

## Liquid Ultrasonic Flowmeter for Permanent Installation

Designed for wall mounting or installation in 19" rack systems

### Features

- Precise bi-directional and highly dynamic flow measurement with the non-intrusive clamp-on technology
- High precision at fast and slow flow rates, high temperature and zero point stability
- Automatic loading of calibration data and transducer detection for a fast and easy set-up (less than 5 min), providing precise and long-term stable results
- User-friendly design
- Transducers available for a wide range of inner pipe diameters (0.25 to 256 in) and fluid temperatures (-40 to +752 °F), applications down to -276 °F possible
- FM Class 1 Div. 2 approved transducers for hazardous areas available
- HybridTrek automatically switches between transit time and NoiseTrek mode of measurement when high particulate flows are encountered

### Applications

- Chemical industry
- Petrochemical industry
- Oil and gas industry
- Pharmaceutical industry
- Semiconductor industry
- Mechanical engineering
- Water and wastewater industry



FLUXUS F704, F705



FLUXUS F709



Measurement with transducers mounted by PermaRail

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## Function

### Measurement Principle

#### Transit Time Difference Principle

In order to measure the flow of a medium in a pipe, ultrasonic signals are used, employing the transit time difference principle. Ultrasonic signals are emitted by a transducer installed on the pipe and received by a second transducer. These signals are emitted alternately in the flow direction and against it.

As the medium in which the signals propagate is flowing, the transit time of the ultrasonic signals in the flow direction is shorter than against the flow direction.

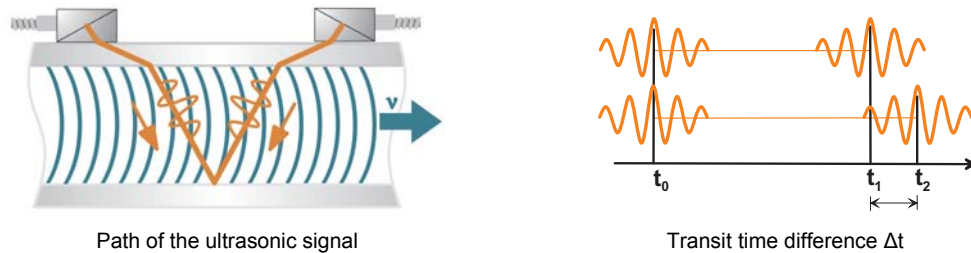
The transit time difference,  $\Delta t$ , is measured and allows the flowmeter to determine the average flow velocity along the propagation path of the ultrasonic signals. A flow profile correction is then performed in order to obtain the area averaged flow velocity, which is proportional to the volumetric flow rate.

Two integrated microprocessors control the entire measuring process. This allows the flowmeter to remove disturbance signals, and to check each received ultrasonic wave for its validity which reduces noise.

#### HybridTrek

If the gaseous or solid content in the medium increases occasionally during measurement, a measurement with the transit time difference principle is no longer possible. NoiseTrek mode will then be selected by the flowmeter. This measurement method allows the flowmeter to achieve a stable measurement even with high gaseous or solid content.

The transmitter can switch automatically between transit time and NoiseTrek mode without any changes to the measurement setup.



### Calculation of Volumetric Flow Rate

$$\dot{V} = k_{Re} \cdot A \cdot k_a \cdot \Delta t / (2 \cdot t_{fl})$$

where

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

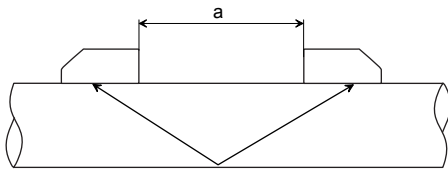
### Number of Sound Paths

The number of sound paths is the number of transits of the ultrasonic signal through the medium 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. Both of 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. Both of the transducers are mounted on opposite sides of the pipe.
- **direct mode**  
Diagonal mode with 1 sound path. This should be used in the case of a high signal attenuation by the medium, pipe or coatings.

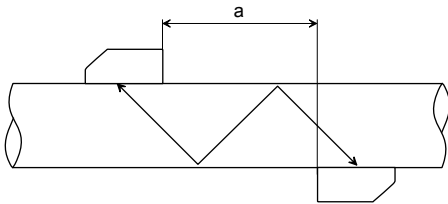
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

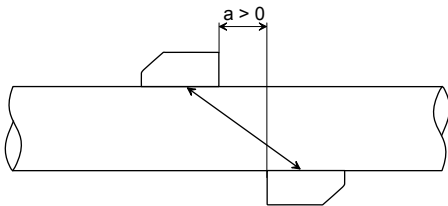


Reflect arrangement, number of sound paths: 2

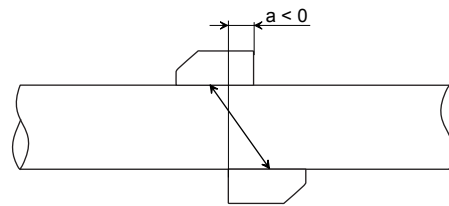
a = transducer distance



Diagonal arrangement, number of sound paths: 3

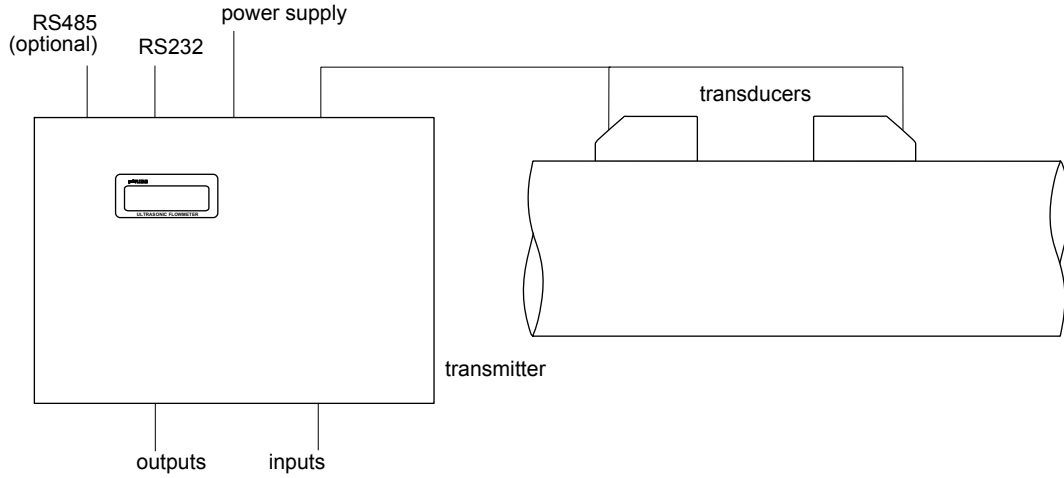


Direct mode, number of sound paths: 1

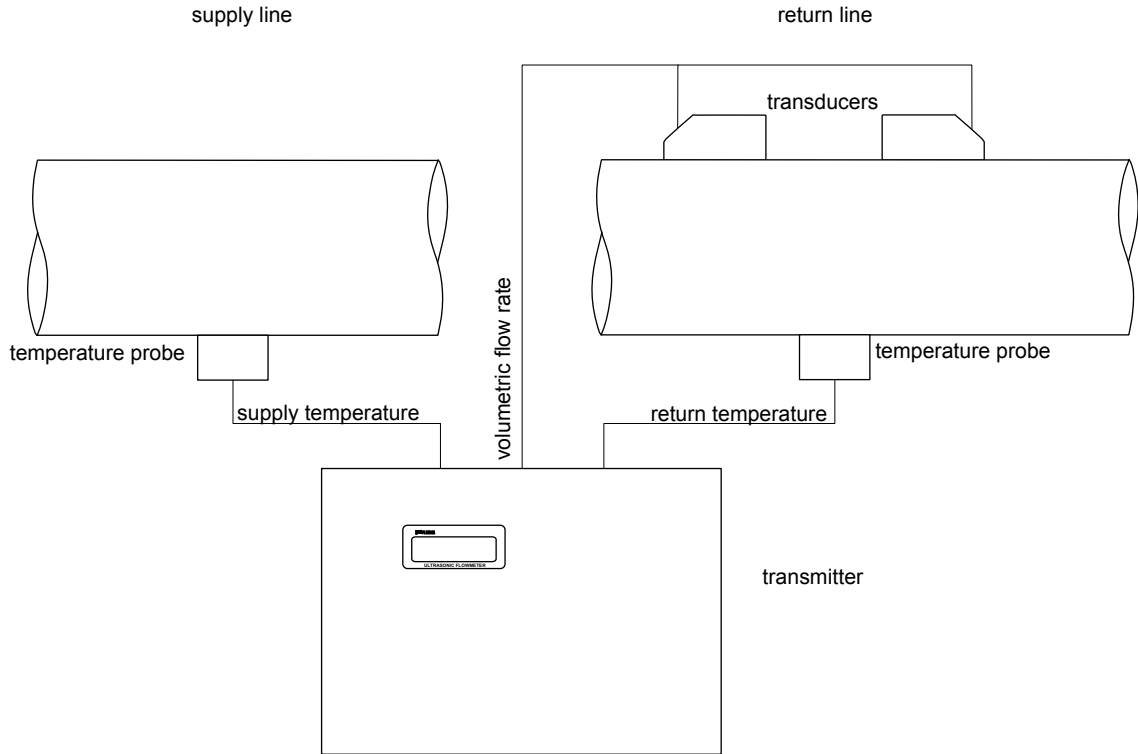


Direct mode, number of sound paths: 1, negative transducer distance

### Typical Measurement Setup










Example of a measurement setup in reflect arrangement



Example of a heat flow measurement

# Flow Transmitter

## Technical Data

FLUXUS	F704**-NN F704**-F2	F705**-NN, F705**-F2 (F704.316SE)	F709**-NN
design	standard field device	field device with stainless steel housing	19 " module
			
<b>measurement</b>			
measurement principle	transit time difference correlation principle, automatic NoiseTrek selection for measurements with high gaseous or solid content		
flow velocity	0.03 to 82 ft/s		
repeatability	0.15 % of reading ±0.03 ft/s		
medium	all acoustically conductive liquids with < 10 % gaseous or solid content in volume (transit time difference principle)		
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5.1-2011		
<b>accuracy<sup>1</sup></b>			
with standard calibration	±1.6 % of reading ±0.03 ft/s		
with advanced calibration (optional)	±1.2 % of reading ±0.03 ft/s		
with field calibration <sup>2</sup>	±0.5 % of reading ±0.03 ft/s		
<b>flow transmitter</b>			
power supply	100 to 240 V/50 to 60 Hz or 20 to 32 V DC		
power consumption	< 15 W		
number of flow measuring channels	1, optional: 2		
signal attenuation	0 to 100 s, adjustable		
measuring cycle (1 channel)	100 to 1000 Hz		
response time	1 s (1 channel), option: 70 ms		
housing material	aluminum, powder coated	stainless steel 316L	aluminum
degree of protection	IP65	IP66	IP20
dimensions	see dimensional drawing		42HP x 3U (without back panel) see dimensional drawing
weight	6.2 lb	10.5 lb	3.8 lb
fixation	wall mounting, optional: 2 " pipe mounting		19 " rack mounting
ambient temperature	-4 to +140 °F		
display	2 x 16 characters, dot matrix, backlight		
menu language	English, German, French, Dutch, Spanish		
<b>explosion protection (optional)</b>			
F M	transmitter marking	F704**-F2 F701Z2**1, F701Z2**2:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T5 Ta = 60 °C  F701Z2**9:  NI/Cl. I,II,III/Div. 2/ GP. A,B,C,D,E,F,G/ T4A Ta = 55 °C	F705**-F2 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
<b>measuring functions</b>			
physical quantities	volumetric flow rate, mass flow rate, flow velocity, heat flow (if temperature inputs are installed)		
totalizer	volume, mass, optional: heat quantity		
calculation functions	average, difference, sum (2 measuring channels necessary)		
diagnostic functions	sound speed, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times		

<sup>1</sup> for transit time difference principle, reference conditions and v > 0.49 ft/s

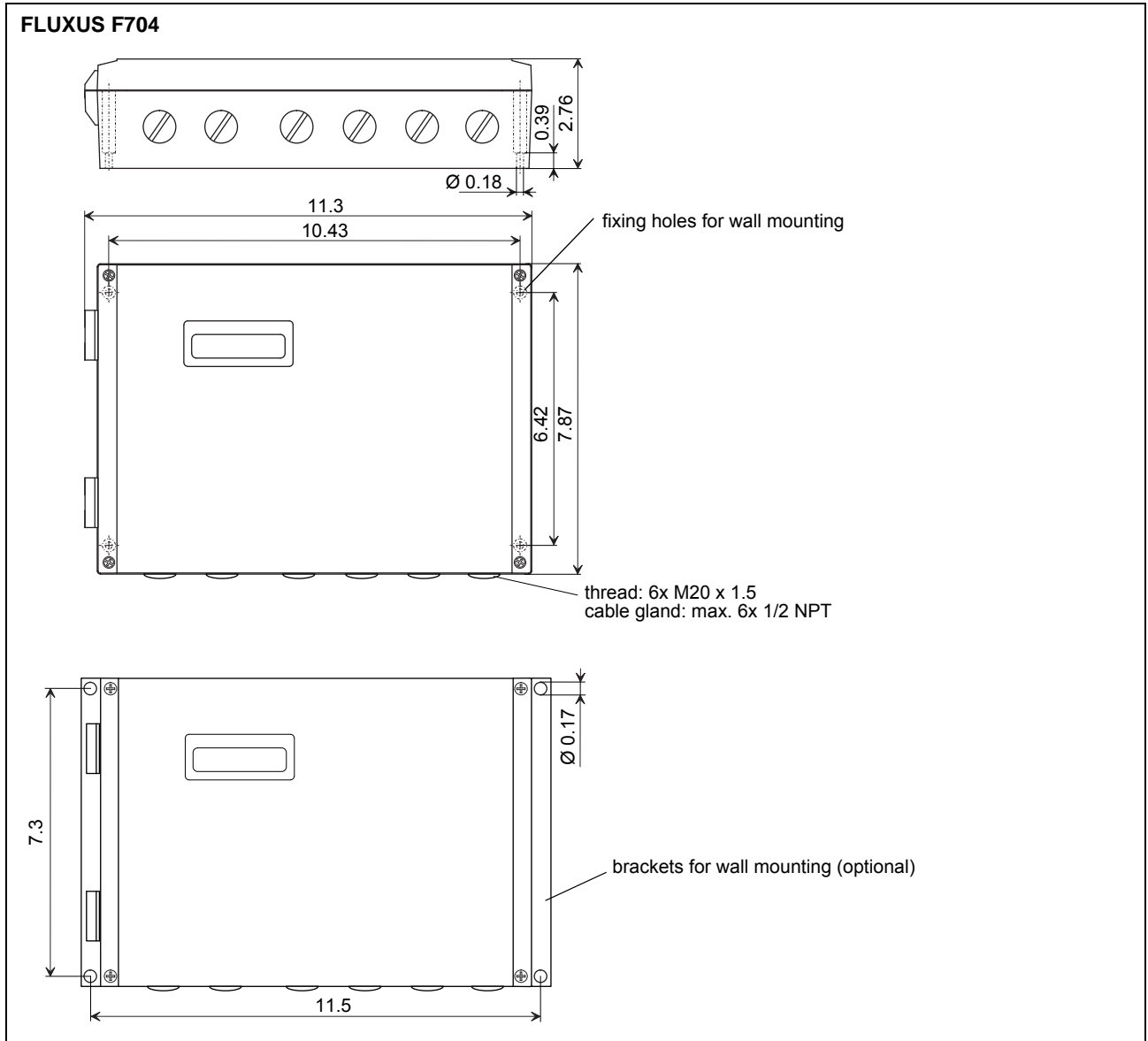
<sup>2</sup> reference uncertainty < 0.2 %

FLUXUS	F704**-NN F704**-F2	F705**-NN, F705**-F2 (F704.316SE)	F709**-NN
<b>data logger</b>			
loggable values	all physical quantities, totalized values and diagnostic values		
capacity	> 100 000 measured values		
<b>SD card, removable (optional, nonEx)</b>			
loggable values	all physical quantities and totalized values		-
capacity	min. 2 GB		-
<b>communication</b>			
interface	- process integration (optional): RS485 (emitter) or Modbus RTU or HART or BACnet MS/TP or BACnet IP (nonEx) or SD card (nonEx) - diagnosis: RS232		- process integration (optional): RS485 (emitter) or Modbus RTU or HART or BACnet MS/TP - diagnosis: RS232
<b>serial data kit (optional)</b>			
software (all Windows™ versions)	-FluxData: download of measurement data, graphical presentation, conversion to other formats (e.g. for Excel™) -FluxDiag (optional): online diagnostics and report generation -FluxKoef: creating medium data sets -FluxSubstanceLoader: upload of medium data sets		
cable	RS232		
adapter	RS232 - USB		
<b>outputs (optional)</b>			
	The outputs are galvanically isolated from the transmitter.		
number	on request		
<b>switchable current output (nonEx)</b>			
	All switchable current outputs are switched to active or passive mode at the same time.		
- range	4 to 20 mA (3.2 to 22 mA)		
- 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 $R_{ext}$ , $R_{ext} < 1 \text{ k}\Omega$		
<b>current output</b>			
current output			
- range	0/4 to 20 mA		
- accuracy	0.1 % of reading ±15 µA		
- active output	$R_{ext} < 500 \Omega$		
- passive output	$U_{ext} = 4 \text{ to } 24 \text{ V}$ , depending on $R_{ext}$ , $R_{ext} < 1 \text{ k}\Omega$		
current output I1 in HART mode			
- range	4 to 20 mA		
- passive output	$U_{ext} = 10 \text{ to } 24 \text{ V}$		
<b>voltage output</b>			
range	0 to 1 V or 0 to 10 V		
accuracy	0 to 1 V: 0.1 % of reading ±1 mV 0 to 10 V: 0.1 % of reading ±10 mV		
internal resistance	$R_i = 500 \Omega$		
<b>frequency output</b>			
range	0 to 5 kHz		
open collector	24 V/4 mA, $R_i = 66.5 \Omega$		
<b>binary output</b>			
Reed relay	48 V/100 mA, P1 to P4: $R_i = 22 \Omega$		48 V/100 mA, P1 to P4: $R_i = 22 \Omega$
open collector	24 V/4 mA, P1 to P4: $R_i = 22 \Omega$		24 V/4 mA, P1 to P4: $R_i = 22 \Omega$
optorelay	26 V/100 mA		-
binary output as alarm output			
- functions	limit, change of flow direction or error		limit, change of flow direction or error
binary output as pulse output			
- pulse value	0.01 to 1000 units		0.01 to 1000 units
- pulse width	optorelay: 1 to 1000 ms Reed relay, open collector: 80 to 1000 ms		80 to 1000 ms

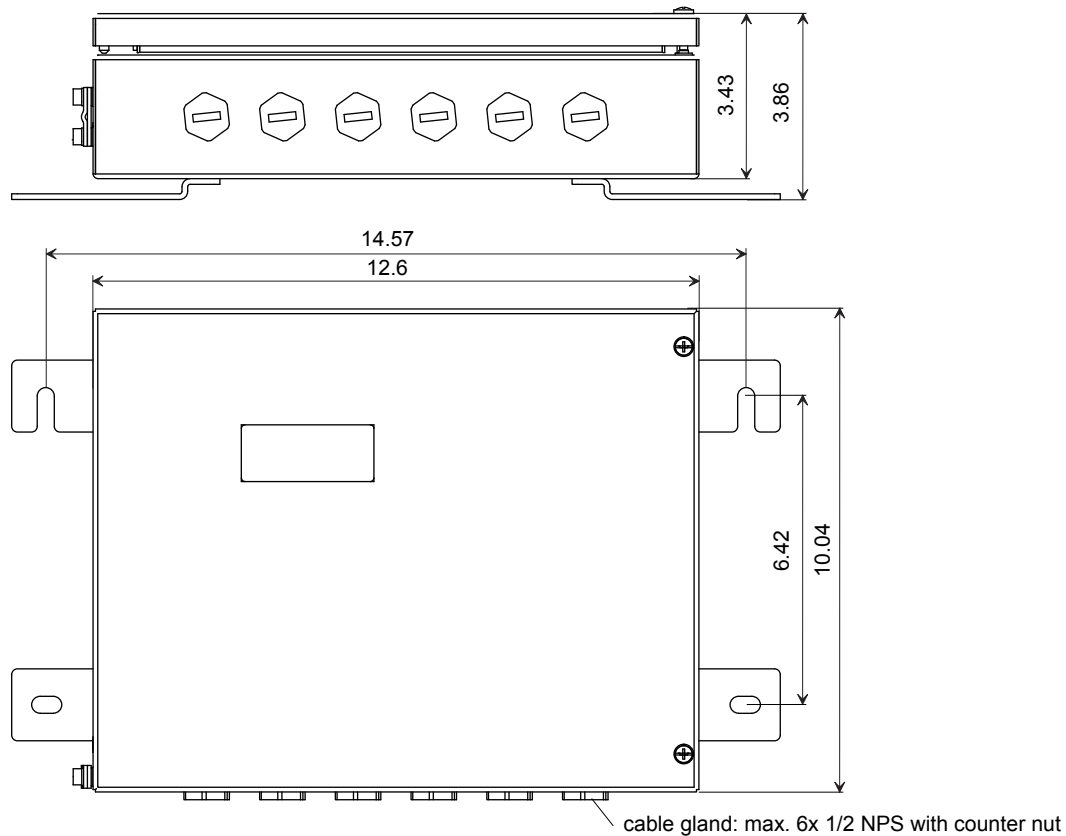
FLUXUS	F704**-NN F704**-F2	F705**-NN, F705**-F2 (F704.316SE)	F709**-NN
<b>inputs (optional)</b>			
	The inputs are galvanically isolated from the transmitter.		
number	max. 4, on request		
<b>temperature input</b>			
type	Pt100/Pt1000		
connection	4-wire		
range	-238 to +1040 °F		
resolution	0.01 K		
accuracy	±0.01 % of reading ±0.03 K		
<b>current input</b>			
accuracy	0.1 % of reading ±10 µA		0.1 % of reading ±10 µA
active input	U <sub>i</sub> = 24 V, R <sub>i</sub> = 50 Ω, P <sub>i</sub> < 0.5 W, not short-circuit proof		U <sub>i</sub> = 15 V, R <sub>i</sub> = 50 Ω, P <sub>i</sub> < 0.5 W, not short-circuit proof
- range	0 to 20 mA		0 to 20 mA
passive input	R <sub>i</sub> = 50 Ω, P <sub>i</sub> < 0.3 W		R <sub>i</sub> = 50 Ω, P <sub>i</sub> < 0.3 W
- range	-20 to +20 mA		-20 to +20 mA
<b>voltage input</b>			
range	0 to 1 V		
accuracy	0.1 % of reading ±1 mV		
internal resistance	R <sub>i</sub> = 1 MΩ		
<b>binary input</b>			
switching signal	5 to 30 V, 1 mA		
functions	FM class I, Div. 2: 5 to 26 V, 1 mA		
	-resetting the measured values		
	-resetting the totalizers		
	-stopping the totalizers		
	-activation of the measuring mode for highly dynamic flows		



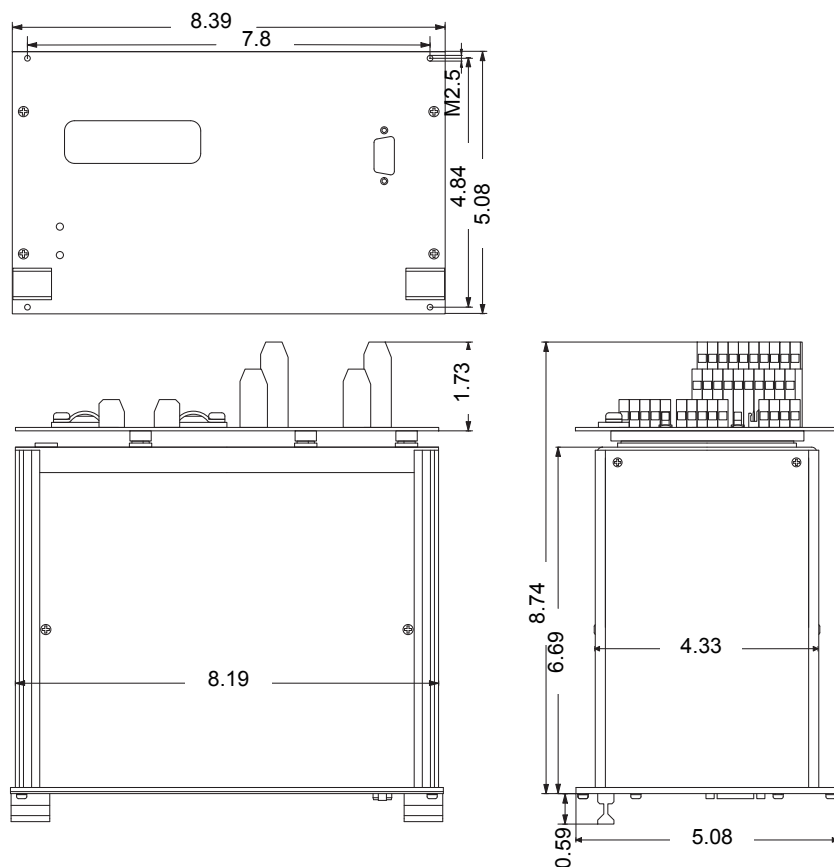
### Dimensions



**FLUXUS F705**



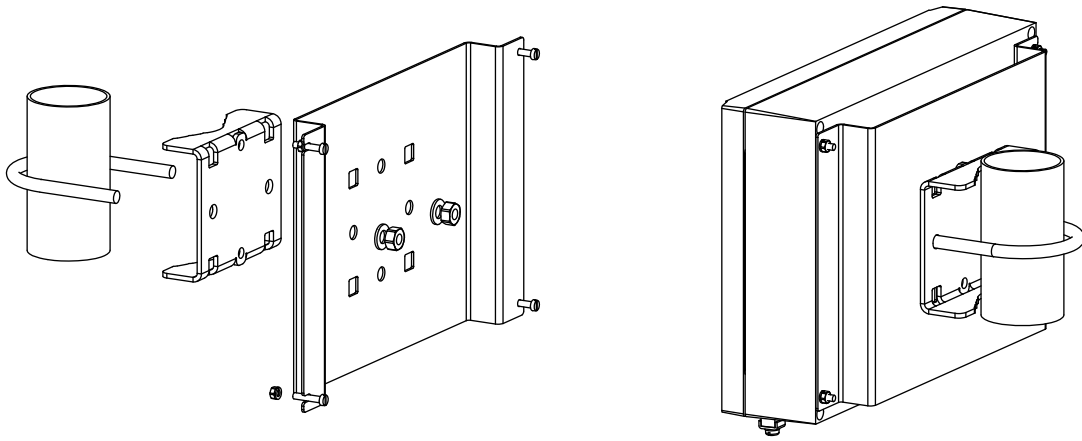
**FLUXUS F709**



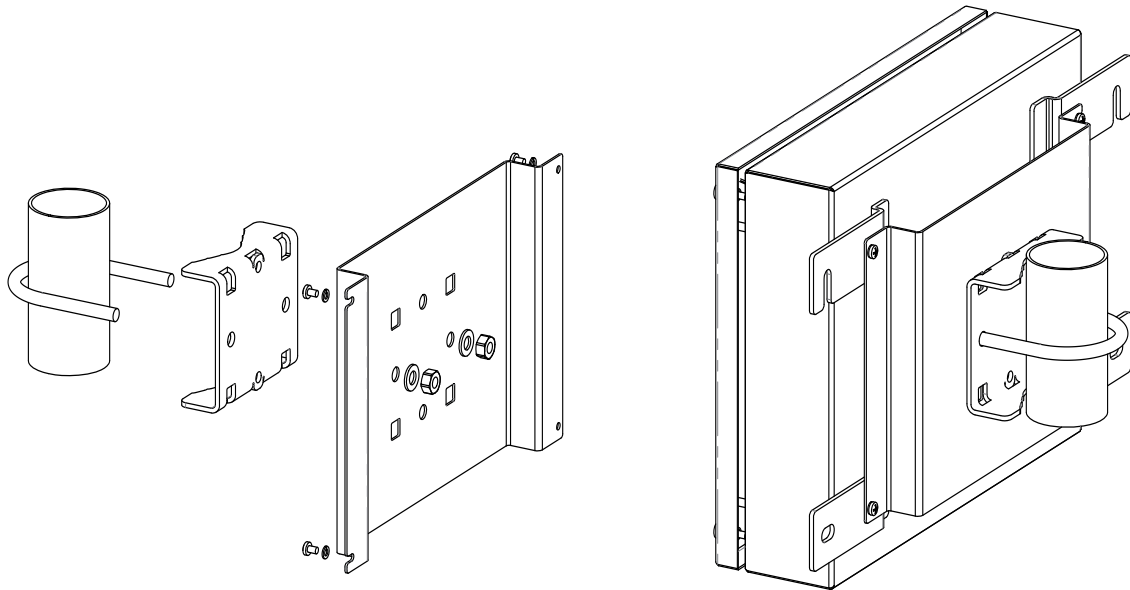
in inch

## 2 " Pipe Mounting Kit (optional)

**FLUXUS F704**

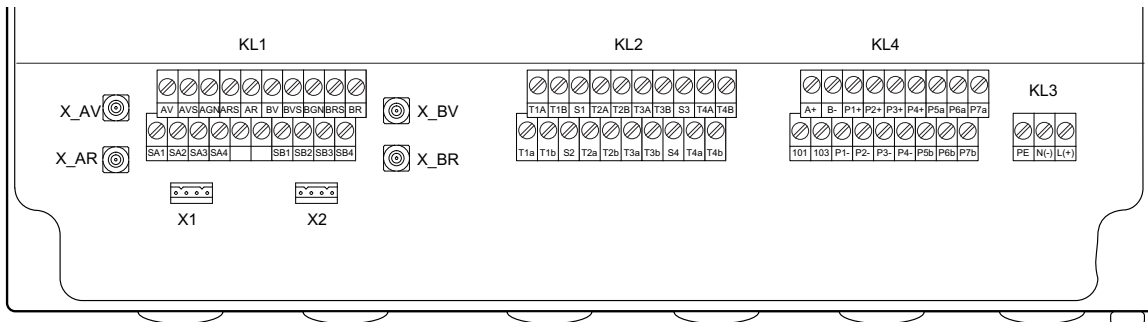


**FLUXUS F705**



## Terminal Assignment

### FLUXUS F704, F705



#### power supply

terminal strip KL3

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

#### transducers

terminal strip KL1

extension cable (transducers ****L1*, *****52) transducer cable (transducers ****L1*)			
measuring channel A		measuring channel B	
terminal	connection	terminal	connection
AV	signal	BV	signal
AVS	shield	BVS	shield
ARS	shield	BRS	shield
AR	signal	BR	signal

transducer cable (transducers *****52)		
measuring channel A	measuring channel B	connection
terminal		
X_AV	X_BV	SMB connector
X_AR	X_BR	SMB connector

#### outputs<sup>2</sup>

terminal strip KL4

terminal	connection
P1+ to P4+, P1- to P4-	current output, voltage output, frequency output or binary output (Reed relay, open collector)
P5a to P7a, P5b to P7b	binary output

#### RS485, Modbus, BACnet MS/TP (optional)

terminal strip KL4

terminal	connection
A+	signal +
B-	signal -
101	shield

#### analog inputs<sup>2</sup>

terminal strip KL2

terminal	temperature probe				passive current source connection of an active input	active current source connection of a passive input
	with connector		without connector			
	direct connection	connection with extension cable	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 to S4	shield	shield	-	-	not connected	not connected

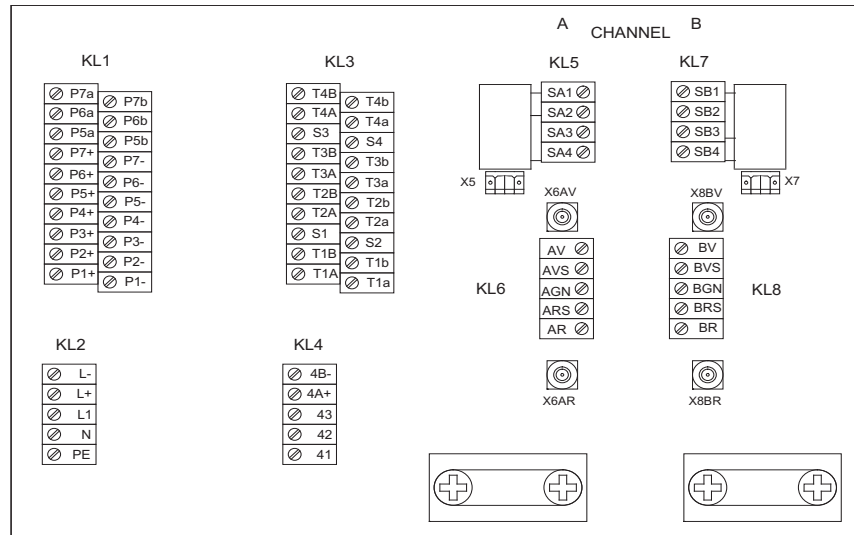
#### binary inputs<sup>2</sup>

terminal strip KL4

terminal
P1+ to P2+, P1- to P2-

<sup>2</sup> The number, type and terminal assignment of the outputs and inputs will be customized.

**FLUXUS F709**



**power supply**

terminal strip KL2

terminal	connection (AC)	terminal	connection (DC)
PE	earth	PE	earth
N	neutral	L-	-
L1	phase	L+	+

**transducers**

terminal strip KL6, KL8

extension cable (transducers ****LI*, ****52)			
transducer cable (transducers ****LI*)			
measuring channel A		measuring channel B	
terminal	connection	terminal	connection
AV	signal	BV	signal
AVS	shield	BVS	shield
ARS	shield	BRS	shield
AR	signal	BR	signal

**outputs<sup>1</sup>**

terminal strip KL1

terminal	connection
P1+ to P4+, P1- to P4-	current output, voltage output, frequency output or binary output
P5+ to P7+, P5- to P7-	binary output (open collector)
P5a to P7a, P5b to P7b	binary output (Reed relay)

**RS485, Modbus, BACnet MS/TP (optional)**

terminal strip KL4

terminal	connection
4A+	signal +
4B-	signal -
43	shield

**analog inputs<sup>1</sup>**

terminal strip KL3

terminal	temperature probe				passive current source connection of an active input	active current source connection of a passive input
	with connector direct connection	without connector direct connection	with connector connection with extension cable	without connector 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 to S4	shield	shield	-	-	not connected	not connected

**binary inputs<sup>1</sup>**

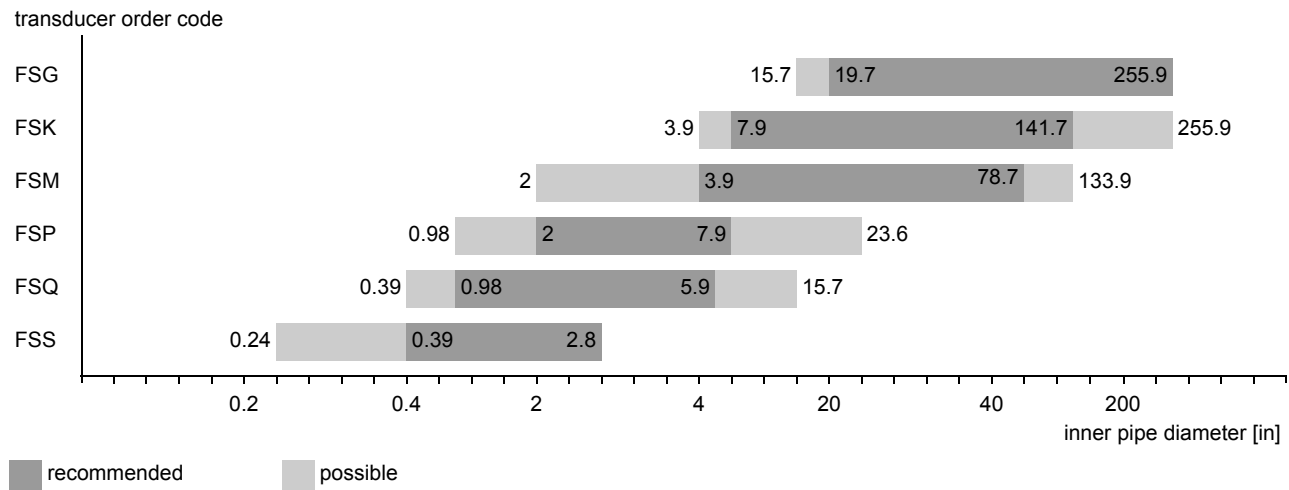
terminal strip KL1

terminal
P1+ to P2+, P1- to P2-

<sup>1</sup> The number, type and terminal assignment of the outputs and inputs will be customized.

## Transducers

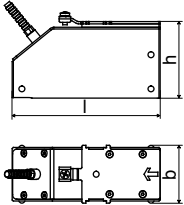
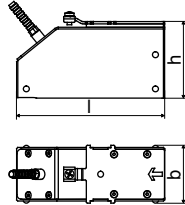
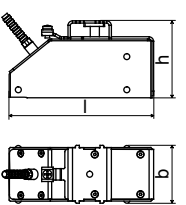
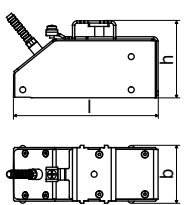
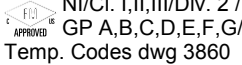
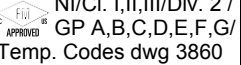
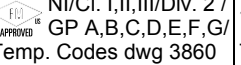
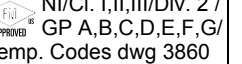
### Transducer Selection



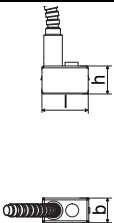



## Technical Data

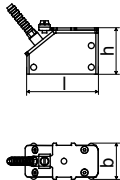
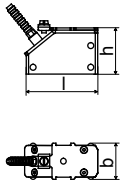
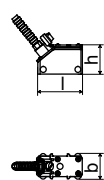



### Shear Wave Transducers (FM or not explosion proof)

technical type		CDG1N52	CLG1N52	CDK1N52	CLK1N52
order code		FSG-NF2TS FSG-NF2TS/OS FSG-NNNTS FSG-NNNTS/OS	FSG-NF2TS/LC FSG-NF2TS/LC/OS FSG-NNNTS/LC FSG-NNNTS/LC/OS	FSK-NF2TS FSK-NF2TS/OS FSK-NNNTS FSK-NNNTS/OS	FSK-NF2TS/LC FSK-NF2TS/LC/OS FSK-NNNTS/LC FSK-NNNTS/LC/OS
transducer frequency	MHz	0.2	0.2	0.5	0.5
<b>inner pipe diameter d</b>					
min. extended	in	15.7	15.7	3.9	3.9
min. recommended	in	19.7	19.7	7.9	7.9
max. recommended	in	255.9	255.9	141.7	141.7
max. extended	in	255.9	255.9	255.9	255.9
<b>pipe wall thickness</b>					
min.	in	-	-	-	-
max.	in	-	-	-	-
<b>material</b>					
housing		PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection		NEMA 6	NEMA 6	NEMA 6	NEMA 6
<b>transducer cable</b>					
type		1699	1699	1699	1699
length	ft	16	29	16	29
<b>dimensions</b>					
length l	in	5.1	5.1	4.98	4.98
width b	in	2.01	2.01	2.01	2.01
height h	in	2.64	2.64	2.66	2.66
dimensional drawing					
<b>ambient temperature</b>					
min.	°F	-40	-40	-40	-40
max.	°F	+266	+266	+266	+266
temperature compensation		x	x	x	x
<b>explosion protection</b>					
order code		FSG-NF2TS FSG-NF2TS/OS	FSG-NF2TS/LC FSG-NF2TS/LC/OS	FSK-NF2TS FSK-NF2TS/OS	FSK-NF2TS/LC FSK-NF2TS/LC/OS
<b>explosion protection temperature</b>					
min.	°F	-40	-40	-40	-40
max.	°F	+257	+257	+257	+257
marking		 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G / Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G / Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G / Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G / Temp. Codes dwg 3860
type of protection		non incendive	non incendive	non incendive	non incendive
remark		on request	on request		

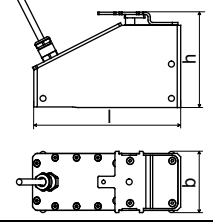
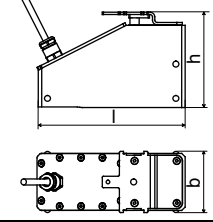
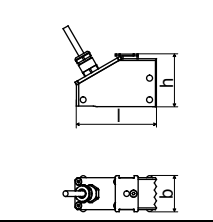
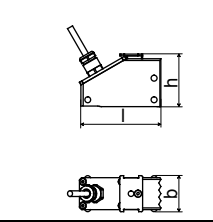


technical type	CDS1N52	
order code	FSS-NF2TS FSS-NNNTS	
transducer frequency	MHz	8
<b>inner pipe diameter d</b>		
min. extended	in	0.24
min. recommended	in	0.39
max. recommended	in	2.8
max. extended	in	2.8
<b>pipe wall thickness</b>		
min.	in	-
max.	in	-
<b>material</b>		
housing	stainless steel 304	
contact surface	PEI	
degree of protection	NEMA 4	
<b>transducer cable</b>		
type	1699	
length	ft	6
<b>dimensions</b>		
length l	in	0.98
width b	in	0.51
height h	in	0.67
dimensional drawing		
<b>ambient temperature</b>		
min.	°F	-22
max.	°F	+266
temperature compensation	x	
<b>explosion protection</b>		
order code	FSS-NF2TS	
<b>explosion protection temperature</b>		
min.	°F	-40
max.	°F	+257
F M	marking	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
	type of protection	non incandive

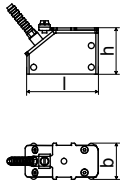
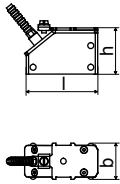
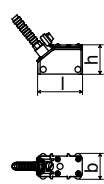



**Shear Wave Transducers (FM or not explosion proof)**

technical type		CDM2N52	CDP2N52	CDQ2N52	
order code		<b>FSM-NF2TS</b> <b>FSM-NF2TS/OS</b> <b>FSM-NNNTS</b> <b>FSM-NNNTS/OS</b>	<b>FSP-NF2TS</b> <b>FSP-NF2TS/OS</b> <b>FSP-NNNTS</b> <b>FSP-NNNTS/OS</b>	<b>FSQ-NF2TS</b> <b>FSQ-NF2TS/OS</b> <b>FSQ-NNNTS</b> <b>FSQ-NNNTS/OS</b>	
transducer frequency	MHz	1	2	4	
<b>inner pipe diameter d</b>					
min. extended	in	2	0.98	0.39	
min. recommended	in	3.9	2	0.98	
max. recommended	in	78.7	7.9	5.9	
max. extended	in	133.9	23.6	15.7	
<b>pipe wall thickness</b>					
min.	in	-	-	-	
max.	in	-	-	-	
<b>material</b>					
housing		PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L	PEEK with stainless steel cap 304, option OS: 316L	
contact surface		PEEK	PEEK	PEEK	
degree of protection		NEMA 6	NEMA 6	NEMA 6	
<b>transducer cable</b>					
type		1699	1699	1699	
length	ft	13	13	9	
<b>dimensions</b>					
length l	in	2.52	2.52	1.57	
width b	in	1.26	1.26	0.87	
height h	in	1.59	1.59	1	
dimensional drawing					
<b>ambient temperature</b>					
min.	°F	-40	-40	-40	
max.	°F	+266	+266	+266	
temperature compensation		x	x	x	
<b>explosion protection</b>					
<b>F M</b>	order code	FSM-NF2TS FSM-NF2TS/OS	FSP-NF2TS FSP-NF2TS/OS	FSQ-NF2TS FSQ-NF2TS/OS	
	<b>explosion protection temperature</b>				
	min.	°F	-67	-67	-67
	max.	°F	+374	+374	+374
	marking		 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
type of protection		non incendive	non incendive	non incendive	

**Shear Wave Transducers (not explosion proof, NEMA 6P)**

technical type		CDG1LI8	CDK1LI8	CDM2LI8	CDP2LI8
order code		<b>FSG-NNNTS/IP68</b>	<b>FSK-NNNTS/IP68</b>	<b>FSM-NNNTS/IP68</b>	<b>FSP-NNNTS/IP68</b>
transducer frequency	MHz	0.2	0.5	1	2
<b>inner pipe diameter d</b>					
min. extended	in	15.7	3.9	2	0.98
min. recommended	in	19.7	7.9	3.9	2
max. recommended	in	255.9	141.7	78.7	7.9
max. extended	in	255.9	255.9	133.9	23.6
<b>pipe wall thickness</b>					
min.	in	-	-	-	-
max.	in	-	-	-	-
<b>material</b>					
housing		PEEK with stainless steel cap 316Ti	PEEK with stainless steel cap 316Ti	PEEK with stainless steel cap 316Ti	PEEK with stainless steel cap 316Ti
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection		NEMA 6P	NEMA 6P	NEMA 6P	NEMA 6P
<b>transducer cable</b>					
type		2550	2550	2550	2550
length	ft	39	39	39	39
<b>dimensions</b>					
length l	in	5.12	5.12	2.76	2.76
width b	in	2.13	2.13	1.26	1.26
height h	in	3.29	3.29	1.81	1.81
dimensional drawing					
<b>ambient temperature</b>					
min.	°F	-40	-40	-40	-40
max.	°F	+212	+212	+212	+212
temperature compensation		x	x	x	x
remark		on request			

**Shear Wave Transducers (extended temperature range, FM or not explosion proof)**

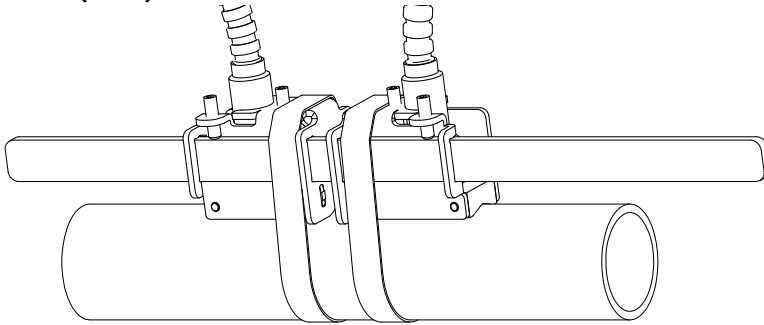
technical type		CDM2E52	CDP2E52	CDQ2E52	
order code		FSM-EF2TS FSM-EF2TS/OS FSM-ENNTS FSM-ENNTS/OS	FSP-EF2TS FSP-EF2TS/OS FSP-ENNTS FSP-ENNTS/OS	FSQ-EF2TS FSQ-EF2TS/OS FSQ-ENNTS FSQ-ENNTS/OS	
transducer frequency	MHz	1	2	4	
<b>inner pipe diameter d</b>					
min. extended	in	2	0.98	0.39	
min. recommended	in	3.9	2	0.98	
max. recommended	in	78.7	7.9	5.9	
max. extended	in	133.9	23.6	15.7	
<b>pipe wall thickness</b>					
min.	in	-	-	-	
max.	in	-	-	-	
<b>material</b>					
housing		PI with stainless steel cap 304, option OS: 316L	PI with stainless steel cap 304, option OS: 316L	PI with stainless steel cap 304, option OS: 316L	
contact surface		PI	PI	PI	
degree of protection		NEMA 4	NEMA 4	NEMA 4	
<b>transducer cable</b>					
type		6111	6111	6111	
length	ft	13	13	9	
<b>dimensions</b>					
length l	in	2.52	2.52	1.57	
width b	in	1.26	1.26	0.87	
height h	in	1.59	1.59	1	
dimensional drawing					
<b>ambient temperature</b>					
min.	°F	-22	-22	-22	
max.	°F	+392	+392	+392	
temperature compensation		x	x	x	
<b>explosion protection</b>					
FM	order code	FSM-EF2TS FSM-EF2TS/OS	FSP-EF2TS FSP-EF2TS/OS	FSQ-EF2TS FSQ-EF2TS/OS	
	<b>explosion protection temperature</b>				
	min.	°F	-49	-49	-49
	max.	°F	+455	+455	+455
	marking		 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860	 NI/Cl. I,II,III/Div. 2 / GP A,B,C,D,E,F,G/ Temp. Codes dwg 3860
type of protection		non incendive	non incendive	non incendive	

# Transducer Mounting Fixture

## Order Code

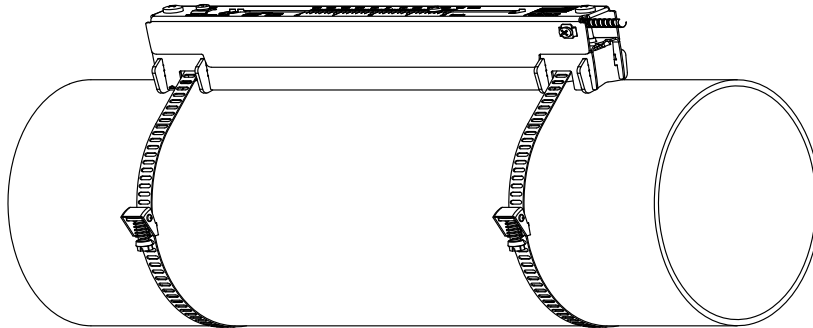
1, 2	3	4	5	6	7 to 9	10, 11	no. of character			
transducer mounting fixture	transducer	-	measurement arrangement	size	-	fixation	outer pipe diameter	/	option	description
PL										PermaLok
VL										PermaRail
WI										transducer box for WaveInjector
	K									transducers with transducer frequency 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
						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	degree of protection NEMA6P
									OS	housing with stainless steel 316
									Z	special design
example										
VL	M	-	D	S	-	S	200			PermaRail and tension straps for transducers with transducer frequency M, P
		-			-			/		

**PermaRail (VLS)**



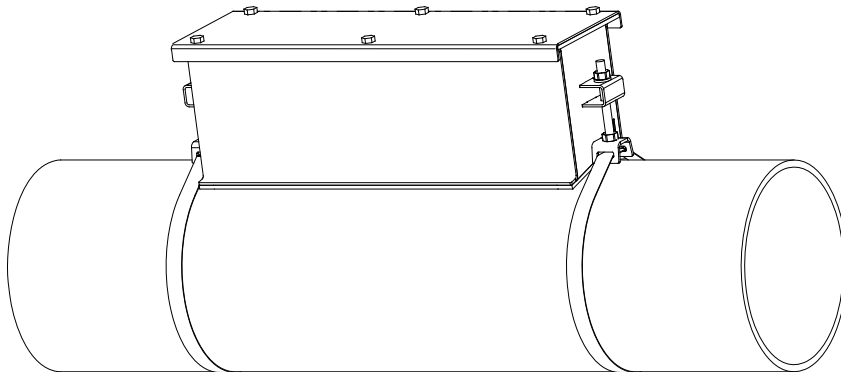
transducers: CDS1N52  
material: stainless steel 304, 303

**PermaRail (VLK, VLM, VLQ)**

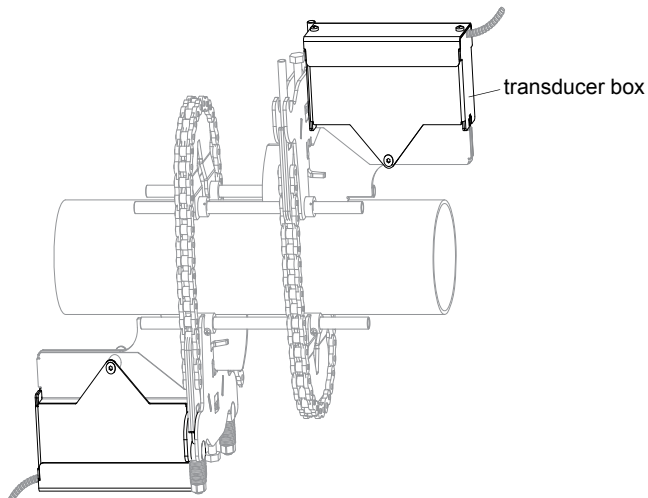


material: stainless steel 304, 301, 410  
option OS: 316, 316L, 17-7PH  
inner length:  
**VLK:** 13.7 in,  
option IP68: 14.5 in  
**VLM:** 9.2 in  
**VLQ:** 6.9 in  
dimensions:  
**VLK:** 16.65 x 3.54 x 3.66 in,  
option IP68: 17.44 x 3.7 x 4.13 in  
**VLM:** 12.17 x 2.24 x 2.48 in  
**VLQ:** 9.72 x 1.69 x 1.85 in

**PermaLok PL**



**transducer box WI for Wavelnjector**



see Technical Specification  
TSWavelnjectorVx-x

### 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	< 536 °F	536 to 752 °F
< 24 h	coupling compound type N or coupling foil type VT	coupling compound type E or coupling foil type VT	coupling compound type E or coupling foil type VT	coupling compound type E or H or coupling foil type VT	coupling foil type A and coupling foil type VT	coupling foil type B and coupling foil type VT
long time measurement	coupling foil type VT <sup>1</sup>	coupling foil type VT <sup>2</sup>	coupling foil type VT <sup>1</sup>	coupling foil type VT <sup>2</sup>	coupling foil type A and coupling foil type VT	coupling foil type B and coupling foil type VT

<sup>1</sup> < 5 years

<sup>2</sup> < 6 months

### Technical Data

type	order code	ambient temperature °F	material	remark
coupling compound type N	990739-1	-22 to +266	mineral grease paste	
coupling compound type E	990739-2	-22 to +392	silicone paste	
coupling compound type H	990739-3	-22 to +482	fluoropolymer paste	
coupling foil type A	990739-7	max. 536	lead	
coupling foil type B	990739-8	> 536 to 752	silver	
coupling foil type VT	990739-0	14 to +392	fluoroelastomer	for transducers with transducer frequency G, H, K
	990739-6			for shear wave transducers with transducer frequency M, P
	990739-14			for shear wave transducers IP68 and Lambwave transducers with transducer frequency M, P
	990739-5			for transducers with transducer frequency Q

### Connection Systems

connection system TS	connection with extension cable	direct connection (only F704, F705)	transducers technical type
			****L*
			*****52

transducer frequency (3d character of transducer order code)		G, H, K		M, P		Q		S		
T S	cable length	ft	x 16	l ≤ 984	x 13	l ≤ 984	x 9	l ≤ 295	x 6	l ≤ 131
	cable length (option LC)	ft	29	≤ 984	-	-	-	-	-	-
	cable length (option IP68)	ft	39	≤ 984	39	≤ 984	-	-	-	-

x = transducer cable length  
 l = max. length of extension cable

### Transducer Cable

#### Technical Data

		transducer cable			extension cable
type		1699	2550 (option IP68)	6111	2615
standard length	ft	see table above			-
max. length	ft	-			see table above
ambient temperature	°F	-67 to +392	-40 to +212	-148 to +437	-40 to +158
properties			longitudinal water tight		halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2
<b>sheath</b>					
material		stainless steel 304 option OS: 316L	-	stainless steel 304 option OS: 316L	-
outer diameter	in	0.31	-	0.31	-
<b>cable jacket</b>					
material		PTFE	PUR	PFA	PUR
outer diameter	in	0.11	0.2 ±0.01	0.11	0.47
thickness	in	0.01	0.04	0.02	0.08
color		brown	gray	white	black
shield	x	x	x	x	x

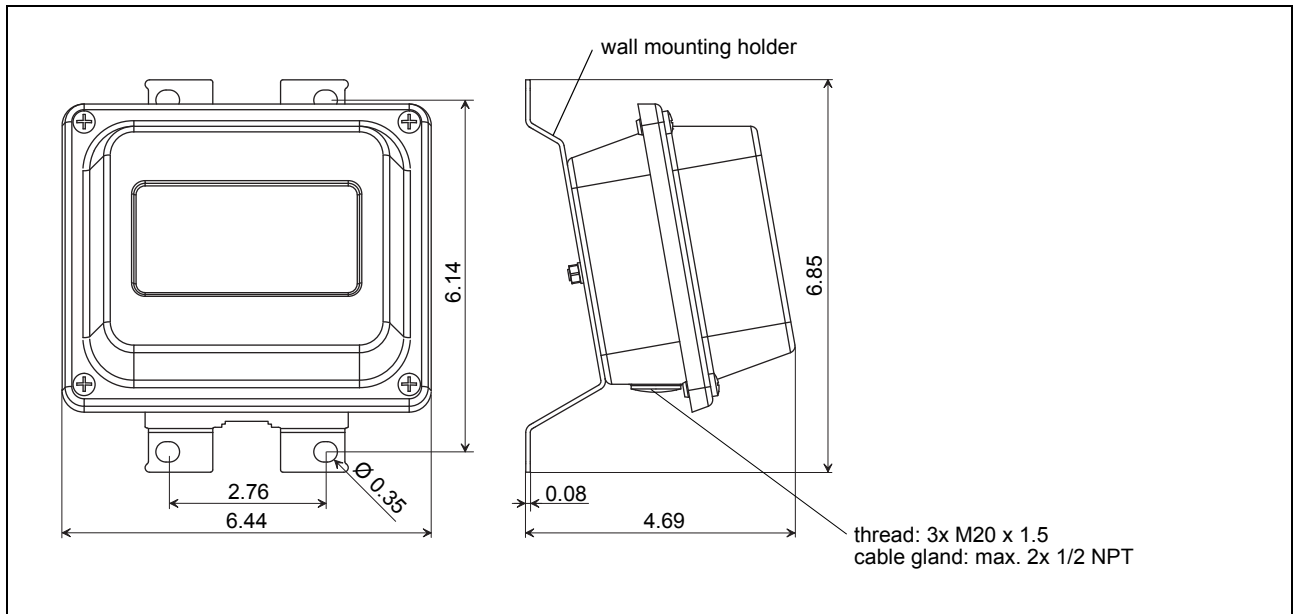


## Junction Box

### Technical Data

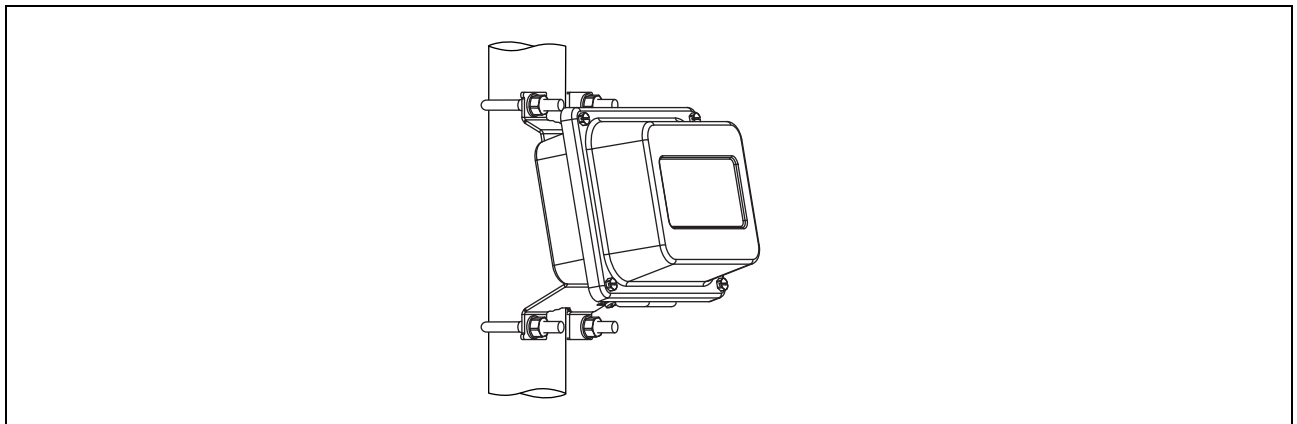
technical type		JB03	JBP3
dimensions		see dimensional drawing	see dimensional drawing
fixation		wall mounting, optional: 2 " pipe mounting	wall mounting, optional: 2 " pipe mounting
<b>material</b>			
housing		stainless steel 304 option OS: 316L	stainless steel 316L
gasket		silicone	silicone
degree of protection		NEMA 6	NEMA 6
<b>ambient temperature</b>			
min.	°F	-40	-40
max.	°F	+176	+176

### Dimensions



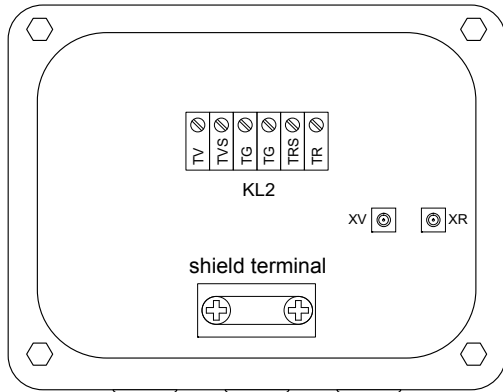
in inch

### 2 " Pipe Mounting Kit (optional)



## Terminal Assignment

### JB03



#### transducers

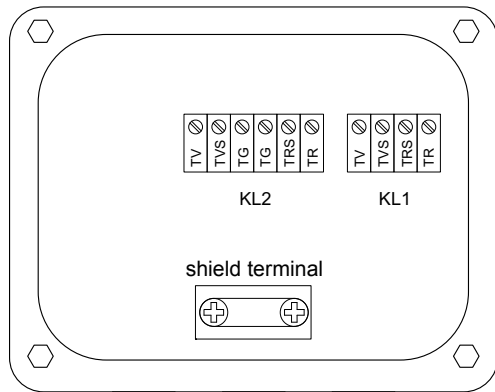
terminal	connection
XV	transducer ↑, SMB connector
XR	transducer ↗, SMB connector
cable gland	external shield

#### extension cable

terminal strip KL2

terminal	connection
TV	signal
TVS	internal shield
TRS	internal shield
TR	signal
shield terminal	external shield

### JBP3



#### transducers

terminal strip KL1

terminal	connection
TV	transducer ↑, signal
TVS	transducer ↑, internal shield
TRS	transducer ↗, internal shield
TR	transducer ↗, signal
cable gland	external shield

#### extension cable

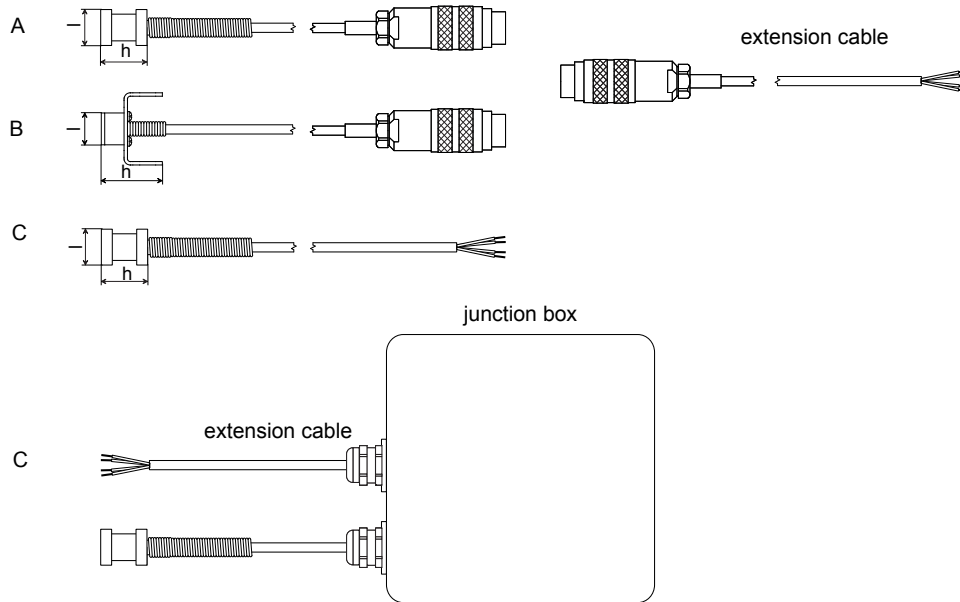
terminal strip KL2

terminal	connection
TV	signal
TVS	internal shield
TRS	internal shield
TR	signal
shield terminal	external shield

## Clamp-on Temperature Probe (optional)

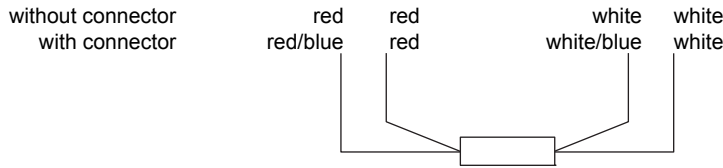
### Technical Data

technical type		PT13N	PT13N	PT13N	PT13N	PT13F	PT13F
order code		670413-1	670412-1	770413-1	770412-1	670413-2	670412-2
design		with connector		without connector		short response time	
type		Pt1000	2x Pt1000 matched according to EN 1434-1	Pt1000	2x Pt1000 matched according to EN 1434-1	Pt1000	2x Pt1000 matched according to EN 1434-1
connection		4-wire		4-wire		4-wire	
measuring range	°F	-22 to +482		-58 to +428		-58 to +482	
accuracy T		$\pm(0.27\text{ }^\circ\text{F} + 2 \cdot 10^{-3} \cdot ( T\text{ }^\circ\text{F}  - 32\text{ }^\circ\text{F}))$ class A		$\pm(0.27\text{ }^\circ\text{F} + 2 \cdot 10^{-3} \cdot ( T\text{ }^\circ\text{F}  - 32\text{ }^\circ\text{F}))$ class A		$\pm(0.27\text{ }^\circ\text{F} + 2 \cdot 10^{-3} \cdot ( T\text{ }^\circ\text{F}  - 32\text{ }^\circ\text{F}))$ class A	
accuracy $\Delta T$		-	$\leq 0.1\text{ K}$ ( $3\text{ K} < \Delta T < 6\text{ K}$ ), more corre- sponding to EN 1434-1	-	$\leq 0.03\text{ }^\circ\text{F}$ (at $50\text{ }^\circ\text{F}$ )	-	$\leq 0.1\text{ K}$ ( $3\text{ K} < \Delta T < 6\text{ K}$ ), more corre- sponding to EN 1434-1
response time	s	50				8	
housing		aluminum		360 brass alloy		PEEK, stainless steel 304, copper	
degree of protection		NEMA 4		NEMA 4		NEMA 4	
weight (without con- nector)	lb	0.6	1.1	0.437	0.875	0.7	1.4
fixation		clamp-on		clamp-on		clamp-on	
<b>accessories</b>							
thermal conductivity paste 392 °F		x		-		x	
thermal conductivity foil 482 °F		x		x		x	
plastic protection plate, insulation foam		-		-		x	
<b>dimensions</b>							
length l	in	0.59		0.59		0.55	
width b	in	0.59		0.49		1.18	
height h	in	0.79		0.79		1.06	
dimensional drawing		A		C		B	



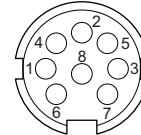
## Connection

### Temperature Probe



### Connector

pin	cable of temperature probe	extension cable
1	white/blue	blue
2	red/blue	gray
3, 4, 5	not connected	
6	red	red
7	white	white
8	not connected	



### Cable

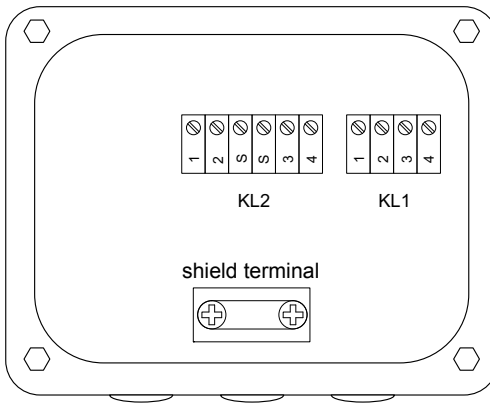
		with connector		without connector	
		cable of temperature probe	extension cable	cable of temperature probe	extension cable
type		4 x 0.25 mm <sup>2</sup> black or white	LIYCY 8 x 0.14 mm <sup>2</sup> gray	4 x 24 AWG	4 x 18 AWG
standard length	ft	9	16/32/82	23	-
max. length	ft	-	656	-	656
cable jacket		PTFE	PVC	fiberglass, PTFE	LS PVC
ambient temperature	°F			max. +752 (fiberglass) max. +266 (transition, PTFE)	

### Junction Box

technical type	<b>JBT3</b>	
dimensions	see dimensional drawing	
fixation	wall mounting optional: 2 " pipe mounting	
<b>material</b>		
housing	stainless steel 304	
gasket	silicone	
degree of protection	NEMA 6	
cable gland	max. 2x 1/2 NPT	
<b>ambient temperature</b>		
min.	°F	-40
max.	°F	+176

### Terminal Assignment

**JBT3**



**temperature probe (with connector)**

terminal strip KL1

terminal	connection
1	red
2	red/blue
3	white
4	white/blue

**extension cable (with connector)**

terminal strip KL2

terminal	connection
1	red
2	gray
3	white
4	blue

**temperature probe (without connector)**

terminal strip KL1

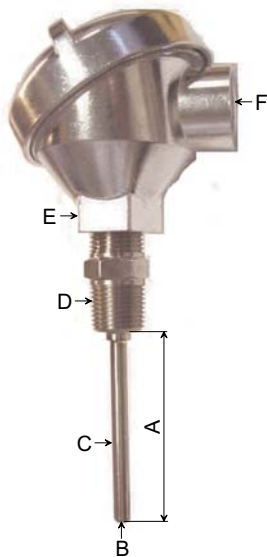
terminal	connection
1	red
2	red
3	white
4	white

**extension cable (without connector)**

terminal strip KL2

terminal	connection
1	white
2	black
3	green
4	red

### Wetted Temperature Probe (optional)



	type	Pt1000
A	insertion length	6 " or specified length
B	resistance	1 000 Ω, 00385
C	insertion length sheath material	6 " or specified length 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



FLEXIM AMERICAS Corporation  
Edgewood, NY 11717  
USA  
Tel.: (631) 492-2300  
Fax: (631) 492-2117

M.A. Selmon Company, Inc  
4 Oxford Rd.  
Milford, CT 06460  
203-377-3525

internet: [www.flexim.com](http://www.flexim.com)  
e-mail: [usinfo@flexim.com](mailto:usinfo@flexim.com)  
1-888-852-7473

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