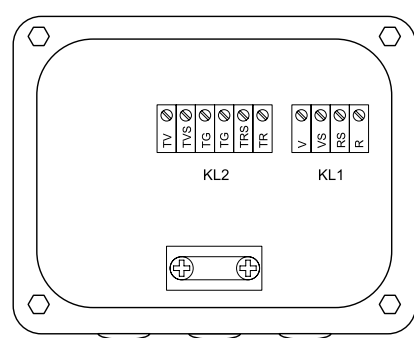
transducer frequency	G, H, K		M	
	x	l	x	l
transducers technical type	x	l	x	l
*R***8*	5	≤ 300	4	≤ 300
option LC: *T***8*	9	≤ 300	9	≤ 300
*R***5*	m 5	≤ 300	4	≤ 300
option LC: *T***5*	m 9	≤ 300	9	≤ 300

x - transducer cable length

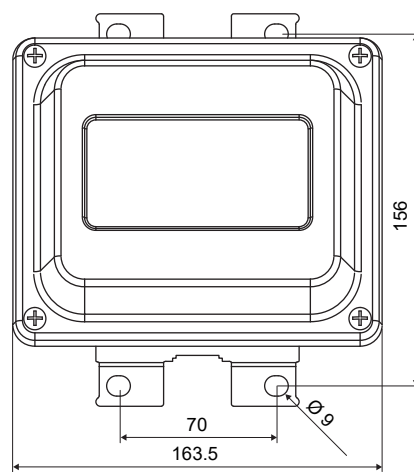
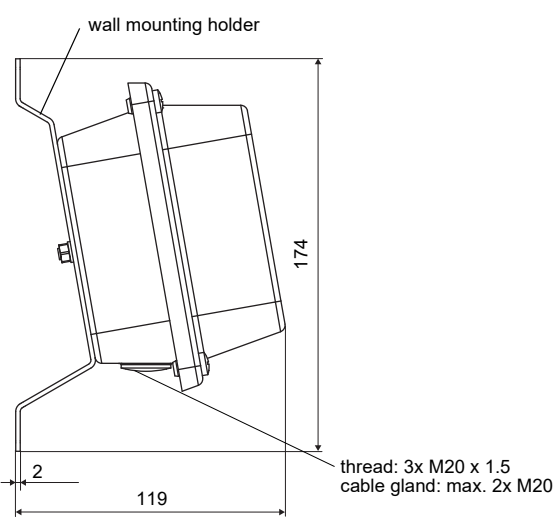
l - max. length of extension cable (depending on the application)

# Junction box

## Technical data

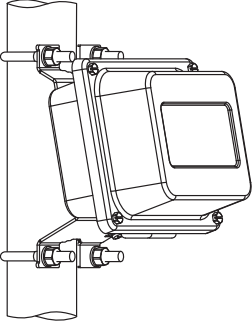
JB01S4E3M																																		
weight	kg	1.2 kg																																
fixation		wall mounting optional: 2" pipe mounting																																
<b>material</b>																																		
housing		stainless steel 316L (1.4404)																																
gasket		silicone																																
degree of protection		IP67																																
<b>ambient temperature</b>																																		
min.	°C	-40																																
max.	°C	+80																																
<b>explosion protection</b>																																		
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marking		CE 0637  II2G II2D Ex eb mb IIC T6...T4 Gb Ex tb IIIC T100 °C Db Ta -40...+70/80 °C																																
certification ATEX		IBExU06ATEX1161																																
certification IECEX		IECEX IBE 08.0006																																
type of protection		gas: increased safety decoupled network: encapsulation dust: protection by enclosure																																
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <table border="1"> <thead> <tr> <th>terminal strip</th> <th>terminal</th> <th>connection</th> <th>transducer</th> </tr> </thead> <tbody> <tr> <td rowspan="4">KL1</td> <td>V</td> <td>signal</td> <td rowspan="2">↑</td> </tr> <tr> <td>VS</td> <td>internal shield</td> </tr> <tr> <td>RS</td> <td>internal shield</td> <td rowspan="2">↕</td> </tr> <tr> <td>R</td> <td>signal</td> </tr> </tbody> </table> </div> <div style="width: 30%;"> <p><b>Transducers</b></p> <table border="1"> <thead> <tr> <th>terminal strip</th> <th>terminal</th> <th>connection</th> <th>transducer</th> </tr> </thead> <tbody> <tr> <td rowspan="4">KL2</td> <td>TV</td> <td>signal</td> <td></td> </tr> <tr> <td>TVS</td> <td>internal shield</td> <td></td> </tr> <tr> <td>TRS</td> <td>internal shield</td> <td></td> </tr> <tr> <td>TR</td> <td>signal</td> <td></td> </tr> </tbody> </table> </div> <div style="width: 30%;"> <p><b>Connection</b></p>  </div> </div>			terminal strip	terminal	connection	transducer	KL1	V	signal	↑	VS	internal shield	RS	internal shield	↕	R	signal	terminal strip	terminal	connection	transducer	KL2	TV	signal		TVS	internal shield		TRS	internal shield		TR	signal	
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	TVS	internal shield																																
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	TR	signal																																
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KL2	TV	signal																																
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	TR	signal																																

## Dimensions

JB0*, JBP*	
	
in mm	

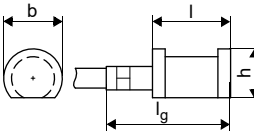
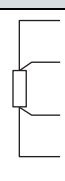
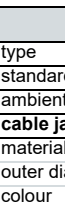


## 2" pipe mounting kit

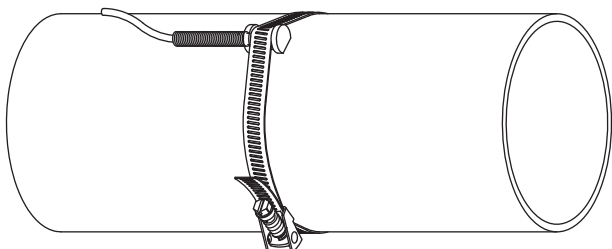
<p><b>JB**</b></p> 	<p>order code: ACC-PE-GNNN-JBPMK4</p>
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# Clamp-on temperature probe (optional)

## Technical data

PT12N																	
order code	ACC-PE-xxxx-/T332																
design	clamp-on Zone 0 (intrinsic safety)																
type	Pt100																
connection	4-wire																
measuring range	°C -45...+230																
accuracy T	$\pm(0.15 \text{ °C} + 2 \cdot 10^{-3} \cdot  T \text{ [°C] })$ class A																
housing material	stainless steel 316																
degree of protection	IP65/IP68																
<b>dimensions</b>																	
length l	mm 20 ( $l_g = 45$ )																
width b	mm 16																
height h	mm 11																
dimensional drawing																	
weight	kg 0.15																
<b>explosion protection</b>																	
• ATEX																	
technical type	LEX25																
marking	CE 0344 Ex II 1G Ex ia IIC T6...T1 Ga																
certification	DEKRA17ATEX0123 X																
intrinsic safety parameters	$U_i = 30 \text{ V DC}$ $I_i = 75 \text{ mA}$ $P_i = 500 \text{ mW}$ $C_i = 0$ $L_i = 0$																
<b>Connection</b>																	
	<table border="1"> <thead> <tr> <th colspan="2">temperature probe</th> </tr> </thead> <tbody> <tr> <td></td> <td>red</td> </tr> <tr> <td></td> <td>red</td> </tr> <tr> <td></td> <td>white</td> </tr> <tr> <td></td> <td>white</td> </tr> </tbody> </table>	temperature probe			red		red		white		white						
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	red																
	red																
	white																
	white																
<b>Cable</b>																	
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material	FEP																
outer diameter	mm 3.6																
colour	black																

## Fixation

<p>tension strap PT12N</p> 	<p>material: stainless steel 301 (1.4310), 410 (1.4006) thermal insulation necessary</p>
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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](http://www.flexim.com)  
e-mail: [info@flexim.com](mailto:info@flexim.com)

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Errors excepted.

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