



**FLEXIM**

## Technical specification

### FLUXUS F532TE

#### Ultrasonic measurement of thermal energy and volumetric flow rate

##### Features

- Integrated flow and thermal energy calculator for the determination of the thermal power in real time
- Very high measuring dynamics and fast response time – suitable for monitoring important processes and plants
- Non-invasive measurement using ultrasonic flow transducers for inner pipe diameters 10...2400 mm and temperatures -40...+130 °C
- Temperature measurement and calculation of the thermal energy according to EN 1434
- Suitable for heating and cooling applications
- Smart meter/IoT ready via Ethernet interface with corresponding IP data protocols (e.g. Modbus TCP)
- Sophisticated support software for parameterization, remote control, recording and automatic state diagnosis (FluxDiagReader, FluxDiag, Advanced Meter Verification)

##### Applications

Building technology, manufacturing industry, local and district heating/cooling, e.g. in the following areas:

- Energy management
- Internal accounting and balancing
- Network and condition monitoring
- Process optimization
- Predictive maintenance



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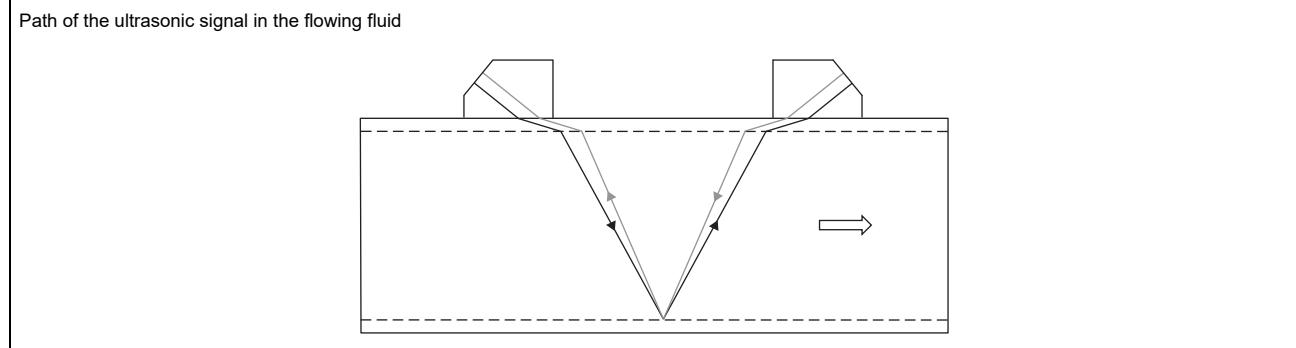
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## Function

### Measurement principle

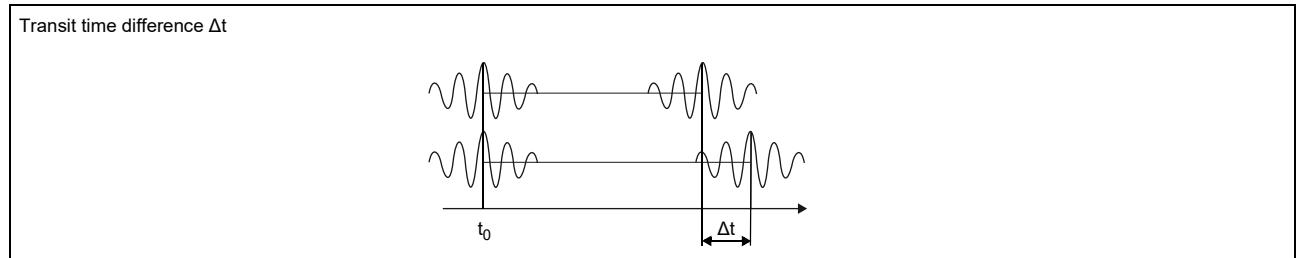
The transducers are mounted on the pipe which is completely filled with the fluid. The ultrasonic signals are emitted alternately by a transducer and received by the other. The physical quantities are determined from the transit times of the ultrasonic signals.



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

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

where

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

## Calculation of thermal energy rate

The thermal energy rate is calculated with the following formula:

$$\Phi = k_i \cdot \dot{V} \cdot (T_V - T_R) \text{ (heating application)}$$

$$\Phi = k_i \cdot \dot{V} \cdot (T_R - T_V) \text{ (cooling application)}$$

where

$\Phi$  – thermal energy rate

$k_i$  – thermal coefficient

$\dot{V}$  – volumetric flow rate

$T_V$  – supply temperature

$T_R$  – return temperature

The thermal coefficient  $k_i$  results from several thermal energy rate coefficients for the specific enthalpy and density of the fluid. The thermal energy rate coefficients of some fluids are stored in the internal database of the transmitter. Further customised fluids are possible.

## Max. permissible error

The max. permissible error MPE of a complete heat meter is according to EN 1434 the arithmetic sum of the max. permissible errors of the subassemblies: calculator, temperature sensor pair and flow sensor.

$$MPE = E_c + E_t + E_f$$

where

MPE – total max. permissible error

$E_c$  – max. permissible relative error of the calculator

$E_t$  – max. permissible relative error of the temperature sensor pair

$E_f$  – max. permissible relative error of the flow sensor

## 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**

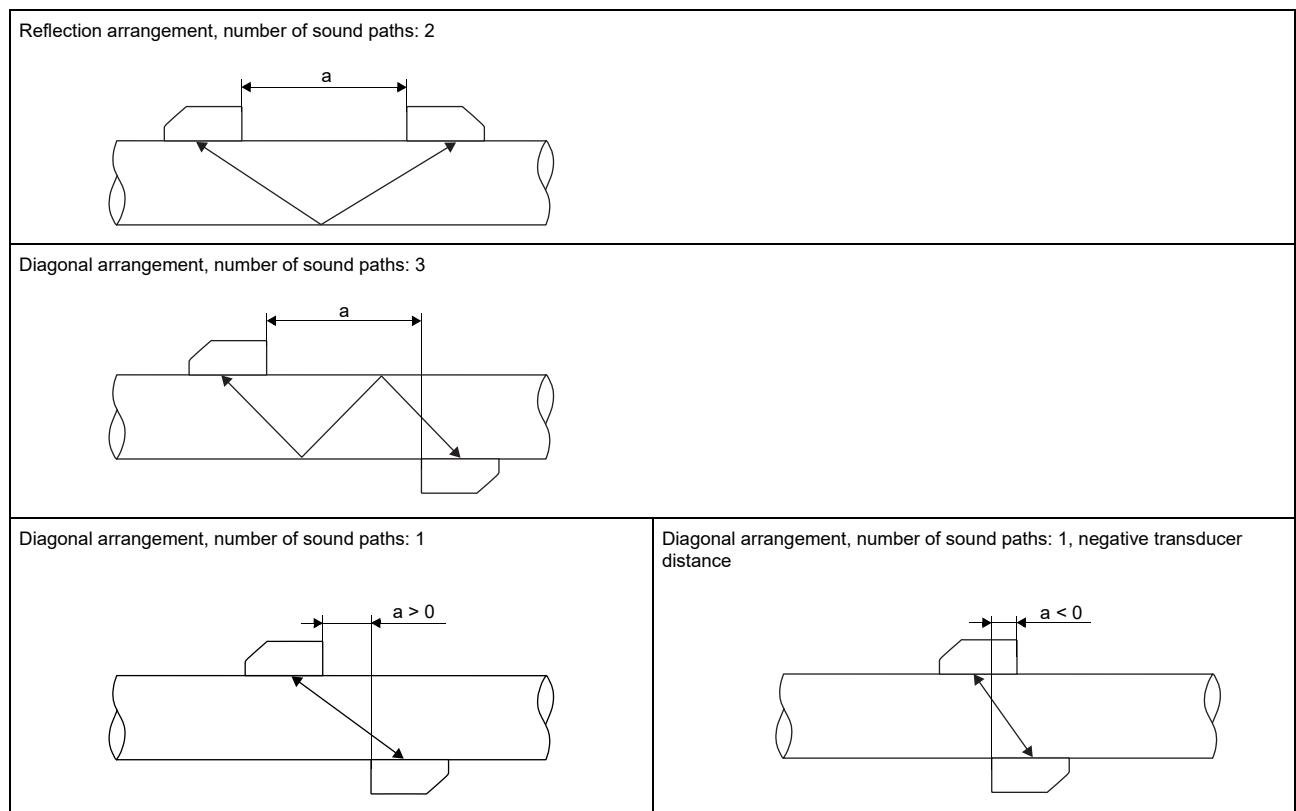
The number of sound paths is even. The transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easy.

- **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.

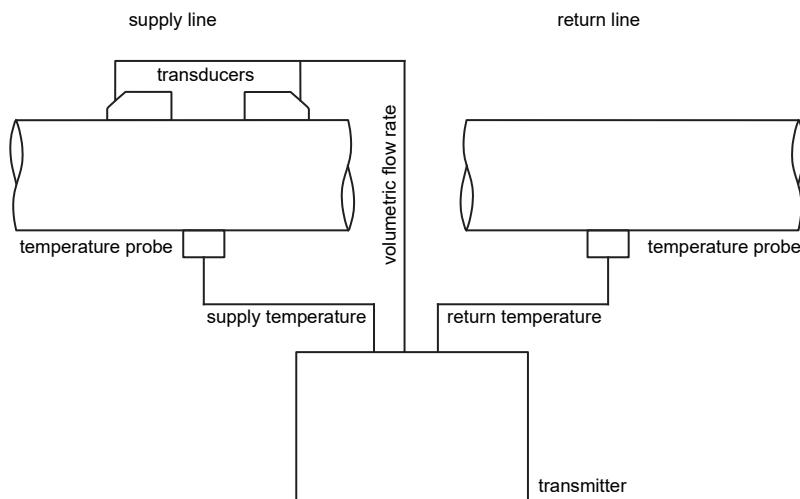
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

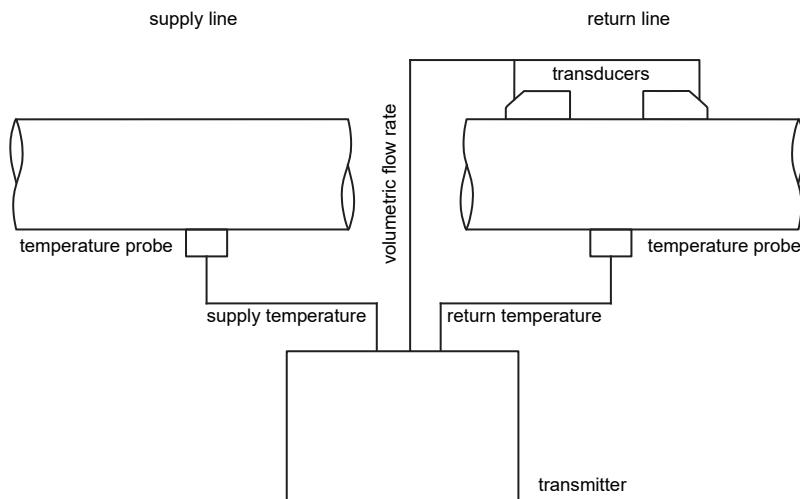


## Typical measurement setup

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



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



## Transmitter

### Technical data

		FLUXUS F532TE (analog outputs)	FLUXUS F532TE (process interface)			
						
design	field device with 1 measuring channel					
application	energy meter					
<b>measurement</b>						
• <b>energy</b>						
max. permissible relative error		calculator: $E_c = \pm(0.4 + 1 K/\Delta\theta) \%$				
• <b>temperature</b>						
temperature difference		$\Delta\theta_{min} = 3 K, \Delta\theta_{max} = 300 K$				
max. permissible relative error		temperature sensor pair: $E_t$ - depending on type, see Technical data of temperature probes				
• <b>flow</b>						
measurement principle		transit time difference correlation principle				
flow	m³/h	example for 2 sound paths and factory default of the cut-off flow: • DN 50: Qp = 0.2...200 • DN 150: Qp = 1.8...900 • DN 500: Qp = 17...5000				
flow velocity	m/s	0.01...25				
repeatability		0.15 % MV ±0.005 m/s				
fluid		water, water/glycol: 0...100 %				
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 <sup>2</sup>		±1 % MV ±0.005 m/s				
<b>transmitter</b>						
power supply		• 90...250 V/50...60 Hz or • 11...32 V DC				
power consumption	W	< 10				
number of measuring channels		1				
damping	s	0...100 (adjustable)				
measuring cycle	Hz	100...1000				
response time	s	1				
housing material		aluminum, powder coated				
degree of protection		IP66				
dimensions	mm	see dimensional drawing				
weight	kg	2.25				
fixation		wall mounting, optional: 2" pipe mounting				
ambient temperature	°C	-20...+60				
display		128 x 64 pixels, backlight				
menu language		English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian, Chinese				
<b>measuring functions</b>						
physical quantities		thermal energy rate, volumetric flow rate, mass flow rate, flow velocity				
totaliser		thermal energy, volume, mass				
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 • LAN	measured value transmission, parametrisation of the transmitter: • USB • LAN			
process interfaces		-	• Modbus RTU or • BACnet MS/TP or • M-Bus or • Modbus TCP or • BACnet IP			
<b>accessories</b>						
data transmission kit		USB cable				
software		• FluxDiagReader: reading of measured values and parameters, graphical representation • FluxDiag (optional): reading of measurement data, graphical representation, report generation, parametrisation of the transmitter				

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

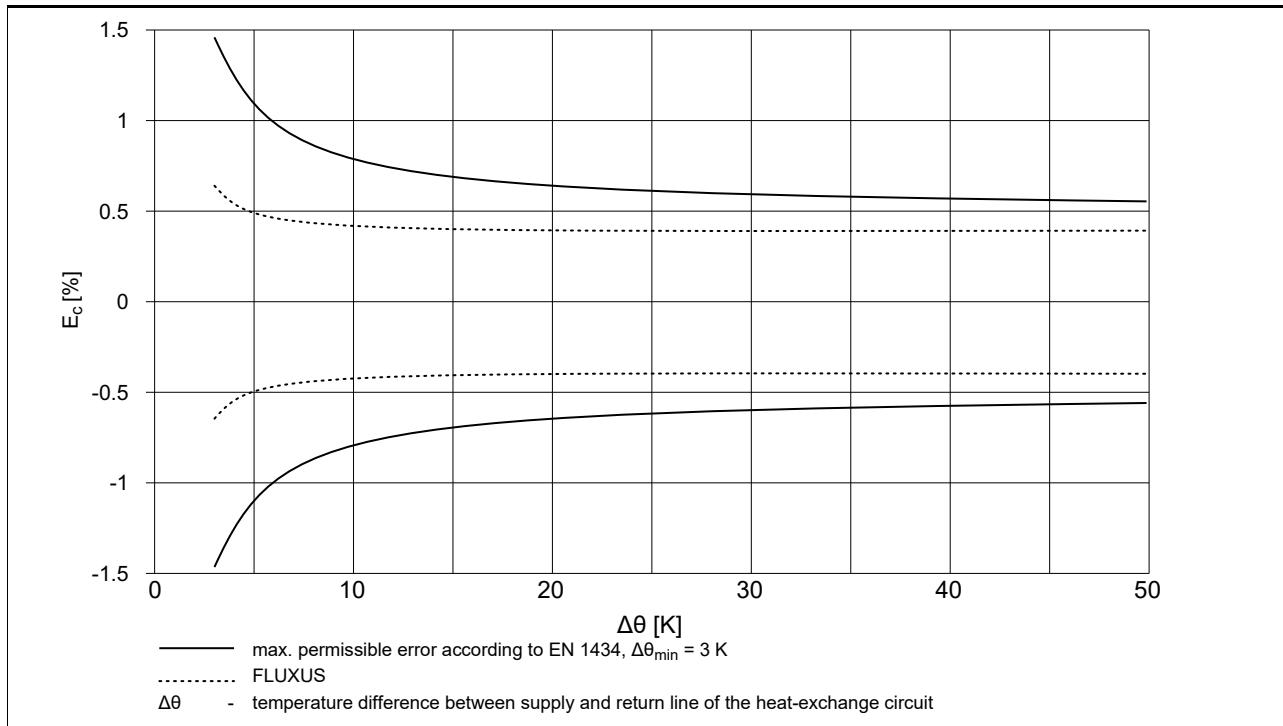
<sup>2</sup> for transit time difference principle and reference conditions

	FLUXUS F532TE (analog outputs)	FLUXUS F532TE (process interface)		
<b>data logger</b>				
loggable values	all physical quantities and totalised physical quantities			
capacity	max. 800 000 measured values			
<b>outputs</b>				
The outputs are galvanically isolated from the transmitter.				
<b>• switchable current output</b>				
number	configurable according to NAMUR NE43	-		
range mA	1	-		
accuracy	4...20 (3.2...24) 0.04 % MV $\pm 3 \mu\text{A}$	-		
active output	$R_{\text{ext}} < 530 \Omega$	-		
passive output	$U_{\text{ext}} = 9...30 \text{ V}$ , depending on $R_{\text{ext}}$ ( $R_{\text{ext}} < 458 \Omega$ at 20 V)	-		
<b>• digital output</b>				
number	2	-		
functions	<ul style="list-style-type: none"> <li>• frequency output</li> <li>• binary output</li> <li>• pulse output</li> </ul>	-		
operating parameters	$U_{\text{ext}} = (8.2 \pm 0.1) \text{ V DC}$	-		
<b>frequency output</b>				
• range kHz	0...10	-		
<b>binary output</b>				
• binary output as alarm output	limit, change of flow direction or error	-		
<b>pulse output</b>				
• pulse value units	0.01...1000	-		
• pulse width ms	0.05...1000	-		
<b>inputs</b>				
The inputs are galvanically isolated from the transmitter.				
<b>• temperature input</b>				
number	2	-		
type	Pt100/Pt1000	-		
connection	4-wire	-		
range °C	-150...+560	-		
resolution K	0.01	-		
accuracy	$\pm 0.01 \% \text{ MV} \pm 0.03 \text{ K}$	-		

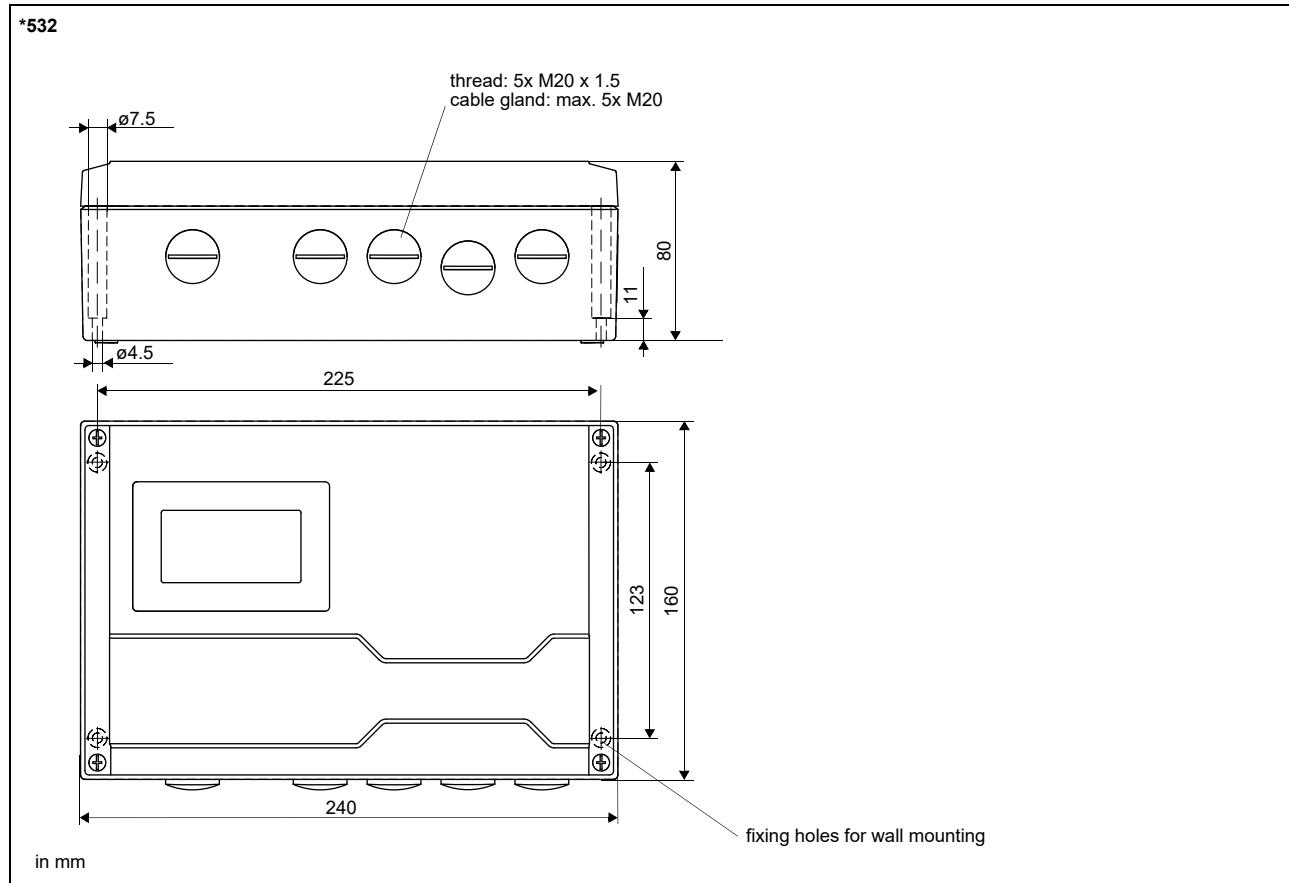
<sup>1</sup> with aperture calibration of the transducers

<sup>2</sup> for transit time difference principle and reference conditions

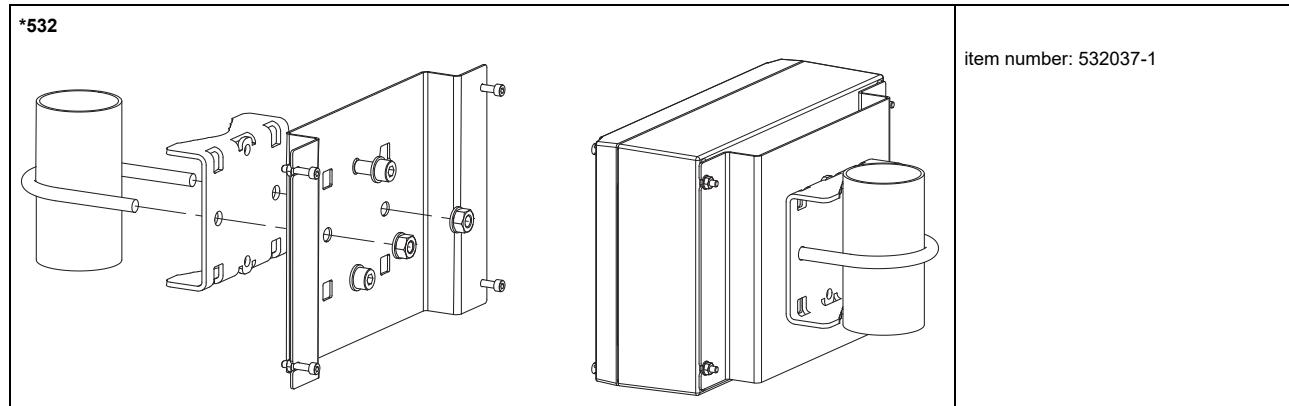
## Max. permissible error of the calculator



## Dimensions



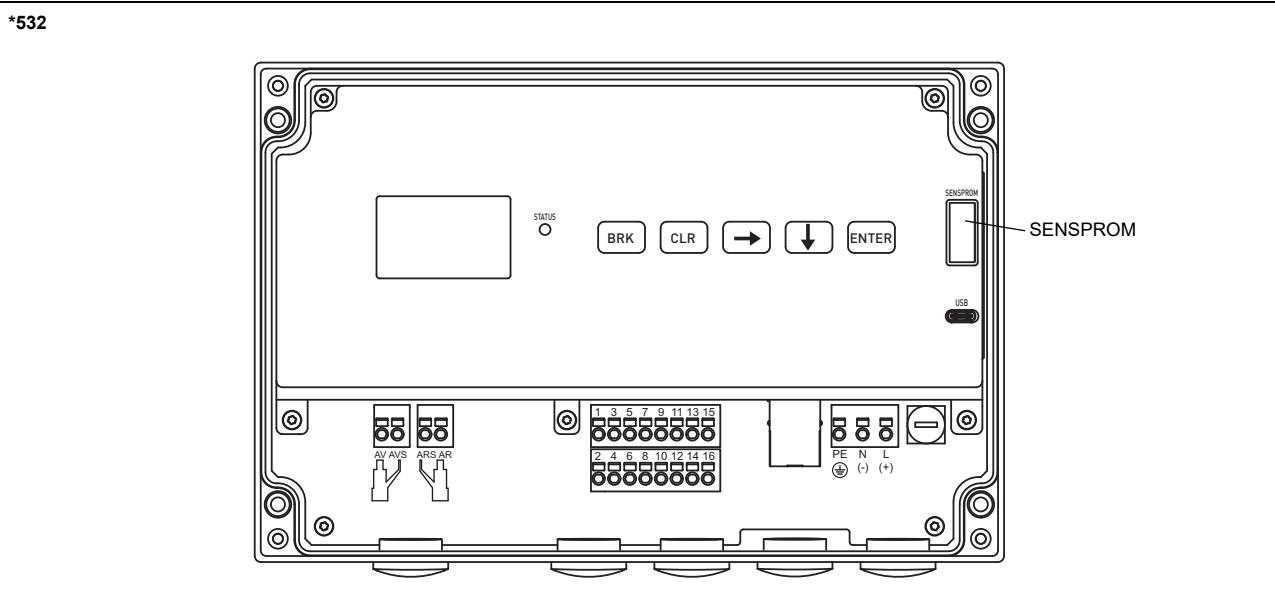
## 2" pipe mounting kit (optional)



## 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: -20...+60 °C

## Terminal assignment



### power supply<sup>1</sup>

terminal	connection (AC)	terminal	connection (DC)
PE	earth	PE	earth
N	neutral	(-)	-
L	phase	(+)	+

### transducers, extension cable

terminal	connection	transducer
AV	signal	↑
AVS	internal shield	
ARS	internal shield	⤻
AR	signal	
cable gland	external shield	↑ ⤻

### outputs, inputs<sup>1, 2</sup>

terminal	connection
13+, 14-	passive current output
13-, 14+	active current output
9+, 10-	digital output
11+, 12-	
1, 2, 3, 4 5, 6, 7, 8	temperature input

### temperature probe

terminal	direct connection (clamp-on)	connection with extension cable (clamp-on)	direct connection (inline)
1, 5	red	red	red
2, 6	white	white	white
3, 7	red/blue	grey	grey
4, 8	white/blue	blue	blue

### communication interfaces

terminal	connection	communication interface
15	signal +	<ul style="list-style-type: none"> <li>Modbus RTU<sup>1</sup></li> <li>BACnet MS/TP<sup>1</sup></li> <li>M-Bus<sup>1</sup></li> </ul>
16	signal -	
USB	type C Hi-Speed USB 2.0 Device	service (FluxDiag/FluxDiagReader)
LAN	RJ45 10/100 Mbps Ethernet	<ul style="list-style-type: none"> <li>service (FluxDiag/FluxDiagReader)</li> <li>Modbus TCP</li> <li>BACnet IP</li> </ul>

<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

### Technical data

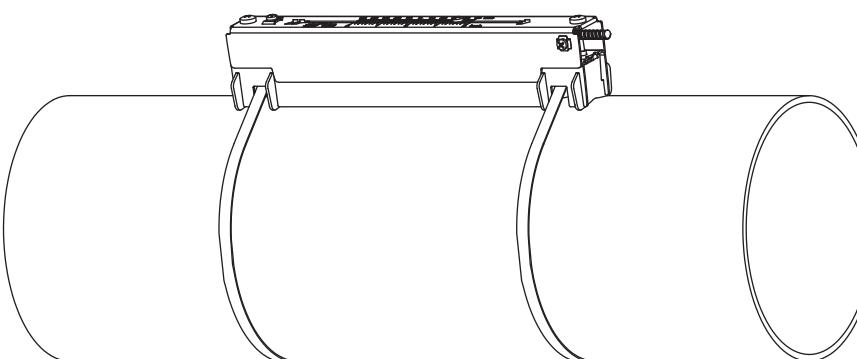
#### Shear wave transducers (max. 100 °C)

order code		FSK-LNNN-**T1	FSM-LNNN-**T1	FSP-LNNN-**T1	FSQ-LNNN-**T1
technical type		CDK1LZ7	CDM2LZ1	CDP2LZ1	CDQ2LZ1
transducer frequency	MHz	0.5	1	2	4
<b>inner pipe diameter d</b>					
min. extended	mm	100	50	25	10
min. recommended	mm	200	100	50	25
max. recommended	mm	2000	1000	400	150
max. extended	mm	2400	1200	480	240
<b>pipe wall thickness</b>					
min.	mm	5	2.5	1.2	0.6
<b>material</b>					
housing		PEEK with stainless steel cover 316Ti (1.4571)			
contact surface		PEEK			
degree of protection		IP66			
<b>transducer cable</b>					
type		2606			
length	m	10			
<b>dimensions</b>					
length l	mm	126.5	64	40	
width b	mm	51	32	22	
height h	mm	67.5	40.5	25.5	
dimensional drawing					
weight (without cable)	kg	0.36	0.066	0.016	
pipe surface temperature	°C	-40...+100			
ambient temperature	°C	-40...+100			

**Shear wave transducers (max. 130 °C)**

order code	FSK-NNNN-**T1	FSM-NNNN-**T1	FSP-NNNN-**T1	FSQ-NNNN-**T1
technical type	C(DL)K1N53	C(DL)M2N53	C(DL)P2N53	C(DL)Q2N53
transducer frequency MHz	0.5	1	2	4
<b>inner pipe diameter d</b>				
min. extended	mm	100	50	25
min. recommended	mm	200	100	50
max. recommended	mm	2000	1000	400
max. extended	mm	2400	1200	480
<b>pipe wall thickness</b>				
min.	mm	5	2.5	1.2
<b>material</b>				
housing	PEEK with stainless steel cover 316L (1.4404)			
contact surface	PEEK			
degree of protection	IP66/IP67			
<b>transducer cable</b>				
type	1699			
length	m	5	4	3
<b>dimensions</b>				
length l	mm	126.5	64	40
width b	mm	51	32	22
height h	mm	67.5	40.5	25.5
dimensional drawing				
weight (without cable)	kg	0.36	0.066	0.016
pipe surface temperature	°C	-40...+130		
ambient temperature	°C	-40...+130		
temperature compensation		x		

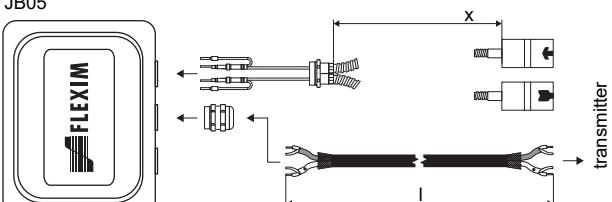
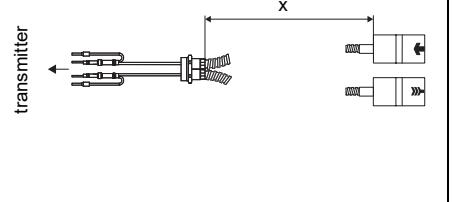
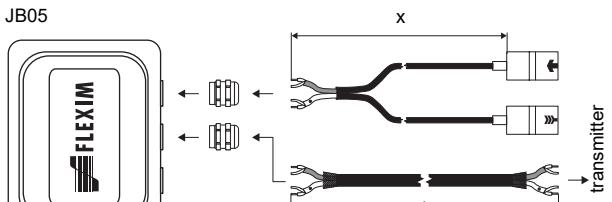
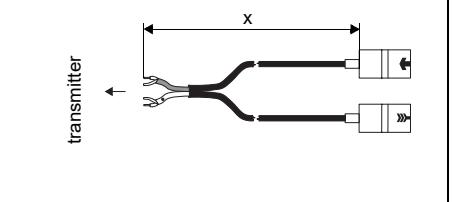
## Transducer mounting fixture

Variofix L (VLK, VLM, VLQ)		material: stainless steel 316Ti (1.4571), 316L (1.4404), 17-7PH (1.4568) inner length: <b>VLK:</b> 348 mm <b>VLM:</b> 234 mm <b>VLQ:</b> 176 mm dimensions: <b>VLK:</b> 423 x 90 x 93 mm <b>VLM:</b> 309 x 57 x 63 mm <b>VLQ:</b> 247 x 43 x 47 mm
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## Coupling materials for transducers

type	ambient temperature °C
coupling compound type N	-30...+130
coupling foil type VT	-10...+200

## Connection systems

connection system T1		transducers technical type
connection with extension cable	direct connection	
 <p>JB05</p>	 <p>transmitter</p>	****N53
 <p>JB05</p>	 <p>transmitter</p>	****LZ*

## Cable

transducer cable		
type	1699	2606
weight kg/m	0.094	0.033
ambient temperature °C	-55...+200	-40...+100
cable jacket		
material	PTFE	PUR
outer diameter mm	2.9	5
thickness mm	0.3	
colour	brown	grey
shield	x	x
sheath		
material	stainless steel 316Ti (1.4571)	-
outer diameter mm	8	

extension cable		
type	2615	
weight kg/m	0.18	
ambient temperature °C	-30...+70	
properties		
	halogen-free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2	
cable jacket		
material	PUR	
outer diameter mm	12	
thickness mm	2	
colour	black	
shield	x	

## Cable length

transducer frequency	K		M, P		Q	
transducers technical type	x		x		x	
CDK1LZ7	m	10	≤ 300	-	-	-
CD*2LZ1	m	-	-	10	≤ 300	10
****N53	m	5	≤ 300	4	≤ 300	3
						≤ 90

x - transducer cable length

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

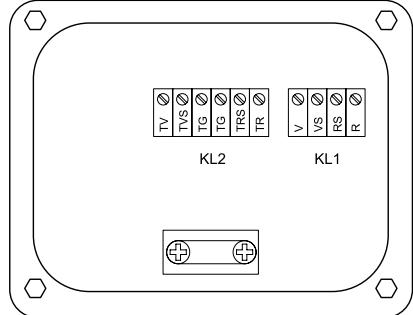
## Junction box

### Technical data

JB05		
weight	kg	1.2 kg
fixation		wall mounting optional: 2" pipe mounting
material		
housing		stainless steel 316L (1.4404)
gasket		silicone
degree of protection		IP67
ambient temperature °C		-40...+80

**Connection**



terminal strip	terminal	connection	transducer
KL1	V	signal	↑
	VS	internal shield	
	RS	internal shield	↗
	R	signal	

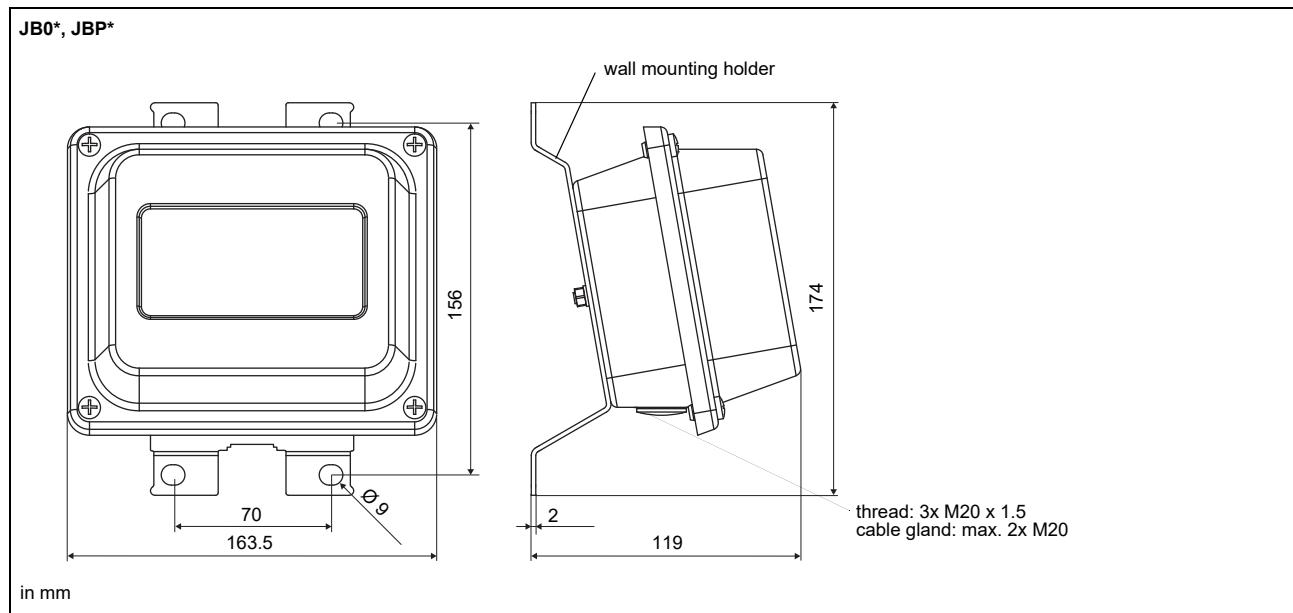
**Transducers**

terminal strip	terminal	connection	
KL2	TV	signal	
	TSV	internal shield	
	TRS	internal shield	
	TR	signal	

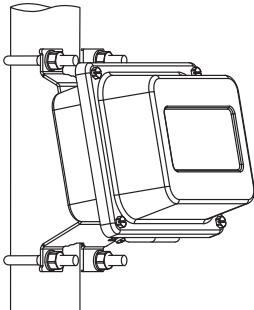
**Extension cable**

terminal strip	terminal	connection	
KL2	TV	signal	
	TSV	internal shield	
	TRS	internal shield	
	TR	signal	

### Dimensions

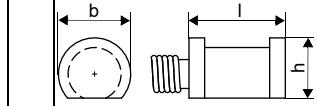
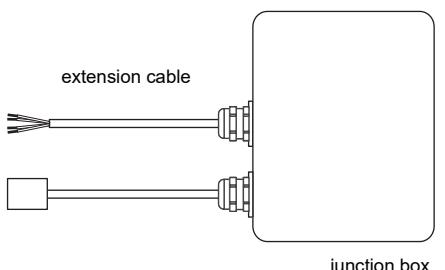
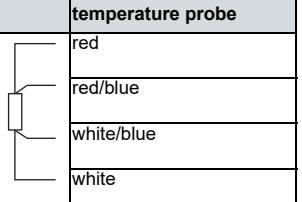


**2" pipe mounting kit**

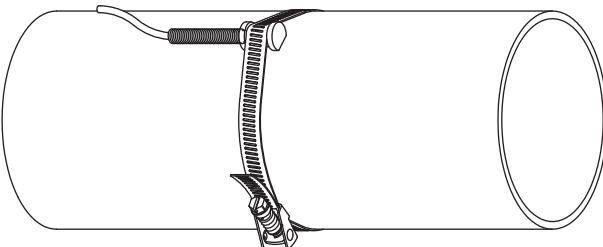
JB** 	item number: 751035-2
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## Clamp-on temperature probe (optional)

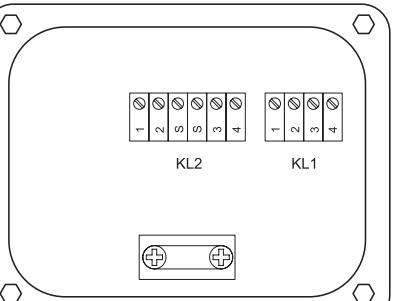
### Technical data

PT12N, PT12N-LC					
order code	<b>PT12N:</b> • 770414-2 <b>PT12N-LC:</b> • 770414-4				
design	clamp-on option: with long cable				
type	2x Pt100, matched according to EN 1434				
connection	4-wire				
measuring range	°C -30...+250				
accuracy $\theta$	$\pm(0.15 \text{ }^{\circ}\text{C} + 2 \cdot 10^{-3} \cdot  \theta  \text{ }^{\circ}\text{C})$ class A				
max. permissible relative error	$E_t = 0.1 \text{ K}$ ( $3 \text{ K} < \Delta\theta \leq 6 \text{ K}$ ) $E_t = 0.2 \text{ K}$ ( $6 \text{ K} < \Delta\theta \leq 30 \text{ K}$ ) $E_t = 0.3 \text{ K}$ ( $30 \text{ K} < \Delta\theta \leq 50 \text{ K}$ )				
response time	s 50				
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			
accessories					
thermal conductivity foil 250 °C		x			
Connection system					
connection with extension cable			direct connection		
					
Connection					
		temperature probe			
					
Cable					
		PT12N			
type		4 x 0.22 mm <sup>2</sup>			
standard length		m 3	15 5/10/25		
max. length		m -	200		
ambient temperature		°C -30...+250	-25...+80		
min. bend radius		mm 27	68		
cable jacket					
material		PFA			
outer diameter		mm 3.8 ±0.15	4.8 ±2		
colour		black			

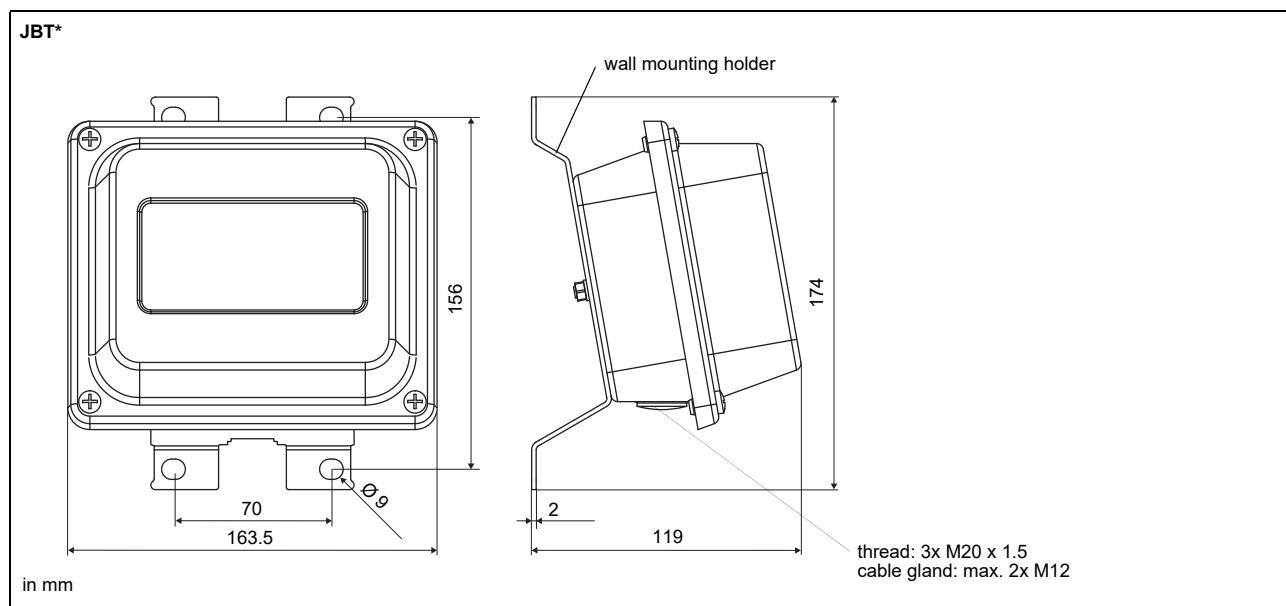
### Fixation

tension strap PT12N		
		material: stainless steel 301 (1.4310), 410 (1.4006) thermal insulation necessary

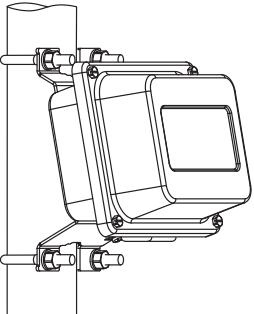
## Junction box

JBT3		
item number	751040-36	
weight	kg	1.2 kg
fixation		wall mounting optional: 2" pipe mounting
material		
housing		stainless steel 316L (1.4404)
gasket		silicone
degree of protection		IP67
ambient temperature		
min.	°C	-40
max.	°C	+80
Connection		
		
Temperature probe		
terminal strip	terminal	connection
KL1	1	red
	2	red/blue
	3	white
	4	white/blue
Extension cable		
terminal strip	terminal	connection
KL2	1	red
	2	grey
	3	white
	4	blue

## **Dimensions**



**2" pipe mounting kit**

JB**		item number: 751035-2
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## Inline temperature probe (optional)

### Technical data

PT12N-IT-P PT12N-IU-P																	
item number	PT12N-IT-P: • 770416-1 (matched, without cable) • 770416-11 (matched, 10 m) • 770416-12 (matched, 20 m) <b>PT12N-IU-P:</b> • 770416-2 (matched, without cable) • 770416-21 (matched, 10 m) • 770416-22 (matched, 20 m)	connection															
type	2x Pt100 matched according to EN 1434	<table border="1"> <thead> <tr> <th></th><th>temperature probe</th><th>cable</th></tr> </thead> <tbody> <tr> <td></td><td>red</td><td>red</td></tr> <tr> <td></td><td>red</td><td>grey</td></tr> <tr> <td></td><td>white</td><td>blue</td></tr> <tr> <td></td><td>white</td><td>white</td></tr> </tbody> </table>		temperature probe	cable		red	red		red	grey		white	blue		white	white
	temperature probe	cable															
	red	red															
	red	grey															
	white	blue															
	white	white															
connection	4-wire	cable															
measuring range	°C -30...+200	<table border="1"> <thead> <tr> <th></th><th>temperature probe</th></tr> </thead> <tbody> <tr> <td>type</td><td>LIYCY 8 x 0.14 mm<sup>2</sup> grey</td></tr> <tr> <td>standard length</td><td>m 10/20</td></tr> <tr> <td>max. length</td><td>m 200</td></tr> <tr> <td>cable jacket</td><td>PVC</td></tr> </tbody> </table>		temperature probe	type	LIYCY 8 x 0.14 mm <sup>2</sup> grey	standard length	m 10/20	max. length	m 200	cable jacket	PVC					
	temperature probe																
type	LIYCY 8 x 0.14 mm <sup>2</sup> grey																
standard length	m 10/20																
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accuracy $\theta$	% $\pm(0.15 \text{ }^{\circ}\text{C} + 2 \cdot 10^{-3} \cdot  \text{T } [{}^{\circ}\text{C}] )$ class A																
max. permissible relative error	% $E_t = \pm 0.9 \cdot (0.5 + 3 \cdot \Delta\theta_{\min}/\Delta\theta)$																
response time	s T50: 5, T90: 19																
housing	316Ti (1.4571) connecting head J: aluminum																
degree of protection	IP65																
dimensions																	
length l	mm 72 PT12N-IT-P: $l_E = 140$ PT12N-IU-P: $l_E = 230$																
width b	mm 51																
dimensional drawing																	
weight	kg PT12N-IT-P: 0.136 PT12N-IU-P: 0.142																

### Fixation

threaded thermowell PT12N-I		
	PT12N-IT-P	PT12N-IU-P
mounting length $l_E$	mm 120	210
material		
threaded thermowell	stainless steel 316L (1.4404)	
clamping nut	galvanised steel 1.0037, PTFE	
weight	kg 0.08	0.091
outer diameter	mm 8	
process connection	G 1/2"	
fluid pressure	PN25 (water)	
max. flow velocity <sup>1</sup>		
water	m/s 6.93	4.37
glycol/H <sub>2</sub> O	m/s 8.4	3.78

<sup>1</sup> max. permissible values for laminar flows; further influences like motors, pumps, valves which provoke turbulences, water hammers, pulsations, oscillations, etc. have to be considered by the customer