

# Miniature flow rate sensor

**RAPIFLOW® FSM**

■ Flow rate sensor



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## Miniature/lightweight & high response

Demonstrates its power in confirmation of suction/release for electronic parts, etc.

Functions focus on equipment integration to create a more compact and lighter system. It can be mounted on the tip of a moving part near the measuring section, contributing to improved system responsiveness. Determination of the flow direction relating to normal-reverse inverted flow due to positive/negative pressure operation is also possible, and the wide flow rate range provides high added-value functions across a range of fields.

Miniature/lightweight/high-speed response flow rate switch

### FSM-X Series

Compact body enabled by separating the sensor head. Reduced volume by 52% compared to conventional products, light weight of 4 g and ultra-thin 8 mm are achieved.

Flow rate range  
±0.5, ±1, ±5, ±10, 0.5, 1, 5, 10 L/min

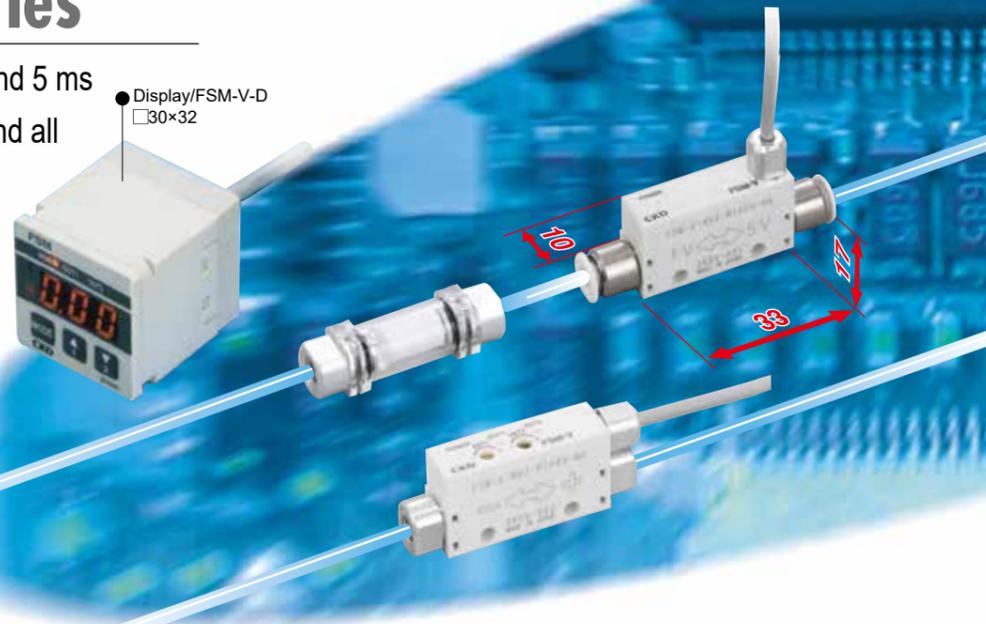


Miniature/ultra-high-speed response flow rate sensor

### FSM-V Series

Astonishing compact size and 5 ms high-speed response, beyond all reasonable expectations, have made possible a design once abandoned.

Flow rate range  
±0.05, ±0.1, ±0.5, ±1, ±5, ±10 L/min



## RAPIFLOW Series variation

### FSM-X Series

Analog output		Body material	Flow direction	Connection	Full scale flow rate				Accuracy (Linearity)	Working pressure range	Analog Output				
Discrete sensor head	Flow path block				mL/min		L/min								
				500	1	5	10	% F.S.	MPa						
FSM-X-AF005	FSM-X-AF005□	Resin	Uni-direction	Sensor head ø4 push-in fitting M5	●				Non-linear	Negative Pressure ← -0.09 Positive Pressure → +0.2					
FSM-X-AF010	FSM-X-AF010□					●									
FSM-X-AF050	FSM-X-AF050□						●								
FSM-X-AF100	FSM-X-AF100□							●							
FSM-X-AR005	FSM-X-AR005□		Bi-direction			●							Negative Pressure ← -0.09 Positive Pressure → +0.2		
FSM-X-AR010	FSM-X-AR010□						●								
FSM-X-AR050	FSM-X-AR050□							●							
FSM-X-AR100	FSM-X-AR100□										●				

Note: Applicable only for AR type.

### FSM-V Series

Analog output	Switch output	Body material	Connection	Full scale flow rate						Accuracy (Linearity)	Working pressure range	Analog Output	
				mL/min			L/min						
				50	100	500	1	5	10	% F.S.	MPa		
FSM-V-A-R0005	FSM-V-N/P-R0005	Resin	ø1.8 Fiber tube ø4 push-in fitting M5	●						±5%	Negative Pressure ← -0.09 Positive Pressure → +0.2		
FSM-V-A-R0010	FSM-V-N/P-R0010				●								
FSM-V-A-R0050	FSM-V-N/P-R0050					●							
FSM-V-A-R0100	FSM-V-N/P-R0100						●						
FSM-V-A-R0500	FSM-V-N/P-R0500							●					
FSM-V-A-R1000	FSM-V-N/P-R1000								●				

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Ending

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Ending



Miniature flow rate switch Rapiflow

# FSM-X Series (for air/nitrogen gas)

- Flow rate range: ±0.5, ±1, ±5, ±10, 0 to 0.5, 0 to 1, 0 to 5, 0 to 10 L/min

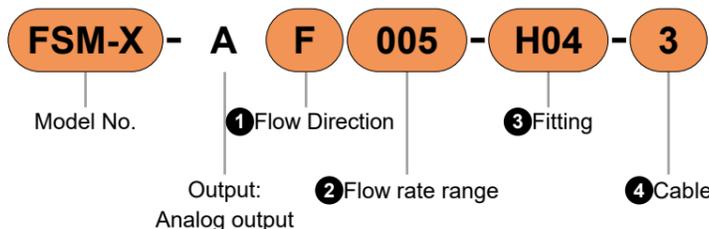


Refer to the CKD website for detailed compatible model Nos.

### Specifications

Model No.	Analog output							
	FSM-X-AR005	FSM-X-AR010	FSM-X-AR050	FSM-X-AR100	FSM-X-AF005	FSM-X-AF010	FSM-X-AF050	FSM-X-AF100
Flow rate range (L/min) *1	-0.5 to +0.5	-1 to +1	-5 to +5	-10 to +10	0 to 0.5	0 to 1	0 to 5	0 to 10
Working Conditions	Clean air ISO 8573-1: 2010 [1:1:1 to 1:6:2], nitrogen gas							
Applicable fluids *2	Clean air ISO 8573-1: 2010 [1:1:1 to 1:6:2], nitrogen gas							
Max. Working Pressure, MPa	0.2							
Min. working pressure MPa	-0.09							
Proof pressure MPa	0.3							
Ambient temperature/humidity °C	0 to 50, 80% RH or less							
Working fluid temperature °C	0 to 50 (no condensation)							
Storage ambient temperature °C	-20 to 60 (no condensation)							
Output	Analog output 1 point (1-5 V voltage output, connected load impedance 50 kΩ and over) *3							
Accuracy *4	Non-linear characteristics							
Linearity	Non-linear characteristics							
Pressure characteristics	Bi-direction: ±5%F.S. or less (-0.09 to 0.2 MPa, 0.1 MPa reference) Uni-direction: ±10%F.S. or less (-0.09 to 0.2 MPa, 0.1 MPa reference)							
Temperature characteristics	Bi-direction: ±0.3%F.S./°C or less (0 to 50°C, base temperature 25°C) Uni-direction: ±0.6%F.S./°C or less (0 to 50°C, base temperature 25°C)							
Reproducibility (repeatability) *5	±2% F.S. or less							
Response time *6	5 ms or less (8 ms or less for 10 L/min)							
External leakage *7	1 mL/min or less (single sensor head), 2 mL/min (with flow path block)							
Current consumption *8	30 mA or less							
Power supply voltage	24 VDC (21.6 to 26.4 VDC) ripple rate 1% or less							
Power supply voltage fluctuation	±2% F.S. or less (21.6 to 26.4 V)							
Lead wire	ø2.9 mm 3-conductor (ø0.38 mm insulator outer diameterø0.8 mm )							
Connector	Product side	SM03B-SRSS-TB (JST Mfg. Co. Ltd.), without lock mechanism						
Compatible connector	Housing	SHR-03V-S (JST Mfg. Co. Ltd.)						
	Connector pin	SSH-003T-P0.2-H (JST Mfg. Co. Ltd.)						
Mounting	Mounting orientation	Unrestricted in vertical/horizontal direction						
	Straight piping section	Not required						
Vibration resistance	10 to 150 Hz, compound amplitude 1.5 mm, max. 10 G, 2 hours per X, Y, Z direction							
EMC Directive	EN61000-6-4, EN61000-6-2							
Weight (g)	Blank	Approx. 4 (cable not included)						
	H04	Approx. 17 (cable not included)						
	M05	Approx. 17 (cable not included)						

### Model No. Notation Method



#### 1 Flow direction

Code	Description
F	Uni-direction
R	Bi-direction

#### 2 Flow rate range

Code	Description
005	Full scale: 0.5 L/min
010	Full scale: 1 L/min
050	Full scale: 5 L/min
100	Full scale: 10 L/min

#### 3 Fitting

Code	Description
Blank	Single sensor head (without fitting)
H04	With flow path block ø4 mm with push-in fitting
M05	With M5

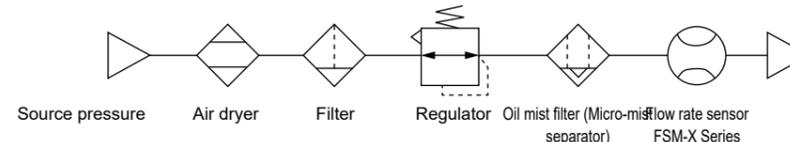
#### 4 Cable

Code	Description
Blank	Without cable
3	Cable with connector (3-conductor, 3 m)

### Model No. Notation for Options

- Cable with connector (3-conductor, 3 m)

## FSM-X-C33

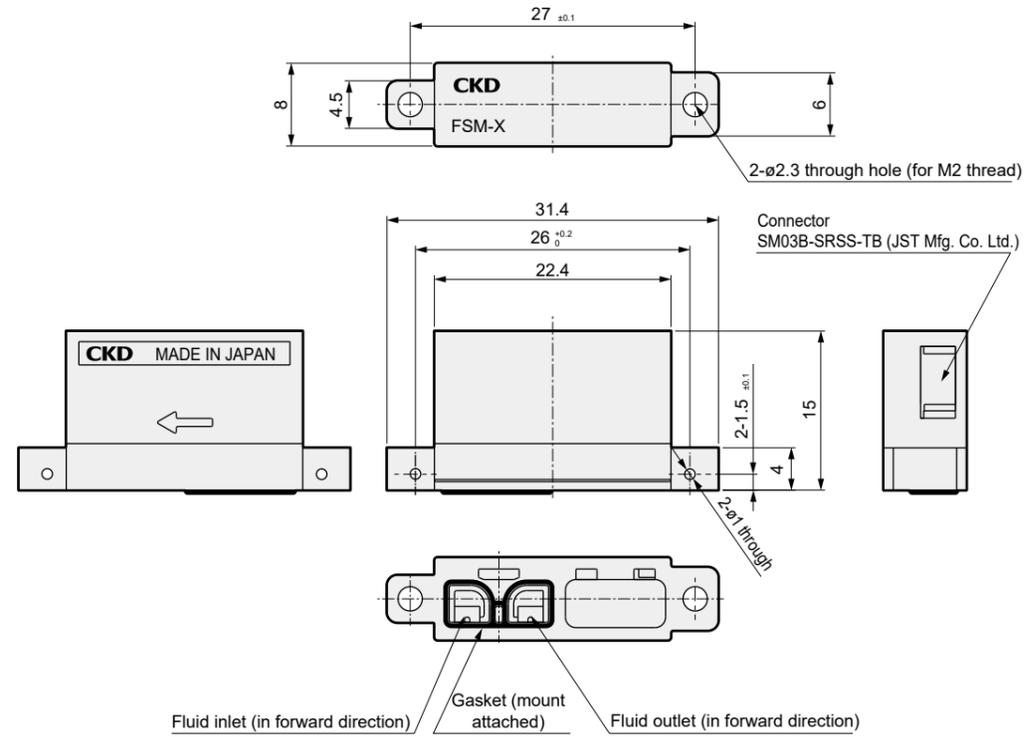


\*1: Flow rate converted to volumetric flow rate at 20°C, 1 atm (101 kPa) and 65% relative humidity.  
\*2: Use air which does not contain corrosive elements such as chlorine, sulfur or acids. When using compressed air, use clean air compliant with ISO 8573-1: 2010 Class [1:1:1 to 1:6:2]. Compressed air from the compressor contains drainage-water, oil oxide, foreign substances, etc. To maintain the function of this product, install a filter, air dryer, and oil mist filter on the primary side (upstream side) of this product. When using this product to confirm suction, be sure to install an air filter between the suction nozzle and this product to prevent intake of foreign matter.

\*3: The flow rate output of this product does not indicate the absolute value of the flow rate.  
\* Connecting load  
The output impedance of the analog output section is 1 kΩ . If the impedance of the connecting load is small, output error increases. Check error with the impedance of the connecting load before using.  
■ Example of calculation  
• Output impedance of FSM-X Ro=1kΩ  
• Load internal impedance Rx=1MΩ  
• Output value = (1-Ro/(Ro+Rx))×100% = (1 - (1 kΩ/(1 kΩ+1 MΩ)))×100%  
→ Output value error = approx. 0.1%  
\* Wiring resistance  
The voltage used for this product is the voltage at the connector. When using the optional cable (FSM-X-C33), note that the voltage varies due to the cable wiring resistance (0.23 Ω/m or less).  
■ Example of calculation  
• Wiring resistance of optional cable (FSM-X-C33) (3 m): 0.23 Ω/m×3 m=0.69 Ω  
• Voltage generated between power supply and wire = Current consumption of product (=30 mA) x Wiring resistance 0.69 Ω = approx. 0.02 V  
• Output value error = 0.02 V / 4 V (full scale) = 0.5%F.S.  
\*4: Calibrate the sensor using uni-direction analog output of 1 to 5 V and bi-direction analog output of 3 to 5 V.  
Accuracy conditions: Temperature 25±3°C, power supply voltage 24±0.01 VDC  
F.S. is defined as analog output 1 to 5 V.  
\*5: When the flow rate is ON, the average value of data taken for 20 seconds at a sampling cycle of 0.5 ms is determined as a measurement value for 1 time, and the repeatability is determined by a flow rate of ON-OFF continuously 10 times. Change over time is not included.  
\*6: The time required for the output to reach 80% of the full scale of flow rate after the flow is detected. The response time varies depending on the piping conditions.  
\*7: The value obtained when an internal pressure of 0.2 MPa is applied in an environment of 25°C±3°C. It is an initial value, not including change over time.  
\*8: Current for when 24 VDC is connected, and no load is connected. Please note that the current consumption changes depending on the load connection status.

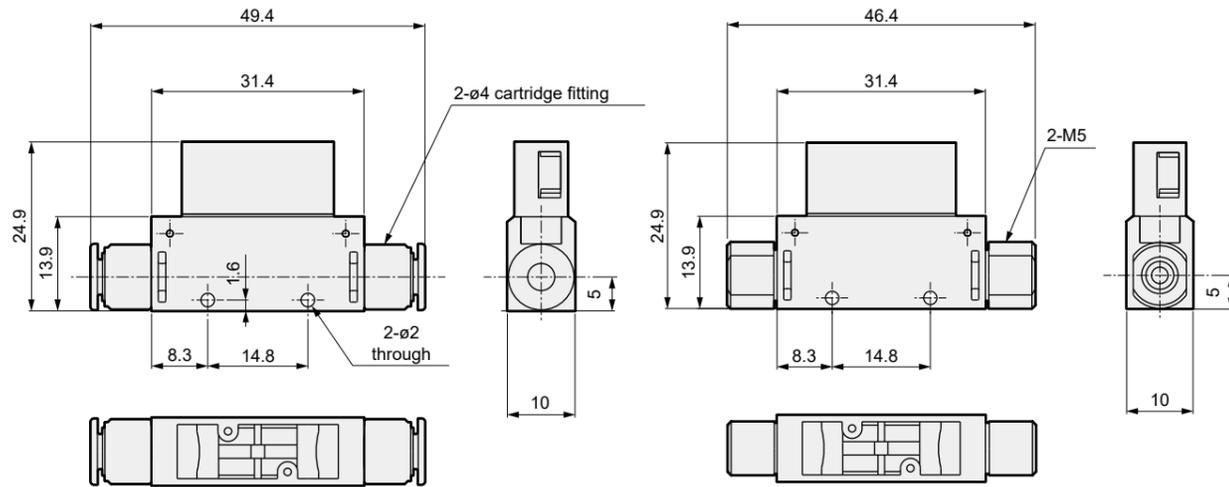
## Dimensions

●Discrete sensor head

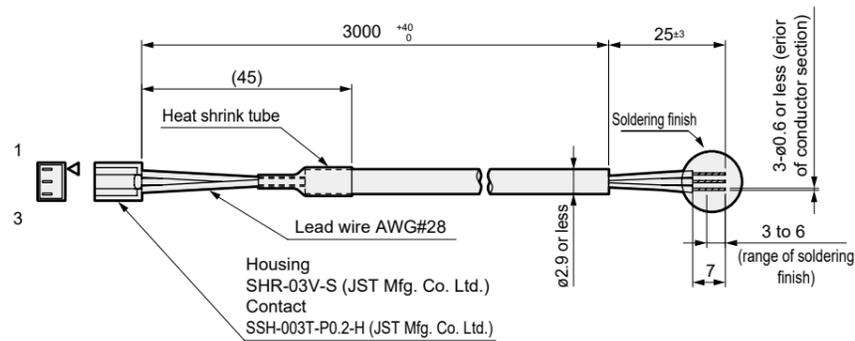


●With flow path block  
•ø4 with push-in fitting

• With M5

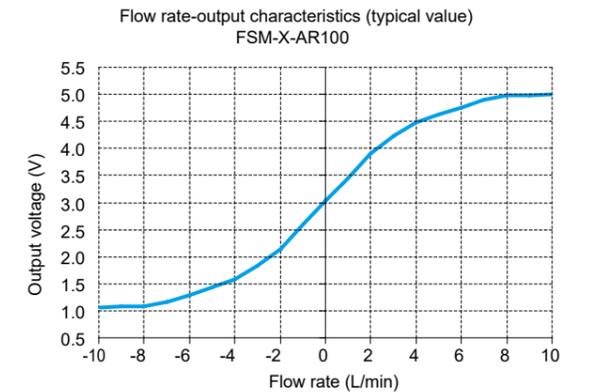
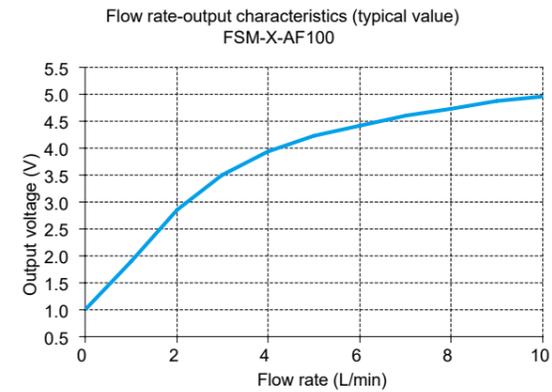
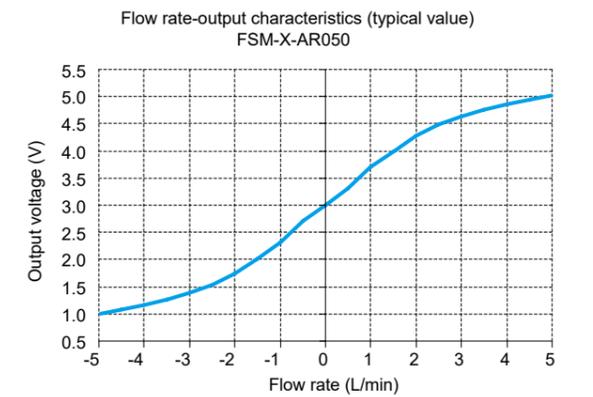
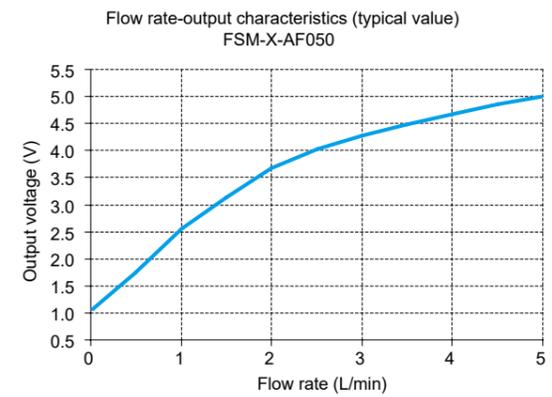
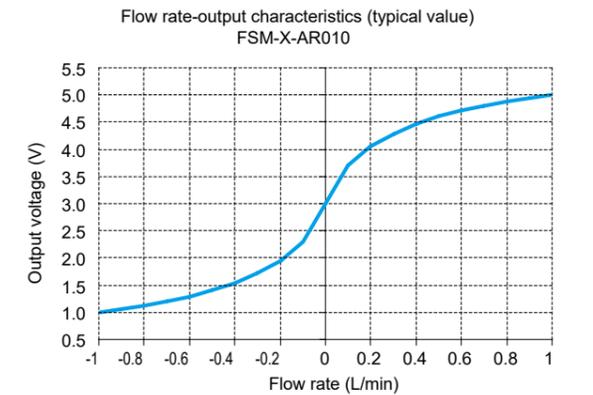
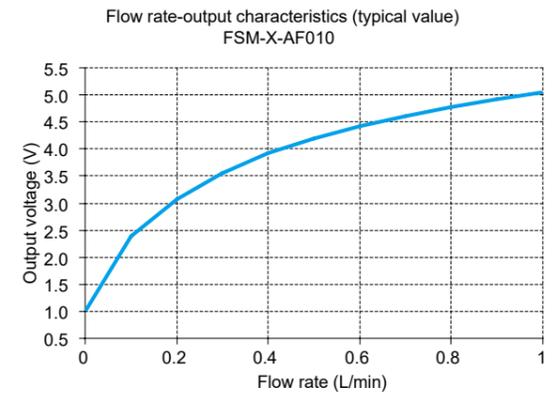
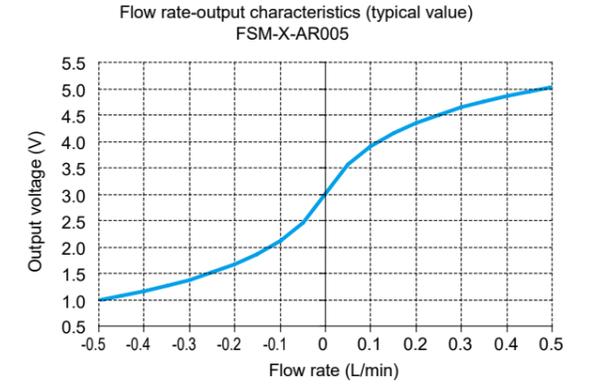
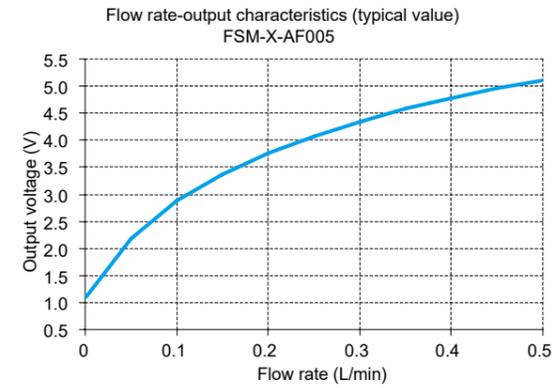


●Optional cable



Pin No.	Line color	Type of signal
1	Brown	Power supply +24 VDC
2	Blue	Power supply - GND
3	Black	Analog output (1 to 5 V)

## Analog output characteristics (reference value)

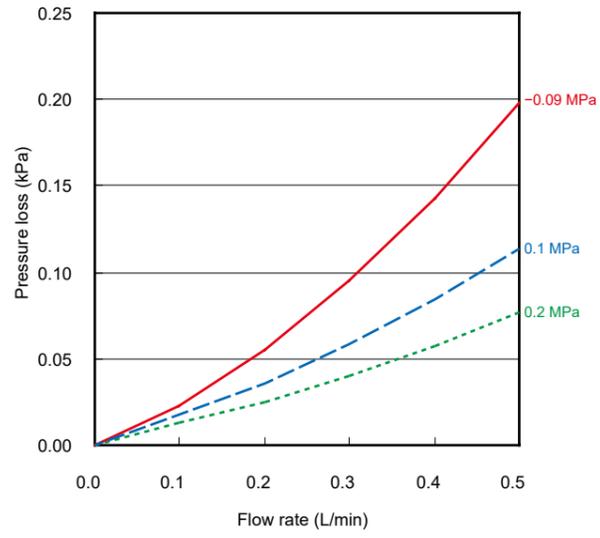


Note: The output voltage may vary depending on the working pressure and piping conditions.

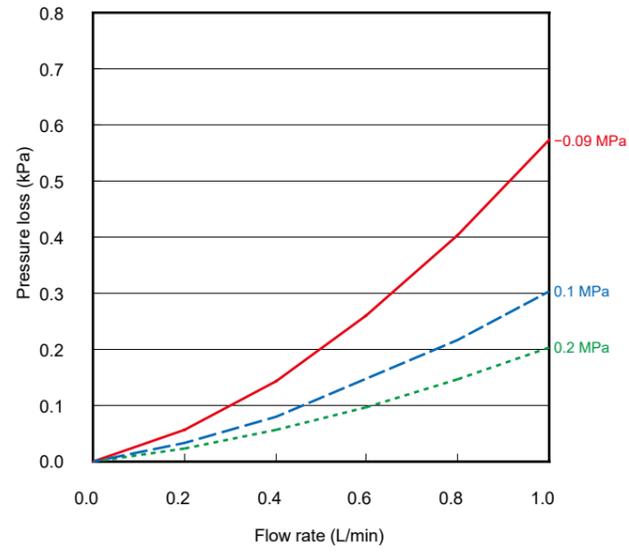
## Pressure loss characteristics

MEMO

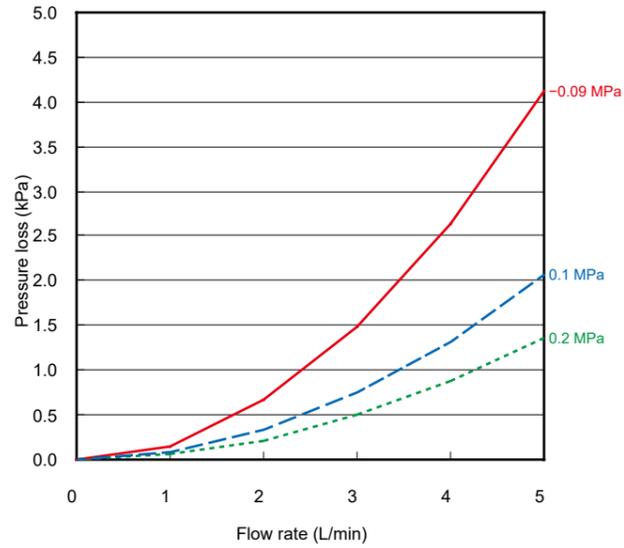
●FSM-X-AF005-H04



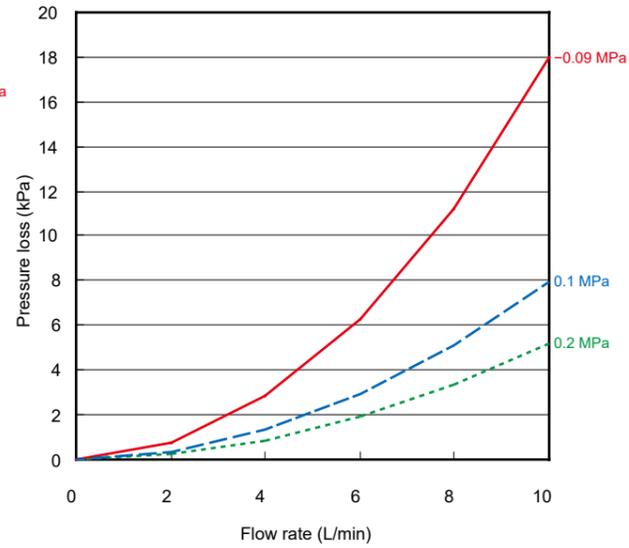
●FSM-X-AF010-H04



●FSM-X-AF050-H04



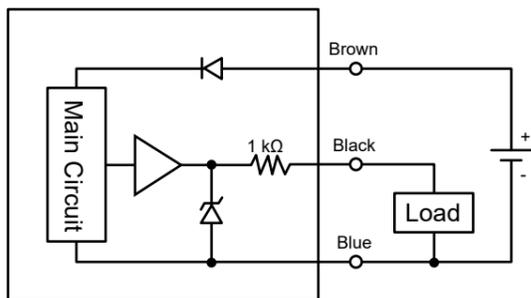
●FSM-X-AF100-H04



Note: The pressure loss may increase depending on the piping conditions.

## Example of internal circuit and load connection

●FSM-X (analog output)



Line color	Description
Brown	Power supply 24 VDC
Blue	0 V (GND)
Black	Analog output: (1 to 5 V) connected load impedance 50 kΩ or more

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

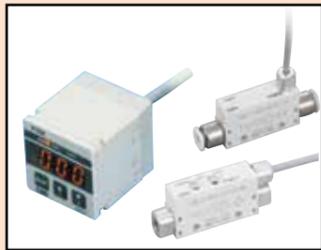
Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Ending

Ending



Miniature flow rate sensor RAPIFLOW  
Analog output/switch output

# FSM-V Series (for air/nitrogen gas)

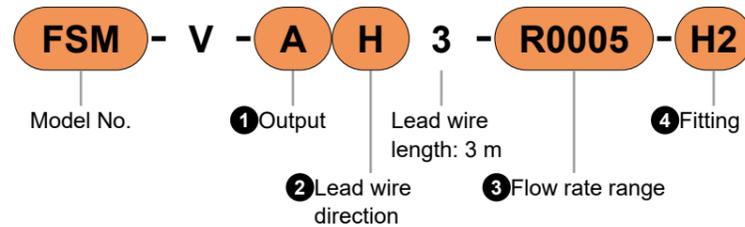
● Flow rate range:  $\pm 0.05$ ,  $\pm 0.1$ ,  $\pm 0.5$ ,  $\pm 1$ ,  $\pm 5$ ,  $\pm 10$  L/min



Refer to the CKD website for detailed compatible model Nos.

## Model No. Notation Method

### ● Sensor body



### 1 Output

Code	Description
A	Analog Output
N	Switch output (NPN)
P	Switch output (PNP)

### 2 Lead wire direction

Code	Description	
H	Straight	
V	L-shaped	

### 3 Flow rate range

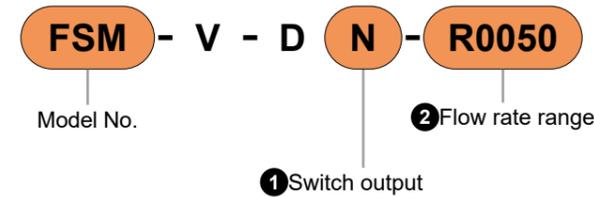
Code	Description
R0005	$\pm 0.05$ L/min
R0010	$\pm 0.1$ L/min
R0050	$\pm 0.5$ L/min
R0100	$\pm 1$ L/min
R0500	$\pm 5$ L/min
R1000	$\pm 10$ L/min

### 4 Fitting

Code	Description	
H2	Straight $\phi 1.8$ fiber tube (Note)	
H4	Straight $\phi 4$ push-in	
HL4	L-shaped $\phi 4$ push-in	
M5	Port size M5	

Note: The "H2" fitting cannot be selected when the 3 flow range is "R1000".

### ● Separated display (dedicated for analog output)



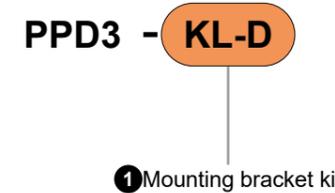
### 1 Switch output

Code	Description
N	NPN output
P	PNP output

### 2 Flow rate range

Code	Description
R0005	$\pm 0.05$ L/min
R0010	$\pm 0.1$ L/min
R0050	$\pm 0.5$ L/min
R0100	$\pm 1$ L/min
R0500	$\pm 5$ L/min
R1000	$\pm 10$ L/min

### ● Mounting bracket for separated display



### 1 Mounting bracket kit

Code	Description	
KL-D	One-side mounting foot (L-shaped mounting)	
KD-D	Two-side mounting foot (parallel mounting)	
KHS-D	Panel mounting bracket set with cover	
KC	Operation protective cover	

Note: Refer to P. 388 and 389 for mounting bracket Dimensions and mounting dimensions.

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

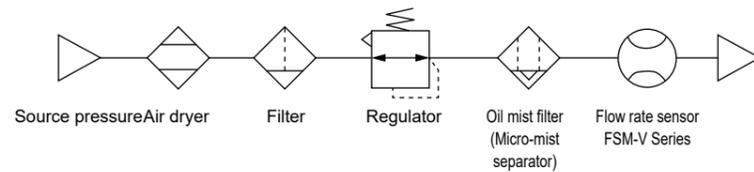
Compact flow sensor (liquid)

Water Manifold Unit

Sensor body specifications

Model No.	Analog output						Switch output					
	FSM-V-A-R0005	FSM-V-A-R0010	FSM-V-A-R0050	FSM-V-A-R0100	FSM-V-A-R0500	FSM-V-A-R1000	FSM-V- <i>s/p</i> -R0005	FSM-V- <i>s/p</i> -R0010	FSM-V- <i>s/p</i> -R0050	FSM-V- <i>s/p</i> -R0100	FSM-V- <i>s/p</i> -R0500	FSM-V- <i>s/p</i> -R1000
Flow rate range (L/min)*1	-0.05 to +0.05	-0.1 to +0.1	-0.5 to +0.5	-1 to +1	-5 to +5	-10 to +10	-0.05 to +0.05	-0.1 to +0.1	-0.5 to +0.5	-1 to +1	-5 to +5	-10 to +10
(Reference) Applicable nozzle for suction/release applications	ø0.1 nozzle	ø0.2 nozzle	ø0.3 nozzle	Collet nozzle			ø0.1 nozzle	ø0.2 nozzle	ø0.3 nozzle	Collet nozzle		
Working Conditions	Applicable fluid Clean air ISO 8573-1: 2010 [1:1:1 to 5:6:2], compressed air ISO 8573-1: 2010 [1:1:1 to 1:6:2]*2, Nitrogen gas											
	Max. Working Pressure, MPa 0.2											
	Min. working pressure MPa -0.09											
	Proof pressure MPa 0.3											
	Ambient temperature/humidity °C 0 to 50, 90% RH or less (no condensation)											
Working fluid temperature °C 0 to 50												
Indicator	Power display (green)						Power display (green), switch output display (yellow)					
Output	Analog output 1 point *3						Switch output 2 points *4					
	(1 to 5 V voltage output, connecting load impedance 50 kΩ and over) *5						(NPN or PNP open collector output, 30 VDC or less and 50 mA or less, PLC/relay compatible)					
Accuracy *6	Linearity ±5% F.S. or less (0.1 MPa, flow rate range ±100% F.S.)						_____					
	Pressure characteristics ±5% F.S. or less (-0.09 to 0.2 MPa, 0.1 MPa reference)						_____					
	Temperature characteristics ±0.2% F.S./°C or less (15 to 35°C, base temperature 25°C)						_____					
	Reproducibility (repeatability) ±1% F.S. or less						±2% F.S. or less					
Response time	5 ms or less (when 90% of the sensor Discrete/final attained output voltage is reached) *7											
Power supply voltage	12/24 VDC (10.8 to 26.4 V)											
Current consumption	30 mA or less											
Lead wire	ø2.6 3-conductor (0.15 mm <sup>2</sup> Outer diameter of insulator ø0.81) 3 m						ø2.6 4-conductor (0.15 mm <sup>2</sup> Outer diameter of insulator ø0.81) 3 m					
Mounting	Mounting orientation Unrestricted in vertical/horizontal direction											
	Straight piping section Not required											
Degree of Protection	IEC standards IP40											
Vibration resistance	10 to 150 Hz, compound amplitude 1.5 mm, max. 10 G, 2 hours per X, Y, Z direction											
EMC Directive	EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8											
Weight g	Approx. 8 (excluding lead wire and fitting)											

\*1: Converted to volumetric flow rate at 20°C, 1 atm (101 Kpa) and 65% relative humidity.  
 \*2: Use air which does not contain corrosive elements such as chlorine, sulfur or acids.  
 When using compressed air, use clean air compliant with ISO 8573-1: 2010 Class [1:1:1 to 1:6:2].  
 Compressed air from the compressor contains drainage-water, oil oxide, foreign substances, etc. A filter, air dryer (minimum pressure dew point 10°C or less) and oil mist filter (maximum oil concentration 0.1 mg/m<sup>3</sup>) must be installed on the primary side (upstream) of the product to maintain the product's function.  
 When using this product in the suction check, be sure to install an air filter (filtering thickness of 30 μm or less) between the suction nozzle and the product to prevent inhalation of foreign matter.



\*3: The analog output indicates 3 V when the flow rate is 0, and changes to 5 V when the fluid flows to the right (when the lead wire is to the right of the body). In addition, it changes to 1 V with reverse flow.  
 \*4: The switch output uses the method of one boundary-value determination with fixed hysteresis, and can be set with all flow rate ranges by rotating the trimmer. In addition, the operation modes of OUT1 and OUT2 are opposite to each other.  
 \*5: The output impedance of the analog output section is 1 kΩ. If the impedance of the connecting load is small, output error increases. Check error with the impedance of the connecting load before using.  
 ■ Example of calculation  
 • Output impedance of FSM-V Ro=1 kΩ  
 • Load internal impedance Rx=1MΩ  
 • Output value =  $(1-Ro/(Ro+Rx)) \times 100\% = (1 - (1 \text{ k}\Omega / (1 \text{ k}\Omega + 1 \text{ M}\Omega)) \times 100\%$   
 → Output value error = approx. 0.1%  
 \*6: Calibrate the sensor at 1 to 5 V.  
 Accuracy conditions: Temperature 25±3°C, power supply voltage 24±0.01 VDC  
 F.S. (full scale) in these specifications indicates the flow rate range. For example, the F.S. for the flow rate range: -10 to +10 L/min is 20 L/min.  
 \*7: The response time varies depending on the piping conditions.

Separated display specifications (dedicated for analog output)\*8

Model No.	Separated display					
	FSM-V-D <sup>s/p</sup> -R0005	FSM-V-D <sup>s/p</sup> -R0010	FSM-V-D <sup>s/p</sup> -R0050	FSM-V-D <sup>s/p</sup> -R0100	FSM-V-D <sup>s/p</sup> -R0500	FSM-V-D <sup>s/p</sup> -R1000
Connectable analog output model No.	FSM-V-A-R0005	FSM-V-A-R0010	FSM-V-A-R0050	FSM-V-A-R0100	FSM-V-A-R0500	FSM-V-A-R1000
Indicator	Indicator type Flow rate display (7-segment 3-digit orange), operation and switch output display (orange)					
	Min. display unit*9		0.1 mL/min *8		0.1 L/min *8	
Output	Switch output 2 points (NPN or PNP open collector output, 30 VDC / 50 mA or less, voltage drop 2.4 V, PLC / relay compatible)					
	Analog output 1 point (1 to 5 V voltage output, connecting load impedance 50 kΩ and over)					
Power supply voltage	12/24 VDC (10.8 to 26.4 V)					
Current consumption	50 mA or less (display only)					
Lead wire	ø3.7 5-conductor (0.2 mm <sup>2</sup> Outer diameter of insulatorø1.0) 1 m					
Functions	Flow rate display, flow rate display peak hold, switch output, analog output					
Operating ambient temperature / humidity	0 to 50°C, 85% RH or less (no condensation)					
Degree of Protection	IEC standards IP40					
EMC Directive	EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8					
Weight (g)	Approx. 55 (including lead wire 1 m)					

\*8: The separated display is dedicated for analog output. Note that the switch output type cannot be connected.  
 \*9: This indicates min. display unit of flow rate, and does not guarantee indicator accuracy.

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

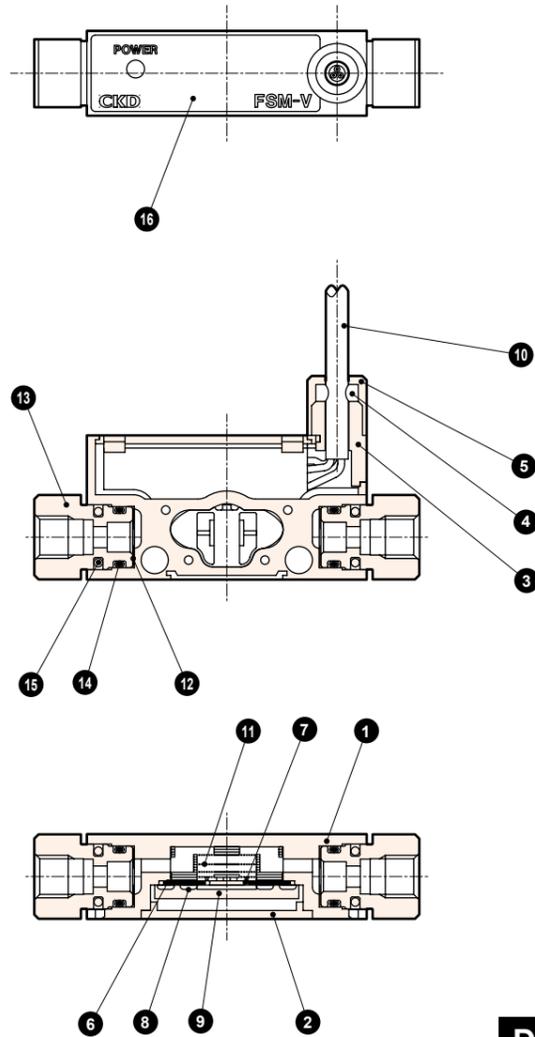
Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Internal Structure Diagram / Material

●FSM-V-□□3-R□-M5 / Analog output  
(switch output type also has the same internal structure)



**Do not disassemble**

Part No.	Part name	Material	Part No.	Part name	Material
1	Body	Polybutylene terephthalate	9	Electronic circuit board	Glass epoxy resin
2	Case	Polybutylene terephthalate	10	Lead wire	Halogen-free polyethylene resin blend
3	Lead wire holder	Polybutylene terephthalate	11	Rectifier	Stainless steel
4	Bush	Nitrile Rubber	12	Filter	Stainless steel
5	Bush holder	Aluminum alloy	13	Cartridge fitting (M5)	Aluminum alloy
6	Sensor gasket	Fluoro rubber	14	O-ring	Nitrile Rubber
7	Sensor chip	Silicone	15	Fitting fixing pin	Stainless steel
8	P-TITE screw	Steel (zinc plated)	16	Front sheet	Polyester film

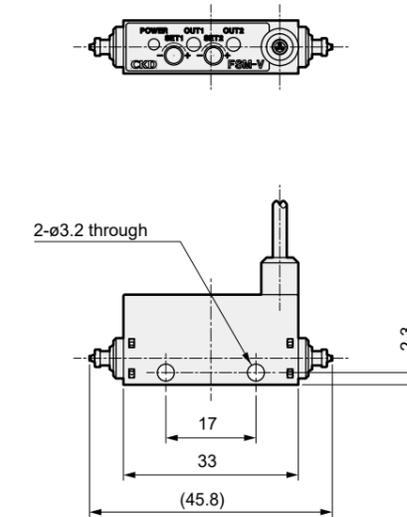
Note: The analog output type and the switch output type differ in appearance of the front sheet section.

●Separated display FSM-V-D□-R□

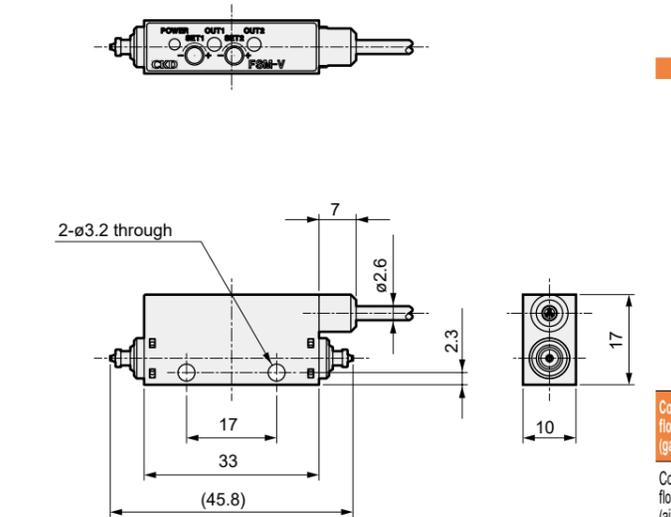
Refer to P. 388 for internal structure.

Dimensions (common to analog output and switch output)

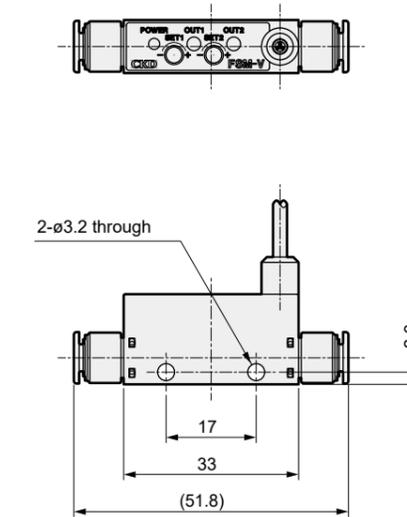
●FSM-V-□V3-R□-H2  
(Radial lead wire, straight  $\phi 1.8$  fiber tube)



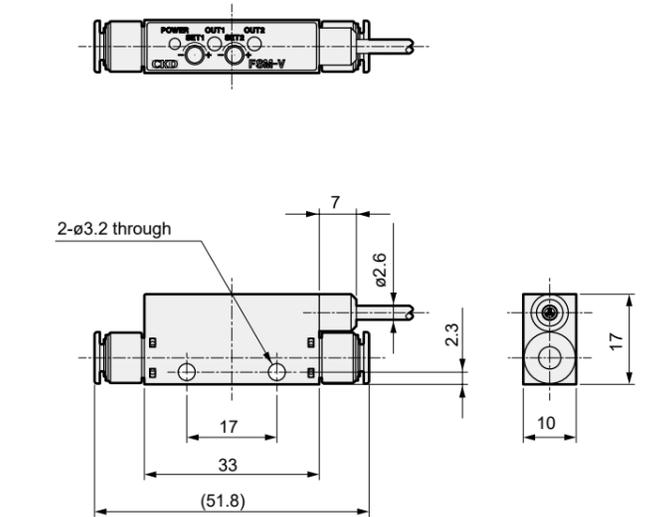
●FSM-V-□H3-R□-H2  
(Axial lead wire, straight  $\phi 1.8$  fiber tube)



●FSM-V-□V3-R□-H4  
(Radial lead wire, straight  $\phi 4$  push-in)



●FSM-V-□H3-R□-H4  
(Axial lead wire, straight  $\phi 4$  push-in)



Note: The analog output type and the switch output type differ in appearance of the front sheet section.

Flow rate sensor

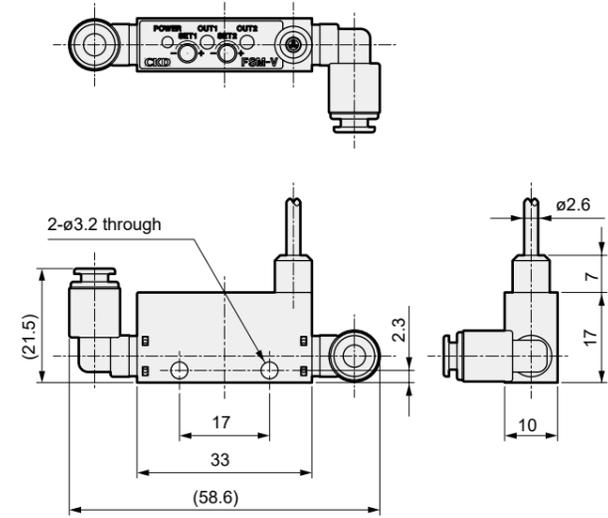
Compact flow sensor (gas)  
Compact flow sensor (air)  
Compact flow sensor (liquid)  
Water Manifold Unit

Flow rate sensor

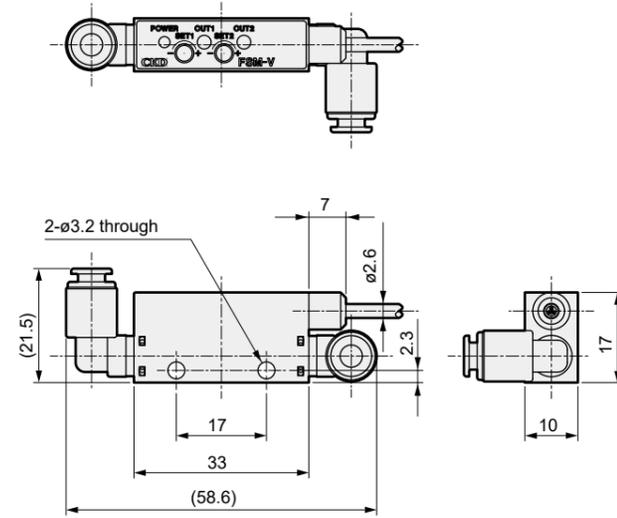
Compact flow sensor (gas)  
Compact flow sensor (air)  
Compact flow sensor (liquid)  
Water Manifold Unit

Dimensions

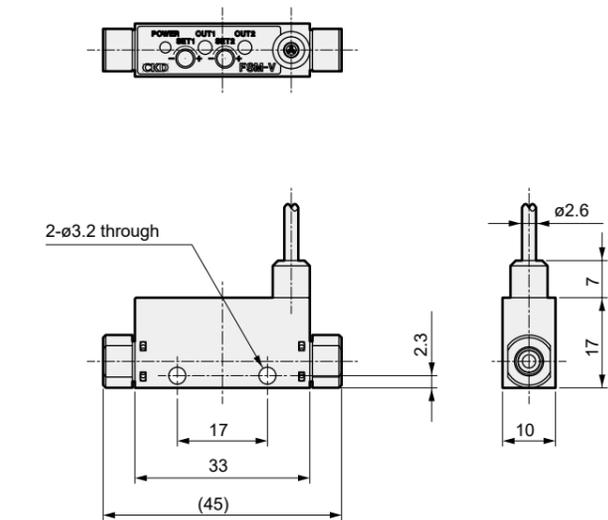
●FSM-V-□V3-R□-HL4  
(Radial lead wire, L-shaped ø4 push-in)



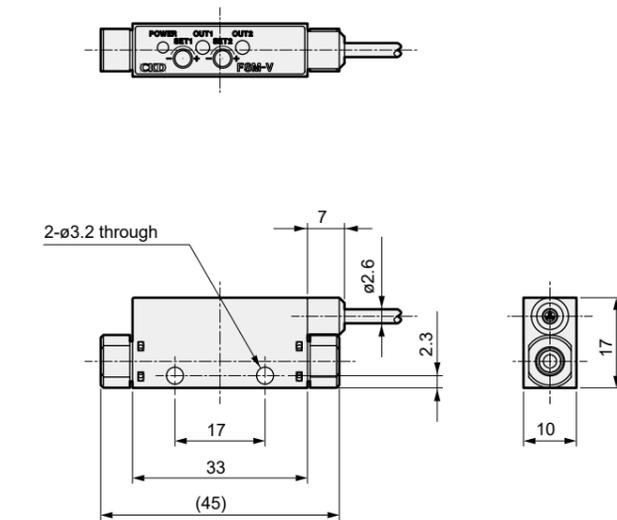
●FSM-V-□H3-R□-HL4  
(Axial lead wire, L-shaped ø4 push-in)



●FSM-V-□V3-R□-M5  
(Radial lead wire, port size M5)



●FSM-V-□H3-R□-M5  
(Lead wire straight, port size M5)

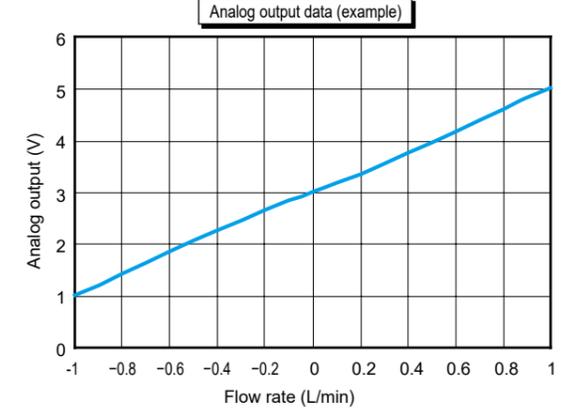
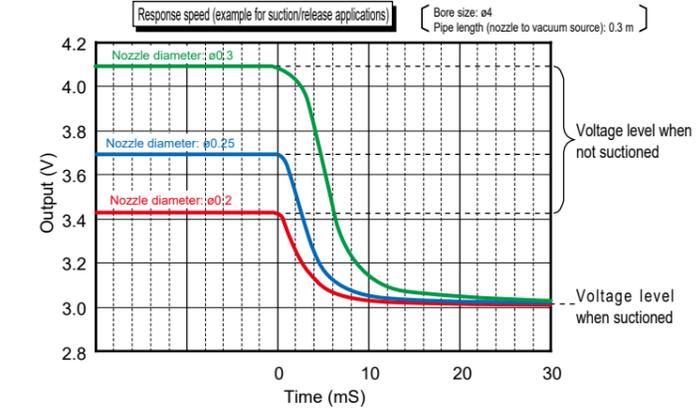


Note: The analog output type and the switch output type differ in appearance of the front sheet section.

Analog output characteristics/pressure loss characteristics

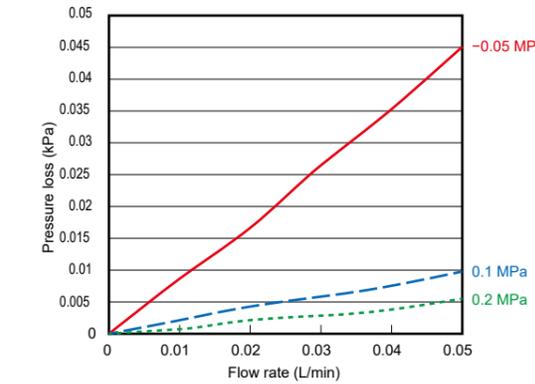
Analog output characteristics

●FSM-V-A-R0100

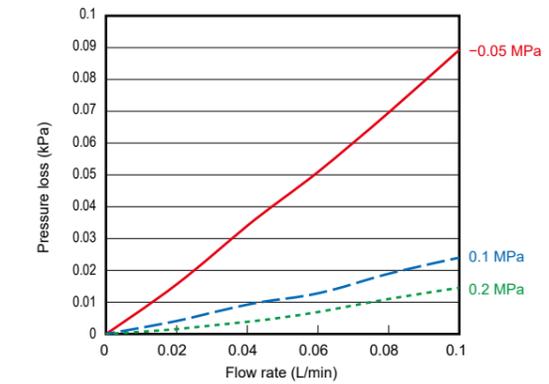


Pressure loss characteristics

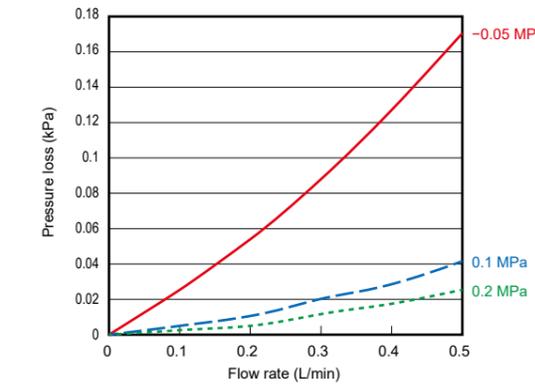
●FSM-V-□-R0005-H4



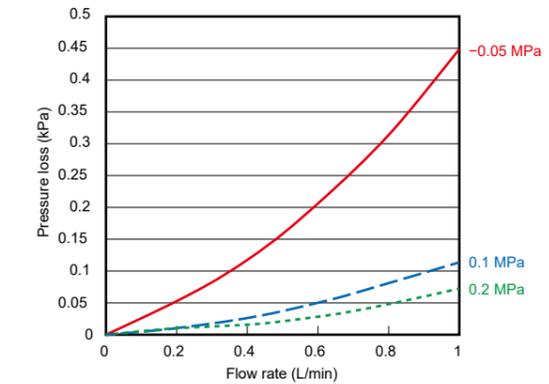
●FSM-V-□-R0010-H4



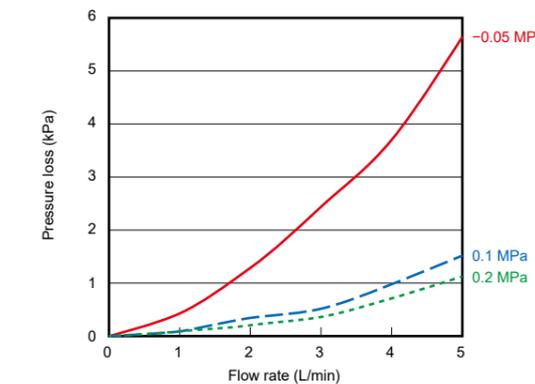
●FSM-V-□-R0050-H4



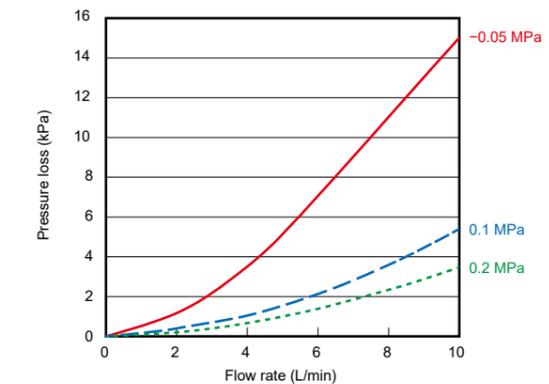
●FSM-V-□-R0100-H4



●FSM-V-□-R0500-H4



●FSM-V-□-R1000-H4



Note: When using the fiber tube, the pressure loss may increase depending on the piping conditions.

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

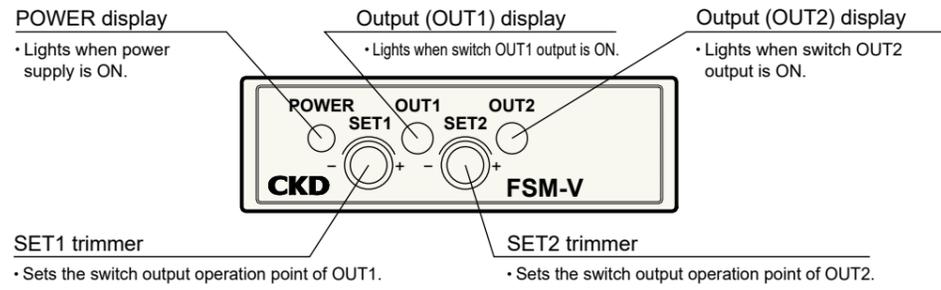
Ending

Ending

## Names, functions and setting method of operation section

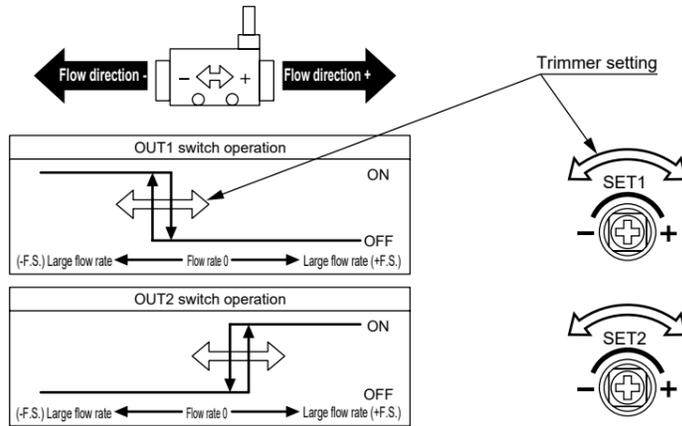
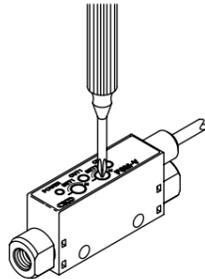
MEMO

### ● Switch output



### Switch setting method (switch operation and flow direction of fluid)

- Rotate the trimmers of SET1 and SET2 to set ON/OFF of 2 switch output points (OUT1/OUT2). Note that the switch operations at 2 output points differ as indicated in the figure at right.
- Use a Phillips screwdriver for 0-bit.



- (Precautions)
- The hysteresis of the switch output is a fixed value (10% F.S. or less).
  - Do not press the trimmer forcibly with the screwdriver. The trimmer will be damaged.

### ● Separated display

Refer to P. 391 for names and functions of the separated display.

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit



Separated display  
**FSM-V-D** Series (For FSM-V)

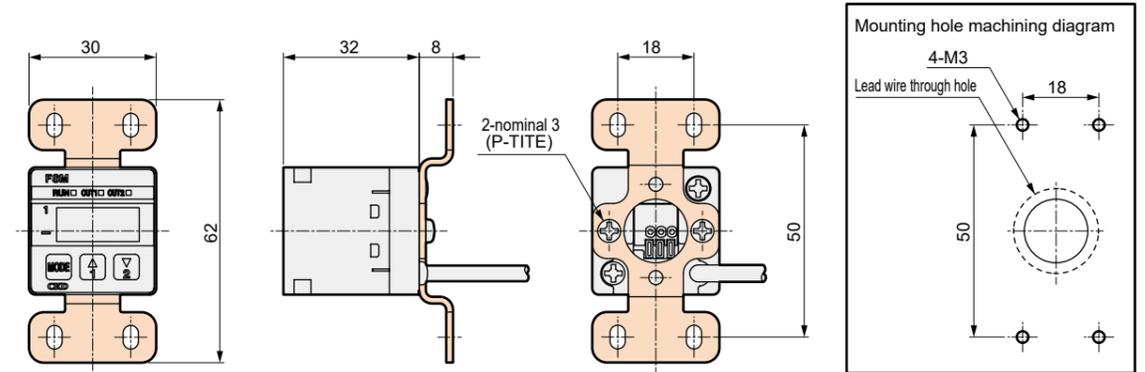


Refer to the CKD website for detailed compatible model Nos.

**FSM-V-D** Series  
 Mounting bracket dimensions

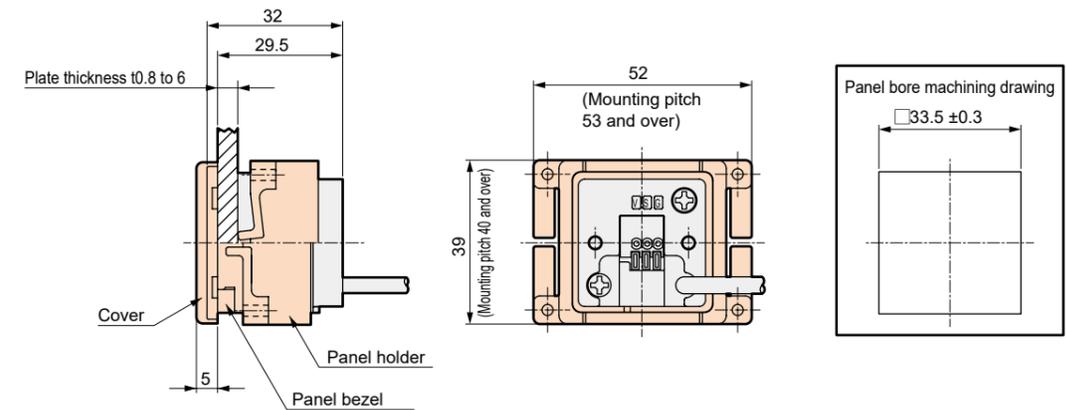
Mounting bracket dimensions

- Two-side mounting foot attached (PPD3-KD-D)  
 \*D-bracket, 2 mounting screws



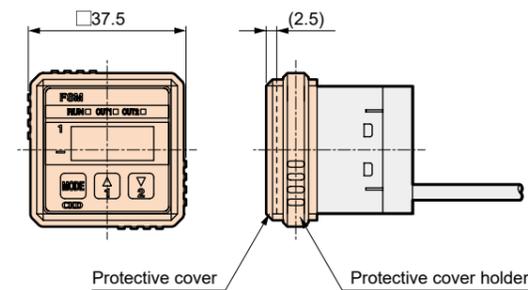
This mounting bracket can be mounted at 90° intervals.  
 Determine the mounting direction according to the mounting location.

- Panel mounting bracket set with cover (PPD3-KHS-D)  
 \*Panel vessel, panel holder, panel key, panel cover



The mounting direction of the panel holder can be changed by 90°.

- Operation protective cover attached (PPD3-KC)  
 \*Protective cover, protective cover holder

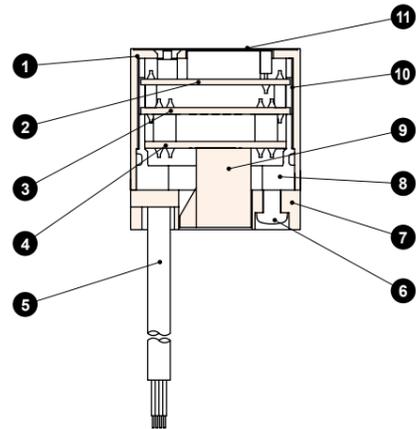


Note: Cannot be combined with PPD3-KHS-D.

Internal Structure Diagram / Material

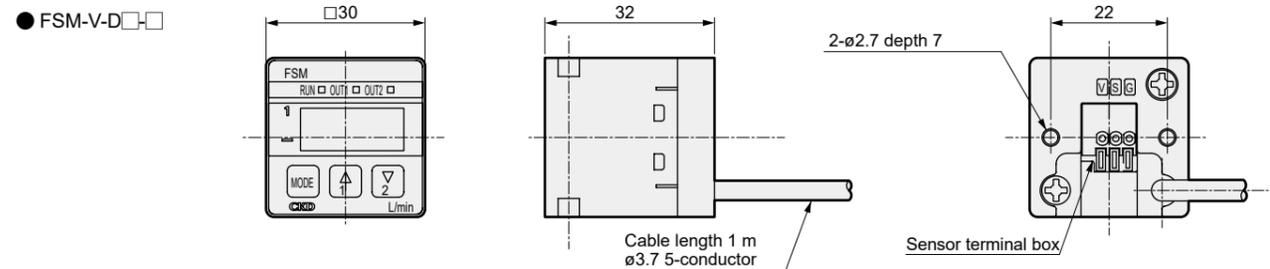
- FSM-V-D (Separated display)

**Do not disassemble**



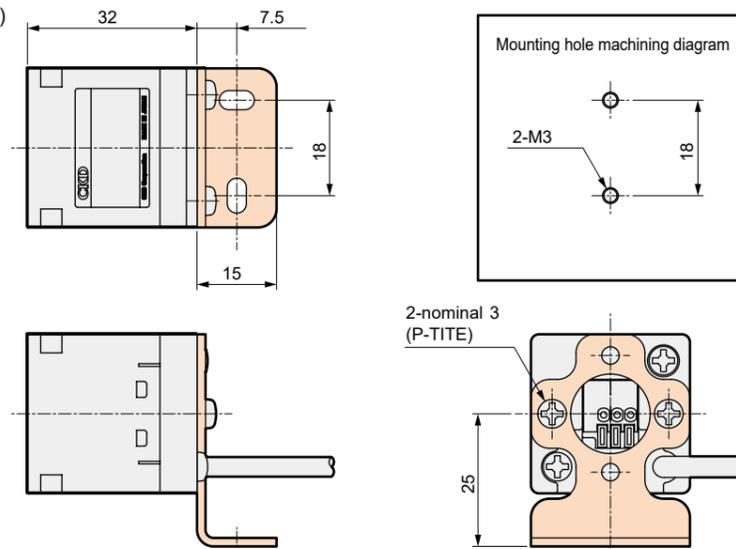
Part No.	Part name	Material
1	On the case	Polybutylene terephthalate
2	Indicator base	Glass epoxy resin
3	CPU board	Glass epoxy resin
4	Sensor board	Glass epoxy resin
5	Lead wire (1 m)	Polyvinyl chloride
6	Thread	Brass/nickeling
7	Back surface cover	Polybutylene terephthalate
8	Inside the case	Polybutylene terephthalate
9	Terminal block	Polyamide/copper alloy (plating)
10	Shield sheet	Aluminum
11	Front surface sheet	Polyester film

Dimensions



Mounting bracket dimensions

- One-side mounting foot attached (PPD3-KL-D)  
 \*L-bracket, 2 mounting screws



This mounting bracket can be mounted at 90° intervals to the switch body.  
 Determine the mounting direction according to the mounting location.

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Ending

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Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Ending

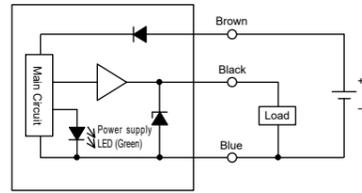
388

Example of internal circuit and load connection

Names and functions of display / operation section

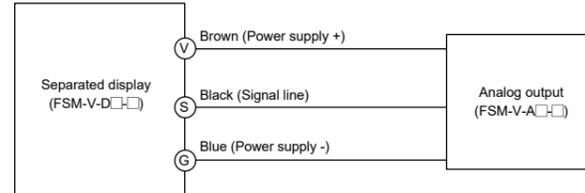
[FSM-V Series]

● FSM-V-A□ (Analog output)



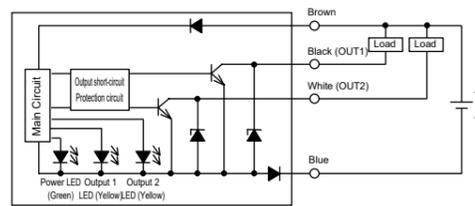
Line color	Description
Brown	Power supply 12 to 24 VDC
Blue	0 V (GND)
Black	Analog output (1 to 5 V)

● Connection method of separated display with analog output



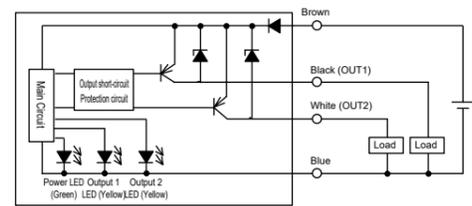
Note: The switch output type cannot be combined with separated display.

● FSM-V-N□ (switch output type NPN output)



Line color	Description
Brown	Power supply 12 to 24 VDC
Blue	0 V (GND)
Black	OUT1 (max. 50 mA)
White	OUT2 (max. 50 mA)

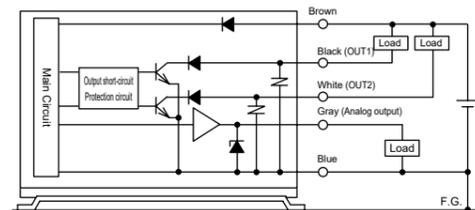
● FSM-V-P□ (switch output type PNP output)



Line color	Description
Brown	Power supply 12 to 24 VDC
Blue	0 V (GND)
Black	OUT1 (max. 50 mA)
White	OUT2 (max. 50 mA)

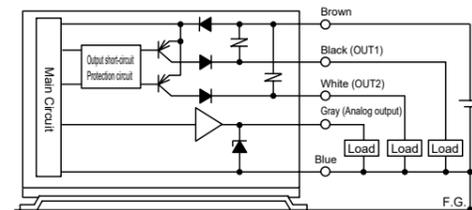
[Separated display]

● FSM-V-DN-□ (separated display NPN output)



Line color	Description
Brown	Power supply 12 to 24 VDC
Blue	0 V (GND)
Gray	Analog output (1 to 5 V)
Black	OUT1 (max. 50 mA)
White	OUT2 (max. 50 mA)

● FSM-V-DP-□ (separated display PNP output)



Line color	Description
Brown	Power supply 12 to 24 VDC
Blue	0 V (GND)
Gray	Analog output (1 to 5 V)
Black	OUT1 (max. 50 mA)
White	OUT2 (max. 50 mA)

• To reset short-circuit protection, turn OFF feed power supply, correct wiring mistakes, etc., then turn the power ON again.

• To reset short-circuit protection, turn OFF feed power supply, correct wiring mistakes, etc., then turn the power ON again.

● Separated display (FSM-V-D)

**RUN display**

- Turns ON when flow rate is displayed.
- Blinks when peak hold operates.

**Output (OUT1) display**

- Lights when switch CH1 output is ON.
- Blinks when overcurrent is detected.

**Output (OUT2) display**

- Lights when switch CH2 output is ON.
- Blinks when overcurrent is detected.

**3-digit LED display**

- Indicators flow rate, switch set values, and machine status
- In case of overflow, **Hi** is displayed. (Hi is displayed at approx. 10% F.S. or more.)
- In case of reverse direction overflow, **Lo** is displayed. (Lo is displayed at approx. -10% F.S. or below.)

**Overflow display (excluding FSM-V-D).**

- Turns ON when 3-digit display limit is exceeded, and indicates **1**.
- (When using the 10.00L/min, this **1** turns ON and displays a 3-digit 0.00 LED)

**Minus display**

- Lights during reverse direction flow.

**MODE key**

- Use to enter each setting mode.
- Used to advance setting mode.
- Used to return to flow rate display.
- Used to cancel peak hold operation.

**1 (UP) key**

- During flow rate display, displays CH1 data sequentially.
- During peak hold operation, displays max. value.
- During mode selection, sets the mode.
- When setting each data, this key is used to count up the values, etc.

**2 (DOWN) key**

- During flow rate display, displays CH2 data sequentially.
- During peak hold operation, displays the min. value.
- During mode selection, sets the mode.
- When setting each data, this key is used to count down the values, etc.

Item	Description	Initial state
Set value confirmation	The switch operation mode, switch ON set value, and switch OFF set value can be confirmed.	-
Peak hold function	The max. and min. values within the mode setting period can be confirmed.	-
Switch output setting	Set the switch operation mode, ON value setting value, and OFF setting value. [Operation mode] Window operation 1 (ON when inside the range), window operation 2 (ON when outside the range), hysteresis operation 1 (ON at low pressure), hysteresis operation 2 (ON at high pressure), stop operation	Stop operation
Forced output function	Forces the switch output to turn ON and is used to check the initial operation of wiring connections and input devices.	-
Switch output test function	Deviation of the display from the zero point is compensated in the atmospheric pressure pressurized state.	-

For details on operation and setting method, refer to CKD components product website (<https://www.ckd.co.jp/kiki/en/>) → "Model No." → Instruction manual

Flow rate sensor selection method

Use as a guideline for selection of the flow rate range when using the flow rate sensor for suction nozzle suction/release confirmation or leakage inspection.

The flow rate can be calculated using the effective cross-sectional area of nozzle (pinhole) and the pressure difference inside and outside the nozzle.

●  $P_1 \geq 1.89P_2$  For (acoustic velocity)

$$Q = 113.2 \times S \times P_1$$

●  $P_1 < 1.89P_2$  For (subsonic velocity)

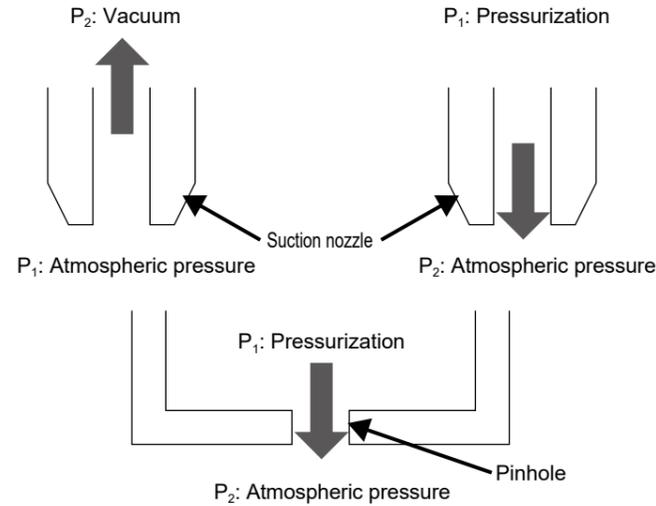
$$Q = 226.4 \times S \times \sqrt{P_2(P_1 - P_2)}$$

Q: Flow rate L/min

$P_1$ : Primary side absolute pressure MPa

$P_2$ : Secondary side absolute pressure MPa

S: Effective cross-sectional area of nozzle (pinhole) mm<sup>2</sup>



Example of calculation

The table below shows the calculated flow rate values when P2 is varied for nozzle diameters from ø0.1 to ø2.

	$P_1$ (MPa) Absolute pressure	$P_2$ (MPa) Gauge pressure	$P_2$ (MPa) Absolute pressure	$P_2$ (MPa) Gauge pressure	Acoustic velocity/ subsonic velocity	Calculated flow rate value (L/min)									
						ø0.1	ø0.2	ø0.3	ø0.4	ø0.5	ø0.7	ø1	ø1.5	ø2	
Vacuum	0.1013	0	0.0313	-0.07	Acoustic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0413	-0.06	Acoustic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0513	-0.05	Acoustic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0613	-0.04	Subsonic velocity	0.088	0.352	0.792	1.408	2.200	4.312	8.800	19.801	35.202	
	0.1013	0	0.0713	-0.03	Subsonic velocity	0.082	0.329	0.740	1.315	2.055	4.028	8.220	18.494	32.878	
	0.1013	0	0.0813	-0.02	Subsonic velocity	0.072	0.287	0.645	1.147	1.792	3.512	7.166	16.125	28.666	
	0.1013	0	0.0913	-0.01	Subsonic velocity	0.054	0.215	0.483	0.859	1.343	2.631	5.370	12.083	21.480	
Blow (leakage inspection)	0.1113	0.01	0.1013	0	Subsonic velocity	0.057	0.226	0.509	0.905	1.414	2.772	5.657	12.727	22.626	
	0.1213	0.02	0.1013	0	Subsonic velocity	0.080	0.320	0.720	1.280	2.000	3.920	8.000	15.679	31.998	
	0.1413	0.04	0.1013	0	Subsonic velocity	0.113	0.453	1.018	1.810	2.828	5.543	11.313	17.999	45.252	
	0.1613	0.06	0.1013	0	Subsonic velocity	0.139	0.554	1.247	2.217	3.464	6.789	13.856	24.454	55.423	
	0.1813	0.08	0.1013	0	Subsonic velocity	0.160	0.640	1.440	2.560	4.000	7.840	15.999	31.175	63.996	
	0.2013	0.1	0.1013	0	Acoustic velocity	0.179	0.716	1.610	2.862	4.472	8.765	17.888	35.998	71.552	
	0.3013	0.2	0.1013	0	Acoustic velocity	0.268	1.071	2.410	4.284	6.694	13.119	26.774	60.242	107.096	
	0.4013	0.3	0.1013	0	Acoustic velocity	0.357	1.426	3.209	5.706	8.915	17.474	35.660	80.236	142.641	
	0.5013	0.4	0.1013	0	Acoustic velocity	0.445	1.782	4.009	7.127	11.137	21.828	44.547	100.230	178.186	
	0.6013	0.5	0.1013	0	Acoustic velocity	0.534	2.137	4.809	8.549	13.358	26.182	53.433	120.224	213.731	

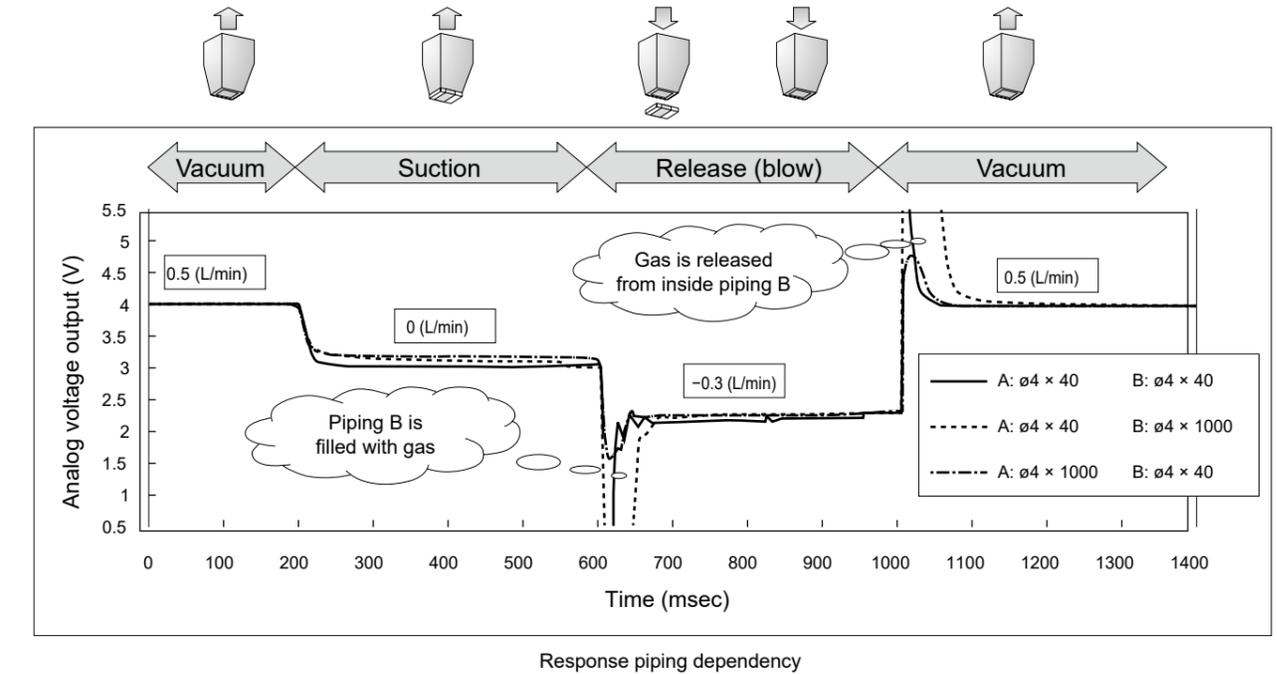
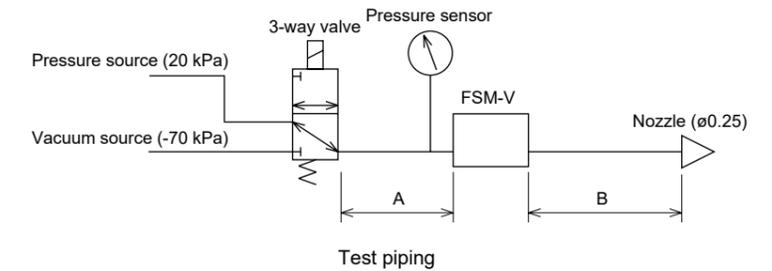
(CAUTION)

- If there is a leak in the piping etc., the actual flow rate will be larger than the calculated value. When selecting the flow rate, consider the amount of leakage in the piping.
- If there is a portion thinner than the suction nozzle diameter in the middle of the piping, the flow rate may be reduced, resulting in a flow rate lower than the calculated value. In addition, suction confirmation, etc., may become impossible.
- The effective cross-sectional area is only a guideline. When the nozzle is long and thin, the effective cross-sectional area becomes smaller than the opening area.
- The response time is determined by the inner volume of the piping from the flow rate sensor to suction nozzle (pinhole). For high-speed detection, reduce the inner volume of the piping as much as possible by installing a flow rate sensor near the suction nozzle, etc.

Suction confirmation

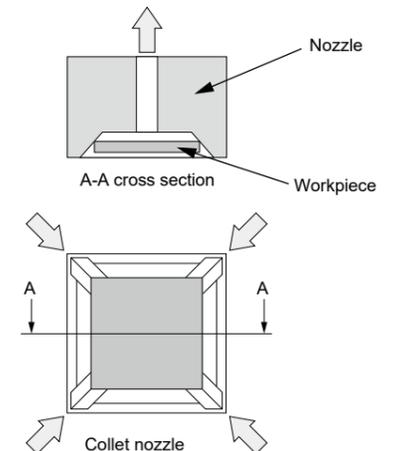
Response time

The response time at suction confirmation is determined by inner volume of the piping or exhaust capacity of the vacuum pump, etc. For example, with piping as in the figure at right, the response time piping dependency is as in the figure below. This result demonstrates that it is effective to reduce the inner volume of the piping from sensor to suction nozzle as small as possible in order to decrease the response time.



When using the collet nozzle

The collet nozzle is commonly used when you do not want the workpiece to be suctioned to contact the nozzle directly. The inside of the collet nozzle is pyramid-shaped, with a structure that creates gaps at the four corners when the workpiece is contacted, generating leaks during suction. If the effective cross-sectional area of the piping (including valves and fittings, etc.) compared to the clearance between the collet nozzle and workpiece is small, the flow rate is determined by the effective cross-sectional area of the piping, and accordingly the flow rate difference between when suctioned and when not suctioned becomes small. In this instance, secure suction confirmation is enabled by making the effective cross-sectional area of the piping as large as possible, larger than the clearance between the collet nozzle and workpiece.



Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit



Dedicated for FSM-X, FSM-V Series  
Miniature inline filter

# FSM-VFM Series



## Features

Inline filter dedicated for miniature flow rate sensor (RAPIFLOW) FSM-X/FSM-V Series  
Due to the small inner volume, the high-speed response at suction confirmation is not affected.

- Miniature type which stays out of the way and helps save space
- Easy element replacement
- Polyamide resin with superior chemical resistance is used for the case material
- As the case is transparent, any dirt on the element can be checked from the outside

## Model No. Notation Method

● Body



### ① Tube O.D.

Code	Description	
H22	ø1.8 (fiber tube)	
H44	ø4 (push-in)	
M55	Port size M5	

### ② Included

Code	Description	
Blank	Without bracket	
B	Bracket included	

● Bracket part model No. (cross-recessed flat head tapping screw M2.5×6:1 pcs.)

## FSM - VFM - B

Clean-room specifications (Catalog No. CB-033SA)

● Maintenance part model No. (element: 5 pcs., fitting fixing pin: 1 pc.)

● Anti-dust generation structure for use in cleanrooms

## FSM - VFM - E

FSM-VFM - . . . . . P7□

## Specifications

Item	FSM-VFM-H22	FSM-VFM-H44	FSM-VFM-M55
Working fluid	Clean air (ISO 8573-1: 2010 [1:1:1 to 5:6:2]), compressed air (ISO 8573-1: 2010 [1:1:1 to 1:6:2]) *1		
Applicable tube bore	ø1.8 (Fiber tube)	ø4 (Push-in)	Port size M5
Proof pressure MPa	0.75		
Working pressure MPa	-0.1 to 0.5		
Ambient temperature °C	0 to 50		
Material	Polyamide		
	Polypropylene, polyethylene		
Degree of Filtration μm	10		
Weight g	5.2	9.5	4.2
Recommended flow rate L/min	10 *2		

\*1: Refer to P. 373 for the compressed air quality class according to ISO 8573-1: 2010.

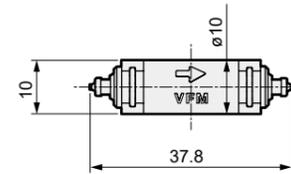
\*2: As the pressure loss increases if the flow rate exceeds 10L/min, use at 10L/min or less.

# FSM-VFM Series

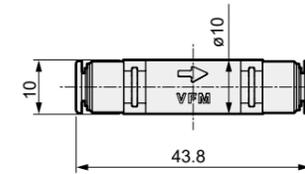
Dimensions diagram/flow characteristics/precautions

## Dimensions

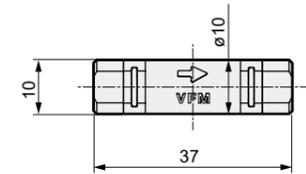
● FSM-VFM-H22



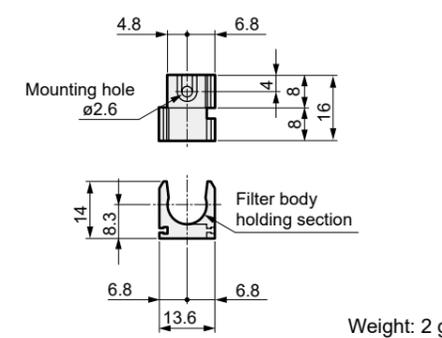
● FSM-VFM-H44



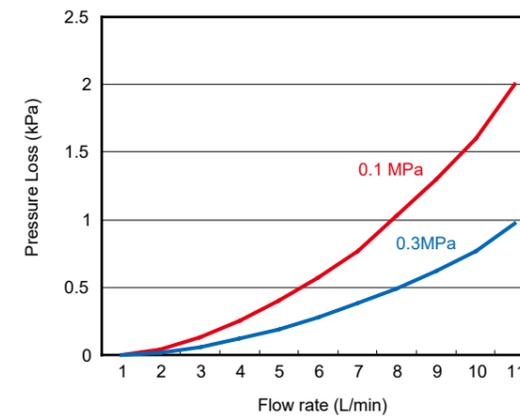
● FSM-VFM-M55



● FSM-VFM-B [Bracket]



## Flow Characteristics (FSM-VFM-H44)

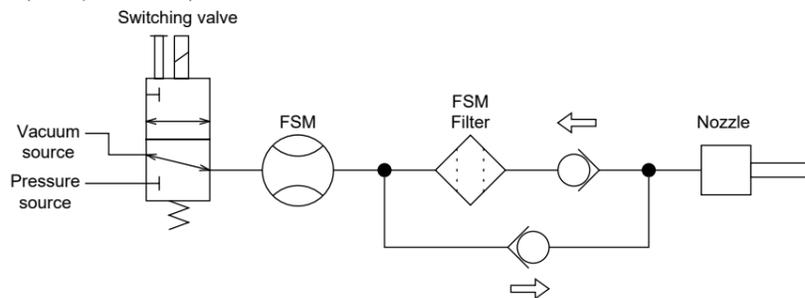


● When using the fiber tube, the pressure loss may increase depending on the piping conditions. Please be careful.

## Caution

● This filter has orientation.  
Use a check valve as a countermeasure against the outflow of dirt when used for suction confirmation, etc.

(Example of circuit)



● Refer to P. 400 for other precautions.

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit



# Pneumatic components (sensors) Safety Precautions

Be sure to read this section before use.  
For general pneumatic components precautions, refer to Intro 17 for details.

## Product-specific cautions: Miniature flow rate sensor FSM-X/FSM-V Series

### Design / Selection

#### Working fluids

##### ⚠ DANGER

- Never use this product with flammable fluids.

##### ⚠ WARNING

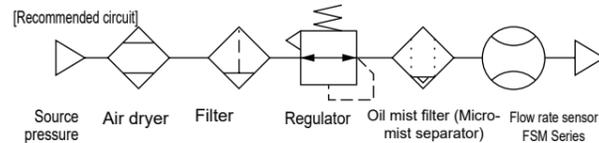
- This product cannot be used as a billing meter. Do not use this product for commercial transactions as it is not compliant with the Measurement Act. Intended applications include industrial sensors.

- Do not use fluids other than the applicable fluids, because accuracy cannot be guaranteed.

- Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist.

- When installing the product during piping or fitting assembly, use the above clean gas for the fluid used to blow out for cleaning. Check that foreign matter does not enter the product from the port of the product. When using compressed air in this process, use clean air compliant with the air quality listed in the following item (ISO 8573-1 Class 2010 1.1.1 to 1.6.2).

- When using compressed air, use clean air that complies with ISO 8573-1 2010 Class 1.1.1 to 1.6.2. Since compressed air from the compressor contains drainage (water, oil oxides, foreign matter, etc.), attach a filter, an air dryer and an oil mist filter (Micro-mist separator) to the primary side (upstream) of the sensor. The sensor's mesh rectifies flow in the pipe. It does not filter out foreign matter, so provide a filter.



- Depending on the fluid, retaining the fluid for long periods could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.

- When using a valve on the primary side of the sensor, use only valves with oil-prohibited specifications. This sensor could malfunction or fail if exposed to splattering grease, oil, etc. As friction powder may be generated depending on the valve, mount a filter to prevent the powder from entering the sensor.

#### Working environment

##### ⚠ DANGER

- Flammable environment**  
Never use this product in an explosive gas atmosphere. The structure is not explosion-proof, and explosions or fires could occur.

##### ⚠ WARNING

- Corrosive environment**  
Do not use this product in an atmosphere containing corrosive gases such as sulfur dioxide.

- Ambient/fluid temperatures**  
Use at ambient/fluid temperatures within the specified range of 0 to 50°C. Even if the temperature is within the specified range, do not use this product if the ambient temperature and fluid temperature could suddenly change and cause dew to condense.

- Working pressure / flow rate range**  
Applications exceeding the max. working pressure and specified flow rate range may result in breakdown. Use this product only within the specified range.

- Drip-proof environment**  
Degree of protection is equivalent to IP40. Do not install this product where water, salt, dust, or swarf is present or in a pressurized or depressurized environment. The product cannot be used with large temperature variations or high temperature/humidity since condensation may occur inside the body.

##### ⚠ CAUTION

- CE-compliance working conditions**  
This product is CE-marked, indicating conformity with the EMC Directives. The standard for the immunity for industrial environments applied to this product is EN61000-6-2; the following requirements must be satisfied in order to conform to this standard:

- Conditions
- The evaluation of this product is performed by using a cable that has a power supply line and a signal line paired to assess the product's performance.
  - This product is not equipped with surge protection. Implement surge protection measures on the system side.

#### Flow rate unit

##### ⚠ CAUTION

- This product's flow rate is measured at a mass flow rate unaffected by temperature or pressure. The unit is L/min, but this is an indication of the mass flow rate converted to volume flow rate at 20°C, 1 atm (101 kPa), and 65% relative humidity.

#### Proof pressure

##### ⚠ CAUTION

- Proof pressure differs depending on the series. Take note at selection.

#### Overflow

##### ⚠ CAUTION

- For each series, there is no problem with the sensor even if the overflow is about twice the measuring range. However, if dynamic pressure is applied near the maximum operating pressure (when the secondary side is open and pressure is applied to the primary side), there is a possibility that the sensor will malfunction. When dynamic pressure is applied, such as when filling a workpiece for leakage inspection, be sure to provide a bypass circuit or a squeezer to prevent dynamic pressure from being applied to the sensor.

#### Use for suction confirmation, etc.

##### ⚠ CAUTION

- When the product is used to confirm suction, etc., select the flow rate range based on the operating vacuum pressure and suction nozzle. Refer to separate sheet "Selection guide for flow rate sensor" on page 392.

- When using the filter to confirm suction, etc., provide an air filter (Degree of filtration 30 μm or less) upstream from suction to prevent the entry of foreign matter. (We recommend the miniature inline filter dedicated for FSM and FSM-V. Refer to P. 394 for details.)

- When using the fiber tube model within the flow rate range of ±5 L/min, or ±10 L/min in the FSM-V Series, the required flow rate may not flow due to large pressure loss depending on the operating pressure.

- When the product is used to confirm suction, etc., consider the atmospheric dew point and this product's ambient temperature, and use the product under conditions in which dew does not condense in pipes.

- When used to confirm suction, etc., response time may be delayed by the piping volume between the suction nozzle and this product. In this case, take countermeasures to reduce piping capacity.

#### When used for leakage inspection

- The working pressure range is -0.09 to 0.2 MPa. In particular, if the sensor is energized in a vacuum of -0.09 MPa or less, the heat dissipation of the sensor will be poor, leading to deterioration of the sensor.

# FSM-X, FSM-V Series

## Product-Specific Cautions

- When this product is used for vacuum applications such as air supply, do not bend the tube near the push-in fitting. If stress is applied to the tube near the push-in fitting, insert an insert ring into the tube, and connect the tube to the push-in fitting.

- When the suction confirmation sensor is switched from a pressure sensor (switch) to a flow rate sensor (switch), sensor output (switch output) logic will be reversed. (Refer to the drawing below.) Note that the PLC sequence program must be changed or revised. If source pressure or vacuum source is not supplied when device power is turned ON, "flow rate 0" = "sensor output (switch output) ON" status is set at the flow rate sensor (switch). Check that this occurs with the PLC sequence program, etc.

	Pressure sensor (switch)	Flow rate sensor (switch)
	ON at setting value or more	ON at setting value or less
Suction confirmation		
	Atmospheric pressure side High vacuum side	Flow rate 0 side High flow rate side

- FSM-X Series**
  - Because the flow rate-output characteristics may vary depending on the flow path structure, when preparing the flow path block, use after checking the actual flow rate-output characteristics.
  - Depending on the fluid, retaining the fluid in the flow path for long periods could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.

#### Wiring

##### ⚠ WARNING

- Use a DC stabilized power supply within the specified rating, insulated from the AC power supply. A non-isolated power supply could result in electrical shock. If power is not stabilized, the peak value in summer could exceed the rating and damage the product or reduce precision.

- Stop the control device and equipment and turn power OFF before wiring. Starting operation suddenly could cause unpredictable and dangerous operation. Conduct an energized test with controls and machine devices stopped, and set target switch data. Be sure to discharge any accumulated electrostatic charge among personnel, tools, or equipment before and during work. Connect and wire bend-resistant material, such as robot wire material, for movable sections.

- Install this product and wiring as far away as possible from sources of noise such as power distribution wires. Provide separate countermeasures for surge applied to the power cable.

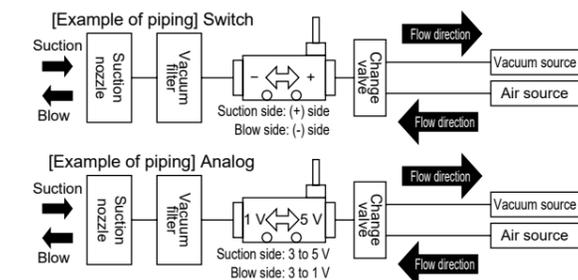
## CAUTION

The power supply for the metal body (stainless steel body, aluminum body) type is a DC stabilized power supply completely isolated from the AC primary side. Connect either the + side or - side of the power to the FG. Between the metal body internal power circuit and metal body, a varistor (limit voltage approx. 40 V) is connected to prevent dielectric breakdown of the sensor. Do not conduct a withstand voltage test or insulation resistance test between the internal power circuit and metal body. Disconnect wiring first if this testing is required. An excessive potential difference between power and metal body will burn internal parts. After installing, connecting and wiring the metal body, electrical welding of the equipment/frame or short-circuit accidents, etc., could cause welding current, excessive high voltage caused by welding, or surge voltage, etc., to run through the wiring, ground wire, or fluid path connected between such devices, damaging wires or devices. Conduct any work such as electrical welding after removing this device and disconnecting all electric wires connected to the FG.

## Piping

## CAUTION

Before installation of piping and FSM-V, check the direction of arrow on the body and consider the fluid direction and switch operation.



## About FSM-X

- Make sure that the lead wire is free of repeated bends and tension. Otherwise, this could lead to disconnection.
- Make sure that no external force is applied to the connector section during use. The internal base or body may be deformed, resulting in output deviation or external leakage.
- Bi-direction (uni-direction) indicates 3 V (1 V) when the flow rate is 0, and changes to 5 V when the fluid flows to the right (when the connector is to the right of the body).

Establish the installation method, piping order, and fitting assembly method from the design stage before use. Check that sealing tape, sealant, and foreign matter do not enter the product during installation and fitting assembly. In particular, freshly piped sections may contain unexpected foreign matter. Be sure to discharge air with air blow, etc., before installing this product.

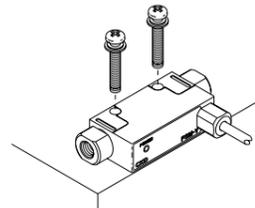
## Mounting

## CAUTION

The sensor can be installed in any direction; top, bottom, left, or right.

## FSM-V Series

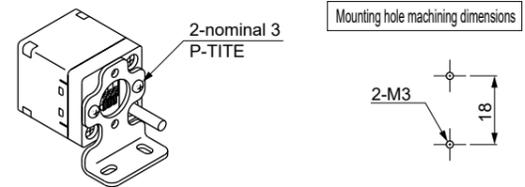
For miniature flow rate sensor Discrete Install using the 2 through holes (ø3.2) on the side.



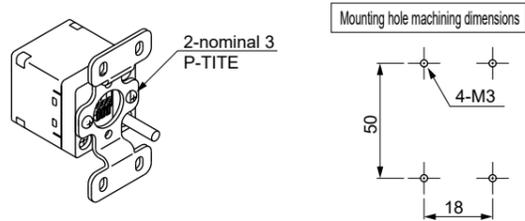
Do not install multiple product bodies in close contact. The generation of heat on each part could cause the product's temperature to rise, hastening changes in characteristics or deterioration of the resin material. When using the products in a row, set intervals of distance of 10 mm and over.

Separated display FSM-H-D, FSM-V-D common Mounting brackets/kits (optional) for installing and mounting the separated display are available.

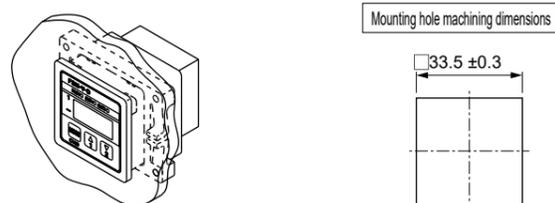
Mounting bracket model No.: PPD3-KL-D : One-side mounting foot (L-shaped mounting)



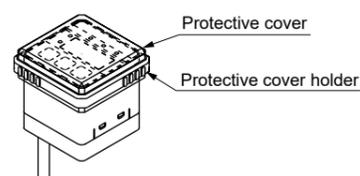
Mounting bracket model No.: PPD3-KD-D : Two-side mounting foot (parallel mounting)



Mounting bracket model No.: PPD3-KHS-D : Panel mounting bracket set, with panel cover



Mounting bracket model No.: PPD3-KC : Operation protective cover



## Other

## WARNING

Output accuracy is affected by temperature characteristics and heat generated when energized. Provide a standby time (5 minutes or more after energizing) before use.

Immediately after power is turned ON, flow rate detection switch operation is not performed for approx. 2 seconds to complete self-diagnosis. Provide a control circuit/program that ignores signals for at least two seconds after power is turned ON.

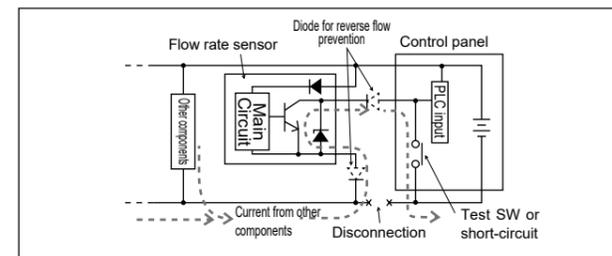
## CAUTION

Use the product within the rated flow range.

Use within the working pressure.

The accuracy may vary from the initial status depending on the working environment or working conditions. It is recommended to check the operation of the product periodically.

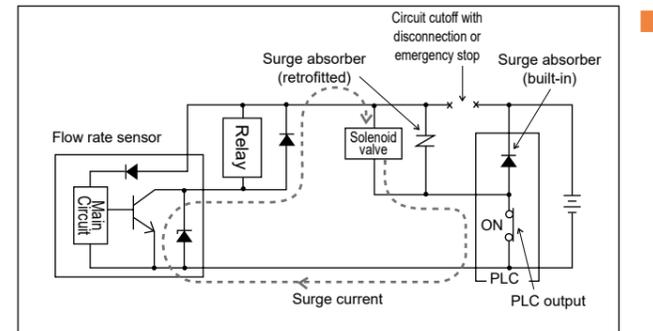
Pay attention to reverse currents caused by disconnected wires and wiring resistance. If other devices, including a flow rate sensor, are connected to the same power supply as the flow rate sensor, and the switch output wire and power cable negative (-) side are short-circuited to check the operation of the control panel input unit, or if the power cable negative (-) side is disconnected, reverse current could flow to the flow rate sensor's switch output circuit and cause damage.



Take the following measures to prevent damage caused by reverse current:

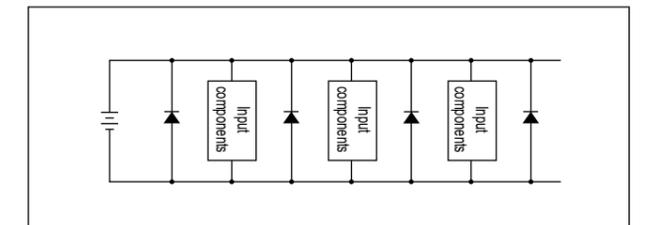
- Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.
- Limit the number of devices connected to the same power source as the flow rate sensor.
- Insert a diode parallel to the flow rate sensor's output line to prevent reverse current.
- Insert a diode parallel to the flow rate sensor power wire's negative (-) side to prevent reverse current.

Pay attention to surge current flow-around. When flow rate sensor power is shared with an inductive load that generates surges, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, surge current could enter the switch output circuit and cause damage depending on where the surge absorber is installed.



Take the measures below to prevent damage from sneak surge current.

- Separate the power supply for output including the inductive load, such as the solenoid valve and relay, and input, such as the flow rate sensor.
- If a separate power supply cannot be used, directly install a surge absorber for all inductive loads. Consider that the surge absorber connected to the PLC, etc., protects only the individual device.
- Connect a surge absorber to places on the power wiring shown in the figure below, as a measure against disconnections in unspecified areas.



When the devices are connected to a connector, the output circuit could be damaged by the above phenomenon if the connector is disconnected while the power is ON. Turn power OFF before connecting or disconnecting the connector.

Analog output continues even if the flow rate range is exceeded. Indicated is the "Hi" display. Note that this is outside the guaranteed precision. Analog output continues even if the flow is reversed. (Note that this is outside the guaranteed precision. Excluding the FSM-V Series.) When confusion with the forward direction signal occurs, use the PLC sequence program to avoid trouble.

## Design / Selection

### CAUTION

■ Do not use this product for vacuum circuits that could come in contact with acids, alkalis, carboxylic acids, other organic compounds, screw-lock agents, solvents, alcohol solutions, or air containing these substances. The body may be damaged, which is dangerous.

■ Use the designated tube and plastic plug.

Tube outer diameter accuracy

• Polyamide tube.....Within  $\pm 0.1$  mm

• Polyurethane tube

( $\leq \phi 6$ ).....Within  $\pm 0.1$  mm

( $\phi 8 \leq$ )..... Within  $+ 0.1$  mm  
 $- 0.15$  mm

CKD recommended model No.

Plastic plug                      GWP□-B Series

Soft nylon tube                F15□□ Series

Polyurethane tube            U95□□ Series

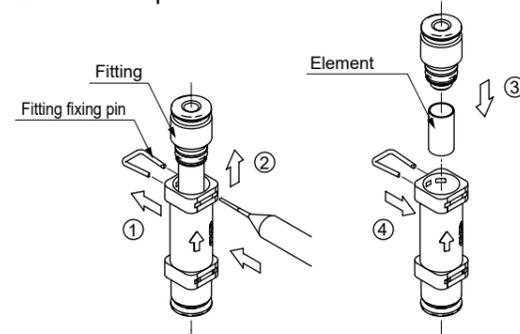
New urethane tube            NU-04, 06 Series

■ For cautions regarding push-in fittings, also read "Safety precautions for fittings/tubes".

■ To check the polyamide case for cracks, damage, and other deterioration, perform periodical inspection/cleaning/replacement.

■ As a clogged filter element may cause degradation of the vacuum source, perform periodical inspection/cleaning/replacement of the element.

### Element replacement method



① Remove the fitting fixing pin using a jig with a pointed tip, etc. (Make sure not to lose the fitting fixing pin because it will be used again.)

② Pull out the fitting.

③ Replace the element and push in the fitting.

④ Push in the fitting fixing pin to fix the fitting.

■ When the body is detached to clean or replace the filter element, the bowl pressure must be reduced to atmospheric pressure before starting work. Because the flow direction has orientation, check the arrow display on body before reassembly. After reassembly, check if the required degree of vacuum is reached.

■ Rinse the body with water after washing with household neutral detergent.

■ If small objects with small particle diameter such as dust during the suction enter the flow path, the foreign matter may flow to the secondary side without being filtered. Select a filter suited to the purpose.

For precautions during mounting, installation, adjustment, use and maintenance, refer to the CKD Components Product Site (<https://www.ckd.co.jp/kiki/en/>) → "Model No." → Instruction Manual