

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

- Integrated measuring system for the determination of thermal energy in real time, enables smart metering
- For inner pipe diameters of 0.5 to 60"
- High-precision temperature measurement using matched pair Pt1000 temperature probes (0.03 °F temperature difference), insertion and surface mount types available
- Extremely high measuring dynamic > 1000 : 1
- Measures even the lowest flow velocities down to 0.03 ft/s – important for the measurement of low flow rates, e.g., during the night
- Permanent acoustic coupling of the ultrasonic transducers by long-lasting coupling pads; does not require further greasing and maintenance
- Bidirectional communication and support of standard bus systems
- Flowmeter can be configured for two independent heat flow measurements
- Integrated calculation functions for two measuring channels, e.g., sum or difference
- Standard configuration includes numerous heat transfer fluids; possible expansion of fluid data sets

Applications

- District heating
 - Heating and cooling systems
 - Cooling towers - condenser water
 - Steam condensate
- Building submetering
 - Heating and cooling systems
 - Internal balancing
- Energy management
 - Energy efficiency
 - Energy monitoring
- Industrial manufacturing facilities
 - Thermal processes
 - Heating and climate control
- Facilities for the generation of renewable energies
 - Solar and geothermal energy, waste heat



FLUXUS F721TE**.*.****A



FLUXUS F721TE**.*.****S



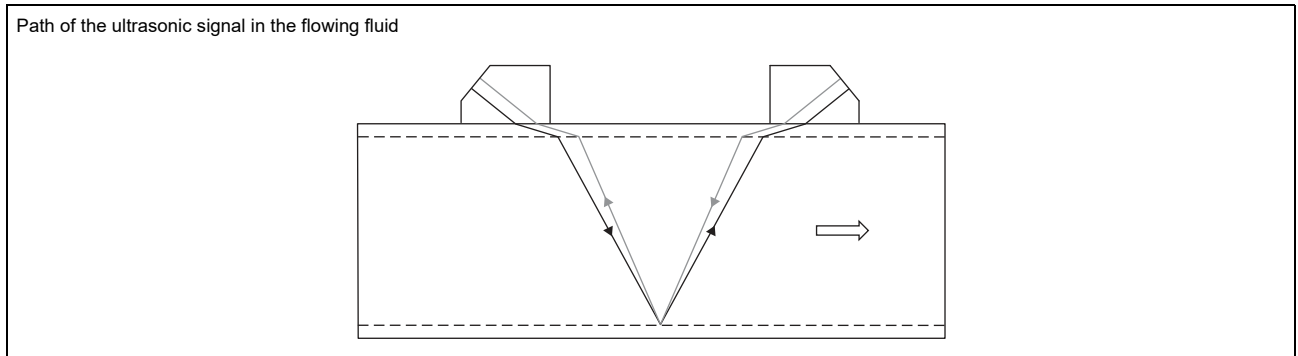
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Function

Measurement principle

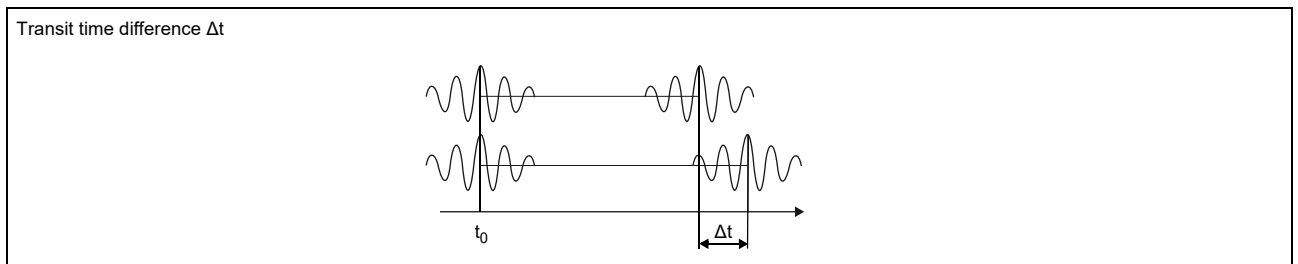
The transducers are mounted on the pipe which is completely filled with the fluid. The ultrasonic signals are emitted alternately by a transducer and received by the other. The physical quantities are determined from the transit times of the ultrasonic signals.



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 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.



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 mechanics calibration factor
- A - cross-sectional pipe area
- k_a - acoustical calibration factor
- Δt - transit time difference
- t_y - average of transit times in the fluid

Calculation of thermal energy rate

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

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

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

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 user-defined 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.

$$\text{MPE} = E_c + E_t + E_f$$

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**

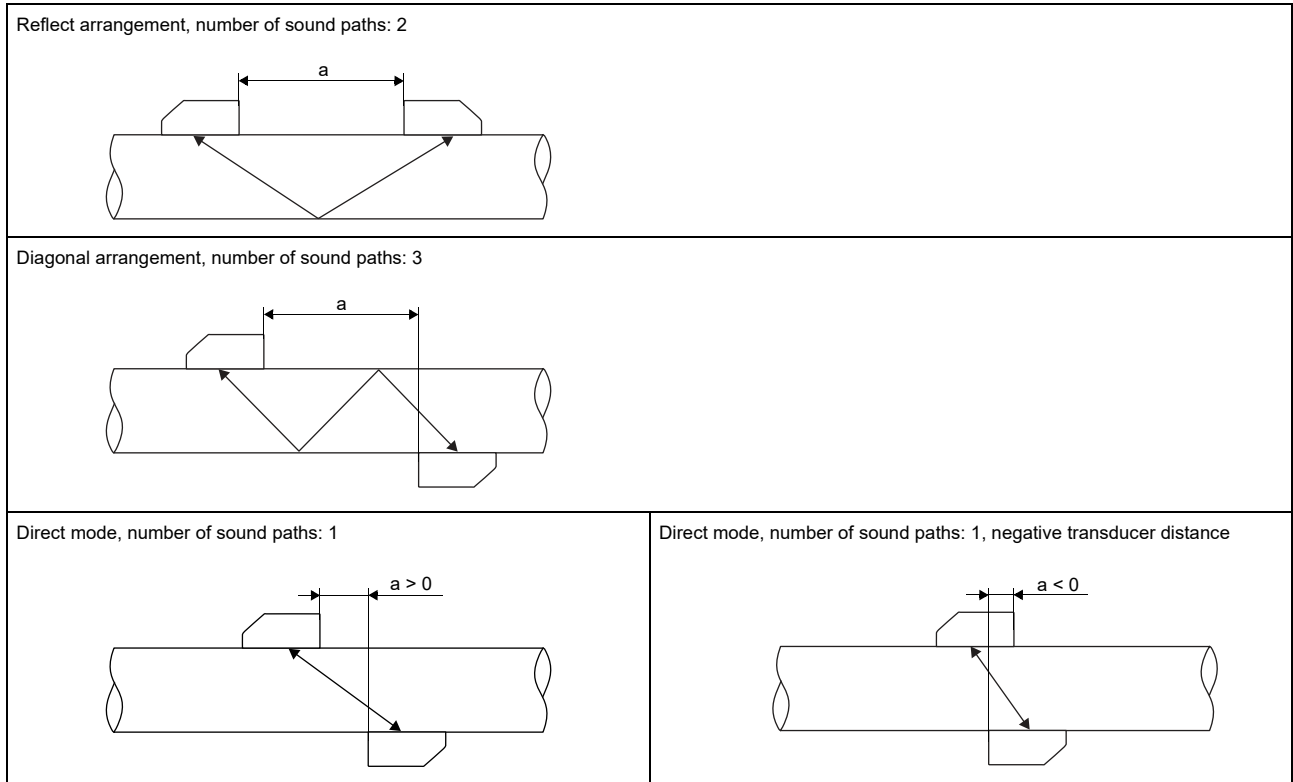
The number of sound paths is odd. The transducers are mounted on opposite sides of the pipe.

- **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.

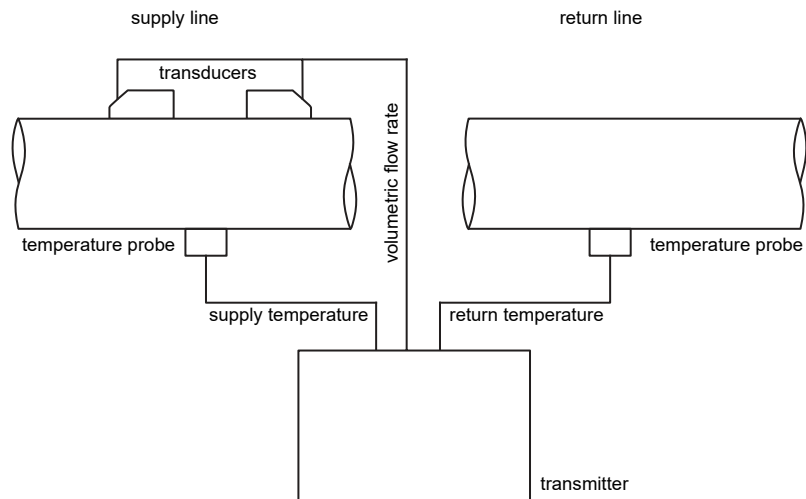
As the transducers can be mounted with the transducer mounting fixture in reflect arrangement or diagonal arrangement, the number of sound paths can be adjusted optimally for the application.



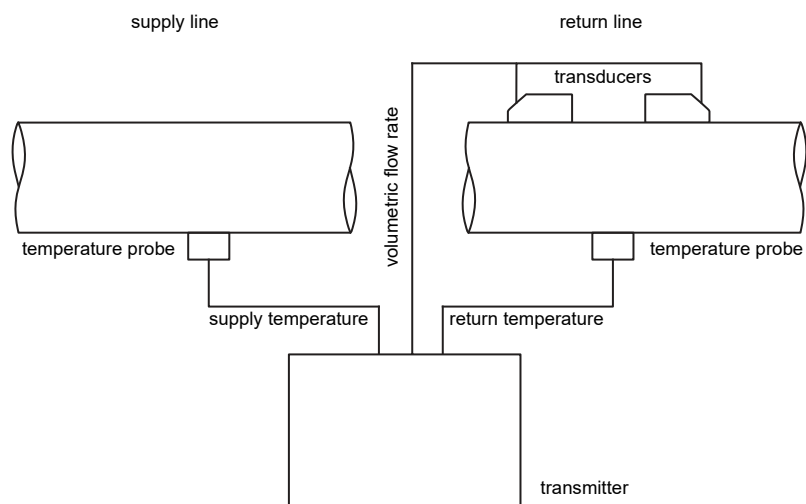
a - transducer distance

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 F721TE-NN0*A | FLUXUS F721TE-NN0*S | FLUXUS F721**-A20*S | FLUXUS F721TE-F20*S |
|---|---|---|---|---|
| |  |  | | |
| design | standard field device nonEx | field device with stainless steel housing nonEx | field device with stainless steel housing zone 2 | field device with stainless steel housing FM Class I Div. 2 |
| application | energy meter | | | |
| measurement | | | | |
| • energy | | | | |
| max. permissible relative error | complies to EN 1434 standard | | | |
| • temperature | | | | |
| temperature difference | ≤ 0.03 °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 | 0.15 % of reading ±0.02 ft/s | | | |
| fluid | <ul style="list-style-type: none"> • water • glycol/H₂O: 20 %, 30 %, 40 %, 50 % • thermal fluids: BP Transcal LT, BP Transcal N, R22 Freon, R134 Freon, ammonia, Shell Termina B, Mobiltherm 594, Mobiltherm 603, R407C, R410A • others on request | | | |
| temperature compensation | corresponding to the recommendations in ANSI/ASME MFC-5.1-2011 | | | |
| measurement uncertainty (volumetric flow rate) | | | | |
| measurement uncertainty of measuring system ¹ | ±0.3 % of reading ±0.02 ft/s includes calibration certificate traceable to NIST calibration facility ISO 17025 accredited | | | |
| measurement uncertainty at the measuring point ² | ±1 % of reading ±0.02 ft/s | | | |
| transmitter | | | | |
| power supply | <ul style="list-style-type: none"> • 100 to 230 V/50 to 60 Hz or • 20 to 32 V DC or • 11 to 16 V DC | | | |
| power consumption | W | < 15 | | |
| number of measuring channels | | 1, optional: 2 | | |
| damping | s | 0 to 100 (adjustable) | | |
| measuring cycle | Hz | 100 to 1000 (1 channel) | | |
| response time | s | 1 (1 channel), option: 0.02 | | |
| housing material | | aluminum, powder coated | stainless steel 316L | |
| degree of protection | | IP65 | IP65 | IP66 |
| dimensions | in | see dimensional drawing | | |
| weight | lb | 11.9 | 11.2 | |
| fixation | | wall mounting, optional: 2" pipe mounting | | |
| ambient temperature | °F | -4 to +131/140 | -4 to +131/140 | -40 to +140 (< -4 °F without operation of the display) |
| display | | 128 x 64 dots, backlight | | |
| menu language | | English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian | | |
| explosion protection | | | | |
| • ATEX/IECEX | | | | |
| marking | - | - | CE 0637  IIB3G IIB2D Ex nA nC ic IIC T4 Gc Ex tb IIIC T120 °C Db T _a -40...+60 °C | - |
| certification ATEX | - | - | IBExU11ATEX1015 | - |
| certification IECEX | - | - | IECEX IBE 11.0008 | - |

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside of explosive atmosphere (housing cover open)

⁴ with inputs and including parametrization of the transmitter

| | FLUXUS F721TE-NN0*A | FLUXUS F721TE-NN0*S | FLUXUS F721**-A20*S | FLUXUS F721TE-F20*S |
|------------------------------------|---|---|---|--|
| • FM | | | | |
| marking | - | - | - | F703Z2**1, F703Z2**2:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 Ta = 60 °C F703Z2**9:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A Ta = 55 °C |
| measuring functions | | | | |
| physical quantities | thermal energy rate, volumetric flow rate, mass flow rate, flow velocity | | | |
| totalizer | thermal energy, 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 | | | |
| communication interfaces | | | | |
| service interfaces | measured value transmission, parametrization of the transmitter: <ul style="list-style-type: none"> • USB³ • LAN³ | | | |
| process interfaces | max. 1 option: <ul style="list-style-type: none"> • RS485 (ASCII sender) • Modbus RTU⁴ • BACnet MS/TP • HART⁴ • Profibus PA⁴ • FF H1⁴ • Modbus TCP⁴ • BACnet IP | max. 1 option: <ul style="list-style-type: none"> • RS485 (ASCII sender) • Modbus RTU⁴ • BACnet MS/TP • HART⁴ • Profibus PA⁴ • FF H1⁴ • Modbus TCP⁴ • BACnet IP | max. 1 option: <ul style="list-style-type: none"> • RS485 (ASCII sender) • Modbus RTU⁴ • BACnet MS/TP • HART⁴ • Profibus PA⁴ • FF H1⁴ • Modbus TCP⁴ • BACnet IP | max. 1 option: <ul style="list-style-type: none"> • RS485 (ASCII sender) • Modbus RTU⁴ • BACnet MS/TP • HART⁴ • Profibus PA⁴ • FF H1⁴ • Modbus TCP⁴ • BACnet IP |
| accessories | | | | |
| serial data kit | USB cable | | | |
| software | <ul style="list-style-type: none"> • FluxDiagReader: download of measured values and parameters, graphical presentation • FluxDiag (optional): download of measurement data, graphical presentation, report generation, parametrization of the transmitter | | | |
| data logger | | | | |
| loggable values | all physical quantities, totalized values and diagnostic values | | | |
| capacity | max. 800 000 measured values | | | |
| outputs | | | | |
| | The outputs are galvanically isolated from the transmitter. | | | |
| number | on request | | | |
| • switchable current output | | | | |
| | The switchable current outputs are menu selectable all together as passive or active. | | | |
| range | mA | 4 to 20 (3.2 to 22) | | |
| accuracy | | 0.04 % of reading ±3 µA | | |
| active output | | $R_{ext} < 350 \Omega$ | | |
| passive output | | $U_{ext} = 8 \text{ to } 30 \text{ V}$, depending on R_{ext} ($R_{ext} < 1 \text{ k}\Omega$ at 30 V) | | |
| • HART | | | | |
| range | mA | 4 to 20 | | |
| accuracy | | 0.1 % of reading ±15 µA | | |
| active output | | $U_{int} = 24 \text{ V}$, $R_{ext} < 500 \Omega$ | | |
| passive output | | $U_{ext} = 10 \text{ to } 24 \text{ V DC}$, depending on R_{ext} ($R_{ext} < 1 \text{ k}\Omega$ at 24 V) | | |
| • voltage output | | | | |
| range | V | 0 to 1 or 0 to 10 | | |
| accuracy | | 0 to 1 V: 0.1 % of reading ±1 mV 0 to 10 V: 0.1 % of reading ±10 mV | | |
| internal resistance | | $R_{int} = 500 \Omega$ | | |
| • frequency output | | | | |
| range | kHz | 0 to 5 | | |
| optorelay | | 24 V/4 mA, $R_{int} = 66.5 \Omega$ | | |
| • binary output | | | | |
| optorelay | | 26 V/100 mA | | |
| Reed relay | | 48 V/100 mA, $R_{int} = 22 \Omega$ | | |
| 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 | optorelay: 1 to 1000 Reed relay: 80 to 1000 | | |

¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside of explosive atmosphere (housing cover open)

⁴ with inputs and including parametrization of the transmitter

| | FLUXUS F721TE-NN0*A | FLUXUS F721TE-NN0*S | FLUXUS F721**-A20*S | FLUXUS F721TE-F20*S |
|----------------------------|---|---------------------|---------------------|---------------------|
| inputs | | | | |
| | The inputs are galvanically isolated from the transmitter. | | | |
| number | max. 4, on request | | | |
| • temperature input | | | | |
| type | Pt100/Pt1000 | | | |
| connection | 4-wire | | | |
| range | °F -238 to +1040 | | | |
| resolution | K 0.01 | | | |
| accuracy | ±0.01 % of reading ±0.03 K | | | |
| • current input | | | | |
| accuracy | 0.1 % of reading ±10 µA | | | |
| active input | U _{int} = 24 V, R _{int} = 50 Ω, P _{int} < 0.5 W, not short-circuit proof | | | |
| • range | mA 0 to 20 | | | |
| passive input | R _{int} = 50 Ω, P _{int} < 0.3 W | | | |
| • range | mA -20 to +20 | | | |
| • voltage input | | | | |
| range | V 0 to 1 | | | |
| accuracy | 0.1 % of reading ±1 mV | | | |
| internal resistance | R _{int} = 1 MΩ | | | |
| • binary input | | | | |
| switching signal | 5 to 30 V, 1 mA | | | 5 to 26 V, 1 mA |
| functions | <ul style="list-style-type: none"> • resetting the measured values • resetting the totalizers • stopping the totalizers • activation of the measuring mode for highly dynamic flows | | | |

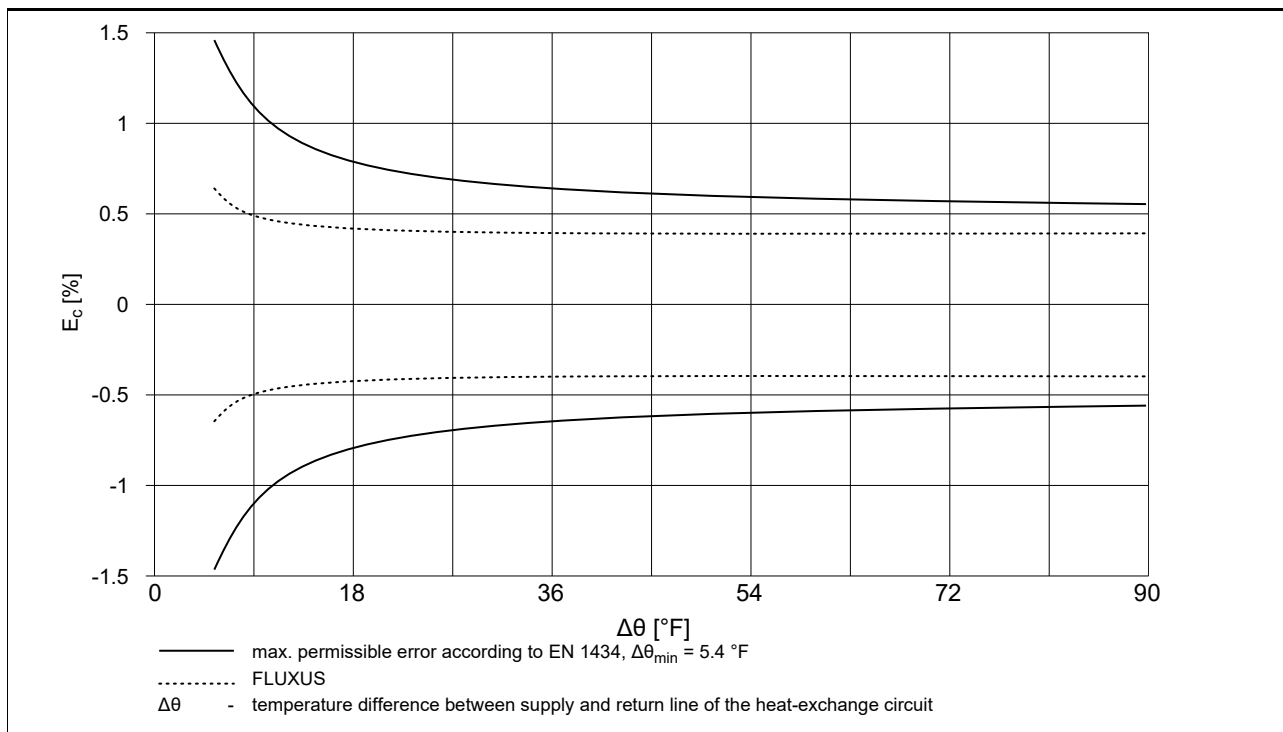
¹ with aperture calibration of the transducers

² for transit time difference principle and reference conditions

³ outside of explosive atmosphere (housing cover open)

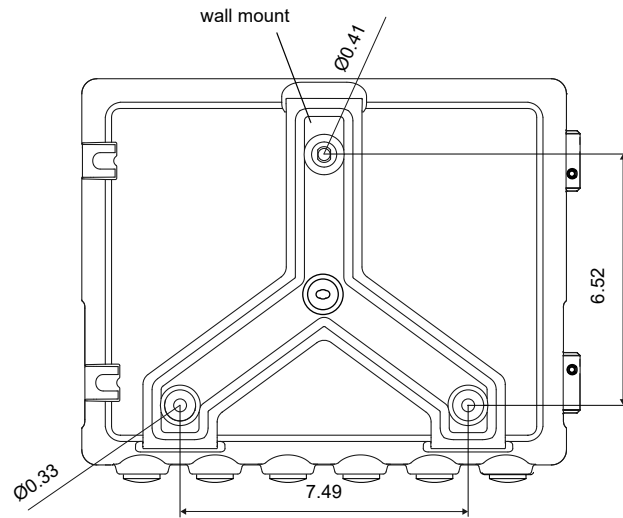
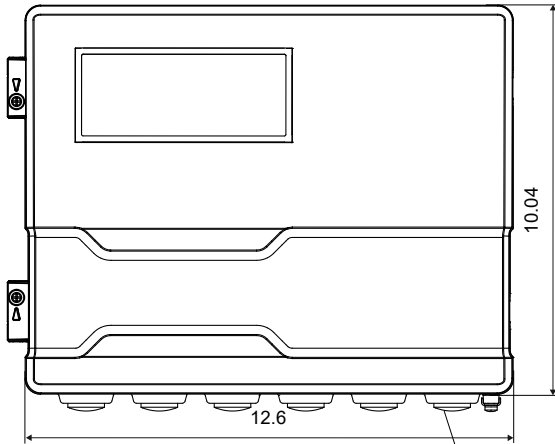
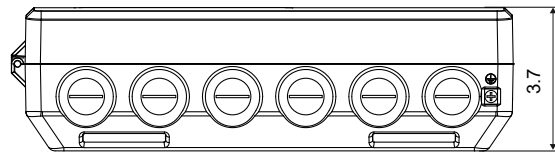
⁴ with inputs and including parametrization of the transmitter

Max. permissible error of the calculator



Dimensions

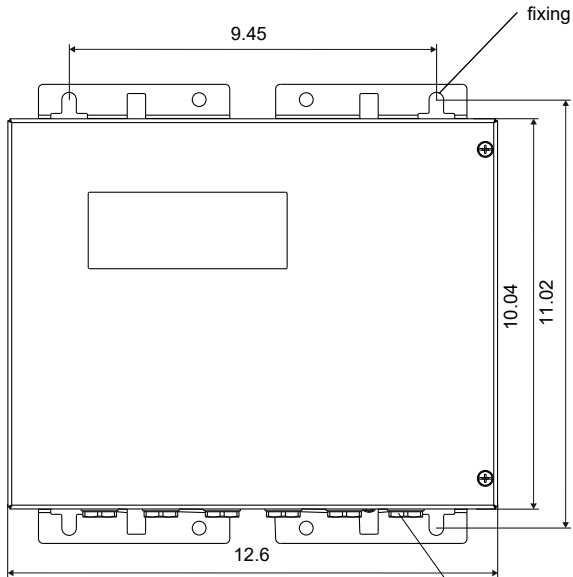
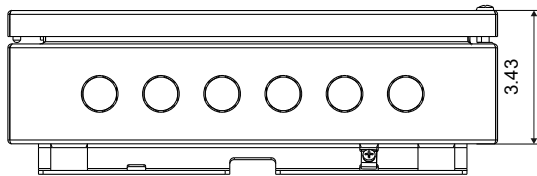
*721**-****A



in inch

thread: 6x M20 x 1.5
cable gland: max. 6x 1/2 NPT

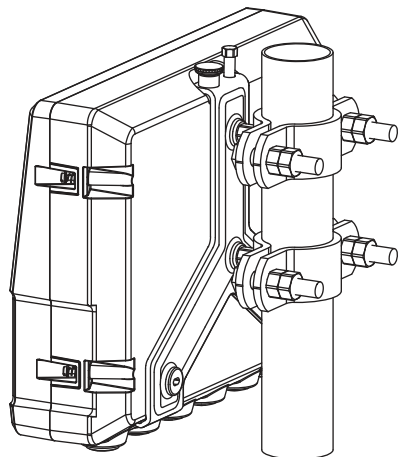
*721**-****S



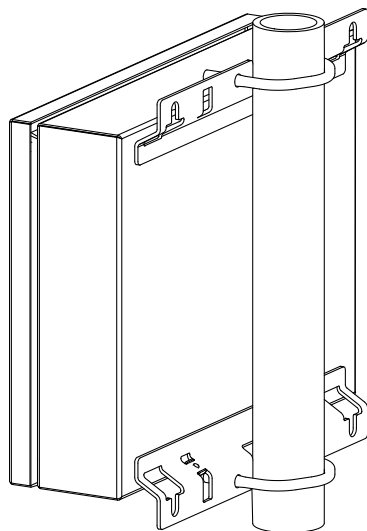
in inch

2" pipe mounting kit

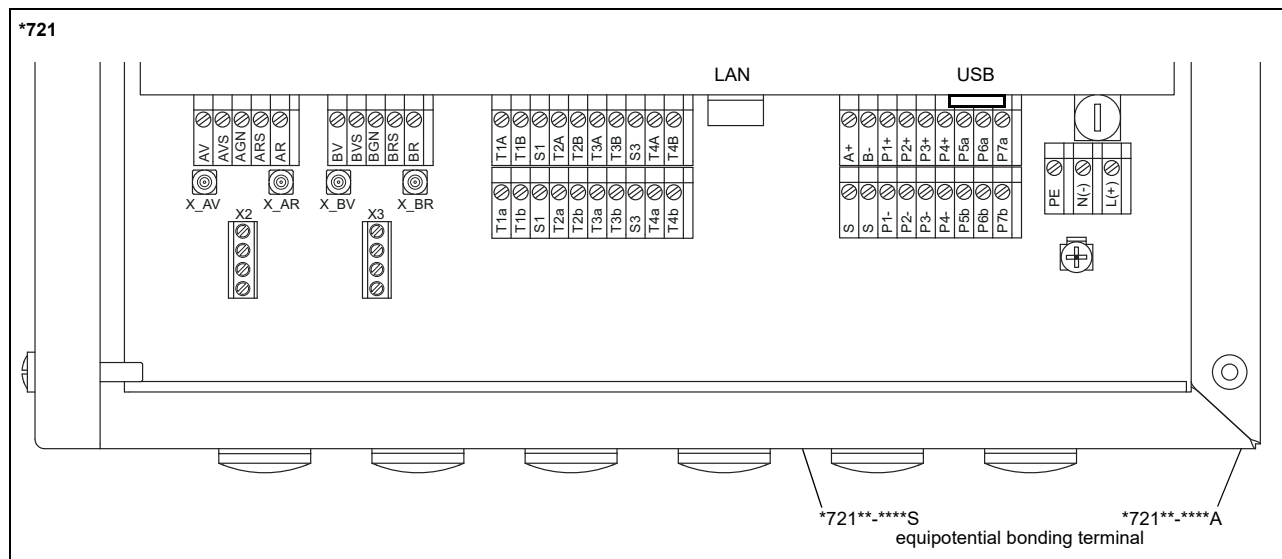
*721**_****A



*721**_****S



Terminal assignment



| power supply ¹ | | |
|---------------------------|-----------------|-----------------|
| terminal | connection (AC) | connection (DC) |
| PE | earth | earth |
| N(-) | neutral | - |
| L(+) | phase | + |

| transducers | | | | | | | |
|---|------------|---------------------|------------|---------------------------------------|---------------------|----------|---------------------|
| transducer cable (transducers ****LI*), extension cable | | | | transducer cable (transducers ****S2) | | | |
| measuring channel A | | measuring channel B | | | measuring channel A | | measuring channel B |
| terminal | connection | terminal | connection | transducer | terminal | terminal | connection |
| AV | signal | BV | signal | ↑ | X_AV | X_BV | SMB connector |
| AVS | shield | BVS | shield | | | | |
| ARS | shield | BRS | shield | ⌋ | X_AR | X_BR | SMB connector |
| AR | signal | BR | signal | | | | |

| outputs ^{1, 2} | | | | |
|--------------------------|---|----------|------------|---|
| terminal | connection | terminal | connection | communication interface |
| P1+ to P4+ P1- to P4- | current output, voltage output, frequency output, binary output (Reed relay), HART (P1) | A+ | signal + | <ul style="list-style-type: none"> • RS485¹ • Modbus RTU¹ • BACnet MS/TP¹ • Profibus PA¹ • FF H1¹ |
| | | B- | signal - | |
| | | S | shield | |
| P5a to P7a P5b to P7b | binary output (optorelay) | USB | type B | <ul style="list-style-type: none"> • service (FluxDiag/FluxDiagReader) |
| | | LAN | RJ45 | |

| analog inputs ^{1, 2} | | | | | | |
|-------------------------------|----------------------------------|---------------------------------|-------------------------------------|---------------------------------|---------------------------|--------------------------|
| terminal | temperature probe | | | | passive sensor connection | active sensor connection |
| | with connector direct connection | connection with extension cable | without connector direct connection | connection with extension cable | | |
| T1a to T4a | red | red | red | white | not connected | not connected |
| T1A to T4A | red/blue | gray | red | black | - | + |
| T1b to T4b | white/blue | blue | white | red | + | not connected |
| T1B to T4B | white | white | white | green | not connected | - |
| S1, S3 | shield | shield | - | - | not connected | not connected |

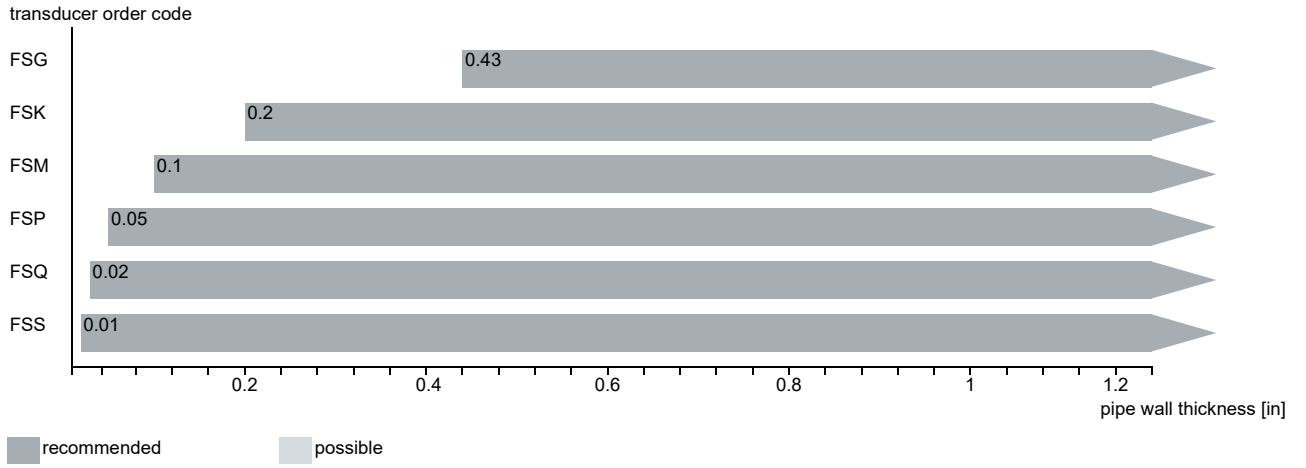
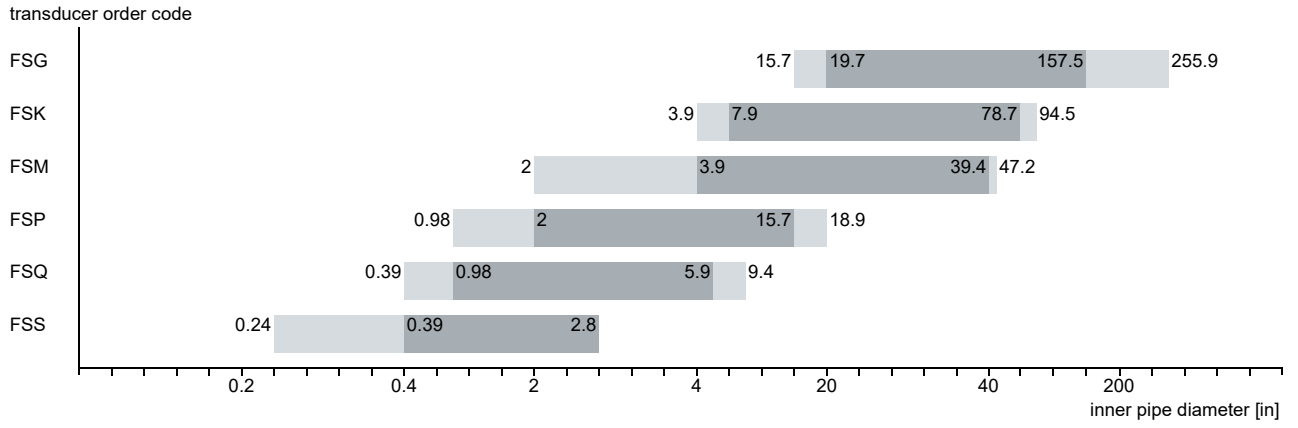
| Binary inputs ^{1, 2} | |
|-------------------------------|------------|
| terminal | connection |
| P1+ to P2+, P1- to P2- | |

¹ cable (by customer):
 - e.g., flexible leads, with insulated wire end ferrules, lead cross sectional area: AWG14 to 24
 - outer diameter of the cable (*721**-****S with ferrite nut): max. 0.3 in

² The number, type and terminal assignment will be customized.

Transducers

Transducer selection



Transducer order code

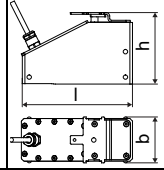
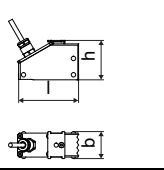
| 1, 2 | 3 | 4 | 5, 6 | 7, 8 | 9 to 11 | no. of character | | | | |
|------------|----------------------|---|---------------------|----------------------|-------------------|------------------|-----------------|------|--------|--|
| transducer | transducer frequency | - | ambient temperature | explosion protection | connection system | - | extension cable | / | option | description |
| FS | | | | | | | | | | set of ultrasonic flow transducers for liquids measurement, shear wave |
| | G | | | | | | | | | 0.2 MHz |
| | K | | | | | | | | | 0.5 MHz |
| | M | | | | | | | | | 1 MHz |
| | P | | | | | | | | | 2 MHz |
| | Q | | | | | | | | | 4 MHz |
| | S | | | | | | | | | 8 MHz |
| | | N | | | | | | | | normal temperature range |
| | | E | | | | | | | | extended temperature range |
| | | | NN | | | | | | | not explosion proof |
| | | | A2 | | | | | | | ATEX zone 2/IECEX zone 2 |
| | | | A1 | | | | | | | ATEX zone 1/IECEX zone 1 |
| | | | F2 | | | | | | | FM Class I Div. 2 |
| | | | | TS | | | | | | direct connection or connection via junction box |
| | | | | | | | XXX | | | 0 m: without extension cable > 0 m: with extension cable |
| | | | | | | | | LC | | long transducer cable |
| | | | | | | | | IP68 | | degree of protection IP68 |
| | | | | | | | | OS | | housing with stainless steel 316 |

Technical data

Shear wave transducers (zone 2 - FM Class I Div. 2 - nonEx, TS)



| order code | FSG-N**TS/** | FSK-N**TS/** | FSM-N**TS/** | FSP-N**TS/** | FSQ-N**TS/** | FSS-N**TS/** |
|---------------------------------|---|--------------|--------------|--------------|--------------|---------------------|
| technical type | C(DL)G1N52 | C(DL)K1N52 | C(DL)M2N52 | C(DL)P2N52 | C(DL)Q2N52 | CDS1N52 |
| transducer frequency/MHz | 0.2 | 0.5 | 1 | 2 | 4 | 8 |
| inner pipe diameter d | | | | | | |
| min. extended | in 15.7 | 3.9 | 2 | 0.98 | 0.39 | 0.24 |
| min. recommended | in 19.7 | 7.9 | 3.9 | 2 | 0.98 | 0.39 |
| max. recommended | in 157.5 | 78.7 | 39.4 | 15.7 | 5.9 | 2.8 |
| max. extended | in 255.9 | 94.5 | 47.2 | 18.9 | 9.4 | 2.8 |
| pipe wall thickness | | | | | | |
| min. | in 0.43 | 0.2 | 0.1 | 0.05 | 0.02 | 0.01 |
| material | | | | | | |
| housing | PEEK with stainless steel cap 304, ***-*****/OS: 316L | | | | | stainless steel 304 |
| contact surface | PEEK | | | | | PEI |
| degree of protection | NEMA 6 | | | | | NEMA 4 |
| transducer cable | | | | | | |
| type | 1699 | | | | | |
| length | ft 16 | 13 | | | 9 | 6 |
| length (**-*****/LC) | ft 29 | | | | | - |
| dimensions | | | | | | |
| length l | in 5.1 | 4.98 | 2.52 | 1.57 | | 0.98 |
| width b | in 2.01 | 2.01 | 1.26 | 0.87 | | 0.51 |
| height h | in 2.64 | 2.66 | 1.59 | 1 | | 0.67 |
| dimensional drawing | | | | | | |
| weight (without cable) | lb 1 | 0.79 | 0.15 | 0.04 | | 0.01 |
| pipe surface temperature | | | | | | |
| min. | °F -40 | | | | | -22 |
| max. | °F +266 | | | | | +266 |
| ambient temperature | | | | | | |
| min. | °F -40 | | | | | -22 |
| max. | °F +266 | | | | | +266 |
| temperature compensation | X | | | | | - |
| explosion protection | | | | | | |
| • ATEX/IECEX | | | | | | |
| order code | FSG-NA2TS/** | FSK-NA2TS/** | FSM-NA2TS/** | FSP-NA2TS/** | FSQ-NA2TS/** | - |
| pipe surface temperature (Ex) | | | | | | |
| • min. | °C -55 | | | | | - |
| • max. | °C gas: +190, dust: +180 | | | | | - |
| marking | CE 0637 Ex II 3G II 2D Ex nA IIC T6...T2 Gc Ex tb IIIC TX Db | | | | | - |
| certification ATEX | IBExU10ATEX1163 X | | | | | - |
| certification IECEX | IECEX IBE 12.0005X | | | | | - |
| • FM | | | | | | |
| order code | FSG-NF2TS/** | FSK-NF2TS/** | FSM-NF2TS/** | FSP-NF2TS/** | FSQ-NF2TS/** | FSS-NF2TS/** |
| pipe surface temperature (Ex) | | | | | | |
| • min. | °F -40 | | | | | |
| • max. | °F +257 | +374 | | | | +257 |
| degree of protection | IP66 | | | | | |
| marking | NI/Cl. I, II, III/Div. 2 / GP A, B, C, D, E, F, G/ Temp. Codes dwg 3860 | | | | | |

Shear wave transducers (zone 2 - nonEx, TS, IP68)

| order code | | FSG-N**TS/IP68 | FSK-N**TS/IP68 | FSM-N**TS/IP68 | FSP-N**TS/IP68 |
|---------------------------------|-----|---|----------------|---|----------------|
| technical type | | CDG1LI8 | CDK1LI8 | CDM2LI8 | CDP2LI8 |
| transducer frequency | MHz | 0.2 | 0.5 | 1 | 2 |
| inner pipe diameter d | | | | | |
| min. extended | in | 15.7 | 3.9 | 2 | 0.98 |
| min. recommended | in | 19.7 | 7.9 | 3.9 | 2 |
| max. recommended | in | 157.5 | 78.7 | 39.4 | 15.7 |
| max. extended | in | 255.9 | 94.5 | 47.2 | 18.9 |
| pipe wall thickness | | | | | |
| min. | in | 0.43 | 0.2 | 0.1 | 0.05 |
| material | | | | | |
| housing | | PEEK with stainless steel cap 316Ti | | | |
| contact surface | | PEEK | | | |
| degree of protection | | IP68 ¹ | | | |
| transducer cable | | | | | |
| type | | 2550 | | | |
| length | ft | 39 | | | |
| dimensions | | | | | |
| length l | in | 5.12 | | 2.76 | |
| width b | in | 2.13 | | 1.26 | |
| height h | in | 3.29 | | 1.81 | |
| dimensional drawing | |  | |  | |
| weight (without cable) | lb | 0.95 | | 0.19 | |
| pipe surface temperature | | | | | |
| min. | °F | -40 | | | |
| max. | °F | +212 | | | |
| ambient temperature | | | | | |
| min. | °F | -40 | | | |
| max. | °F | +212 | | | |
| temperature compensation | | x | | | |
| explosion protection | | | | | |
| • ATEX/IECEX | | | | | |
| order code | | FSG-NA2TS/IP68 | FSK-NA2TS/IP68 | FSM-NA2TS/IP68 | FSP-NA2TS/IP68 |
| pipe surface temperature (Ex) | | | | | |
| • min. | °C | -40 | | | |
| • max. | °C | gas: +90, dust: +80 | | | |
| marking | | CE 0637 Ex II 3G II 2D Ex nA IIC T6...T2 Gc Ex tb IIIC TX Db | | | |
| certification ATEX | | IBExU10ATEX1163 X | | | |
| certification IECEX | | IECEX IBE 12.0005X | | | |

¹ test conditions: 3 months/29 psi (65 ft)/36 °F

Shear wave transducers (zone 2 - FM Class I Div. 2 - nonEx, TS, extended temperature range)

| | | | | |
|---------------------------------|-----|---|--------------|--------------|
| order code | | FSM-E**TS/** | FSP-E**TS/** | FSQ-E**TS/** |
| technical type | | C(DL)M2E52 | C(DL)P2E52 | C(DL)Q2E52 |
| transducer frequency | MHz | 1 | 2 | 4 |
| inner pipe diameter d | | | | |
| min. extended | in | 2 | 0.98 | 0.39 |
| min. recommended | in | 3.9 | 2 | 0.98 |
| max. recommended | in | 39.4 | 15.7 | 5.9 |
| max. extended | in | 47.2 | 18.9 | 9.4 |
| pipe wall thickness | | | | |
| min. | in | 0.1 | 0.05 | 0.02 |
| material | | | | |
| housing | | PI with stainless steel cap 304, ***-****/OS: 316L | | |
| contact surface | | PI | | |
| degree of protection | | NEMA 4 | | |
| transducer cable | | | | |
| type | | 6111 | | |
| length | ft | 13 | | 9 |
| length (**-****/LC) | ft | 29 | | |
| 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 | -22 | | -22 |
| max. | °F | +450 ¹ | | +392 |
| ambient temperature | | | | |
| min. | °F | -22 | | -22 |
| max. | °F | +104 +140 ² +392 ³ | | +392 |
| temperature compensation | | x | | |
| explosion protection | | | | |
| • ATEX/IECEX | | | | |
| order code | | FSM-EA2TS/** | FSP-EA2TS/** | FSQ-EA2TS/** |
| pipe surface temperature (Ex) | | | | |
| • min. | °C | -45 | | |
| • max. | °C | gas: +235 ¹ , dust: +225 ¹ | | |
| marking | | CE 0637 Ex II 3G II 2D Ex nA IIC T6...T2 Gc Ex tb IIIA TX Db | | |
| certification ATEX | | IBExU10ATEX1163 X | | |
| certification IECEX | | IECEX IBE 12.0005X | | |
| • FM | | | | |
| order code | | FSM-EF2TS/** | FSP-EF2TS/** | FSQ-EF2TS/** |
| pipe surface temperature (Ex) | | | | |
| • min. | °F | -40 | | |
| • max. | °F | +455 ¹ | | |
| degree of protection | | IP66 | | |
| marking | |  NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860 | | |

¹ > +200 °C/+392 °F:

Variofix L (nonEx, Ex) or quick release clasps and tension straps (nonEx)
 observe the insulation instruction
 Ex: ambient temperature max. +40 °C/+104 °F

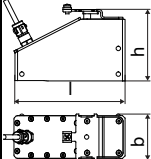
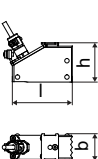
² pipe surface temperature +200 to +232 °C/+392 to +450 °F: quick release clasps and tension straps

³ pipe surface temperature max. +200 °C/+392 °F

Shear wave transducers (zone 1, TS)

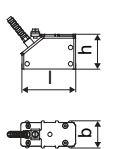
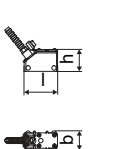

| order code | | FSG-N*1TS/** | FSK-N*1TS/** | FSM-N*1TS/** | FSP-N*1TS/** | FSQ-N*1TS/** |
|---------------------------------|-----|--|--------------|--------------|--------------|--------------|
| technical type | | C(DL)G1N81 | C(DL)K1N81 | C(DL)M2N81 | C(DL)P2N81 | C(DL)Q2N81 |
| transducer frequency | MHz | 0.2 | 0.5 | 1 | 2 | 4 |
| inner pipe diameter d | | | | | | |
| min. extended | in | 15.7 | 3.9 | 2 | 0.98 | 0.39 |
| min. recommended | in | 19.7 | 7.9 | 3.9 | 2 | 0.98 |
| max. recommended | in | 157.5 | 78.7 | 39.4 | 15.7 | 5.9 |
| max. extended | in | 255.9 | 94.5 | 47.2 | 18.9 | 9.4 |
| pipe wall thickness | | | | | | |
| min. | in | 0.43 | 0.2 | 0.1 | 0.05 | 0.02 |
| material | | | | | | |
| housing | | PEEK with stainless steel cap 304 , ***-*****/OS: 316L | | | | |
| contact surface | | PEEK | | | | |
| degree of protection | | IP65 | IP66 | | | IP65 |
| transducer cable | | | | | | |
| type | | 1699 | | | | |
| length | ft | 16 | | 13 | | 9 |
| length (**-*****/LC) | ft | 29 | | | | |
| dimensions | | | | | | |
| length l | in | 5.1 | 4.98 | 2.52 | | 1.57 |
| width b | in | 2.01 | 2.01 | 1.26 | | 0.87 |
| height h | in | 2.64 | 2.66 | 1.59 | | 1 |
| dimensional drawing | | | | | | |
| weight (without cable) | lb | 1 | 0.79 | 0.15 | | 0.04 |
| pipe surface temperature | | | | | | |
| min. | °F | -40 | | | | |
| max. | °F | +266 | | | | |
| ambient temperature | | | | | | |
| min. | °F | -40 | | | | |
| max. | °F | +266 | | | | |
| temperature compensation | | x | | | | |
| explosion protection | | | | | | |
| • ATEX/IECEx | | | | | | |
| order code | | FSG-NA1TS/** | FSK-NA1TS/** | FSM-NA1TS/** | FSP-NA1TS/** | FSQ-NA1TS/** |
| pipe surface temperature (Ex) | | | | | | |
| • min. | °C | -55 | | | | |
| • max. | °C | +180 | | | | |
| marking | | CE 0637 II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db | | | | |
| certification ATEX | | IBExU07ATEX1168 X | | | | |
| certification IECEx | | IECEx IBE 08.0007X | | | | |

Shear wave transducers (zone 1, TS, IP68)

| | | | | | |
|---------------------------------|-----|---|----------------|---|----------------|
| order code | | FSG-N*1TS/IP68 | FSK-N*1TS/IP68 | FSM-N*1TS/IP68 | FSP-N*1TS/IP68 |
| technical type | | CDG1LI1 | CDK1LI1 | CDM2LI1 | CDP2LI1 |
| transducer frequency | MHz | 0.2 | 0.5 | 1 | 2 |
| inner pipe diameter d | | | | | |
| min. extended | in | 15.7 | 3.9 | 2 | 0.98 |
| min. recommended | in | 19.7 | 7.9 | 3.9 | 2 |
| max. recommended | in | 157.5 | 78.7 | 39.4 | 15.7 |
| max. extended | in | 255.9 | 94.5 | 47.2 | 18.9 |
| pipe wall thickness | | | | | |
| min. | in | 0.43 | 0.2 | 0.1 | 0.05 |
| material | | | | | |
| housing | | PEEK with stainless steel cap 316Ti | | | |
| contact surface | | PEEK | | | |
| degree of protection | | IP68 ¹ | | | |
| transducer cable | | | | | |
| type | | 2550 | | | |
| length | ft | 39 | | | |
| dimensions | | | | | |
| length l | in | 5.12 | | 2.76 | |
| width b | in | 2.13 | | 1.26 | |
| height h | in | 3.29 | | 1.81 | |
| dimensional drawing | |  | |  | |
| weight (without cable) | lb | 0.95 | | 0.19 | |
| pipe surface temperature | | | | | |
| min. | °F | -40 | | | |
| max. | °F | +212 | | | |
| ambient temperature | | | | | |
| min. | °F | -40 | | | |
| max. | °F | +212 | | | |
| temperature compensation | | x | | | |
| explosion protection | | | | | |
| • ATEX/IECEX | | | | | |
| order code | | FSG-NA1TS/IP68 | FSK-NA1TS/IP68 | FSM-NA1TS/IP68 | FSP-NA1TS/IP68 |
| pipe surface temperature (Ex) | | | | | |
| • min. | °C | -55 | | | |
| • max. | °C | +80 | | | |
| marking | | CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db | | | |
| certification ATEX | | IBExU07ATEX1168 X | | | |
| certification IECEX | | IECEX IBE 08.0007X | | | |

¹ test conditions: 3 months/29 psi (65 ft)/36 °F

Shear wave transducers (zone 1, TS, extended temperature range)

| | | | | |
|---------------------------------|-----|---|--------------|---|
| order code | | FSM-E*1TS/** | FSP-E*1TS/** | FSQ-E*1TS/** |
| technical type | | C(DL)M2E85 | C(DL)P2E85 | C(DL)Q2E85 |
| transducer frequency | MHz | 1 | 2 | 4 |
| inner pipe diameter d | | | | |
| min. extended | in | 2 | 0.98 | 0.39 |
| min. recommended | in | 3.9 | 2 | 0.98 |
| max. recommended | in | 39.4 | 15.7 | 5.9 |
| max. extended | in | 47.2 | 18.9 | 9.4 |
| pipe wall thickness | | | | |
| min. | in | 0.1 | 0.05 | 0.02 |
| material | | | | |
| housing | | PI with stainless steel cap 304, ***-****/OS: 316L | | |
| contact surface | | PI | | |
| degree of protection | | IP66 | | IP56 |
| transducer cable | | | | |
| type | | 6111 | | |
| length | ft | 13 | | 9 |
| length (***/****/LC) | ft | 29 | | |
| 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 | -22 | | -22 |
| max. | °F | +450 ¹ | | +392 |
| ambient temperature | | | | |
| min. | °F | -22 | | -22 |
| max. | °F | +104 +392 ² | | +392 |
| temperature compensation | | x | | |
| explosion protection | | | | |
| • ATEX/IECEx | | | | |
| order code | | FSM-EA1TS/** | FSP-EA1TS/** | FSQ-EA1TS/** |
| pipe surface temperature (Ex) | | | | |
| • min. | °C | -45 | | |
| • max. | °C | +225 ¹ | | |
| marking | | CE 0637  II2G II2D Ex q IIC T6...T2 Gb Ex tb IIIA TX Db | | |
| certification ATEX | | IBEXU07ATEX1168 X | | |
| certification IECEx | | IECEx IBE 08.0007X | | |

¹ > +200 °C/+392 °F:

Variofix L

observe the insulation instruction

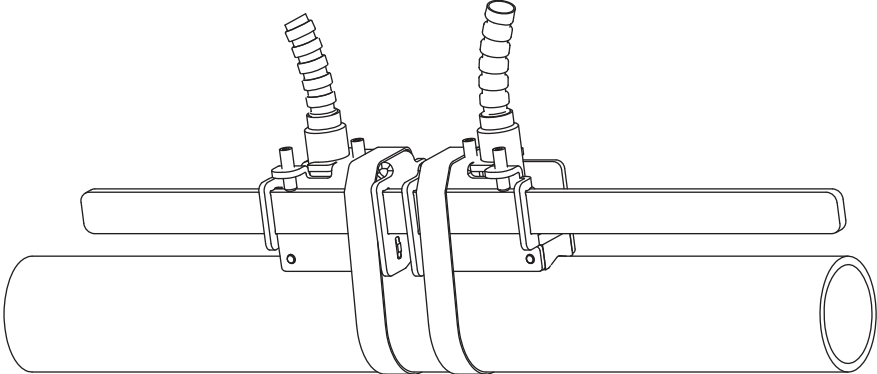
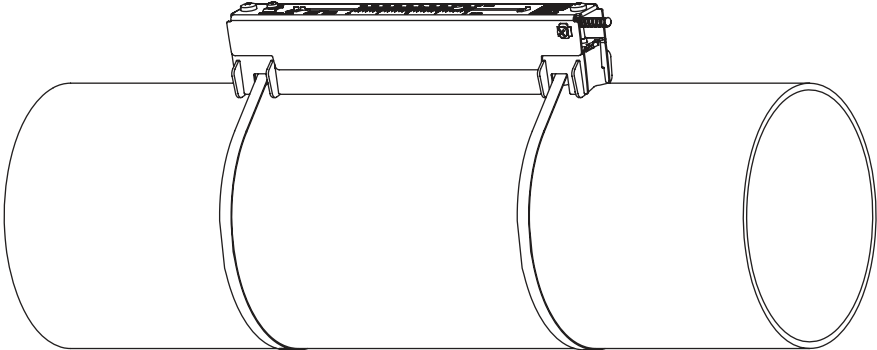
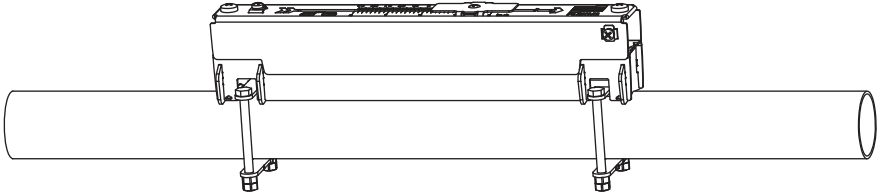
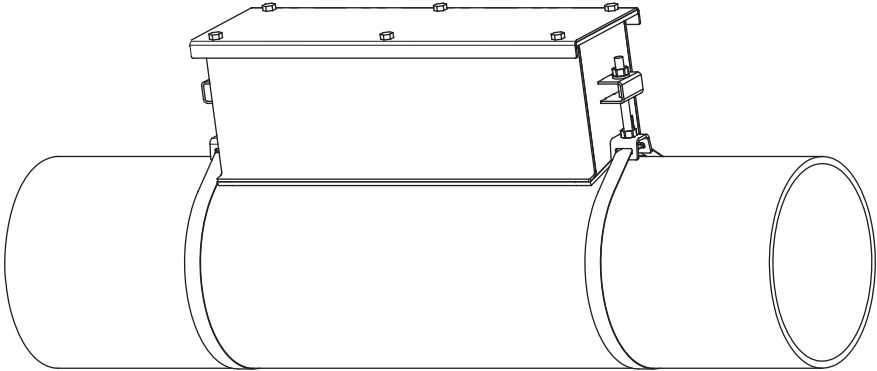
ambient temperature max. +40 °C/+104 °F

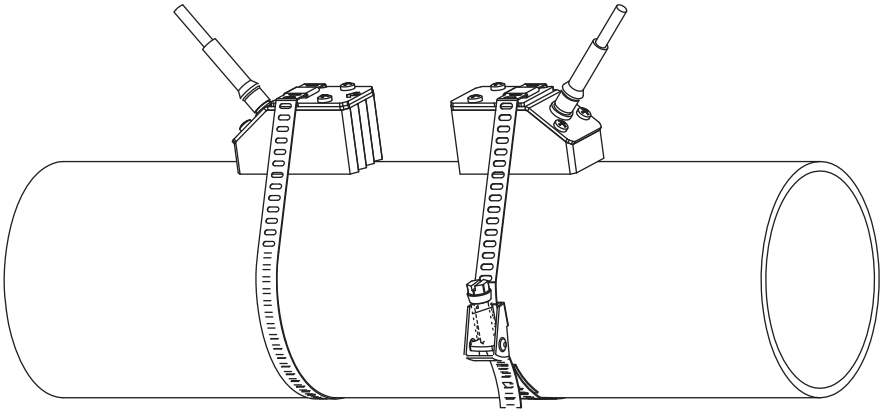
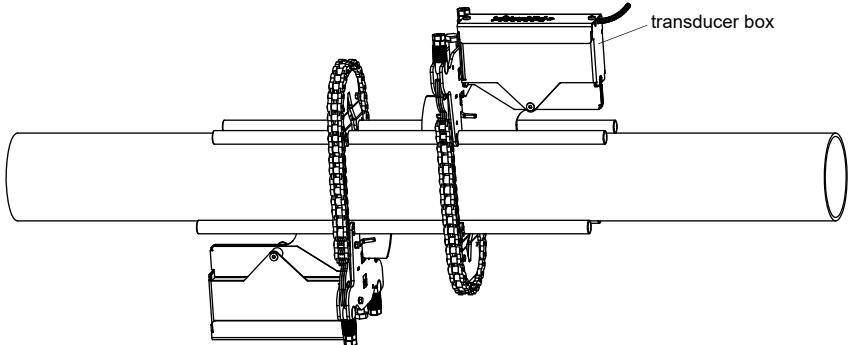
² pipe surface temperature max. +200 °C/+392 °F

Transducer mounting fixture

Order code

| 1, 2 | 3 | 4 | 5 | 6 | 7 to 9 | no. of character |
|-----------------------------|------------|-------------------------|------|----------|---------------------|---|
| transducer mounting fixture | transducer | measurement arrangement | size | fixation | outer pipe diameter | option |
| | | | | | | description |
| PL | | | | | | PermaLok |
| VL | | | | | | PermaRail |
| WI | | | | | | transducer box for WaveInjector |
| | K | | | | | transducers with transducer frequency G, K |
| | M | | | | | transducers with transducer frequency M, P |
| | Q | | | | | transducers with transducer frequency Q |
| | S | | | | | transducers with transducer frequency S |
| | | D | | | | reflect arrangement or diagonal arrangement/direct mode |
| | | R | | | | reflect arrangement |
| | | | S | | | small |
| | | | M | | | medium |
| | | | L | | | large |
| | | | | B | | bolts |
| | | | | S | | tension straps |
| | | | | W | | welding |
| | | | | N | | without fixation |
| | | | | | SK1 | 0.5 to 2.5 in |
| | | | | | SK2 | 3 to 6 in |
| | | | | | SK3 | 8 to 10 in |
| | | | | | SK4 | 12 to 18 in |
| | | | | | SK5 | 20 to 36 in |
| | | | | | SK6 | 42 to 100 in |
| | | | | | SK7 | 100 to 170 in |
| | | | | | SK8 | 170 to 370 in |
| | | | | | NDR | any |
| | | | | | | IP68 for transducers with degree of protection IP68 |
| | | | | | | OS housing with stainless steel 316 |
| | | | | | | Z special design |

| | |
|---|--|
| <p>PermaRail (VLS)</p>  | <p>transducer frequency: S material: stainless steel 304, 303</p> |
| <p>PermaRail (VLK, VLM, VLQ)</p>  | <p>material: stainless steel 304, 301, 410 option OS: 316Ti, 316L, 17-7PH inner length: VLK: 13.7 in, option IP68: 14.5 in VLM: 9.2 in VLQ: 6.9 in dimensions: VLK: 16.65 x 3.54 x 3.66 in option IP68: 17.44 x 3.7 x 4.13 in VLM: 12.17 x 2.24 x 2.48 in VLQ: 9.72 x 1.69 x 1.85 in</p> |
| <p>PermaRail with bolt mounting plates (VL**-B)</p>  | <p>material: stainless steel 304, 301, 410 option OS: 316Ti, 316L, 17-7PH inner length: VLM: 9.2 in VLQ: 6.9 in dimensions: VLM: 12.17 x 2.24 x 2.48 in VLQ: 9.72 x 1.69 x 1.85 in outer pipe diameter: max. 1.9 in</p> |
| <p>PermaLok PL</p>  | <p>material: stainless steel 316</p> |

| | |
|--|---|
| <p>quick release clasp and tension straps</p>  <p>The drawing shows a cylindrical component with two quick release clasps mounted on its top surface. Each clasp is connected to a tension strap that loops around the cylinder. The clasps have a lever mechanism for easy attachment and detachment.</p> | <p>material: stainless steel 410, 200</p> |
| <p>transducer box WI for WaveInjector</p>  <p>The drawing shows a cylindrical component with a transducer box mounted on its top surface. The transducer box is connected to a chain drive mechanism that loops around the cylinder. A label 'transducer box' points to the rectangular component on top of the cylinder.</p> | <p>see Technical specification TSWaveInjectorVx-x</p> |

Coupling materials for transducers

| | normal temperature range (4th character of transducer order code = N) | | extended temperature range (4th character of transducer order code = E) | | | WaveInjector WI-400 | |
|-----------------------|--|--|--|---|----------------------|--|--|
| | < 212 °F | < 338 °F | < 302 °F | < 392 °F | 392 to 464 °F | < 536 °F | 536 to 752 °F |
| < 24 h | coupling compound type N or coupling pad type VT | coupling compound type E or coupling pad type VT | coupling compound type E or coupling pad type VT | coupling compound type E or H or coupling pad type VT | coupling pad type TF | coupling pad type A and coupling pad type VT | coupling pad type B and coupling pad type VT |
| long time measurement | coupling pad type VT ¹ | coupling pad type VT ² | coupling pad type VT ¹ | coupling pad type VT ² | coupling pad type TF | coupling pad type A and coupling pad type VT | coupling pad type B and coupling pad type VT |

¹ < 5 years

² < 6 months

Technical data

| type | ambient temperature °F |
|--------------------------|---------------------------|
| coupling compound type N | -22 to +266 |
| coupling compound type E | -22 to +392 |
| coupling compound type H | -22 to +482 |
| coupling pad type A | max. 536 |
| coupling pad type B | 536 to 752 |
| coupling pad type VT | 14 to +392 |
| coupling pad type TF | 392 to 464 |

Connection systems

| connection system TS | | |
|---------------------------------|-------------------|----------------------------|
| connection with extension cable | direct connection | transducers technical type |
| <p>JB01</p> | | <p>*****8*</p> |
| <p>JBP3</p> | | <p>****L *</p> |
| <p>JB02, JB03, JB04</p> | | <p>*****52</p> |

Cable

| transducer cable | | | | |
|---------------------|-------|---|-------------------------|---|
| type | | 1699 | 2550 | 6111 |
| weight | lb/ft | 0.06 | 0.02 | 0.06 |
| ambient temperature | °F | -67 to +392 | -40 to +212 | -148 to +437 |
| properties | | | longitudinal watertight | |
| cable jacket | | | | |
| material | | PTFE | PUR | PFA |
| outer diameter | in | 0.11 | 0.2 ±0.01 | 0.11 |
| thickness | in | 0.01 | 0.04 | 0.02 |
| color | | brown | gray | white |
| shield | | x | x | x |
| sheath | | | | |
| material | | stainless steel 304 option OS: 316Ti | - | stainless steel 304 option OS: 316Ti |
| outer diameter | in | 0.31 | - | 0.31 |

| extension cable | | | | |
|---------------------|-------|--|--|--|
| type | | 2615 | 5245 | |
| weight | lb/ft | 0.12 | 0.26 | |
| ambient temperature | °F | -22 to +158 | -22 to +158 | |
| 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 | in | 0.47 | 0.47 | |
| thickness | in | 0.08 | 0.08 | |
| color | | black | black | |
| shield | | x | x | |
| sheath | | | | |
| material | | - | steel wire braid with copolymer sheath | |
| outer diameter | in | - | 0.61 | |

Cable length

| transducer frequency | | F, G, H, K | | M, P | | Q | | S | |
|----------------------------|----|------------|-------|------|-------|----|-------|---|-------|
| connection system TS | | | | | | | | | |
| transducers technical type | | x | l | x | l | x | l | x | l |
| *(DR)***8* | ft | 16 | ≤ 984 | 13 | ≤ 984 | 9 | ≤ 295 | - | - |
| option LC: *(LT)***8* | ft | 29 | ≤ 984 | 29 | ≤ 984 | 29 | ≤ 295 | - | - |
| *(DR)***5* | ft | 16 | ≤ 984 | 13 | ≤ 984 | 9 | ≤ 295 | 6 | ≤ 131 |
| option LC: *(LT)***5* | ft | 29 | ≤ 984 | 29 | ≤ 984 | 29 | ≤ 295 | - | - |
| option IP68: ****L* | ft | 39 | ≤ 984 | 39 | ≤ 984 | - | - | - | - |

x = transducer cable length

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

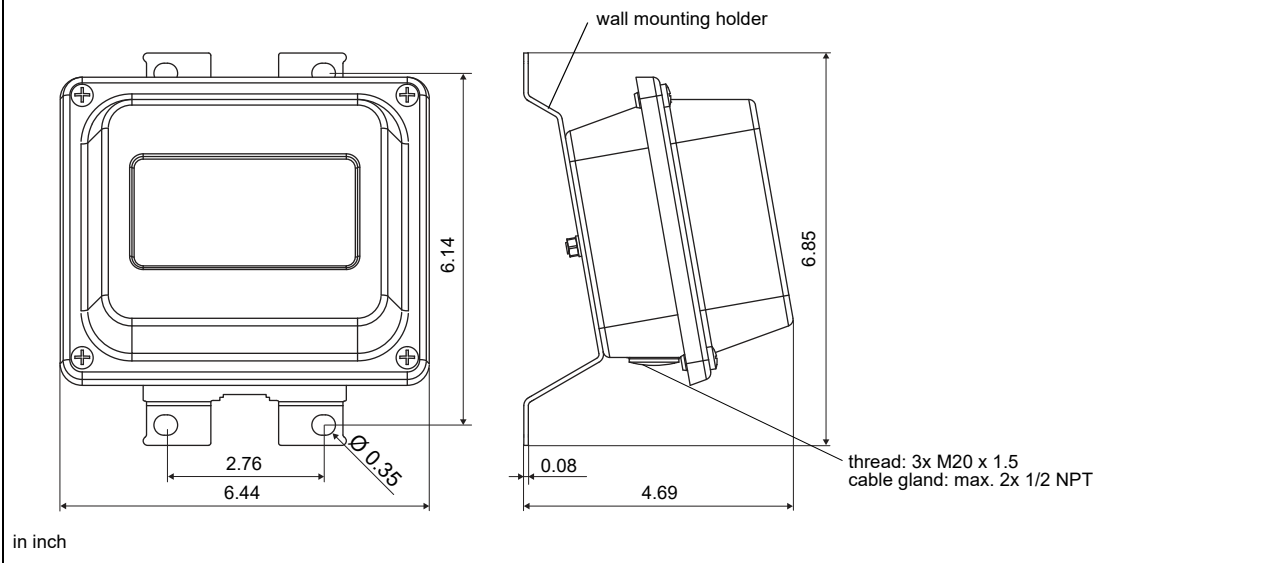
Junction box

Technical data

| JB01S4E3M, JBP2, JBP3 | | | |
|-----------------------------|---|-------------------|-------------------|
| weight | lb 2.6 lb | | |
| fixation | wall mounting optional: 2" pipe mounting | | |
| material | | | |
| housing | stainless steel 316L | | |
| gasket | silicone | | |
| degree of protection | NEMA 6 | | |
| ambient temperature | | | |
| min. | °F -40 | | |
| max. | °F +176 | | |
| explosion protection | | | |
| • ATEX/IECEX (zone 1) | | | |
| junction box marking | JB01S4E3M CE 0637 Ex 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 | | |
| • ATEX (zone 2) | | | |
| junction box marking | JBP2 CE Ex II3G Ex nA IIC (T6)...T4 Gc II3D Ex tc IIIC T 100 °C Dc Ta -40...+(70)80 °C | | |
| 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 | |
| JB02, JB03, JB04 | | | |
| 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 | | |
| explosion protection | | | |
| • ATEX | | | |
| junction box marking | JB02 CE Ex II3G Ex nA IIC (T6)...T4 Gc II3D Ex tc IIIC T 100 °C Dc Ta -40...+(70)80 °C | | |
| • FM | | | |
| junction box marking | JB04 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G / T6 Ta = -40...+60 °C | | |
| Connection | | | |
| | | | |
| Transducers | | | |
| terminal | connection | transducer | |
| XV | SMB connector | ↑ | |
| XR | SMB connector | ↕ | |
| Extension cable | | | |
| terminal strip | terminal | connection | |
| KL2 | TV | signal | |
| | TVS | internal shield | |
| | TRS | internal shield | |
| | TR | signal | |

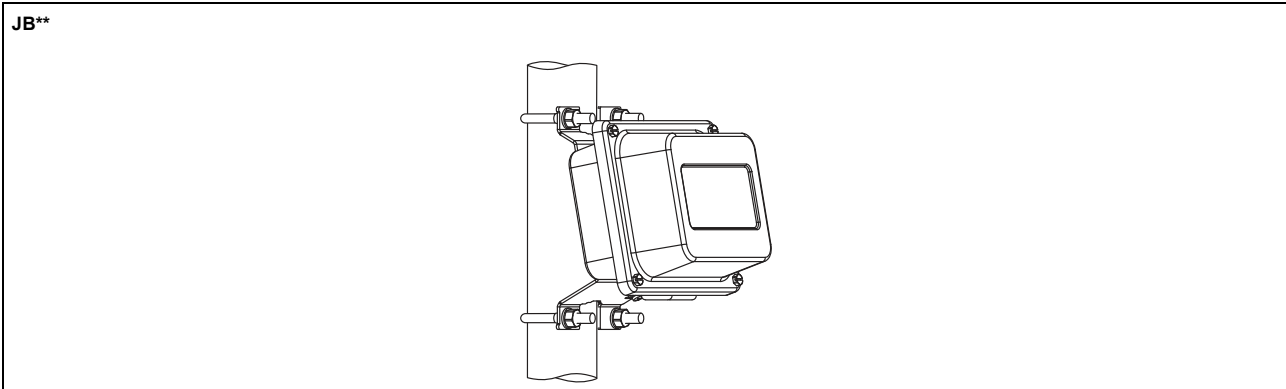
Dimensions

JB0*, JBP*



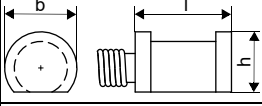
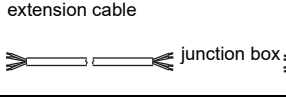
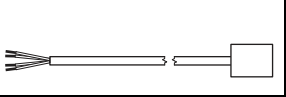
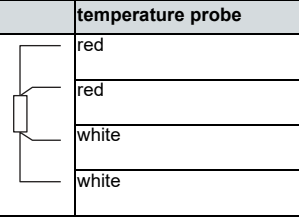
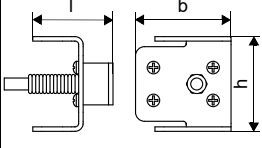
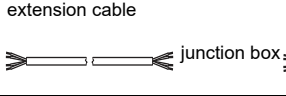
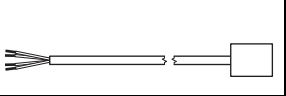
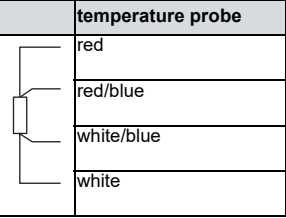
2" pipe mounting kit

JB**



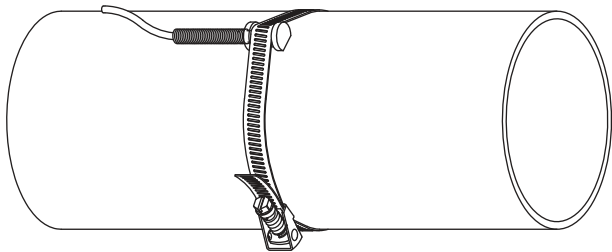
Clamp-on temperature probe (optional)

Technical data

| PT13N | | |
|--|---|---|
| design | clamp-on | |
| type | Pt1000 | |
| connection | 4-wire | |
| measuring range | °F -40 to +392 | |
| accuracy T | ±(0.27 °F + 2 · 10 ⁻³ · (T [°F] - 32 °F)) class A | |
| accuracy ΔT (2x Pt matched according to EN 1434-1) | ≤ 0.03 °F (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 |
|  | |  |
| Connection | | |
|  | | |
| 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 |
| PT13F | | |
| design | clamp-on short response time | |
| type | Pt1000 | |
| connection | 4-wire | |
| measuring range | °F -58 to +482 | |
| accuracy T | ±(0.27 °F + 2 · 10 ⁻³ · (T [°F] - 32 °F)) class A | |
| accuracy ΔT (2x Pt matched according to EN 1434-1) | ≤ 0.1 K (3 K < ΔT < 6 K), more corresponding to EN 1434 | |
| response time | s | 8 |
| housing | PEEK, stainless steel 304, copper | |
| degree of protection | NEMA 4 | |
| dimensions | | |
| length l | in | 0.55 |
| width b | in | 1.18 |
| height h | in | 1.06 |
| dimensional drawing |  | |
| weight | lb | 0.7 |
| accessories | | |
| thermal conductivity paste 392 °F | x | |
| thermal conductivity foil 482 °F | x | |
| plastic protection plate, insulation foam | x | |
| Connection system | | |
| connection with extension cable | | direct connection |
|  | |  |
| Connection | | |
|  | | |
| Cable | | |
| | temperature probe | extension cable |
| type | 4 x 0.25 mm ² black | 4 x 18 AWG |
| standard length | ft 9 | - |
| max. length | ft - | 656 |
| cable jacket | PTFE | PVC |

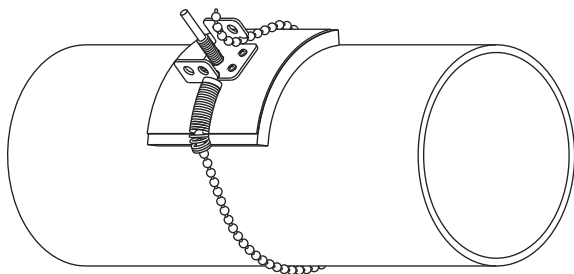
Fixation

tension strap PT13N



material: stainless steel 301, 410

ball chain PT13F



material: stainless steel 316L
length: 3 ft

Junction box

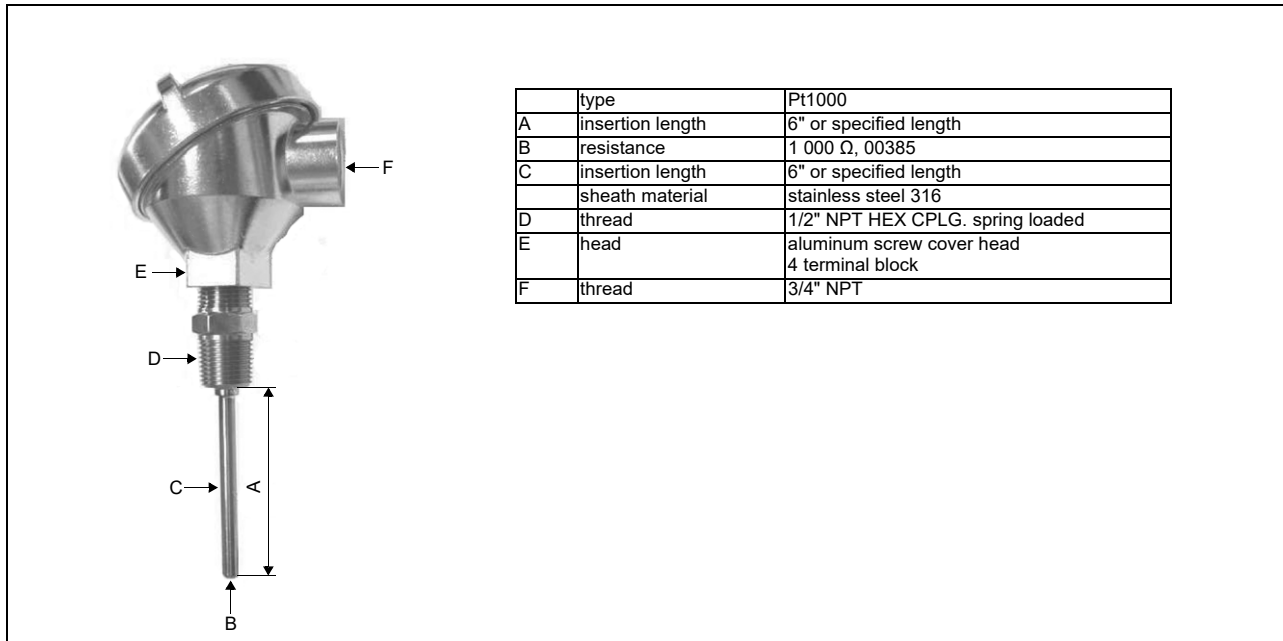
Top View dimensions: 1.18" (left offset), 4.72" (main length), 1.18" (right offset). Label: 1/2" COVER. Port: 1/2" NPT.

Side View dimension: 1.34" (height).

connection

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

Inline temperature probe (optional)



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