FLEXIM

Technical specification

FLUXUS F502TE

Permanently installed and non-invasive ultrasonic flowmeter for the measurement of thermal energy and volumetric flow rate

Stationary ultrasonic clamp-on system for thermal energy and volume flow measurement of water

Features

- Non-invasive BTU measurement with high measuring accuracy for stationary use
- Complete integrated BTU system
- For inner pipe diameters of 0.5 to 20"
- Very high temperature accuracy, 1000 Ω temperature probes matched to 0.06 °F
- Available with 4 to 20 mA current outputs and offering Modbus or BACnet functionality
- Extremely high turndown ratio > 1000 : 1
- Measures very low flow velocities down to 0.03 ft/s - very important for submetering off peak flow rates
- Permanent coupling pads - no grease, no maintenance required

FLUXUS F502TE

Low flow sensitivity

Thermal energy supply systems are designed to deliver adequate cooling or heating during peak climate conditions. As a result, most submetering applications run at low and sometimes very low flow velocities.

One of the biggest problems with accurate BTU metering is that most meters cannot detect such flow velocities and, consequently, often fail to monitor low energy flows. The FLUXUS F502TE meter is specially designed to accurately meter flow velocities in this low range.

Temperature accuracy

In applications with small temperature differentials such as chilled water applications, the temperature measurement accuracy is critically important.

FLEXIM's temperature measurement system provides a differential measurement uncertainty of better than 0.06 °F.

Applications

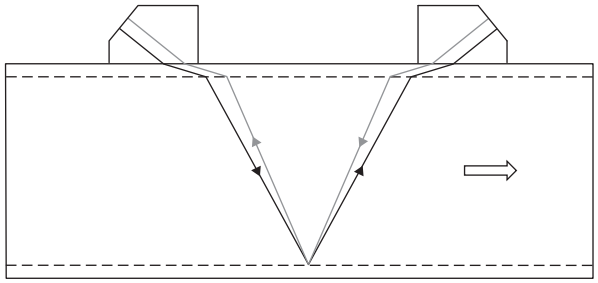
- HVAC
- District energy
- Chilled and hot water plants in
  - College campuses
  - Corporate complexes
  - Government complexes
  - Commercial buildings
  - Malls
  - Hospitals
  - Sports arenas
  - etc.
- Industrial cooling and heating
- Geothermal installations
- Industrial processes

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.

Path of the ultrasonic signal in the flowing fluid

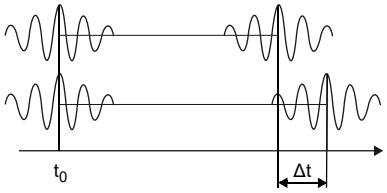


As the fluid where the ultrasound propagates is flowing, the transit time of the ultrasonic signal in flow direction is shorter than the one against the flow direction.

The transit time difference Δt 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.

Transit time difference Δt



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

Δt - transit time difference

t_γ - average of transit times in the fluid

Calculation of thermal energy rate

The thermal energy rate is internally calculated with the following formula:

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

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

where

Φ – thermal energy rate

k_i – heat coefficient

$\dot{V}$ – volumetric flow rate

T_V – supply temperature

T_R – return temperature

The heat 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 customized 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

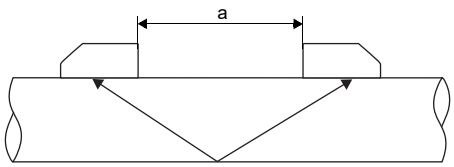
The number of sound paths is the number of transits of the ultrasonic signal through the fluid in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **reflect 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 easier.
- **diagonal arrangement**
  The number of sound paths is odd. The transducers are mounted on opposite sides of the pipe.
- **direct mode**
  Diagonal arrangement with 1 sound path. This should be used in the case of a high signal attenuation by the fluid, pipe or coatings.

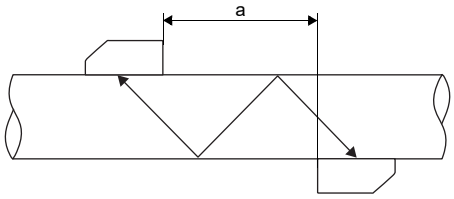
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

As the transducers can be mounted with the transducer mounting fixture in reflect arrangement or diagonal arrangement, the number of sound paths can be adjusted optimally for the application.

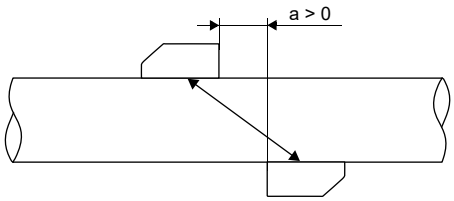
Reflect arrangement, number of sound paths: 2



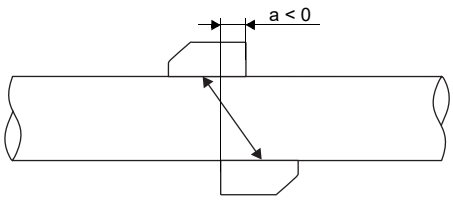
Diagonal arrangement, number of sound paths: 3



Direct mode, number of sound paths: 1



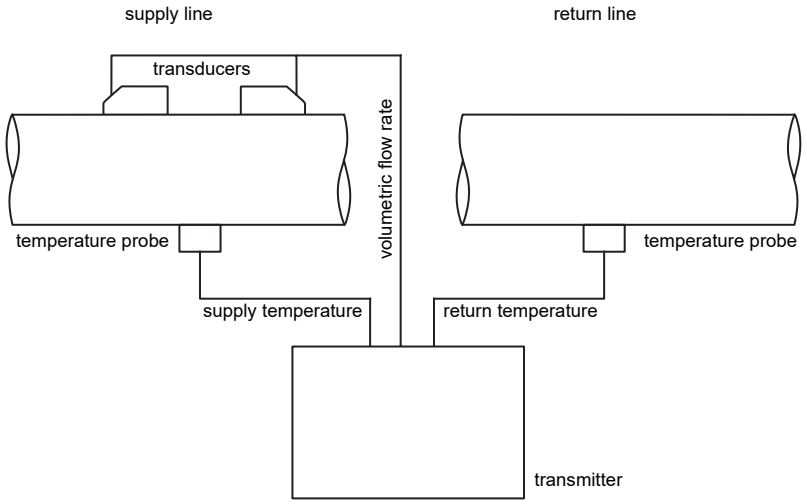
Direct mode, number of sound paths: 1, negative transducer distance



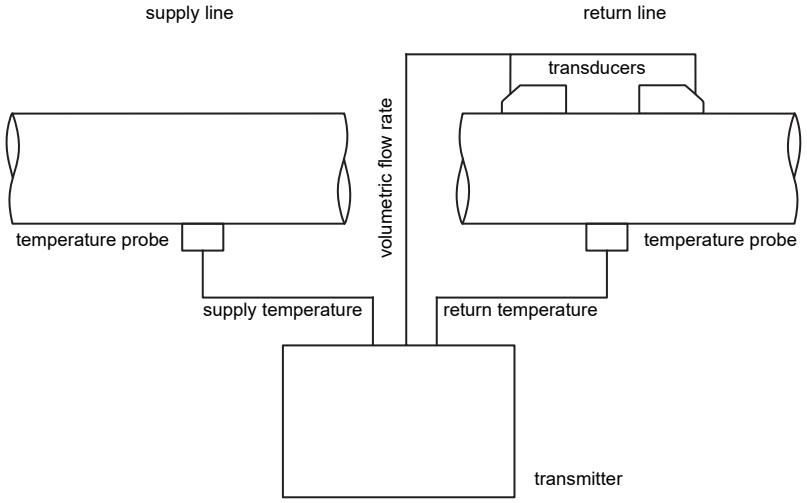
a - transducer distance

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

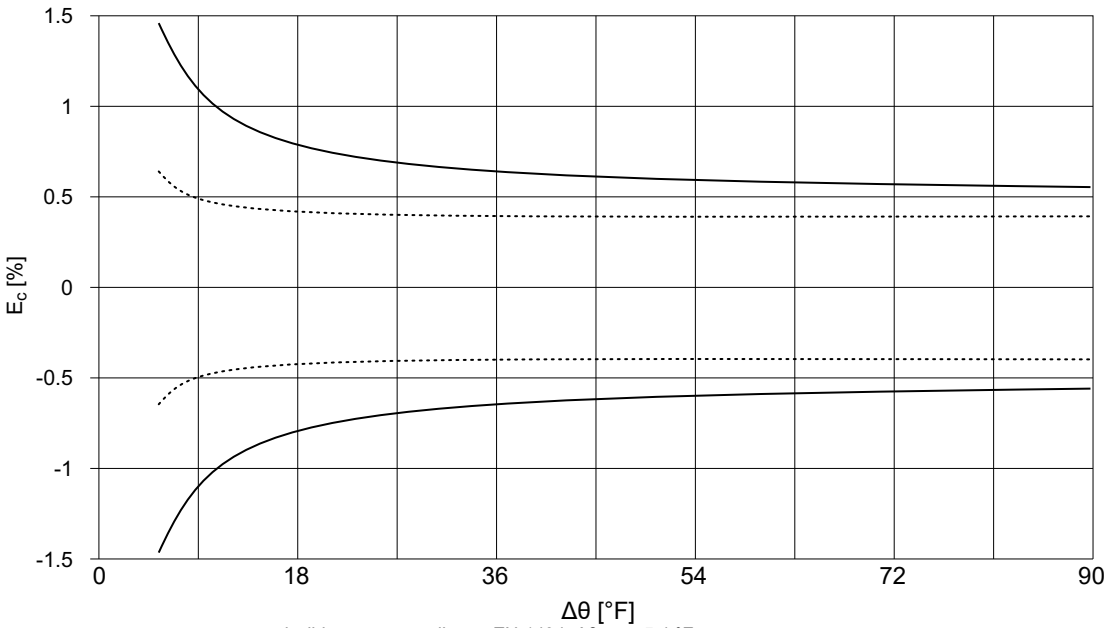
		FLUXUS F502TE
		
design		field device with 1 measuring channel
application		energy meter
transducers		CDM2LZ1, CDP2LZ1, CDQ1LZ1
measurement		
• energy		
max. permissible relative error		complies to EN 1434 standard
• temperature		
temperature difference		≤ 0.06 °F (2x Pt matched)
max. permissible relative error		complies to EN 1434 standard
• flow		
measurement principle		transit time difference correlation principle
flow velocity	ft/s	0.03 to 82
fluid pressure		without influence
pressure loss		-
repeatability		0.25 % of reading ±0.03 ft/s
fluid		• water • glycol/H_2O: 20 %, 30 %, 40 %, 50 %
max. permissible relative error		flow sensor: E_f = ±1.5 % of reading ±0.03 ft/s [1]
transmitter		
power supply		• 100 to 230 V/50 to 60 Hz or • 20 to 32 V DC or • 11 to 16 V DC
power consumption	W	< 10
number of measuring channels		1
damping	s	0 to 100 (adjustable)
measuring cycle	Hz	10
response time	s	1
housing material		aluminum, powder coated
degree of protection		IP66
dimensions	in	see dimensional drawing
weight	lb	4.2
fixation		wall mounting, optional: 2" pipe mounting
ambient temperature	°F	14 to +140
display		2 x 16 characters, dot matrix, backlight
menu language		English, German, French, Dutch, Spanish, polnisch, tschechisch
measuring functions		
physical quantities		thermal energy rate, volumetric flow rate, mass flow rate, flow velocity
totalizer		thermal energy, volume, mass
communication interfaces		
service interfaces		• RS232 • USB (with adapter)
process interfaces		max. 1 option: • RS485 (sender) • Modbus RTU, sender (switchable) • BACnet MS/TP, sender (switchable) • Modbus TCP (max. 1 current output) • BACnet IP (max. 1 current output)
accessories		
serial data kit • cable • adapter		 RS232 RS232 - USB
software		• FluxDiagReader: download of measured values and parameters, graphical presentation • FluxDiag (optional): download of measurement data, graphical presentation, report generation
data logger		
loggable values		all physical quantities and totalized values
capacity		> 100 000 measured values

[1] for reference conditions and v > 0.82 ft/s, with transducer module

		FLUXUS F502TE
outputs		
		The outputs are galvanically isolated from the transmitter.
• current output		
number		2
range	mA	0/4 to 20
accuracy		0.1 % of reading ±15 µA
active output		R_{ext} < 500 Ω
• binary output		
number		2
optorelay		28 V/100 mA
binary output as alarm output		
• functions		limit, change of flow direction or error
binary output as pulse output		
• functions		mainly for totalizing
• pulse value	units	0.01 to 1000
• pulse width	ms	80 to 1000
inputs		
		The inputs are galvanically isolated from the transmitter.
• temperature input		
number		2
type		Pt100/Pt1000
connection		4-wire
range	°F	-238 to +1040
resolution	K	0.01
accuracy		±0.01 % of reading ±0.03 K

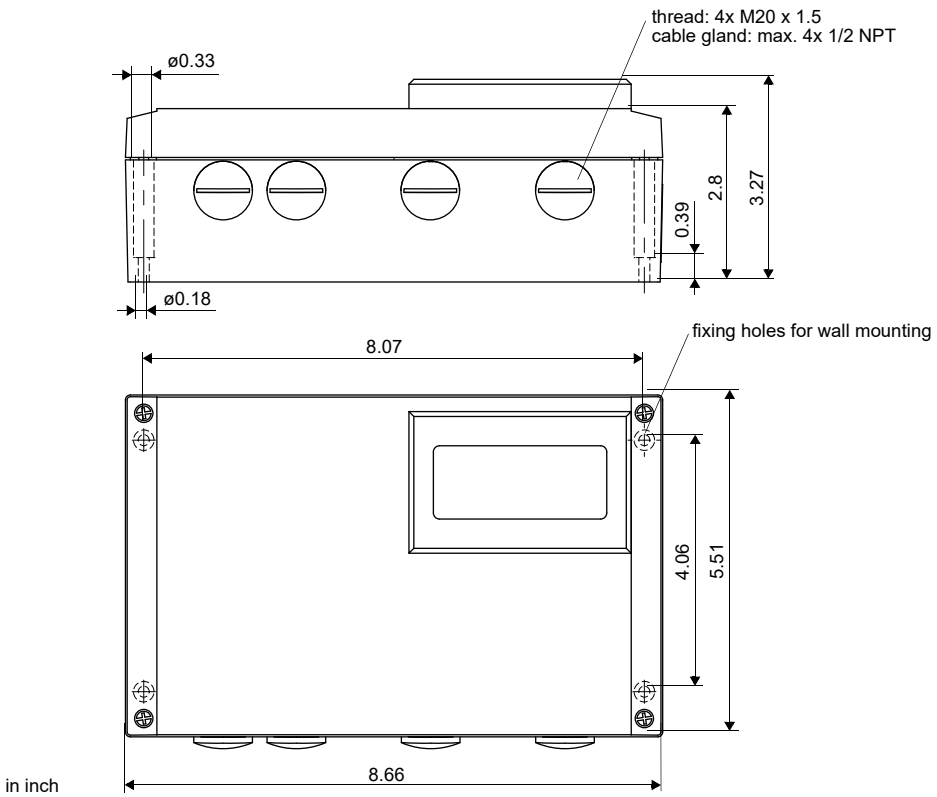
[1] for reference conditions and v > 0.82 ft/s, with transducer module

Max. permissible error of the calculator



Dimensions

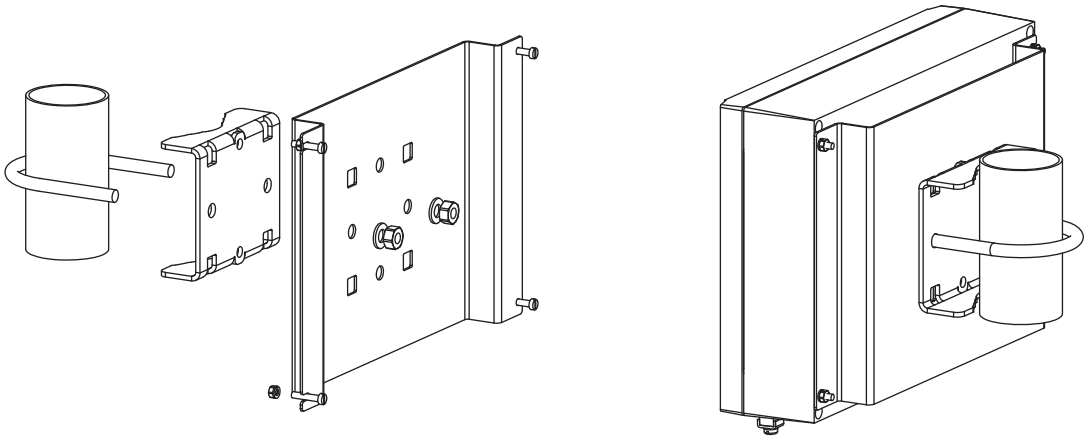
***502**



in inch

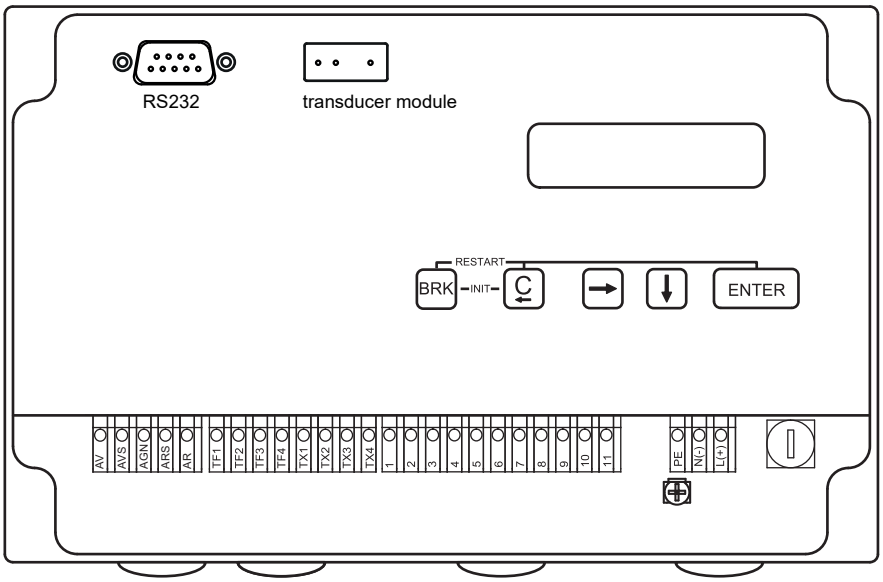
2" pipe mounting kit

50



Terminal assignment

***502**



power supply[1]		
terminal	**connection (AC)**	**connection (DC)**
PE	earth	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[1]				
terminal	**connection**	**terminal**	**connection**	**communication interface**
1(-), 2(+)	binary output B1	10	signal +	• RS485[1] • Modbus RTU[1] • BACnet MS/TP[1]
3(-), 4(+)	binary output B2	9	signal -	
5(-), 6(+)	current output I1	11	shield	
7(-), 8(+)	current output I2	LAN	RJ45	• BACnet IP • Modbus TCP

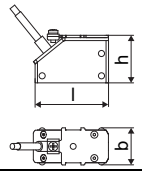
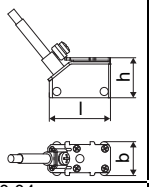
inputs[1]			
terminal	**temperature probe**		
	direct connection (clamp-on)	**connection with extension cable (clamp-on)**	**direct connection (inline)**
TF1, TX1	white	white	white
TF2, TX2	white	black	black
TF3, TX3	red	red	red
TF4, TX4	red	green	green

[1] cable (by customer): e.g., flexible leads, with insulated wire end ferrules, lead cross sectional area: AWG14 to 24

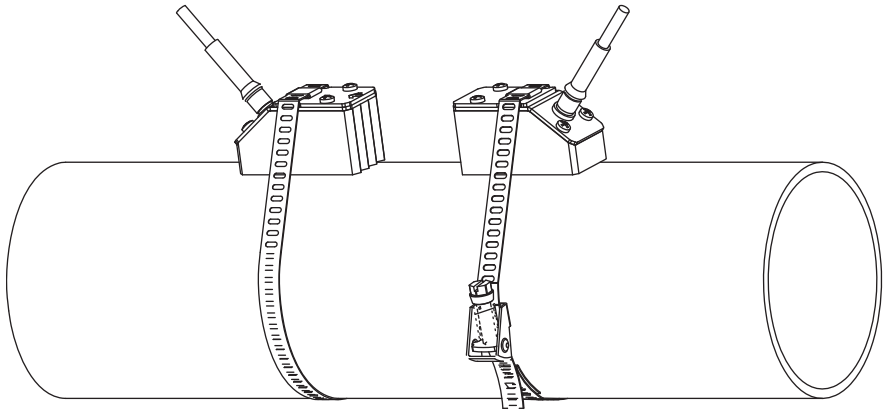
Transducers

Technical data

Shear wave transducers

technical type		CDM2LZ1	CDP2LZ1	CDQ2LZ1
transducer frequency	MHz	1	2	4
nominal size				
min.	in	4	1	0.5
max.	in	20	8	4
pipe wall thickness				
min.	in	0.1	0.05	0.02
material				
housing		PEEK with stainless steel cap 316L		
contact surface		PEEK		
degree of protection		NEMA 6		
transducer cable				
type		2606		
length	ft	32		
length (***-*****/LC)	ft	65		
dimensions				
length l	in	2.52		1.57
width b	in	1.26		0.87
height h	in	1.59		1
dimensional drawing				
weight (without cable)	lb	0.15		0.04
pipe surface temperature				
min.	°F	-40		
max.	°F	+212		
ambient temperature				
min.	°F	-40		
max.	°F	+212		

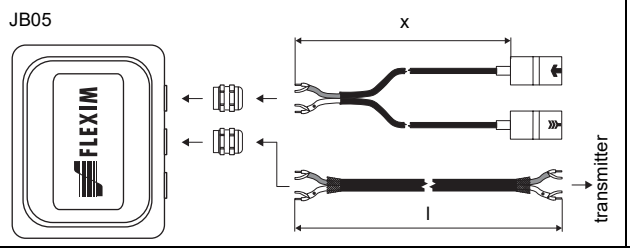
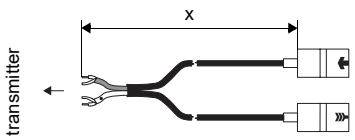
Transducer mounting fixture

quick release clasp and tension straps 	material: stainless steel 410, 200

Coupling materials for transducers

type	**ambient temperature** °F
coupling compound type N	-22 to +266
coupling pad type VT	14 to +392

Connection systems

connection with extension cable	direct connection	transducers technical type
		****LZ1

Cable

transducer cable		
type		**2606**
weight	lb/ft	0.07
ambient temperature	°F	-40 to +212
cable jacket		
material		PUR
outer diameter	in	0.2
thickness	in	
color		gray
shield		x
sheath		
material		-
outer diameter	in	-

extension cable		
type		**2615**
weight	lb/ft	0.12
ambient temperature	°F	-22 to +158
properties		halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2
cable jacket		
material		PUR
outer diameter	in	0.47
thickness	in	0.08
color		black
shield		x

Cable length

transducer frequency		**M, P**		**Q**	
connection system TS					
transducers technical type		x	l	x	l
****LZ1	ft	13	≤ 295	9	≤ 295

x = transducer cable length

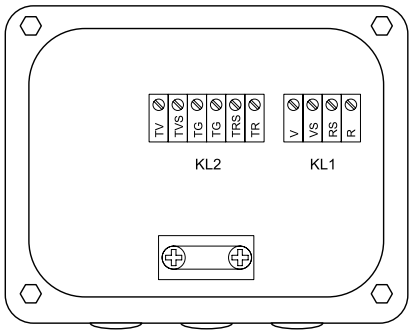
l = max. length of extension cable (depending on application)

Junction box

Technical data

JB05		
weight	lb	2.6 lb
fixation		wall mounting optional: 2" pipe mounting
material		
housing		stainless steel 316L
gasket		silicone
degree of protection		IP67
ambient temperature		
min.	°F	-40
max.	°F	+176

Connection



Transducers

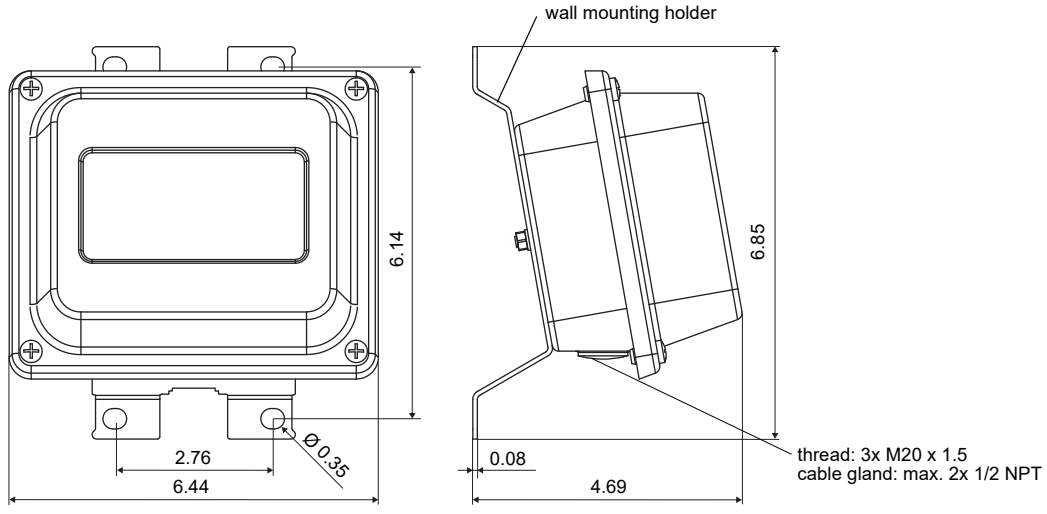
terminal strip	terminal	connection	transducer
KL1	V	signal	
	VS	internal shield	
	RS	internal shield	
	R	signal	

Extension cable

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

Dimensions

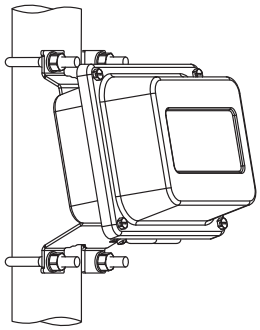
JB0*, JBP*



in inch

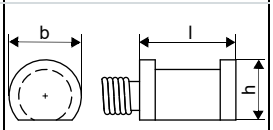
2" pipe mounting kit

JB**

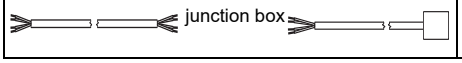


Clamp-on temperature probe (optional)

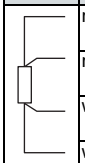
Technical data

PT13N		
design		clamp-on
type		2x Pt1000, matched according to EN 1434
connection		4-wire
measuring range	°F	-40 to +392
accuracy θ		±(0.27 °F + 2 · 10^{-3} · (|θ [°F]| - 32 °F)) class A
accuracy Δθ		≤ 0.06 °F (2x Pt matched, at 50 °F)
housing		360 brass alloy
degree of protection		NEMA 4
dimensions		
length l	in	0.79
width b	in	0.59
height h	in	0.49
dimensional drawing		
weight	lb	0.437
accessories		
thermal conductivity foil 482 °F		x

Connection system

connection with extension cable	direct connection
extension cable 	

Connection

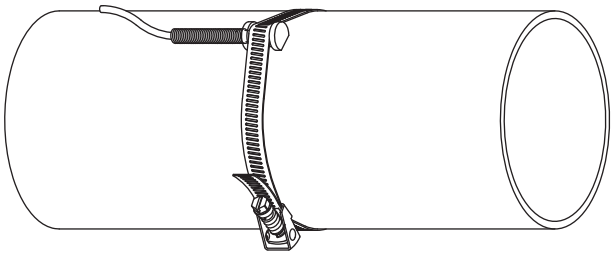
	temperature probe
	red
	red
	white
	white

Cable

		temperature probe	extension cable
type		4 x 24 AWG	4 x 18 AWG
standard length	ft	20	-
max. length	ft	-	656
cable jacket		PTFE	LS PVC

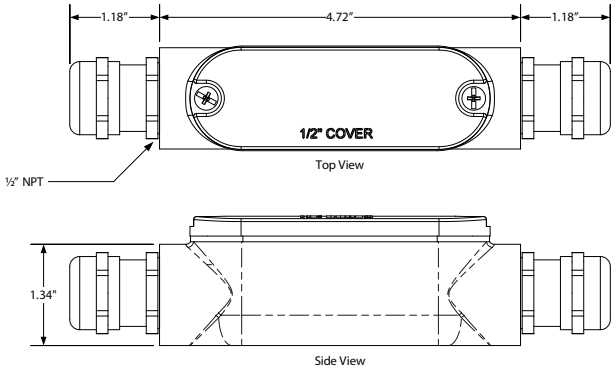
Fixation

tension strap PT13N



material: stainless steel 301, 410

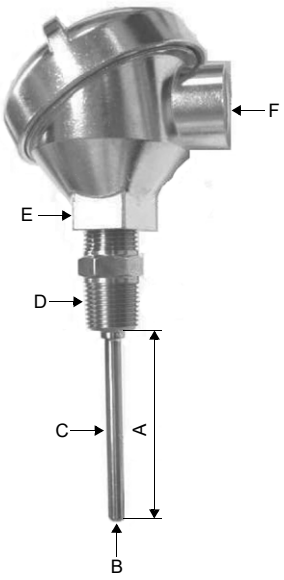
Junction box



Connection

temperature probe	extension cable
red	white
red	black
white	green
white	red

Inline temperature probe (optional)



	type	Pt1000
A	insertion length	6" or specified length
B	resistance	1 000 Ω, 00385
C	insertion length	6" or specified length
	sheath material	stainless steel 316
D	thread	1/2" NPT HEX CPLG. spring loaded
E	head	aluminum screw cover head 4 terminal block
F	thread	3/4" NPT

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