

Flowmeter Series



Wide Selection of Flowmeter

PRODUCT'S CONCEPT

- Suitable for versatile application among process automation and factory automation.
- Liquid, gas, and vapor can be measured.
- The most appropriate model for the fluid property can be selected.

Liquid flow rate measurement



Electromagnetic flowmeter



Ultrasonic flowmeter



Vortex flowmeter



Differential pressure flowmeter

Connected measuring instrument



Recorder (PHR or PHL)



Integrator (FDC-281)



Integrator (FDC-981)



Alarming indicator (PCP)



Distributor (PTL)



Controller (PDA)



Personal computer

Gas flow rate measurement



Vortex flowmeter



Differential pressure flowmeter

Vapor flow rate measurement



Vortex flowmeter



Differential pressure flowmeter

Flowmeters with various measuring principle to meet your needs

Simply select to suit the application

		Ultrasonic	Electromagnetic	Differential pressure	Vortex	
Object of measurement	Fluid	○	○	○	○	
	Gas	×	×	○	○	
	Vapor	×	×	○	○	
	Slurry	△	○	×	×	
Application	Control	○	○	○	○	
	Monitor	○	○	○	○	
	Supply	×	○	×	×	
Operating condition	Temperature	-40 to 200°C	-20 to 120°C	-40 to 600°C	-10 to 200°C	
	Pressure	—	-1 to 2MPa	-0.1 to 42MPa	max 5MPa	
	Pressure loss	None	None	Large	Large	
	Rangeability	Large	Large	Small	Medium	
Installing condition	Bore	φ13 to φ6000	φ2.5 to φ300	φ25 to φ3000	φ4 to φ100	
	Straight pipe length	Upstream side	10D	5D	10D	7D
		Downstream side	5D	2D	5D	3D
	Piping work	Not required	Required	Required	Required	
	Explosion-proofing	×	×	○	×	
Performance	Accuracy	±1% of rate	±0.5% of rate	±2.0% FS	1 to 3% of rate	
	Velocity range	-32 to +32m/s (0.3m/s min.)	0 to 15m/s (0.1m/s min.)	—	0.3 to 4m/s	

Note: Straight pipe length (D): Represents pipe bore.

Typical applications for flowmeter

Application	Measuring fluid	Oil	Ultra-demineralized water	Chemical	Warm cooling water	Pure water	Drainage	Sludge	Condensed sludge	High purity alcohol	Liquor	Milk / fruit juice	Soy sauce, dip	Air	Vapor
		Chemical & petroleum chemical	Crude oil, refined oil, fertilizer, chemical	✓		✓									
Steel	Cooling water				✓										
Water treatment	Pure water, drainage, sludge, condensed sludge, chemical, air			✓		✓	✓	✓	✓					✓	
Semiconductor	Demineralized water, chemical, drainage		✓	✓			✓								
Food & beverage	Water, liquor, milk, fruit juice, sauce, etc.									✓	✓	✓	✓		✓
Pharmaceuticals	Chemical, water			✓		✓									
Building and regional heating / cooling	Chilled water, hot water				✓										
Energy conservation	Air, vapor, water				✓									✓	✓
Assembly plant	Air, vapor, water, oil, chemical	✓		✓	✓	✓								✓	✓
Molding plant	Cooling water				✓										

Applicable flowmeter

Fluid	Ultrasonic	Electromagnetic	Differential pressure	Vortex
Oil	○	×	○	○
Ultra-demineralized water	○	×	○	△
Chemical	○	○	○	○
Warm cooling water	○	○	○	○
Pure water	○	○	○	○
Drainage	○	○	△	△
Sludge	△	○	△	△
Condensed sludge	×	○	×	×
High purity alcohol	○	×	○	○
Liquor	○	○	○	○
Milk, fruit juice	○	○	○	△
Soy sauce, dip	○	○	○	○
Air	×	×	○	○
Vapor	×	×	○	○
Gas	×	×	○	○

◎ : Optimum
 ○ : Suitable
 △ : May be used (but conditional)
 × : Should not be used

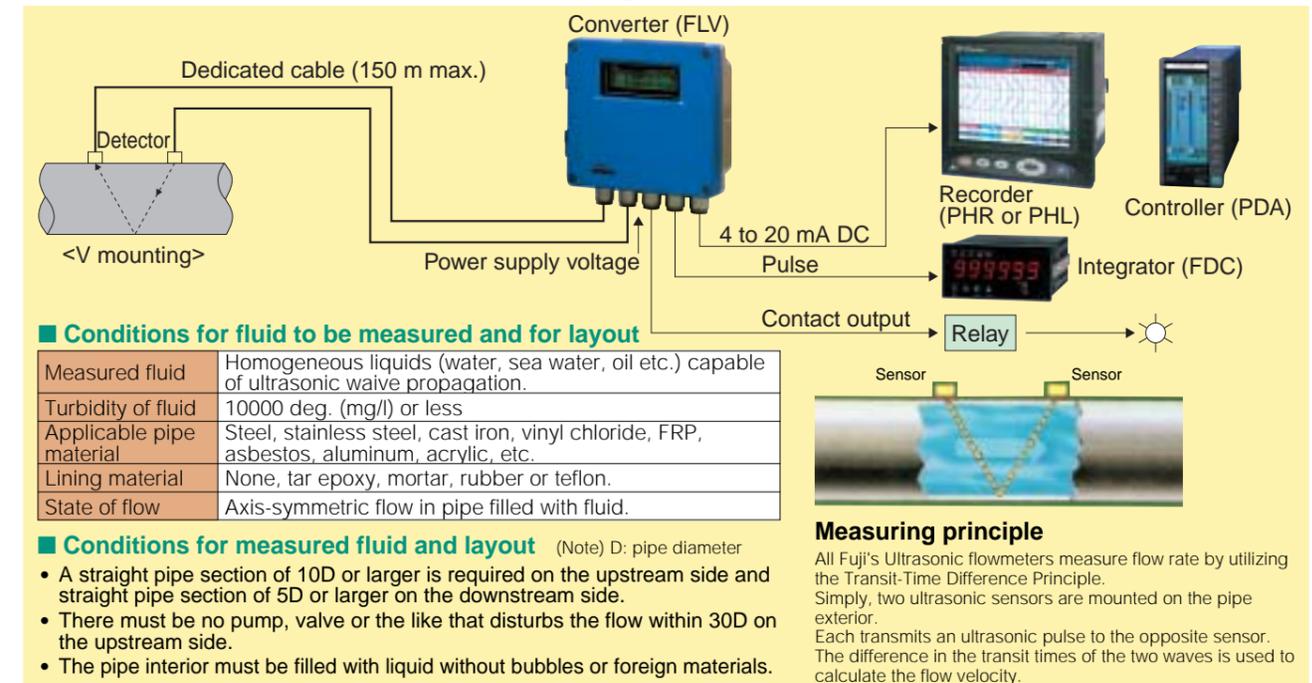
Ultrasonic Flowmeter series

Ultrasonic flowmeter for measuring flow rate from outside the pipe



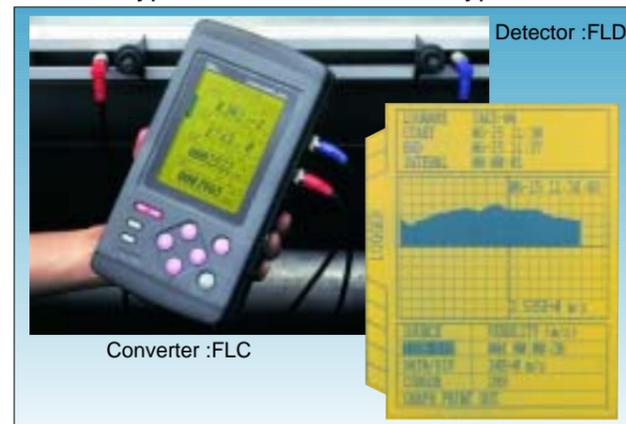
Ultrasonic Flowmeter series

No troublesome piping work! Typical system configuration



PORTAFLOW-X, offering true mobility

Detector type:FLD Converter type:FLC



Features

- Portable, 1.5kg & 5hours operation
- Superior operability with large graphic display
- Dedicated carrying case for easy carriage
- 40,000 data logging function

Specifications

- Detector types:
 - FLD22: For $\phi 13$ to $\phi 100$ mm /-40 to 100°C
 - FLD12: For $\phi 50$ to $\phi 400$ mm /-40 to 100°C
 - FLD41: For $\phi 200$ to $\phi 1200$ mm /-40 to 80°C
 - FLD51: For $\phi 200$ to $\phi 6000$ mm /-40 to 80°C
 - FLD32: For $\phi 50$ to $\phi 400$ mm /-40 to 200°C
- Measurement range: -32 to 0 to 32 m/s (0.3m/s min.)
- Response time: 1s or less
- Output signal: 4 to 20mA DC
- Communication interface: RS 232C
- Accuracy: 1% of rate
- Power supply voltage: 100 to 240V AC, built-in battery
- Printer: Option

Compact M-Flow PW

Detector type: FLS Converter type: FLR



Features

- Small converter, front face of 140X130 mm
- High speed response in 0.2 second
- Almost unaffected by fluid temperature or pressure variations

Specifications

- Detector types:
 - FLSS12: For $\phi 25$ to $\phi 100$ mm /-20 to 100°C
 - FLSS22: For $\phi 50$ to $\phi 225$ mm /-20 to 100°C
 - FLSS31: For $\phi 50$ to $\phi 300$ mm /-20 to 80°C
 - FLSS41: For $\phi 300$ to $\phi 600$ mm /-20 to 80°C
- Measurement range: -10 to 0 to 10 m/s (0.3m/s min.)
- Response time: 0.2s
- Output signal: 4 to 20mA DC, pulse output, alarm output
- Communication interface: RS485 or RS232C
- Accuracy: 1.5% or 2% of rate
- Structure: Both of converter and detector are of IP65 waterproof structure
- Power supply voltage: 100 to 120V AC, 200 to 240V AC or 20 to 30V DC
- Cable length between detector and converter: 30 m max

TIME DELTA-S for general use

Detector type: FLW, D Converter type: FLV



Features

- Resistant to bubbles in the liquid
- Accurate measurement: 1.0% of rate
- Various sensors available according to usage
- Almost unaffected by fluid temperature or pressure variations

Specifications

- Detector types:
 - FLD22: For $\phi 13$ to $\phi 100$ mm /-40 to 100°C
 - FLW12: For $\phi 50$ to $\phi 400$ mm /-40 to 80°C
 - FLW51: For $\phi 200$ to $\phi 6000$ mm /-40 to 80°C
 - FLD32: For $\phi 50$ to $\phi 400$ mm /-40 to 200°C
- Measurement range: -32 to 0 to 32 m/s (0.3m/s min.)
- Response time: 0.5s or less
- Output signal: 4 to 20mA DC, pulse output, alarm output
- Accuracy: 1.0% of rate
- Structure: Converter is of IP65 waterproof structure
- Power supply voltage: 100 to 240V AC
- Cable length between detector and converter: 150 m max

TIME DELTA-F, high-functionality type

Detector type: FLW, Converter type: FLH



Features

- Resistant to bubbles in the liquid
- Simultaneous measurement of two lines or pipes
- Accurate measurement: 1.0% of rate
- Almost unaffected by fluid temperature or pressure variations

Specifications

- Detector types:
 - FLW12: For $\phi 50$ to $\phi 400$ mm /-40 to 80°C
 - FLW51: For $\phi 200$ to $\phi 6000$ mm /-40 to 80°C
 - FLD32: For $\phi 50$ to $\phi 400$ mm /-40 to 200°C
- Measurement range: -32 to 0 to 32 m/s (0.3m/s min.)
- Response time: 1.5s or less
- Output signal: 4 to 20mA DC, pulse output, alarm output, BCD output
- Communication interface: RS485 or RS232C
- Accuracy: 1.0% of rate
- Power supply voltage: 100 to 120V AC or 200 to 240V AC
- Cable length between detector and converter: 150 m max

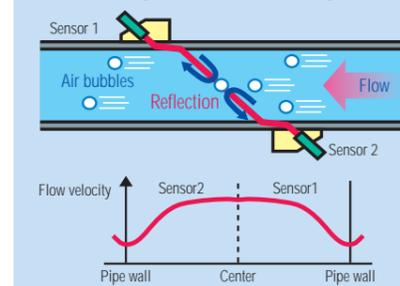
High-Accuracy Hybrid Ultrasonic Flowmeter <DUOSONICS>

Ultrasonic flowmeter based on a new concept of using pulse Doppler profiling and propagation time difference methods in combination



Pulse Doppler profiling method

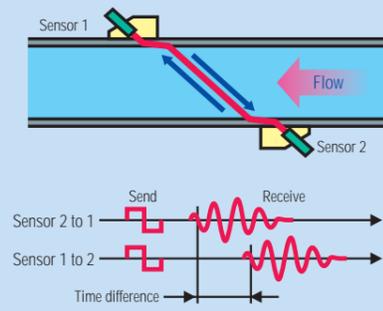
- Flow rate is calculated from profiling the flow velocity distribution across the inside diameter, eliminating dependence on a correction coefficient (K-factor). Changing Doppler frequency shifts from reflectors such as air bubbles and particles are calculated to model the actual flow profile.
- Suitable for liquid with entrained air or particles.



Measurement method automatically switched depending on fluid conditions

Propagation time difference method

- Ultrasonic wave pulses are made to propagate diagonally from the upstream side and the downstream side. Time difference caused by the flow is detected and used for the measurement of the flow rate.
- Suitable for clean liquid.



Features

- The automatic switchover function between the two methods, utilizing reflection and penetration respectively, enables flow rate measurement of various liquids with/without air bubbles and solid particles
- High accuracy to within 0.5% to 1%
- Real time monitoring of velocity profile (pulse Doppler method) Eliminates need for correction coefficient, eases straight pipe restrictions, applicable to undeveloped flow
- High speed response: 0.1s (Pulse Doppler method) / 0.5s (transit time method)

Specifications

- Detector types:
 - FSWS12: For ϕ 50 to ϕ 100mm /-40 to 100°C
 - FSWS21: For ϕ 100 to ϕ 200mm /-40 to 80°C
 - FSWS40: For ϕ 200 to ϕ 500mm /-40 to 80°C
 - FSWS50: For ϕ 500 to ϕ 1000mm /-40 to 80°C
- Measurement range: Transit time method: -32 to 0 to +32m/s (0.3m/s min.) Pulse Doppler method: -4 to 0 to +4m/s (0.3m/s min.)
- Response time: Transit time method: 0.5s or less Pulse Doppler method: 0.1s or less
- Output signal: 4 to 20mA DC, pulse, alarm
- Communication interface: RS485/RS232C (selectable)
- Accuracy: 0.5% to 1.0% of rate
- Structure: converter IP67 (waterproof), detector IP68 (submersible)
- Power supply voltage: 100 to 240V AC or 20 to 30V DC
- Cable length between detector and converter: 150m max.

Measured fluid and piping conditions

Measured fluid	Homogeneous fluid capable of ultrasonic wave propagation
Fluid temperature	-40 to 80°C or -40 to 100°C (depending on the types of detector)
Air bubble quantity	Pulse Doppler method: 0.02 to 15% of volume. Transit time method: 0 to 12% of volume
Applicable pipe material	Plastics (PVC, FRP, etc.) or metals (carbon steel, SS, aluminum, etc.)
Liner	Tar epoxy, mortar, etc.
Type of flow	Pulse Doppler method: axisymmetric flow in a filled pipe. Transit time method: well-developed turbulent or laminar flow in a filled pipe.



Applications

Crude oil emulsions, HVAC, petroleum products, waste & water management, potable water, effluent monitoring, slurries, dyestuff, juice with pulp, dressing, yogurt, etc. Flow rate measurements for fluids that were previously difficult to measure are now possible.

Electromagnetic flowmeter series

Electromagnetic flowmeters capable of measuring the flow rate of conductive fluids with high accuracy



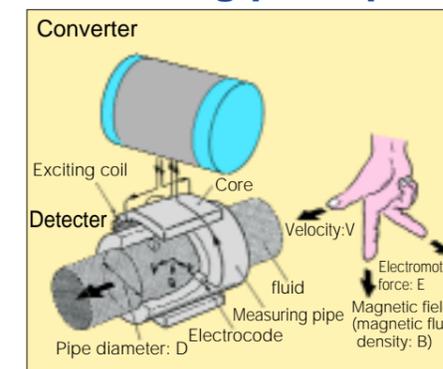
Features

- High accuracy to within 0.5%
- The terminal and circuit area inside the converter consist of a tightly sealed 2-chamber structure resistant to condensation and water
- Wide measurement range of 0 to 0.1 ...15m/s

Specifications

Application	General industrial water, wastewater, sewage, sludge, milk, chemical, soil slurry, cement slurry, etc.	
Configuration	Detector/converter integral type or separate type	
Bore	Wafer type: 2.5mm to 200mm, Flange type: 6mm to 2600mm	
Fluid pressure	0 to 2000kPa (flange working pressure in case of flange type)	
Fluid temperature	-10 to 120°C (in case of Teflon material), -10 to 50°C (in case of polyurethane material)	
Measurement range	Flow rate: FS0.1 to 15m/s (integral structure), FS0.3 to 15m/s (separate structure)	
Material	Lining	Teflon or Polyurethane
	Electrode	Either SUS316L, Hastelloy C, titanium, tantalum or platinum
	Earth ring	Either SUS316, Hastelloy C, titanium or tantalum
Output signal	4 to 20mA DC, integrated pulse, alarm output	
Indicator	LCD of 2-stage display with back light (upper stage: momentary flow rate value, lower stage: percent display)	
Function	Zero adjustment, integration constant setup, low cut point setup, damping adjustment, flow switch, etc.	
Accuracy	0.5% of rate	
Power supply voltage	100 to 240V AC, 50/60 Hz	
Protection class	IP67 waterproof structure	
Exclusive signal cable	Required in case of separate structure (150m max.)	

Measuring principle



Faraday's law of electromagnetic induction, "When a conductor moves in a magnetic field, an electromotive force is generated in the conductor in a direction that is perpendicular to both the magnetic field and moving direction, and its magnitude is proportional to the density and speed of the magnetic flux density".

Material grade

Typical recommended material grades of components that come in contact with typical fluids measured with electromagnetic flowmeters are shown, based on various references and results of use.

Feature of lining material grade

Material grade	Wear resistance	Heat resistance	Corrosion resistance	Adhesion resistance	Remarks
Teflon PFA	X	○	○	○	Optimum for corrosive and adhesive fluid. Not good for wearing fluid (such as slurry).
Teflon TFE	X	○	○	○	*TFE is not suited for high temperature and negative pressure fluids. Also be careful of penetration in case of TFE.
Polyurethane	○	X	X	△	Optimum for non-corrosive slurry, etc., but inferior in heat resistance and corrosion resistance

Features of electrode (earth ring)

Material grade	Recommended use
SUS316	Mildly acidic/mildly alkaline and corrosion-resistant. Suited for clean water and sewage, but should not be used for organic/inorganic acid and chlorides.
Platiniridium	Corrosion-resistant to most chemicals, but should not be used for aqua regia.
Hastelloy C	Suitable for medium-degree oxidizability and reducibility, and the working range is broad. But should not be used for chlorides or strong acid.
Tantalum	Corrosion resistant to most chemicals (especially strong acids). However, should not be used for alkalis, hydrofluoric acid, fuming sulfuric, etc.
Titanium	Corrosion-resistant to chlorides, sulfides and alkalis, however, should not be used for hydrochloric acid, vitriolic acid, nitric acid, etc.

Vortex flowmeter series

Vortex flowmeters for measurement of liquids, gases and vapors



DELTA FLOWPET - A compact and robust body made of stainless steel

Type: FMR



The display can be turned for easy observation.

Features

- Measurement of flow rate of gases, liquids and vapors
- Range of bores, from 10 mm to 100 mm
- Ideal for high-temperature measurement up to 200°C
- 8-digit actual scale display optimum for integrated display

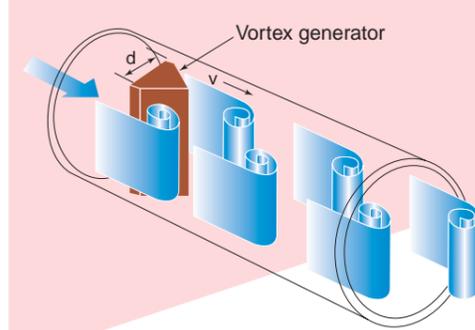
Specifications

Nominal diameter	10, 15, 25, 40, 50, 80, 100mm						
Piping connection	Flange clipping type						
Applicable fluid	Liquid up to 80°C Gas up to 80°C High temperature gas and saturated vapor up to 200°C High temperature liquid up to 200°C						
Flow rate range	Nominal diameter (mm)	For water (20°C) <Unit: m³/h>		For compressed air (20°C) <When pressure is 0.7 MPa> <Unit: m³/h>		For saturated vapor <When pressure is 0.7 MPa> <Unit: kg/h>	
		Min.	Max.	Min.	Max.	Min.	Max.
	10	0.2	2.2	9.5	62	—	—
	15	0.3	4.7	20	132	15	74
	25	0.7	16	49	442	37	249
	40	1.2	31	82	876	61	495
	50	2.0	53	134	1460	100	828
	80	4.6	118	294	5460	219	3080
	100	11	205	504	9430	376	5330
Accuracy	±1% of full scale (±2% of full scale in case of nominal diameter 10 mm)						
Material	SCS14A						
Output signal	4 to 20mA DC or scaled unscaled pulse output. Alarm output (H, L) may also be issued.						
Display function	Selective display out of cumulative integration, instantaneous flow rate (every hour), instantaneous flow rate (every minute) and reset integration. Alarm display (H, L).						
Power supply voltage	Local display only: Built-in lithium battery unit With output signal: 12 to 45V DC (analog output: 2-wire system, pulse output: 3-wire system, Pulse/alarm output: 5-wire system), provided with 1 m cable						

Vortex flowmeter series

Perfect for measuring terminal flow rate of cooling water process and works air

Measuring principle



A regular stream of vortices is generated alternately on the right-hand side and left-hand side under certain conditions downstream of an object located in a flow. These vortices are called Karman vortices. Letting the number of vortices (vortex frequency) generated per unit time be f , the flow velocity in the aperture portion be v , and the width of the object (vortex generator) be d , then the following relation holds:

$$f = st \cdot v/d$$

where st is a proportional constant called Strouhal number. The Strouhal number is a function of the shape of the vortex generator, and it is a fixed value of about 0.16 over a broad range of Reynolds number. Since the vortex frequency is proportional to the flow velocity in the range in which the Strouhal number is a fixed value, the flow velocity can be deduced by counting this vortex frequency, and the flow rate can be calculated as the area through which the fluid passes is known.

Typical connection



Eggs DELTA - Lightweight and compact
Type: FMP□□1



The display can be turned for easy observation.

Features

- Weighs just 285 g (for nominal diameter of 4 mm).
- Compact size of 65X102X83 mm (for nominal diameter of 4 mm)
- 8-digit actual scale display, perfect for display of integrated value
- Battery driven, ideal for display only

Eggs DELTA Pulse - Lightweight and compact
Type: FMP□□0



Features

- For measurement of liquids and gases
- Weighs just 270g (for nominal diameter of 4 mm)
- Compact size of 36X68X80 mm (for nominal diameter of 4 mm)
- Cheaper version of pulse output dedicated model

Specifications

	Eggs DELTA	Eggs DELTA Pulse
Nominal diameter, material	4, 8, 15, 25mm, PPS resin	
Piping connection	Screw-in type (female thread or male thread)	
Applicable fluid	Liquid up to 80°C: Water, alcohol, various aqueous solution, etc. Gas up to 60°C: Air, nitrogen, oxygen, argon, etc.	
Flow rate range	Nominal diameter (mm)	For liquid
		For Air
	4	0.4 to 4L /min
	8	1.1 to 15L /min
	15	2.8 to 45L /min
	25	8.3 to 133L /min
Accuracy	±3% of full scale	
Output signal	4 to 20mA DC or scaled/unscaled pulse output. Alarm output (H, L) may also be issued.	Unscaled pulse output (open collector)
Display function	Selective display out of cumulative integration, instantaneous flow rate (every hour), instantaneous flow rate (every minute) and reset integration. Alarm display (H, L).	None
Power supply voltage	Local display only: Built-in lithium battery unit With output signal: 12 to 45V DC (analog output: 2-wire system, pulse output: 3-wire system, Pulse/alarm output: 5-wire system), provided with 1 m cable	12 to 24 V DC (pulse output 3-wire system) with 1 m cable

Differential pressure flowmeter series

Differential pressure flowmeters for a broad range of applications



Differential pressure (flow rate) transmitter
<Model: FKX>



Remote seal type differential pressure (flow rate) transmitter
<Model: FDK, FKX>

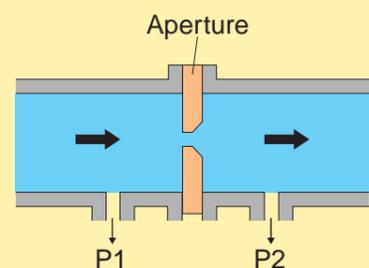


Differential pressure (flow rate) transmitter of sanitary specification
<Model: FKD>

Features

- Measurement of flow rate of gases, liquids and vapors
- FCX-All series capacitance-type transmitter of high accuracy (0.1%) and high reliability
- Pressure diaphragm available in various material grades to suit the application
- Fluid aperture mechanism available in wide range of types and material grades

Measuring principle

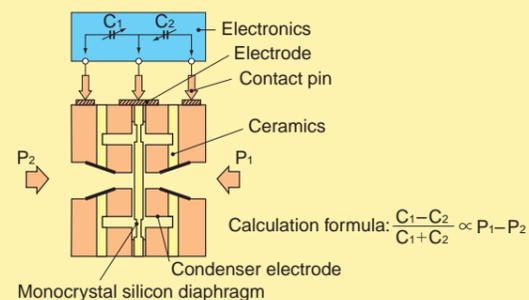


$$Q: K \times \sqrt{P_1 - P_2}$$

Q: Flow rate
K: Constant
P1-P2: Differential pressure

An aperture is located along the pipeline, the differential pressure produced before and after it is detected, and hence the flow rate is calculated.

<Principle of sensor of differential pressure (flow rate) transmitter>



$$\text{Calculation formula: } \frac{C_1 - C_2}{C_1 + C_2} \propto P_1 - P_2$$

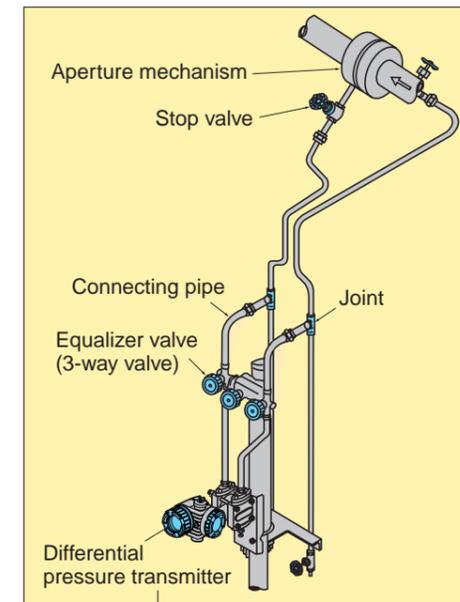
The silicon diaphragm is displaced when pressure is applied from P1 and P2, and the capacitance between the condenser electrode and the silicon diaphragm changes. This change in capacitance is proportional to the differential pressure.

Specifications

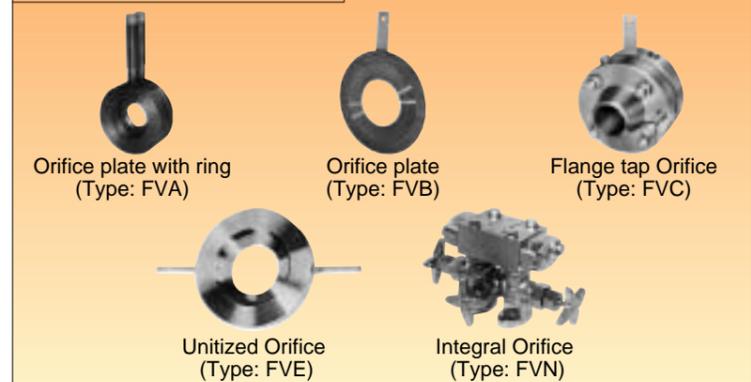
Type	Differential pressure (flow rate) gauge <Model: FKX>	Remote seal type differential pressure (flow rate) gauge <Model: FDK, FKX>
Measuring span	1 kPa min., 3,000 kPa max.	32 kPa min., 500 kPa max.
Used pressure	3.2.....42MPa	Within flange rating
Accuracy	0.1%	0.2%
Diaphragm material grade	SUS316L, Hastelloy C, Monel, tantalum, gold plated SUS316L, gold, ceramic coating	SUS316L, Hastelloy C, Monel, tantalum, titanium, zirconium, gold plated SUS316L
Process connecting port	Rc1/4 or 1/4-18NPT	Flange (IDF standard for sanitary specification)
Measuring period	120ms (High speed response is also possible (optional 40msec.))	
Working transmission range	-40 to 120°C (sensing part), -40 to 85°C (converting part)	
Output signal	4 to 20mA (2-wire system) / Load resistance 600Ω max.	
Power supply voltage	10.5 to 45V DC	
Communication function	HART protocol / Fuji protocol	
Structure	IP67 waterproof structure	
Explosion-proof specification	ATEX, FM, CSA, RIIS, JIS	

Differential pressure flowmeter series

System configuration



Aperture mechanism



Panel instrument

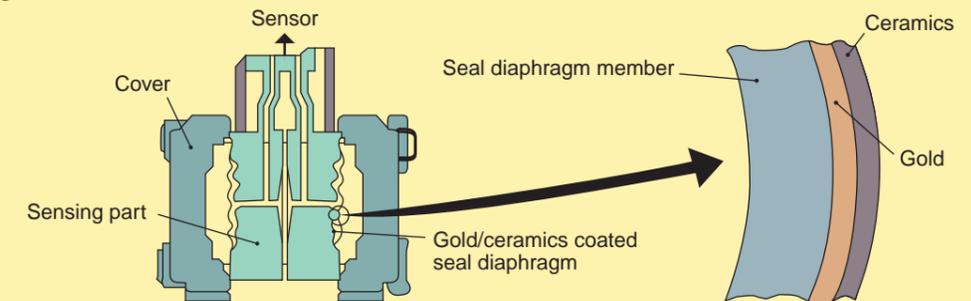


Material grade of the pressure diaphragm can be selected to suit the application.

SUS316L (standard), Hastelloy C, Monel, tantalum, titanium, zirconium and Hydro-seal (gold and ceramics coating or gold-plated SUS316L) are available.

Note: Hydro-seal: If hydrogen is contained in the fluid to be measured, hydrogen gas enters the sensing part of the transmitter and may cause deformation of the seal diaphragm and malfunctions such as zero drift. Therefore, the sensing part that is in contact with the fluid is coated with gold and ceramics, thus preventing the transmission of hydrogen more than 100 times better than conventional products. (It is superior to gold plating.)

Hydrogen transmission treatment



Typical application

Pressure diaphragm material grade	Use	Immeasurable fluid
SUS316L	Tap water, sewage, weak alkali	Inorganic acid, organic acid, chlorides, etc.
Monel	Alkali, hydrofluoric acid	Sulfuric acid, ferric chloride, aqua regia, etc.
Tantalum	Strong sulfuric acid, sulfuric acid, nitric acid, aqua regia	Alkali, fluorides, smoke emitting sulfuric acid, etc.
Hastelloy C	Various organic acids, inorganic acid, alkali	Chlorides, sulfuric acid, valve waste liquid, etc.
Zirconium	Hydrochloric acid, sulfuric acid, caustic soda, bleaching agent	Hydrogen fluoride, ferric chloride, etc.
Titanium	Chlorides, sulfides, sulfuric acid compound	Hydrochloric acid, sulfuric acid, nitric acid, etc.
Gold/ceramics coating or gold plates SUS316L	Hydrogen or hydrogen chloride generation plant or measuring environment that permits easy generation of hydrogen in the measuring fluid	



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