Ultrasonic flowmeters for liquids for permanent installation in hazardous areas

Especially designed for the stationary use in explosive atmosphere

Features

- Instrument with two measuring channels for exact and reliable flow measurement under complex flow conditions
- Precise bi-directional and highly dynamic flow measurement with the non-invasive clamp-on technology
- High precision at fast and slow flow rates, high temperature and zero point stability
- Transmitter housing:
  - Robust and non-corrosive
  - Transmitter F809**-A1 in a flameproof housing (degree of protection IP66)
  - Transmitter F809**-F1 in an explosionproof housing (NEMA 4X)
- Certifications:
  - F809**-A1: ATEX/IECEx
  - F809**-F1: FM Class I Div. 1
- The transmitter can be operated by a magnet pen without opening the housing
- 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
- Communication interfaces Modbus RTU and HART available
- Transducers available for a wide range of inner pipe diameters and fluid temperatures (-328 to +1112 °F)
- ATEX/IECEx, FM Class I Div. 1 approved transducers for hazardous areas available
- HybridTrek automatically switches between transit time and NoiseTrek mode of measurement when high particulate flows are encountered
- Measurement is unaffected by fluid density, viscosity and solid content (max. 10 % of volume)

Transmitter FLUXUS F809

Measurement with transducers mounted with PermaRail

Measurement with transducers mounted with PermaFiX

Applications

Designed for industrial use in harsh environments, especially for oil extraction and processing in the petrochemical and chemical industry.

- Chemical industry
- Petrochemical industry
- Oil extraction and exploration
- Refineries

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Function

Measurement principle

Transit time difference principle

In order to measure the flow of a fluid 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 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.

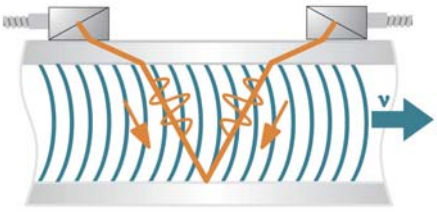
The transit time difference, Δt, is measured and allows the flowmeter to determine the average flow velocity along the propagation path of the ultrasonic signals. A flow profile correction is then performed in order to obtain the area averaged flow velocity, which is proportional to the volumetric flow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

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.

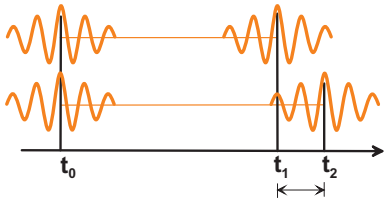
HybridTrek

If the gaseous or solid content in the fluid 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.



Path of the ultrasonic signal



Transit time difference Δt

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
Δt	=	transit time difference
t_{fl}	=	transit time in the fluid

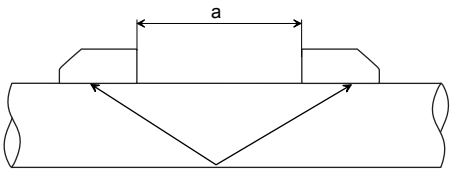
Number of sound paths

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. 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 arrangement with 1 sound path. This should be used in the case of a high signal attenuation by the fluid, pipe or coatings.

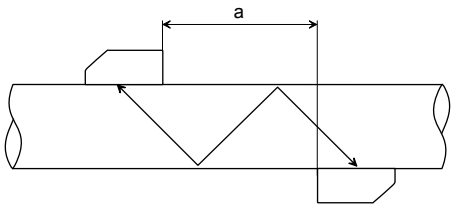
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application will be determined automatically by the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

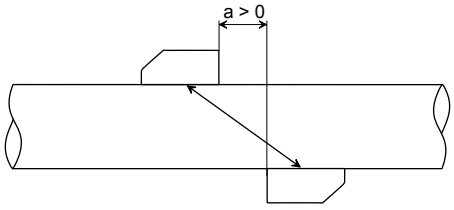


a = transducer distance

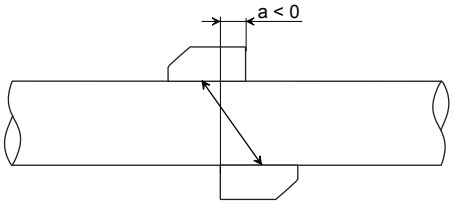
Reflect arrangement, number of sound paths: 2



Diagonal arrangement, number of sound paths: 3

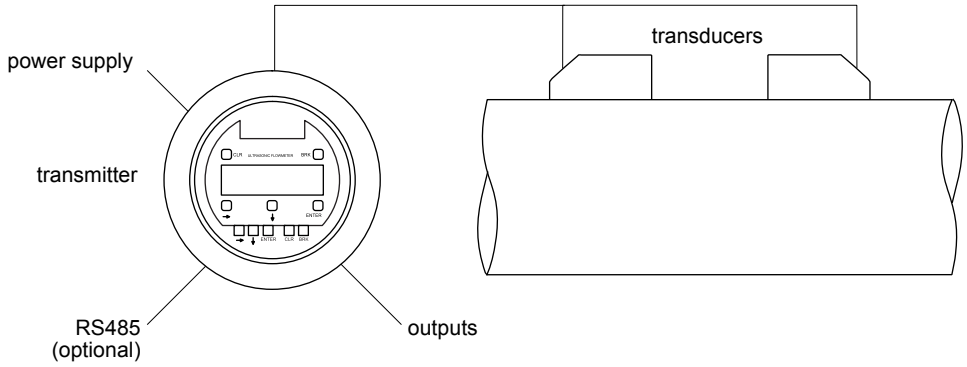


Direct mode, number of sound paths: 1



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

Typical measurement setup



Example of a reflect arrangement

Flow transmitter

Technical data

FLUXUS	**F809**-A1**	**F809**-A1A**	**F809**-F1**
design	explosion proof field device 1 or 2 measuring channels		
	zone 1	zone 1 (intrinsically safe current output)	FM Class I Div. 1
transducers	C****81, C****LI1, C***2E85		C**1N62
			
measurement			
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		
fluid	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		
accuracy[1]			
with standard calibration with advanced calibration (optional) with field calibration[2]	±1.6 % of reading ±0.03 ft/s ±1.2 % of reading ±0.03 ft/s ±0.5 % of reading ±0.03 ft/s		
flow transmitter			
power supply	100 to 230 V/50 to 60 Hz or 20 to 32 V DC	20 to 32 V DC	100 to 230 V/50 to 60 Hz or 20 to 32 V DC
power consumption	< 8 W		
number of flow measuring channels	1, optional: 2		
damping	0 to 100 s, adjustable		
measuring cycle (1 channel)	100 to 1000 Hz		
response time	1 s, option: 70 ms		
housing material	cast aluminum, special heavy-duty coating		
degree of protection	IP66		
dimensions	see dimensional drawing		
weight	15.7 lb		
fixation	wall mounting, 2" pipe mounting		
operating temperature	-22 to +140 °F (< -4 °F without operation of the display)		
display	2 x 16 characters, dot matrix, backlight		
menu language	English, German, French, Dutch, Spanish		

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

[2] reference uncertainty < 0.2 %

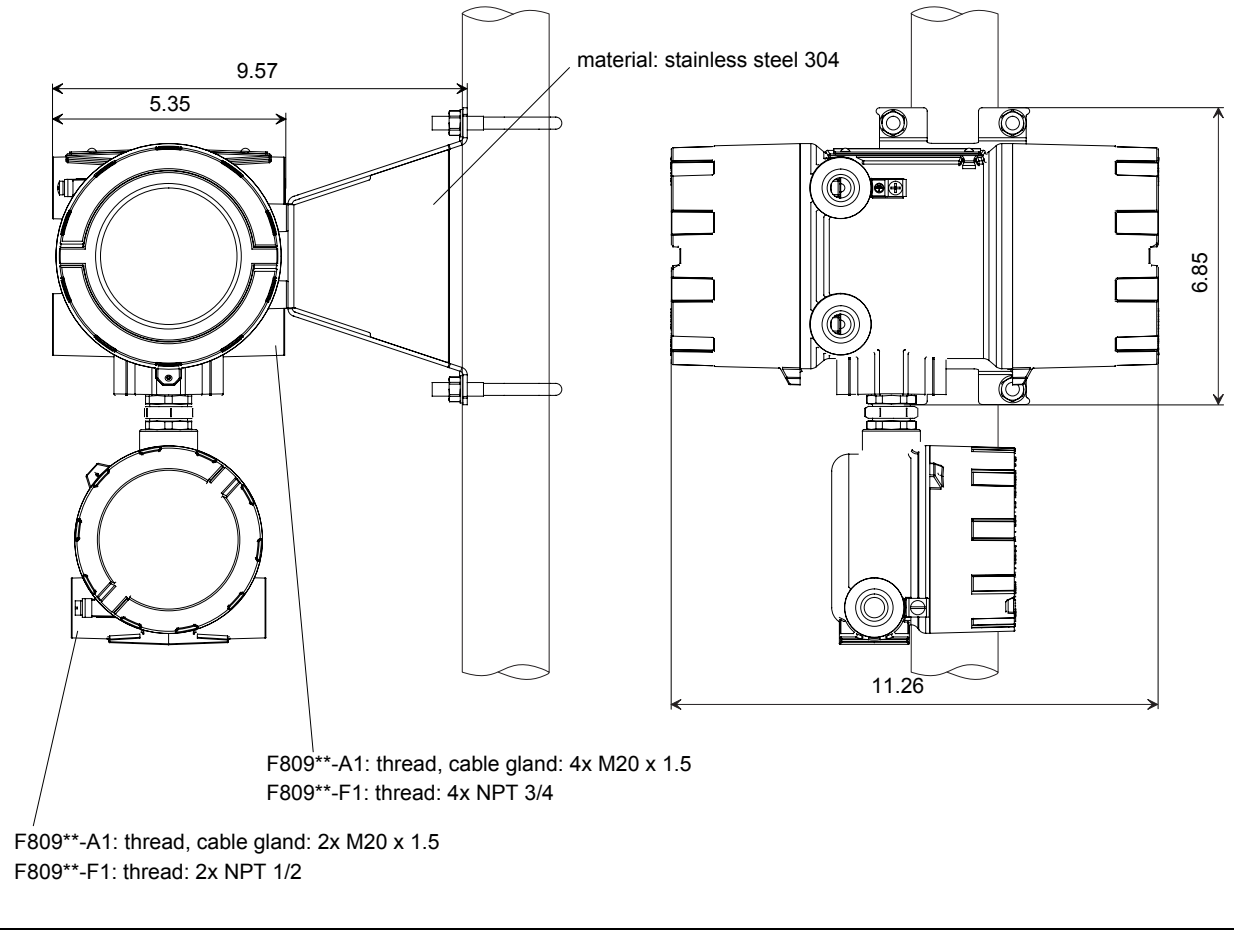
FLUXUS		F809**-A1	F809**-A1A	F809**-F1
explosion protection				
ATEX / IECEx	zone	1	1	-
	marking	CE 0637 Ex II2G II2D Ex db eb IIC T6 Gb Ex tb IIIC T 100 °C Db T_a -40...+60 °C	CE 0637 Ex II2G II2D Ex db eb ia IIC T6 Gb Ex tb ia IIIC T 100 °C Db T_a -40...+60 °C	-
	certification ATEX	IBExU11ATEX1022 X	IBExU11ATEX1022 X	-
	certification IECEx	IECEx IBE 11.0006X	IECEx IBE 11.0006X	-
	type of protection	gas: electronics compartment: flameproof enclosure, connection compartment: increased safety dust: protection by enclosure	gas: electronics compartment: flameproof enclosure, connection compartment: increased safety dust: protection by enclosure	-
	intrinsic safety parameters	-	U_m = 250 V U_i = 30 V DC I_i = 100 mA P_i = 0.75 W C_i = 3 nF L_i negligible	-
FM	marking	-	-	FM APPROVED Cl. I, II, III/Div. 1/ GP. A, B, C, D, E, F, G/ For Group A, conduit seal of connection compartment is required within 18 inches. FM c APPROVED Cl. I, II, III/Div. 1/ GP. B, C, D, E, F, G T4A Ta = 60 °C
	type of protection	-	-	gas: explosionproof electrical equipment dust: dust-ignitionproof electrical equipment
measuring functions				
physical quantities		volumetric flow rate, mass flow rate, flow velocity		
totalizer		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				
diagnostic interfaces		- RS232[3] - USB (with adapter)[3]		
process interfaces (max. 1 optional)		- RS485 (sender) - Modbus RTU - HART	-	- RS485 (sender) - Modbus RTU - HART
data logger				
loggable values		all physical quantities, totalized values and diagnostic values		
capacity		> 100 000 measured values		
serial data kit (optional)				
software		- FluxDiagReader: download of measured values and parameters, graphical presentation - FluxDiag (optional): download of measurement data, graphical presentation, report generation - FluxSubstanceLoader: upload of fluid data sets		
cable		RS232[3]		
adapter		RS232 - USB[3]		

[3] connection of the interface RS232 outside of explosive atmosphere (housing cover open)

FLUXUS	F809**-A1	F809**-A1A	F809**-F1
outputs			
	The outputs are galvanically isolated from the transmitter.		
number	max. 4	1	max. 4
	current output		
number	max. 2	-	max. 2
current output I1, I2		-	
- range	0/4 to 20 mA	-	0/4 to 20 mA
- accuracy	0.1 % of reading ±15 µA	-	0.1 % of reading ±15 µA
- active output	R_{ext} < 500 Ω	-	R_{ext} < 500 Ω
- passive output	U_{ext} = 4 to 26.4 V, depending on R_{ext}, R_{ext} < 1 kΩ	-	U_{ext} = 4 to 26.4 V, depending on R_{ext}, R_{ext} < 1 kΩ
current output I1 in HART mode			
- range	4 to 20 mA	-	4 to 20 mA
- passive output	U_{ext} = 7 to 30 V DC	-	U_{ext} = 7 to 30 V DC
- active output	U_{int} = 24 V	-	U_{int} = 24 V
	current output (intrinsic safety)		
number	-	1	-
current output I1			
- range	-	4 to 20 mA	-
- accuracy	-	0.04 % of reading ±3 µA	-
- passive output	-	U_{ext} = 7 to 30 V, depending on R_{ext}, R_{ext} < 1 kΩ	-
current output I1 in HART mode			
- range	-	4 to 20 mA	-
- passive output	-	U_{ext} = 7 to 30 V DC	-
	frequency output		
number	max. 1	-	max. 1
range	0 to 5 kHz	-	0 to 5 kHz
open collector	30 V/100 mA or 8.2 V DIN EN 60947-5-6 (NAMUR) or 24 V/4 mA (on request)	-	30 V/100 mA or 8.2 V DIN EN 60947-5-6 (NAMUR) or 24 V/4 mA (on request)
	binary output		
number	max. 2	-	max. 2
Reed relay	48 V/100 mA	-	48 V/100 mA
open collector	24 V/4 mA optional: 30 V/100 mA or 8.2 V DIN EN 60947-5-6 (NAMUR)	-	24 V/4 mA optional: 30 V/100 mA or 8.2 V DIN EN 60947-5-6 (NAMUR)
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	mainly for totalizing		mainly for totalizing
- pulse value	0.01 to 1000 units	-	0.01 to 1000 units
- pulse width	80 to 1000 ms	-	80 to 1000 ms

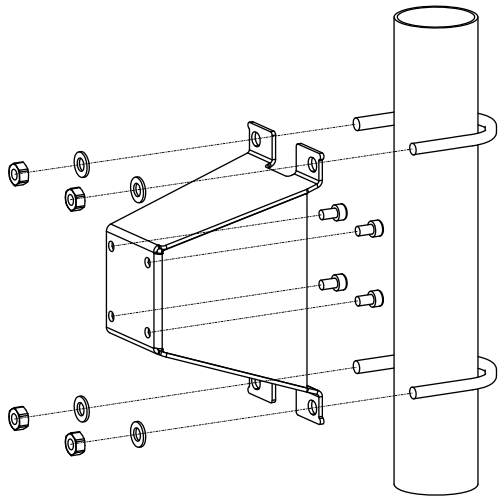
Dimensions

FLUXUS F809



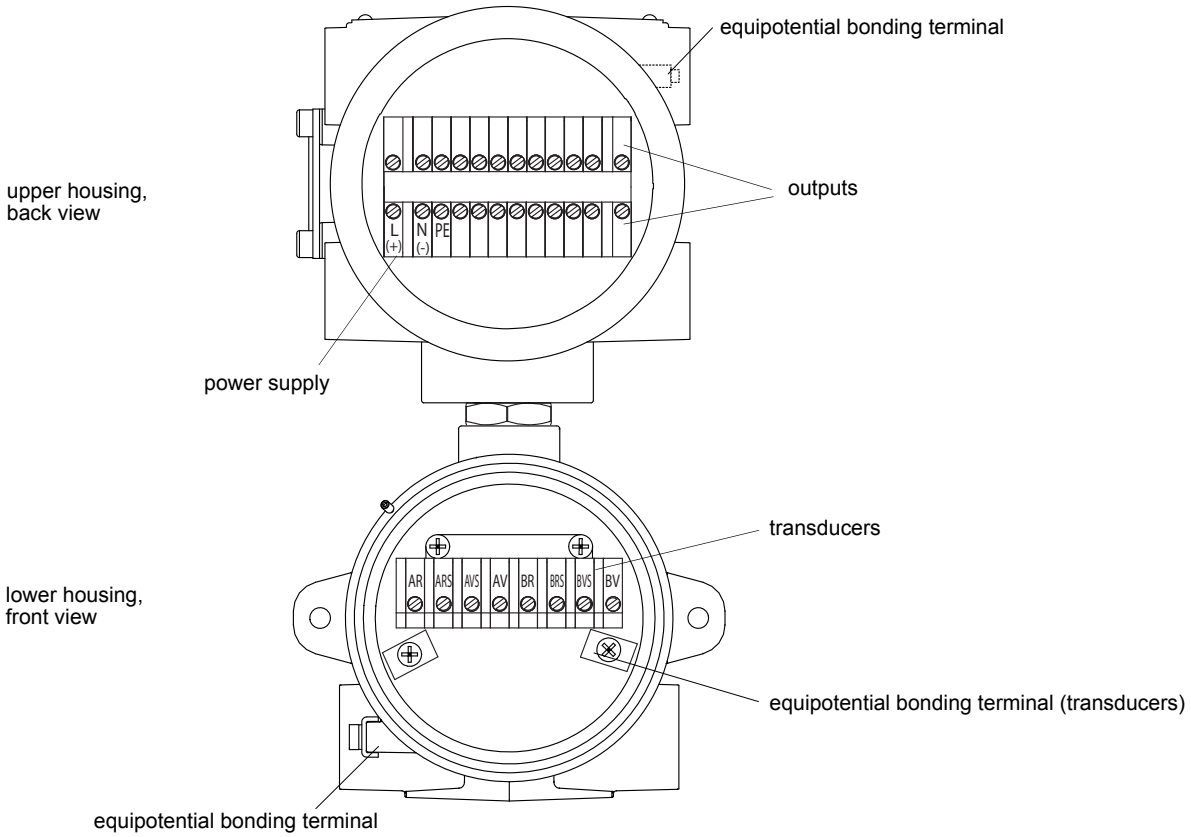
in inch

Wall and 2" pipe mounting kit



Terminal assignment

FLUXUS F809



power supply[1]

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

transducers

measuring channel A		measuring channel B	
terminal	**connection**	**terminal**	**connection**
AV	transducer ↑, signal	BV	transducer ↑, signal
AVS	transducer ↑, internal shield	BVS	transducer ↑, internal shield
ARS	transducer ⇈, internal shield	BRS	transducer ⇈, internal shield
AR	transducer ⇈, signal	BR	transducer ⇈, signal
cable gland or equipotential bonding terminal (transducers)	external shield	cable gland or equipotential bonding terminal (transducers)	external shield

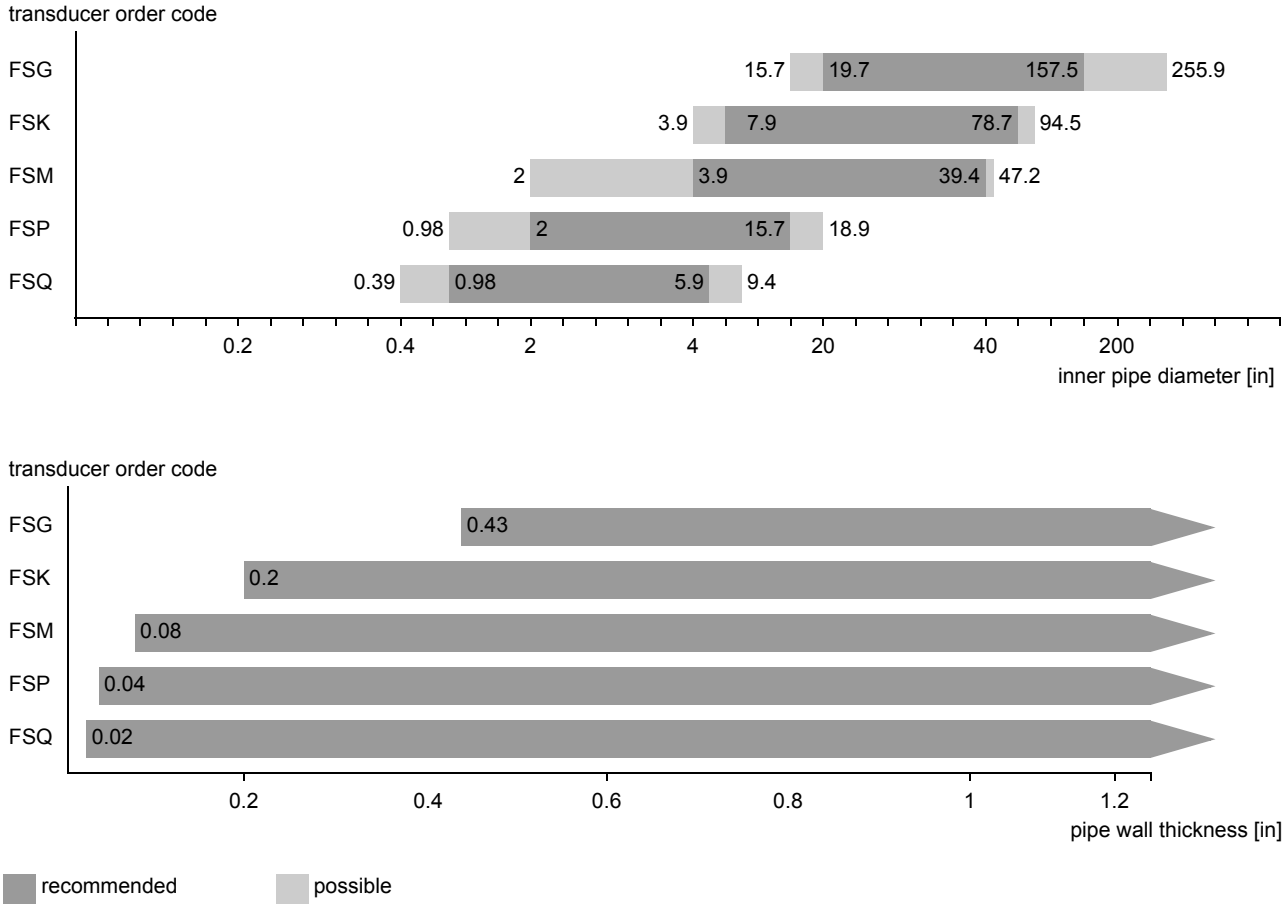
outputs[1]

terminal	connection	
1(-), 2(+)	current output I1	frequency output F1
3(-), 4(+)	current output I2	
5(-), 6(+)	binary output B1 (open collector)	
7(-), 8(+)	binary output B2 (open collector)	
9(-), 10(+)	binary output B1 (Reed relay)	binary output B1 (open collector)
A+, B-, S	communication interface	

[1] cable (by customer): - lead cross sectional area: AWG14 to 24

Transducers

Transducer selection

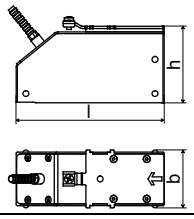
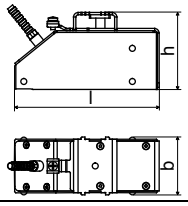


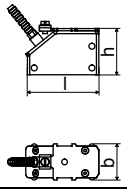
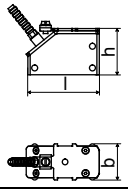
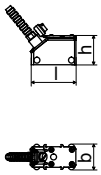
Transducer order code

1, 2	3		4	5, 6	7, 8		9 to 11		12, 13	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
			N							normal temperature range
			E							extended temperature range (FSM, FSP, FSQ)
				A1						ATEX zone 1/IECEx zone 1
				F1						FM Class I Div. 1
					TS					direct connection or connection via junction box
							XXX			0 m: without extension cable > 0 m: F809**-A1: with junction box, F809**-F1: with terminal board KFM1
									LC	long transducer cable
									IP68	degree of protection NEMA6P
									OS	housing with stainless steel 316
example										
FS	M	-	N	A1	TS	-	000			shear wave transducer 1 MHz, normal temperature range, ATEX zone 1/IECEx zone 1, connection system TS (direct connection)
		-				-		/		

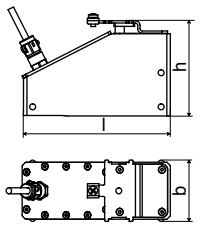
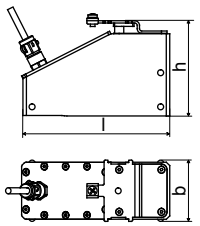
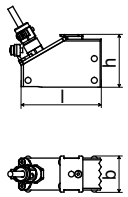
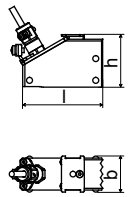
Technical data

Shear wave transducers (zone 1)

technical type		CDG1N81	CDK1N81
order code		**FSG-NA1TS** **FSG-NA1TS/OS**	**FSK-NA1TS** **FSK-NA1TS/OS**
transducer frequency	MHz	0.2	0.5
inner pipe diameter d			
min. extended	in	15.7	3.9
min. recommended	in	19.7	7.9
max. recommended	in	157.5	78.7
max. extended	in	255.9	94.5
pipe wall thickness			
min.	in	0.43	0.2
material			
housing contact surface		PEEK with stainless steel cap 304 , option OS: 316L PEEK	PEEK with stainless steel cap 304 , option OS: 316L PEEK
degree of protection		IP65	IP66
transducer cable			
type		1699	1699
length	ft	16	16
dimensions			
length l	in	5.1	4.98
width b	in	2.01	2.01
height h	in	2.64	2.66
dimensional drawing			
ambient temperature			
min.	°F	-40	-40
max.	°F	+266	+266
temperature compen-sation		x	x
explosion protection			
ATEX/IECEx category EPL zone		gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21
explosion protection temperature (pipe surface)			
ATEX/IECEx min.	°C	-55	-55
ATEX/IECEx max.	°C	+180	+180
ATEX/IECEx marking		CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db
ATEX/IECEx certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X
ATEX/IECEx certification IECEx		IECEx IBE 08.0007X	IECEx IBE 08.0007X
ATEX/IECEx type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
ATEX/IECEx transducer mounting fixture necessary		x	x
remark		on request	

technical type			CDM2N81	CDP2N81	CDQ2N81
order code			**FSM-NA1TS** **FSM-NA1TS/OS**	**FSP-NA1TS** **FSP-NA1TS/OS**	**FSQ-NA1TS** **FSQ-NA1TS/OS**
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		0.08	0.04	0.02
material					
housing contact surface			PEEK with stainless steel cap 304 , option OS: 316L PEEK	PEEK with stainless steel cap 304 , option OS: 316L PEEK	PEEK with stainless steel cap 304 , option OS: 316L PEEK
degree of protection			IP66	IP66	IP65
transducer cable					
type			1699	1699	1699
length	ft		13	13	9
dimensions					
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					
ambient temperature					
min.	°F		-40	-40	-40
max.	°F		+266	+266	+266
temperature compensation			x	x	x
explosion protection					
ATEX / IECEx	category EPL zone		gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21
	explosion protection temperature (pipe surface)				
	min. max.	°C °C	-55 +180	-55 +180	-55 +180
	marking		CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db
	certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
	certification IECEx		IECEx IBE 08.0007X	IECEx IBE 08.0007X	IECEx IBE 08.0007X
	type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
	transducer mounting fixture necessary		x	x	x

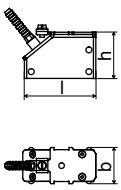
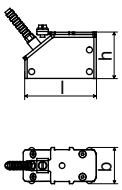
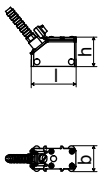
Shear wave transducers (zone 1, IP68)

technical type		CDG1LI1	CDK1LI1	CDM2LI1	CDP2LI1
order code		**FSG-NA1TS/IP68**	**FSK-NA1TS/IP68**	**FSM-NA1TS/IP68**	**FSP-NA1TS/IP68**
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	0.08	0.04
material					
housing contact surface		PEEK with stainless steel cap 316Ti PEEK	PEEK with stainless steel cap 316Ti PEEK	PEEK with stainless steel cap 316Ti PEEK	PEEK with stainless steel cap 316Ti PEEK
degree of protection		IP68	IP68	IP68	IP68
transducer cable					
type		2550	2550	2550	2550
length	ft	39	39	39	39
dimensions					
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					
ambient temperature					
min.	°F	-40	-40	-40	-40
max.	°F	+212	+212	+212	+212
temperature compensation		x	x	x	x
explosion protection					
category EPL zone		gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21
explosion protection temperature (pipe surface)					
min.	°C	-55	-55	-55	-55
max.	°C	+180	+180	+180	+180
marking		CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T3 Gb Ex tb IIIC TX Db
certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
certification IECEx		IECEx IBE 08.0007X	IECEx IBE 08.0007X	IECEx IBE 08.0007X	IECEx IBE 08.0007X
type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
transducer mounting fixture necessary		x	x	x	x
remark		on request			

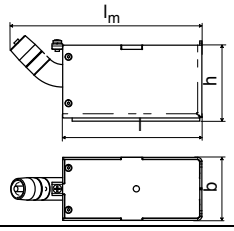
ATEX / IECEx

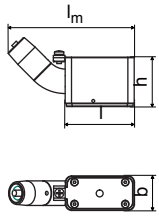
[1] test conditions: 3 months/29 psi (65 ft)/36 °F

Shear wave transducers (zone 1, extended temperature range)

technical type		CDM2E85	CDP2E85	CDQ2E85
order code		**FSM-EA1TS** **FSM-EA1TS/OS**	**FSP-EA1TS** **FSP-EA1TS/OS**	**FSQ-EA1TS** **FSQ-EA1TS/OS**
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	0.08	0.04	0.02
material				
housing contact surface		PI with stainless steel cap 304, option OS: 316L PI	PI with stainless steel cap 304, option OS: 316L PI	PI with stainless steel cap 304, option OS: 316L PI
degree of protection		IP66	IP66	IP56
transducer cable				
type		6111	6111	6111
length	ft	13	13	9
dimensions				
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				
ambient temperature				
min.	°F	-22	-22	-22
max.	°F	+392	+392	+392
temperature compensation		x	x	x
explosion protection				
ATEX/IECEx category EPL zone		gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21	gas: 2G dust: 2D Gb Db 1 21
explosion protection temperature (pipe surface)				
ATEX/IECEx min.	°C	-45	-45	-45
ATEX/IECEx max.	°C	+225	+225	+225
ATEX/IECEx marking		CE 0637 Ex II2G II2D Ex q IIC T6...T2 Gb Ex tb IIIA TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T2 Gb Ex tb IIIA TX Db	CE 0637 Ex II2G II2D Ex q IIC T6...T2 Gb Ex tb IIIA TX Db
ATEX/IECEx certification ATEX		IBExU07ATEX1168 X	IBExU07ATEX1168 X	IBExU07ATEX1168 X
ATEX/IECEx certification IECEx		IECEx IBE 08.0007X	IECEx IBE 08.0007X	IECEx IBE 08.0007X
ATEX/IECEx type of protection		gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure	gas: powder filling dust: protection by enclosure
ATEX/IECEx transducer mounting fixture necessary		x	x	x

Shear wave transducers (FM Class I Div. 1)

technical type		CDG1N62	CLG1N62	CDK1N62	CLK1N62
order code		**FSG-NF1TS FSG-NF1TS/OS**	**FSG-NF1TS/LC FSG-NF1TS/OS/LC**	**FSK-NF1TS FSK-NF1TS/OS**	**FSK-NF1TS/LC FSK-NF1TS/OS/LC**
transducer frequency	MHz	0.2		0.5	
inner pipe diameter d					
min. extended	in	15.7		3.9	
min. recommended	in	19.7		7.9	
max. recommended	in	157.5		78.7	
max. extended	in	255.9		94.5	
pipe wall thickness					
min.	in	0.43		0.2	
material					
housing		stainless steel 304, option OS: 316L		stainless steel 304, option OS: 316L	
contact surface		PEEK		PEEK	
degree of protection		IP66		IP66	
transducer cable					
type		2549	2549	2549	2549
length	ft	32	150	32	150
dimensions					
length l	in	5.2		5.2	
width b	in	2.36		2.36	
height h	in	2.83		2.83	
mounting length l_m	in	7.28		7.28	
dimensional drawing					
operating temperature					
min.	°F	-40		-40	
max.	°F	+230		+230	
temperature compensation		x		x	
explosion protection					
FM	**explosion protection temperature**				
	min.	°F	-40		-40
	max.	°F	+257		+257
	marking		S/Cl. I, II, III / Div. 1 / GP A, B, C, D, E, F, G / Temperature Codes dwg 3831		S/Cl. I, II, III / Div. 1 / GP A, B, C, D, E, F, G / Temperature Codes dwg 3831
remark		on request			

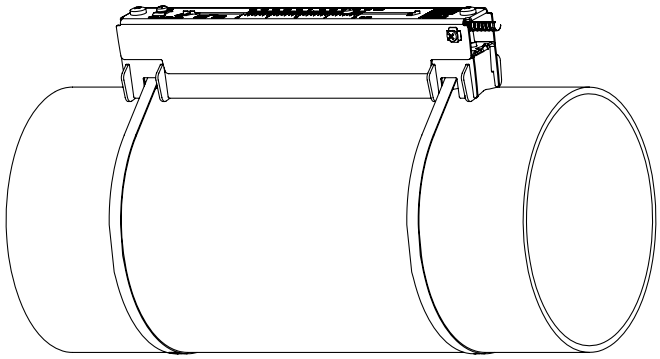
technical type		CDM1N62	CLM1N62	CDP1N62	CLP1N62	CDQ1N62	CLQ1N62
order code		**FSM-NF1TS FSM-NF1TS/ OS**	**FSM-NF1TS/LC FSM-NF1TS/OS/ LC**	**FSP-NF1TS FSP-NF1TS/ OS**	**FSP-NF1TS/LC FSP-NF1TS/OS/ LC**	**FSQ-NF1TS FSQ-NF1TS/ OS**	**FSQ-NF1TS/LC FSQ-NF1TS/OS/ LC**
transducer frequency	MHz	1		2		4	
inner 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	0.08		0.04		0.02	
material							
housing		stainless steel 304, option OS: 316L		stainless steel 304, option OS: 316L		stainless steel 304, option OS: 316L	
contact surface		PEEK		PEEK		PEEK	
degree of protection		IP66		IP66		IP66	
transducer cable							
type		2549	2549	2549	2549	2549	2549
length	ft	32	150	32	150	32	150
dimensions							
length l	in	2.36		2.36		2.36	
width b	in	1.18		1.18		1.18	
height h	in	1.69		1.69		1.69	
mounting length l_m	in	4.33		4.33		4.33	
dimensional drawing							
operating temperature							
min.	°F	-40		-40		-40	
max.	°F	+230		+230		+230	
temperature compensation		x		x		x	
explosion protection							
FM **explosion protection temperature**							
min.	°F	-40		-40		-40	
max.	°F	+257		+257		+257	
marking		S/Cl. I, II, III / Div. 1 / GP A, B, C, D, E, F, G / Temperature Codes dwg 3831		S/Cl. I, II, III / Div. 1 / GP A, B, C, D, E, F, G / Temperature Codes dwg 3831		S/Cl. I, II, III / Div. 1 / GP A, B, C, D, E, F, G / Temperature Codes dwg 3831	

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
VL										PermaRail
VC										Variofix C
PF										PermaFiX
WI										transducer box for WaveInjector
	K									transducers with transducer frequency G, K
	M									transducers with transducer frequency M, P, Q
	Q									transducers with transducer frequency Q
			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
							002			0.39 to 0.79 in
							004			0.79 to 1.6 in
							T36			1.6 to 14.2 in
							013			0.39 to 5.1 in
							036			5.1 to 14.2 in
							092			14.2 to 36.2 in
							200			36.2 to 78.7 in
							450			78.7 to 177.2 in
							940			177.2 to 370.1 in
							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
							SB2			3 to 6 in
							SB3			8 to 10 in
							SB4			12 to 18 in
							SB5			20 to 36 in
							SB6			30 to 100 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
PF	M	-	D	S	-	S	200			PermaFiX and tension straps for transducers with transducer frequency M, P, Q
		-			-			/		

PermaRail (VLK, VLM, VLQ)

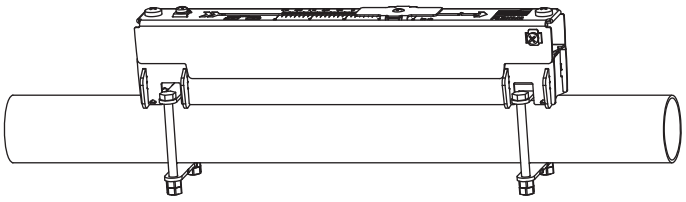


material: stainless steel 304, 301, 410
option OS: 316, 316L, 17-7PH

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

PermaRail with bolt mounting plates (VL*-**-B)



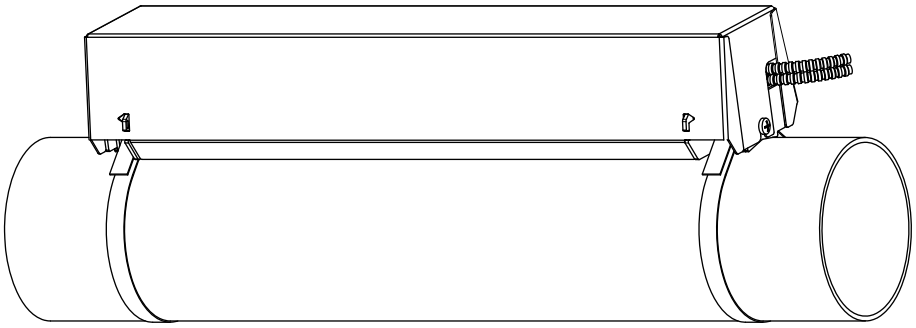
material: stainless steel 304, 301, 410
option OS: 316, 316L, 17-7PH

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

Variofix C (VC)

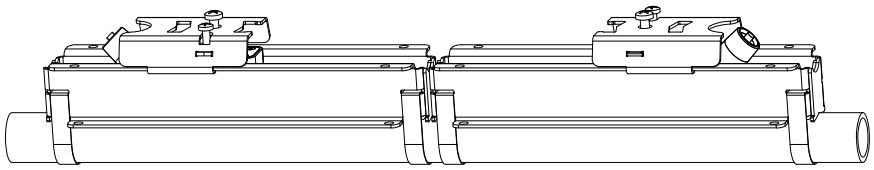


material: stainless steel 304, 301
option OS: 316

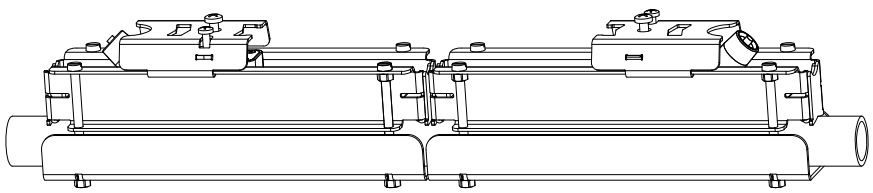
inner length:
VCK-*L: 19.7 in
VCK-*S: 13.8 in
VCM: 15.7 in
VCQ: 9.8 in

dimensions:
VCK-*L: 22.05 x 4.8 x 4.02 in,
option IP68: 22.05 x 4.96 x 4.72 in
VCK-*S: 16.14 x 4.8 x 4.02 in,
option IP68: 16.14 x 4.96 x 4.72 in
VCM: 18.11 x 3.78 x 31.5 in
VCQ: 12.2 x 3.35 x 2.44 in

PermaFiX with tension straps (PF*-DS-S)



PermaFiX with bolts (PF*-DS-B)

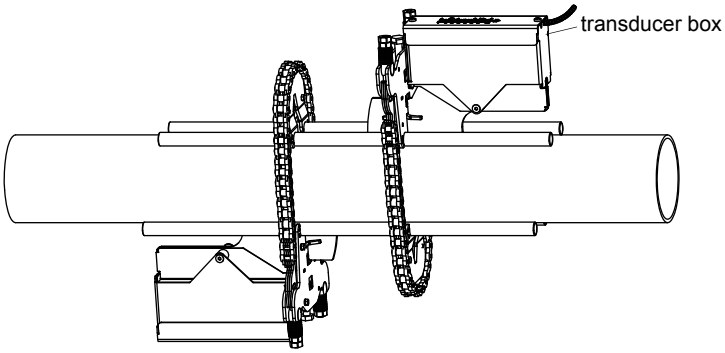


material: stainless steel 304, 301
option OS: 316

inner length:
PFK: 14.69 in
PFM: 10.87 in

dimensions:
PFK: 16.14 x 3.54 x 2.87 in
PFM: 12.2 x 2.68 x 1.73 in

transducer box WI for WaveInjector



see Technical specification
TSWaveInjectorVx-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 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 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 A and coupling pad type VT	coupling pad type B and coupling pad type VT

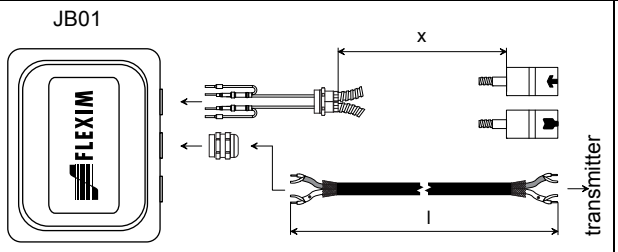
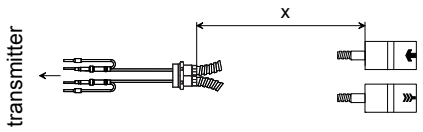
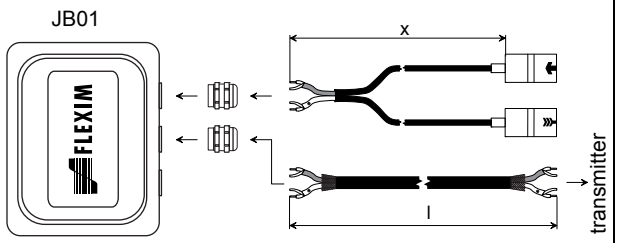
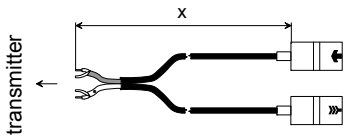
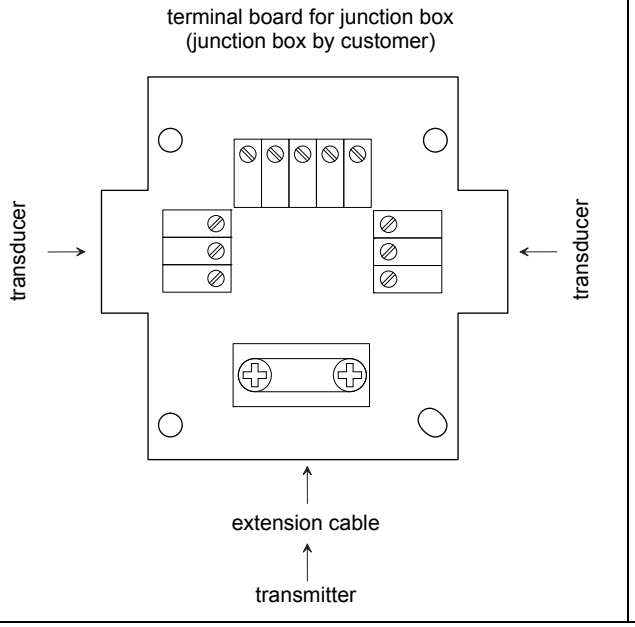
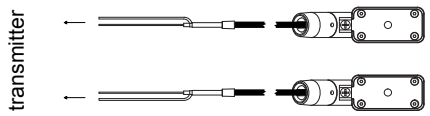
[1] < 5 years
[2] < 6 months

Technical data

type	**ambient temperature** °F	**material**
coupling compound type N	-22 to +266	mineral grease paste
coupling compound type E	-22 to +392	silicone paste
coupling compound type H	-22 to +482	fluoropolymer paste
coupling pad type A	max. 536	lead
coupling pad type B	> 536 to 752	silver
coupling pad type VT	14 to +392	fluoroelastomer

Connection systems

connection system TS

connection with extension cable	direct connection	transducers technical type
		*****8*
		****LI*
		*****62

	transducer frequency (3d character of transducer order code)		F, G, H, K		M, P		Q		S	
			x	**l**	**x**	**l**	**x**	**l**	**x**	**l**
T S	cable length	ft	16	≤ 984	13	≤ 984	9	≤ 295	6	≤ 131
	cable length (*****62)	ft	32	≤ 984	32	≤ 984	32	≤ 295	-	-
	cable length (option LC)	ft	29	≤ 984	-	-	-	-	-	-
	cable length (option LC, *****62)	ft	150	≤ 984	150	≤ 984	150	≤ 295	-	-
	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			
type		1699	2550 (option IP68)	6111	2549
ambient temperature	°F	-67 to +392	-40 to +212	-148 to +437	-148...+392
properties			longitudinal watertight		
cable jacket					
material		PTFE	PUR	PFA	PTFE
outer diameter	in	0.11	0.2 ±0.01	0.11	0.21
thickness	in	0.01	0.04	0.02	0.02
color		brown	gray	white	black
shield		x	x	x	x
sheath					
material		stainless steel 304 option OS: 316Ti	-	stainless steel 304 option OS: 316Ti	-
outer diameter	in	0.31	-	0.31	-

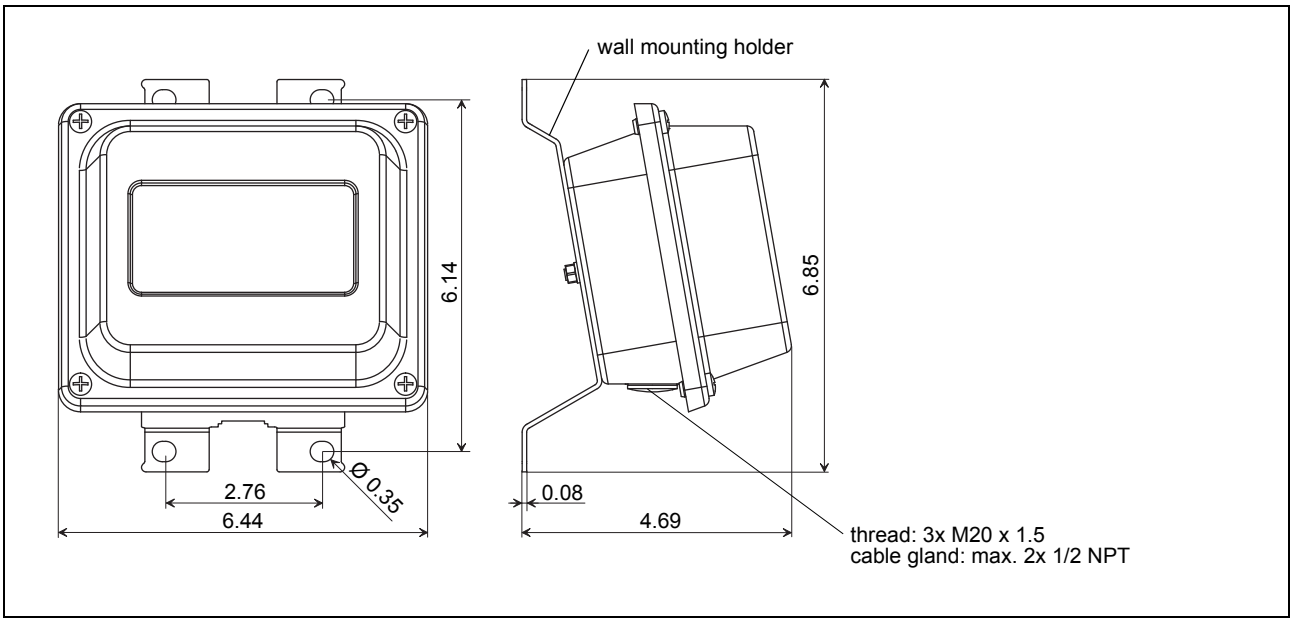
		extension cable	
type		2615	5245
ambient temperature	°F	-22 to +158	-22 to +158
properties		halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2	halogen free fire propagation test according to IEC 60332-1 combustion test according to IEC 60754-2
cable jacket			
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

Junction box (F809**-A1)

Technical data

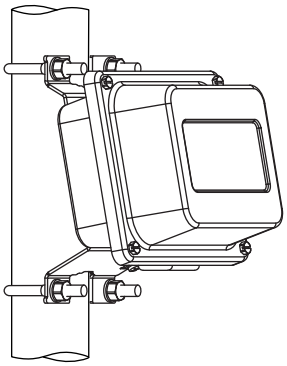
technical type			**JB01S4E3M**
dimensions			see dimensional drawing
weight		lb	2.6 lb
fixation			wall mounting, optional: 2" pipe mounting
material			
housing gasket			stainless steel 316L silicone
degree of protection			IP67
ambient temperature			
min. max.		°F °F	-40 +176
explosion protection			
ATEX / IECEx	zone		1
	marking		CE 0637 Ex II2G II2D Ex e mb IIC (T6)...T4 Gb Ex tb IIIC T 100 °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

Dimensions



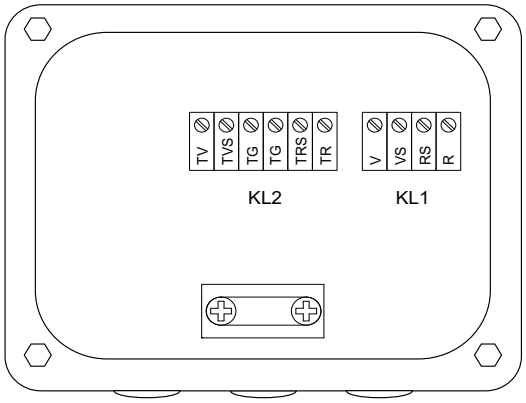
in inch

2" pipe mounting kit (optional)



Terminal assignment

JB01



transducers

terminal strip KL1

terminal	connection
V	transducer ↑, signal
VS	transducer ↑, internal shield
RS	transducer ↑↑, internal shield
R	transducer ↑↑, signal

extension cable

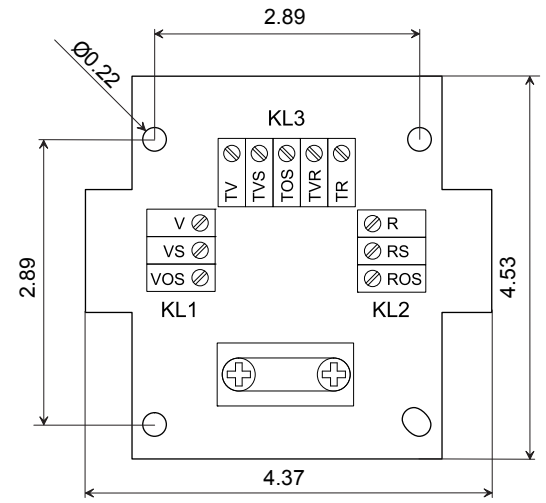
terminal strip KL2

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

Extension cable (F809**-F1)

The extension cable and the transducers are connected via terminal board KFM1. The terminal board has to be installed into a junction box (by customer) approved for hazardous areas.

Terminal assignment KFM1



in inch

transducers

terminal	connection
terminal strip KL1	
V	transducer ↑, signal
VS	transducer ↑, internal shield
VOS	transducer ↑, external shield
terminal strip KL2	
R	transducer ⅄, signal
RS	transducer ⅄, internal shield
ROS	transducer ⅄, external shield

extension cable

terminal strip KL3

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

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