

SmallFlow sensor FSM

■ Sensors / flow sensor



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Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending

Small
Flow sensor

Miniature and high-response

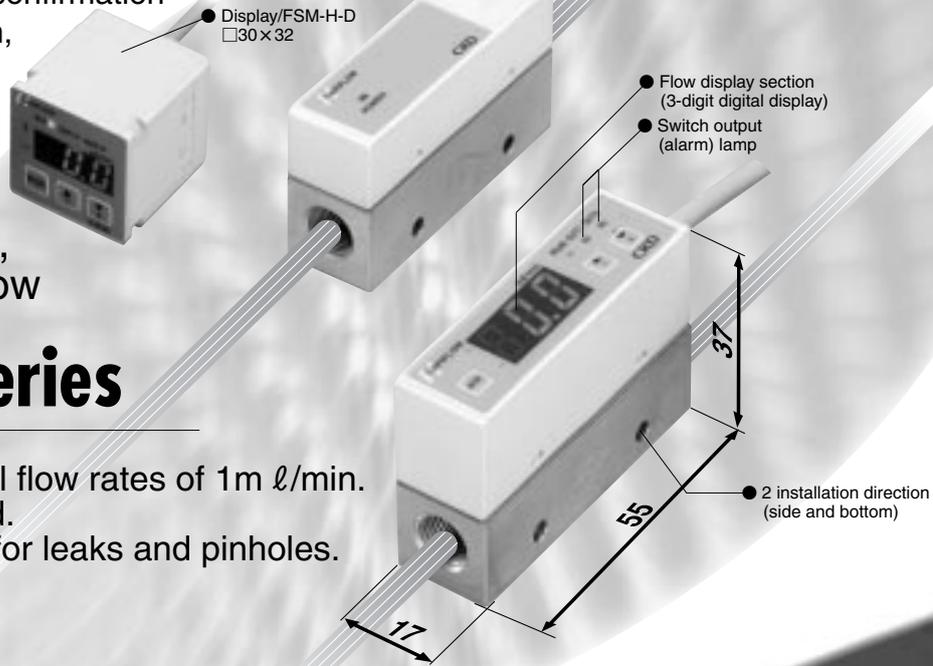
Three series of compact flow sensors supporting various applications

An unprecedented compact size and high-speed response are realized with the platinum sensor chip incorporating silicone micro machining and the newly proposed rectifying mechanism. This thermal flow sensor can be used for a variety of applications such as confirmation of electronic part suction, leak inspections and various gas flow control.

Small, high-speed, extremely small flow FSM-H Series

Detect extremely small flow rates of 1 m ℓ/min. or less at a high speed. Perfect for inspecting for leaks and pinholes.

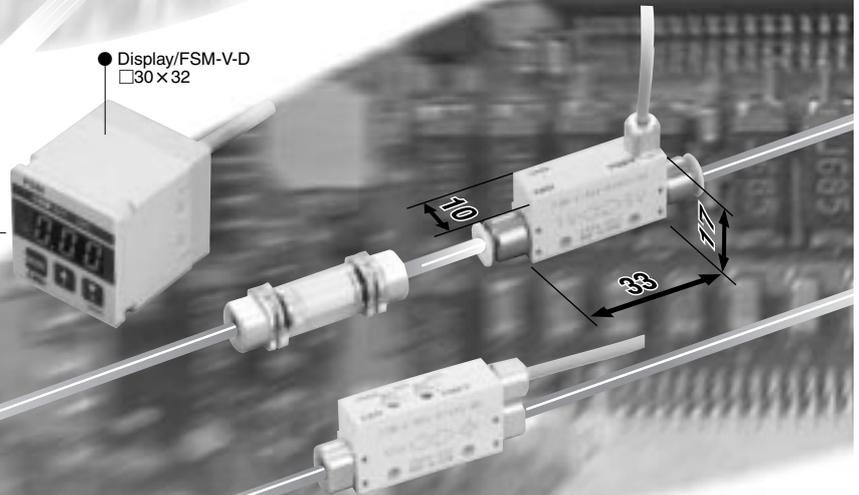
Flow range
5, 10, 50, 100 m ℓ/min.



Miniature, ultra high-speed response FSM-V Series

The unbelievably small size and 5ms high speed response support unconventional designs.

Flow range
0.05, 0.1, 0.5, 1, 5, 10 ℓ/min.



Ample variations

Series	Size	Response speed	Display	Materials	Output	Interactive detection	Flow range
FSM-H Series	Compact, light weight	50 msec Quick response	Separated type Integrated type	SUS Body material	NPN PNP Switch output Analog output		5 ~ 100 mℓ/min Extremely small flow type
FSM-V Series	Miniature, light weight	5 msec Instantaneous response	Separated type	PBT Body material	NPN PNP Switch output Analog output		0.05 ~ 10 ℓ/min Low flow type
Separated indicator							

Miniature inline filters dedicated for available

FSM-VFM Series Maintain sensor performance and prevent trouble.

See the next page for applications and series variation. →

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- Desiccant type dryer
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- F.R.L. (Separate)
- Compact F.R.
- Precise regulator
- F.R.L. (Related products)
- Clean F.R.
- Electro pneumatic regulator
- Air booster
- Speed control valve
- Silencer
- Check valve / others
- Joint / tube
- Vacuum filter
- Vacuum regulator
- Suction plate
- Magnetic spring buffer
- Mechanical pressure SW
- Electronic pressure SW
- Contact / close contact cont. SW
- Air sensor
- Pressure SW for coolant
- Small flow sensor
- Small flow controller
- Flow sensor for air
- Flow sensor for water
- Total air system
- Total air system (Gamma)
- Ending

Small size flow sensor series variations

Extremely small flow FSM-H Series						Miniature, ultra high-speed response FSM-V Series						
FSM-H-A-005ML	FSM-H-A-010ML	FSM-H-A-050ML	FSM-H-A-100ML	Analog output 1 point Separated display mountable (optional)	Display separated type	Analog output 1 point Separated display mountable (optional)	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-H-N-005ML	FSM-H-N-010ML	FSM-H-N-050ML	FSM-H-N-100ML	Analog output 1 point Switch output NPN output 2 points	Display integrated type	NPN output 2 points	FSM-V-N-R0005	FSM-V-N-R0010	FSM-V-N-R0050	FSM-V-N-R0100	FSM-V-N-R0500	FSM-V-N-R1000
FSM-H-P-005ML	FSM-H-P-010ML	FSM-H-P-050ML	FSM-H-P-100ML	Analog output 1 point Switch output PNP output 2 points	Display integrated type	PNP output 2 points	FSM-V-P-R0005	FSM-V-P-R0010	FSM-V-P-R0050	FSM-V-P-R0100	FSM-V-P-R0500	FSM-V-P-R1000
Body material												
●	●	●	●	Resin body		●	●	●	●	●	●	●
				Stainless steel body								
				Aluminum body								
Port size												
				ø1.8 air fiber		●	●	●	●	●	●	●
				ø4 push-in		●	●	●	●	●	●	●
				ø6 push-in								
●	●	●	●	M5		●	●	●	●	●	●	●
				Rc 1/8								
●	●	●	●	Rc 1/4								
				G 1/8								
Full scale flow rate												
●				5	ml/min.							
	●			10								
		●		50		●						
			●	100			●					
				500				●				
				1	l/min.					●		
				5							●	
				10								●
				20								
				50								
				100								
±3%				Precision (linearity)			% F.S.			±5%		
				Working pressure range			MPa					
				Analog output (1 to 5V)								

Note 1: Only AR type is supported.

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Total air system (Gamma)
Ending

Small Flow sensor



Safety precautions

Pneumatic components: Warning and Cautions

Always read this section before starting use.
Refer to Intro 67 for general precautions.

Small size flow sensor FSM-H/FSM-V series

Design & Selection

1. Working fluid

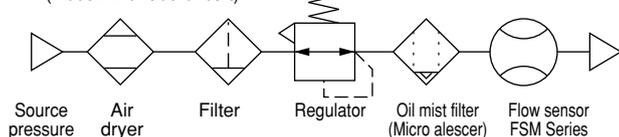
⚠ DANGER

- Do not use this product for flammable fluids.
- When this product is used for liquified gas, evaporate gas. This product could fail if processing liquified gas.

⚠ WARNING

- This product cannot be used as a business meter. This product does not comply with Measurement Laws, and cannot be used for commercial business. Use this as an industrial sensor.
- Do not use fluids other than the applicable fluid because accuracy cannot be guaranteed.
- Compressed air from the compressor contains drainage - water, oil oxide, foreign substances, etc. - so install a filter, air dryer, and oil mist filter on the primary side (upper stream side) of the sensor. The sensor's meshing rectifies flow in the pipe. It does not filter out foreign substances, so provide a filter.

(Recommended circuit)



- When using a valve on the primary side of this product, use only an oil-prohibit specification valve. This sensor could malfunction or fail if exposed to splattering grease, oil, etc.
- 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.
- Depending on the fluid, retaining the fluid for a long time could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.

2. Working Environment

⚠ DANGER

- Flammable environment
Do not use this product in an explosive gas environment. The structure is not explosion-proof, and explosions or fires could occur.

⚠ WARNING

- Corrosive environment
Do not use this product in an environment containing corrosive gases such as sulfurous acid.
- Ambient temperature, fluid temperature
Use ambient temperature/fluid temperature from 0 to 50°C within specified range. (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.)
- Maximum working pressure and specified flow rate range
Applications exceeding the maximum working pressure and specified flow rate range may result in faults. Use this product only within the specified range.
- Drip-proof environment
This product's protective structure is IP40 or equivalent. Do not install it where it could be exposed to water, salt, dust, or cutting chips, or a compressed or decompressed environment. This product cannot be used where the temperature changes sharply or in a highly humid environment where internal damage could be caused by dew condensation.

3. Flow unit

⚠ CAUTION

- This product's flow rate is measured at a mass flow unaffected by temperature or pressure. The unit is $\ell / \text{min.}$, but this is the display when the mass flow is converted to volumetric flow at 20°C 1 barometric pressure (101 kPa).

4. Withstand pressure

⚠ CAUTION

- Withstanding pressure differs by each series. Selection time care must be taken.

5. Overflow

⚠ CAUTION

- With each series, no problem will occur in the sensor, even in an overflow double the measurement range. If dynamic pressure is applied near the maximum working pressure (when a pressure difference exceeding the maximum working pressure is applied between primary and secondary sides), a problem could occur with the sensor. If dynamic pressure is applied, such as when a workpiece is filled for leakage inspection, provide a bypass circuit or restrictor so that dynamic pressure is not applied to the sensor.

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Total air system
Total air system (Gamma)
Ending

Small Flow sensor

6. Use for vacuum confirmation, etc.

CAUTION

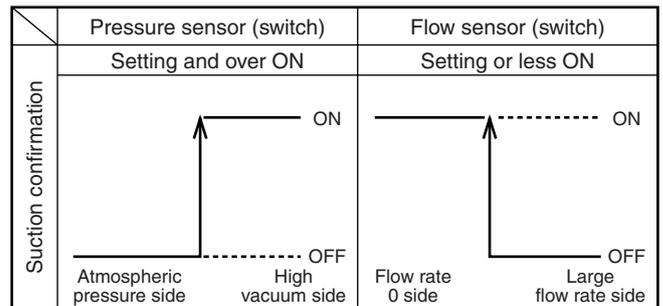
- When this product is used to confirm vacuum, etc., select the flow range based on the working vacuum pressure and vacuum nozzle. Refer to "Methods for calculating theoretic flow" on page 1358 for details.
- When this product is used to confirm vacuum, etc., provide an air filter (filtration 30 μ m or less) upstream from suction to prevent the entry of foreign matter. (Use of a miniature dedicated inline filter is recommended for FSM or FSM-V. Refer to page 1362 for details.)
- When a fiber tube model with the FSM-V Series is used in a flow range of ±5 ℓ /min. or ±10 ℓ /min., pressure loss may increase because of working pressure and the required flow rate may not be reached.
- When this product is used to confirm vacuum, etc., consider the atmospheric dew point and this product's ambient temperature, and use under conditions in which dew does not condense in pipes.
- When this product is used to confirm vacuum, etc., response speed may be delayed by the capacity of the pipe between the vacuum nozzle and this product. In this case, take measures to reduce piping capacity.

Using for leakage inspections

- The working pressure range of this product
 FSM-H: -0.09 to 1.0MPa
 FSM-V: -0.09 to 0.2MPa

If it is energized in a vacuum state less than -0.09Mpa, the sensor's heat dissipation performance will drop and could degrade the sensor.

- When this product is used for vacuum applications such as air supply, do not bend the tube near the push-in joint. If stress is applied to the tube near the push-in joint, insert an insert ring into the tube, and connect the tube to the push-in joint.
- When the vacuum confirmation sensor is switched from a pressure sensor (switch) to a flow sensor (switch), sensor output (switch output) logic will be reversed (See 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 0" = "sensor output (switch output) on" status is set at the flow sensor (switch). Check that this is not a problem with the PLC sequence program, etc.



Installation & Adjustment

Wiring

DANGER

- Use power voltage and output within the specified voltage. If voltage exceeding the specified voltage is applied, the sensor could malfunction or be damaged, or electrical shock or fire could occur. Do not use a load exceeding the output rating. Failure to observe this could result in output damage or fire.

WARNING

- Check line color when wiring. Incorrect wiring connections could result in sensor damage, problems, and malfunctions, so check wire color against the instruction manual before wiring.
- Check wiring insulation. Check that wires do not contact other circuits and that there are no ground faults or insulation faults across terminals. Overcurrent could flow in and damage the sensor.
- Use a DC stabilized power supply, within the specified rating, insulated from the AC power supply. Failure to

insulate the power supply could result in electric shock. If power is not stabilized, the peak could be exceeded during the summer. This could damage this product or cause accuracy to drop.

- Stop the control device and machine devices, and turn the power off before wiring. Starting operation suddenly could result in unpredictable operation and hazards. Conduct an energized test with control devices and machine devices stopped, and set target switch data. Discharge electrostatic accumulated in personnel or tools before and during work. Connect and wire bend-resistant material, such as robot wire material, for movable sections.
- Do not use this product at levels exceeding the power voltage range. If voltage exceeding this range is applied or if AC power is applied, the controller could rupture or burn.
- Install the product and wiring as far away as possible from sources of noise such as power distribution wires. Provide separate measures for surge applied to the power cable.
- Do not short-circuit the load. Failure to observe this could result in rupture or burning.

Installation & Adjustment

CAUTION

For metal body (stainless steel, aluminum) power supplies, use DC-stabilized power separated from the AC primary side. Connect either the plus or minus side of the power supply to the F.G. A varistor (limit voltage 40 V) is connected between the metal body internal power circuit and metal body 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 if this testing is required. An excessive potential difference between power and metal body will burn internal parts. After installation, connecting and wiring the metal body, electrical welding of the device or frame, or short-circuit accidents, etc., could cause welding current, excessive high voltage caused by welding, or surge voltage, etc., to run through wiring or ground line connected between such devices, damaging lines or devices. Do any work such as electrical wiring after removing this device and disconnecting all electric wires connected to the F.G.

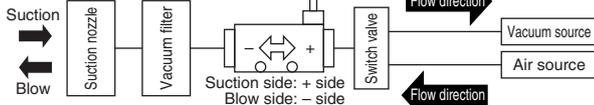
Piping

CAUTION

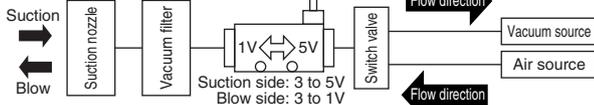
When piping FSM-H/FSM, check that the fluid's direction matches the direction indicated on the component.

With the FSM-V, check the direction of the arrow and pipe and install based on the fluid flow direction and switch operation.

(Example of piping) Switch type



(Example of piping) Analog type



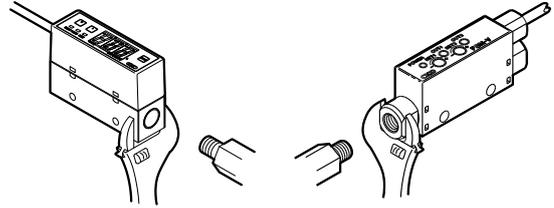
When installing the sensor on piping, see the torque below so that excessive screw-in torque or load torque is not applied to the connection port.

(Reference value)

Port thread	Tightening torque N·m
M5	0.5 to 1.0
Rc1/8(G1/8)	3 to 5
Rc1/4	6 to 8

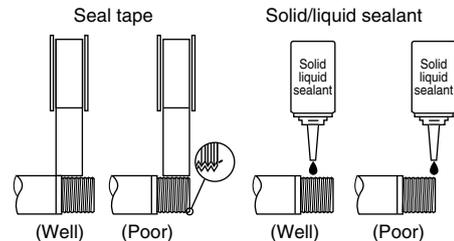
Clean out pipe with air blow to remove foreign substances, swarf, etc., before piping. The rectifier or sensor chip could be damaged if a large amount of foreign matter, swarf, etc., occurs.

Attach a wrench to metal sections when tightening pipes so that pressure is not applied to the resin section.



Check that sealing tape or adhesive does not get inside when piping.

When winding fluorine resin sealing tape around threads, wind sealing tape once or twice, leaving two to three threads open at the end of the screw. Press tape with a nail tip to stick it onto threads. When using liquid sealing agent, leave one to two threads open from the end, and avoid applying too much. Check that the sealing agent does not get on device threads.

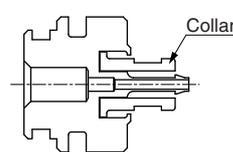


Connect a joint even when using the metal body type with the out side opened. The port filter could come off.

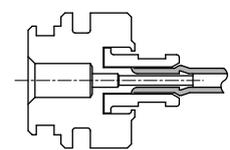
When using a push in joint, accurately insert tube and confirm that it does not become dislocated even when pulled. Cut tube at a right angle with a dedicated cutter before use.

Connect fiber tubing as follows (step (1) to (5)).

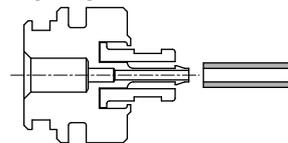
(1) Set the collar to the very back.



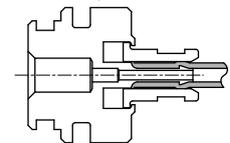
(4) Insert fiber tubing at the last position



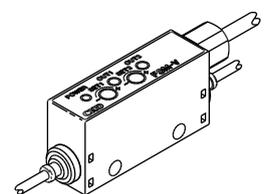
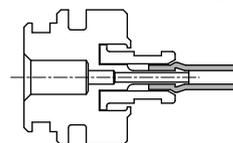
(2) Cut the end of fiber tubing at a right angle.



(5) Pull the collar forward to lock it in place.



(3) Pass the collar through, and confirm that fiber tubing is correctly inserted during work.



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Small flow controller
Flow sensor for air
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Total air system
Total air system (Gamma)

Ending

Small Flow sensor

Adjustment

CAUTION

■ If switches are operated when flow is not stable, such as pulsating, operation may be unstable. In this case, provide sufficient margin between the two setting values and avoid setting switches in an unstable area. Confirm that switch operation is stable before use.

■ When setting the FSM-V Series switch output, use a flat-tip screwdriver fitting the trimmer groove (0.5 wide, 1.9 long, and 0.45 deep) or a Phillips screwdriver for 0 bits. The trimmer rotates 240 degrees and could break if turned more or forced when turned.

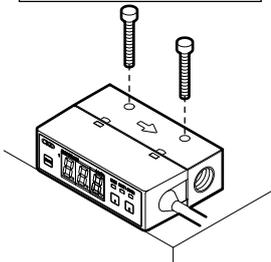
Installation

CAUTION

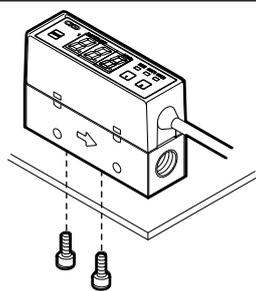
■ This product can be installed in any direction; top, bottom, left, or right.

FSM-H Series

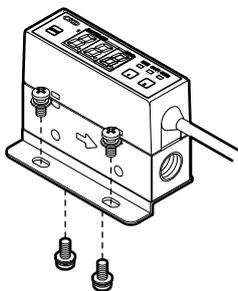
Horizontal installation
(through hole used)



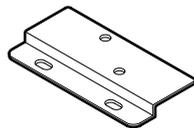
Vertical installation (bottom side female thread used)



Bracket installation (*bracket used)



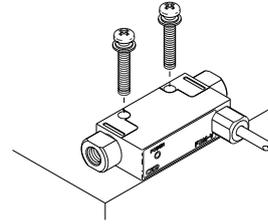
*A dedicated bracket (option) is available. (Model no.: FSM-LB1) (Refer to page 1335.)



Enclosed four M3 (length 6mm) setscrews for fixing

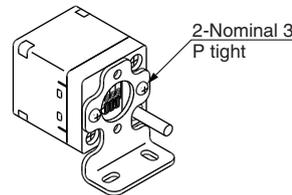
FSM-V Series

■ For discrete miniature flow sensor
Install using the two penetration holes (ø3.2) on the side.

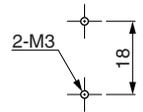


■ Separate indicator FSM-H-D*, FSM-V-D* common
A mounting bracket and kit (option) are available for installing the separated display.

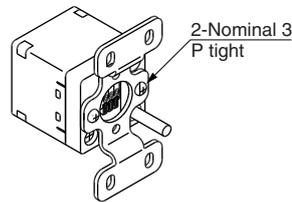
Bracket model no.: PPD3-KL-D : One side installation foot (radial)



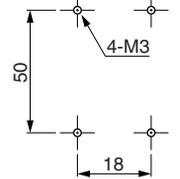
Installation hole machining dimensions



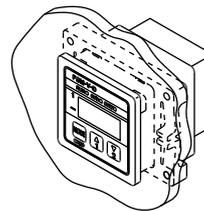
Bracket model no.: PPD3-KD-D : Both sides installation foot (parallel)



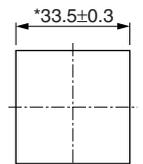
Installation hole machining dimensions



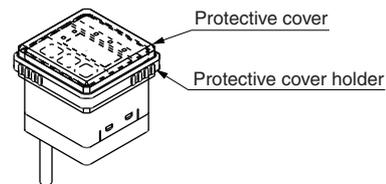
Bracket model no.: PPD3-KHS-D : With panel mount bracket set and panel guard



Installation hole machining dimensions



Bracket model no.: PPD3-KC : Operation protective cover



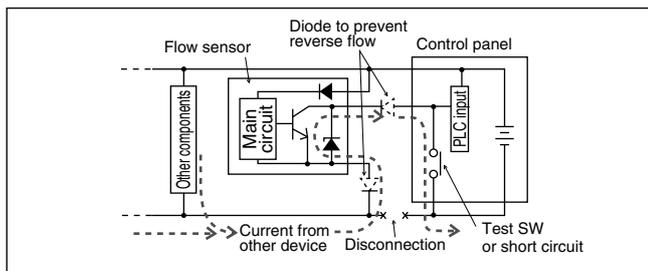
During Use & Maintenance

⚠ WARNING

- Output accuracy is affected by temperature characteristics and heat generated when energized. Provide standby time of five minutes or more after turning power on when using.
- This product does not use flow control for two seconds after power is turned ON to complete self-diagnostics. Provide a control circuit and program that ignore signals for two seconds after power is turned ON.

⚠ CAUTION

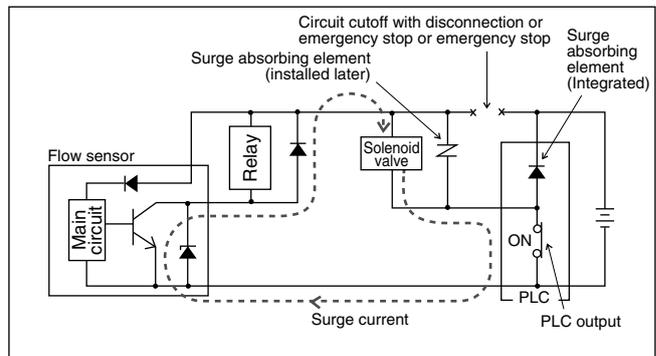
- If a problem occurs during operation, immediately turn power off, stop use, and contact your dealer.
- Keep this product's flow within the rated flow range.
- Use this product within the working pressure range.
- If the output setting value is changed, control system devices could operate unintentionally. Stop devices before changing settings.
- Regularly inspect the product at least once a year or more, and confirm that it is operating correctly.
- Do not disassemble or modify this product. Doing so could result in faults.
- The case is made of resin. Do not use solvent, alcohol, or detergent in cleaning, or resin could absorb it. Wipe contaminations with a well wrung rag, etc., after soaked in weakened neutral detergent.
- Pay attention to reverse currents caused by disconnected wires and wiring resistance. If other devices, including a flow sensor, are connected to the same power sensor as the flow sensor, and the switch output wire and power cable minus (-) side are short-circuited to check the operation of the control panel's input device, or if the power cable's minus (-) side is disconnected, back current could flow to the flow sensor's switch output circuit and cause damage.



Take countermeasures as followings to prevent damages caused by reverse current.

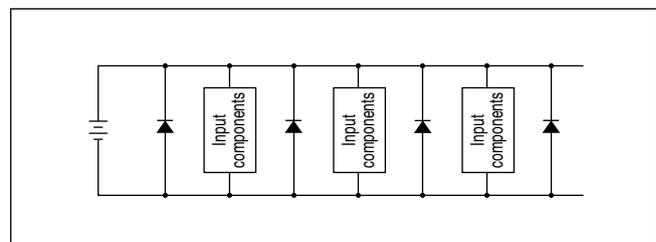
- (1) Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick wire as possible.
- (2) Limit the number of devices connected to the same power source as the flow sensor.
- (3) Insert a diode in serial with the flow sensor's output cable to prevent reversal of current.
- (4) Insert a diode in serial with the pressure switch's power cable minus side to prevent reversal of current.

- Care must be taken for surge current leading. When flow 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 output circuit and cause damage depending on where the surge absorption element is installed.



Take countermeasures as followings to prevent damage caused by surge current leading.

- (1) Separate the power supply for the output system comprising the inductive load, such as the solenoid valve and relay, and the input system, such as the pressure switch.
- (2) If separate power supplies cannot be used, directly install a surge absorption element for all inductive loads. Remember that the surge absorption element connected to the PLC, etc., protects only that device.
- (3) Connect a surge absorption element to the following places on the power wiring as shown below as a measure against disconnections in unspecified areas:



When components are connected with connectors, if a connector is dislocated during energizing, the output device could be damaged because of the reason above. Turn off the power before dislocating a connector.

- Refrigerating type dryer
- Desiccant type dryer
- High polymer membrane type dryer
- Air filter
- Auto. drain / others
- F.R.L. (Module unit)
- F.R.L. (Separate)
- Compact F.R.
- Precise regulator
- F.R.L. (Related products)
- Clean F.R.
- Electro pneumatic regulator
- Air booster
- Speed control valve
- Silencer
- Check valve / others
- Joint / tube
- Vacuum filter
- Vacuum regulator
- Suction plate
- Magnetic spring buffer
- Mechanical pressure SW
- Electronic pressure SW
- Contact / close contact cont. SW
- Air sensor
- Pressure SW for coolant
- Small flow sensor
- Small flow controller
- Flow sensor for air
- Flow sensor for water
- Total air system
- Total air system (Gamma)
- Ending

- Even if the flow range is exceeded, analog output will continue. "Hi" is displayed.
Note that this is outside guaranteed precision.
Analog output is also made when fluid flows in reverse. (This exceeds the guaranteed accuracy. Excluding the FSM-V Series.) If the signal could be confused with the forward direction signal, check that there is no problem with the PLC sequence program.

Miniature inline filter FSM-VFM series

During Use & Maintenance

⚠ CAUTION

- Do not use this product for vacuum circuits that could come in contact with acids, alkaline, carboxylic acid, other organic compounds, screw-lock agent, solvent, or alcohol solutions, or air containing these substances.
The body could be damaged, and cause a hazardous situation.

- Use the designated tube and plastic plug.

- Tube outer diameter precision
- Polyamide tube : Within $\pm 0.1\text{mm}$
 - Polyurethane tube
 - (Up to $\varnothing 6$) : Within $\pm 0.1\text{mm}$
 - ($\varnothing 8$ and over) : Within $+0.1$
 -0.15mm

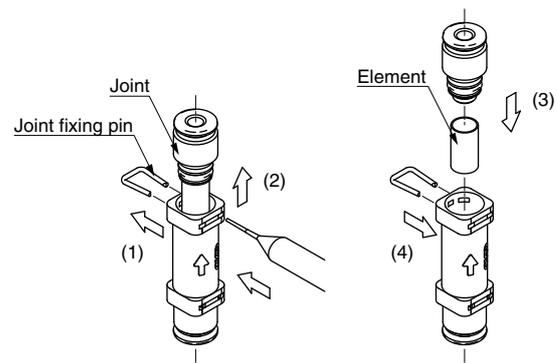
CKD recommended model

- | | |
|--------------------------|-----------------|
| Plastic tube | GWP*-B series |
| Soft nylon tube | F15** series |
| Polyurethane rubber tube | U95** series |
| Urethane tube | NU-04/06 Series |

- Read "Safety precaution on joint tube" for push-in joint.
- Regularly inspect the polyamide case for cracks, damage, and other deterioration. Clean, and replace as necessary.
- Filter element clogging will decrease vacuum source conductance. Regularly inspect, clean, and replace the element.
- Return the container to atmospheric pressure before removing the body to clean or replace, etc., the filter element.
The flow direction is oriented. Check the arrow on the body during reassembly.
Check that the required vacuum degree is attained in the circuit after reassembly.

- Use a household-grade neutral detergent to clean the body, then rinse with water.
- If small particles such as dust during suction enter the flow path, foreign matter will not be filtered and may flow to the secondary side.
Select a filter suiting the purpose.

Replacing the element

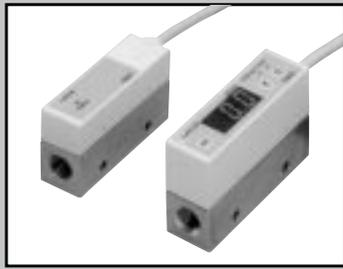


- (1) Pull out the joint fixing pin using a blunt jig, etc.
The joint fixing pin must be reused, so do not lose it.
- (2) Pull the joint out.
- (3) Replace the element, and insert the joint.
- (4) Inset the joint fixing pin, and fix the joint.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending

Small Flow sensor



Small flow sensor
 Small flow sensor extremely small flow type
 Indicator type/analog output type

FSM-H Series (air/nitrogen gas)

● Flow rate range: 0.25 to 5, 0.5 to 10, 2.5 to 50, 50 to 100m ℓ/min.



Indicator type specifications

Descriptions	Indicator type			
	FSM-H-N/P-005ML	FSM-H-N/P-010ML	FSM-H-N/P-050ML	FSM-H-N/P-100ML
Flow rate range mℓ/min. Note 1	0.25 to 5	0.5 to 10	2.5 to 50	5 to 100
Working conditions	Working fluid Clean air (JIS B 8392-1. 1. 1 to 5. 6. 2), compressed air (JIS B 8392-1. 1. 1 to 1. 6. 2) Note 2, nitrogen gas Note 3			
	Max. working pressure MPa 1.0			
	Min. working pressure MPa -0.09			
	Withstanding pressure MPa 1.5			
	Ambient temperature/humidity 0 to 50°C, 90%RH or less			
Precision	Working fluid temperature °C 0 to 50 (with no dew condensation)			
	Linearity (display/analog output) ±3%F.S. or less (0.1MPa, 25°C, flow rate range 5 to 100%F.S.)			
	Pressure characteristics ±3%F.S. or less (-0.09 to 1.0MPa, where 0.1MPa is reference)			
	Temperature characteristics ±0.2%F.S./°C or less (15 to 35°C, where 25°C is reference)			
Repeatability		±0.5%F.S. or less		
Responsiveness		50ms or less Note 5		
Indicator	Type of display Flow display (3.5-digit 7-segment display, orange), run and switch output display (orange)			
	Display min. unit Note 6 0.01mL/min. Note 1		0.1mL/min. Note 1	
Output type		Switch output 2 points (NPN or PNP open collector output, 30 VDC and 50 mA or less, voltage drop of 2.4 V or less, PLC- and relay-compatible)		
		Analog output 1 point (1 to 5V voltage output, connected load impedance 50KΩ and over)		
Power voltage		12/24 VDC (10.8 to 26.4V)		
Current consumption		60mA or less		
Lead wire		ø3.7 0.2mm ² × 5-conductor 1m		
Functions		Flow display, flow display peak hold, switch output, analog output		
Installation	Installation attitude		Horizontal or vertical	
	Straight piping section		Not required	
Protective structure		IEC standards IP40		
Protective circuit Note 4		Power supply reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection		
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8		

Indicator type Weight

Unit: g

Model no.	FSM-N/P-005	FSM-N/P-010	FSM-N/P-050	FSM-N/P-100
Port size (body material)				
6A Rc1/8 (Stainless steel)	150	150	150	150
6G G1/8 (Stainless steel)				

Analog output type weight

Unit: g

Model no.	FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100
Port size (body material)				
6A Rc1/8 (Stainless steel)	140	140	140	140
6G G1/8 (Stainless steel)				

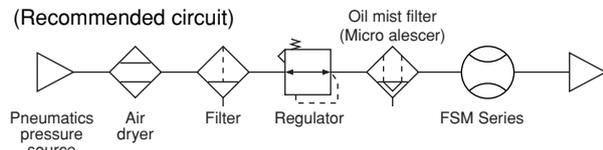
Analog output type specifications (without display)

Descriptions		Analog output type			
		FSM-H-A-005ML	FSM-H-A-010ML	FSM-H-A-050ML	FSM-H-A-100ML
Flow rate range m ³ /min. Note 1		0.25 to 5	0.5 to 10	2.5 to 50	5 to 100
Working conditions	Working fluid	Clean air (JIS B 8392-1. 1. 1 to 5. 6. 2), compressed air (JIS B 8392-1. 1. 1 to 1. 6. 2) Note 2, nitrogen gas Note 3			
	Max. working pressure MPa	1.0			
	Min. working pressure MPa	-0.09			
	Withstanding pressure MPa	1.5			
	Ambient temperature/humidity	0 to 50°C, 90%RH or less			
Working fluid temperature °C		0 to 50 (with no dew condensation)			
Precision	Linearity (display/analog output)	±3%F.S. or less (0.1MPa, 25°C, Flow rate range 5 to 100%F.S.)			
	Pressure characteristics	±3%F.S. or less (-0.09 to 1.0MPa, where 0.1MPa is reference)			
	Temperature characteristics	±0.2%F.S./°C or less (15 to 35°C, where 25°C is reference)			
	Repeatability	±0.5%F.S. or less			
Responsiveness		50ms or less Note 5			
Type of display		Power display (green)			
Output type		Analog output 1 point (1 to 5V voltage output, connected load impedance 50KΩ and over)			
Power voltage		12/24 VDC (10.8 to 26.4V)			
Current consumption		50mA or less			
Lead wire		ø3.7 0.2mm ² × 3-conductor 1m			
Functions		Analog output			
Protective circuit Note 4		Power supply reverse connection protection			
Installation	Installation attitude	Horizontal or vertical			
	Straight piping section	Not required			
Protective structure		IEC standards IP40			
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8			

Note 1: Converted to volumetric flow at 20°C 1 barometric pressure (101kPa)

Note 2: When using compressed air, use clean air that complies to JIS B 8392-1:2003 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration: 5 μm), air dryer (minimum pressure dew point: 10°C or less), and oil mist filter (maximum oil concentration: 0.1 mg/m³) on the primary side of this product to maintain product functions.

(Recommended circuit)



(Recommended component)

Air filter: F Series

Oil mist filter: M Series

Note 3: Consult with CKD when using gas other than air or N₂.

Note 4: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.

Note 5: Response time varies depending on the piping conditions.

Note 6: This indicates the minimum display for the flow, and does not guarantee display accuracy.

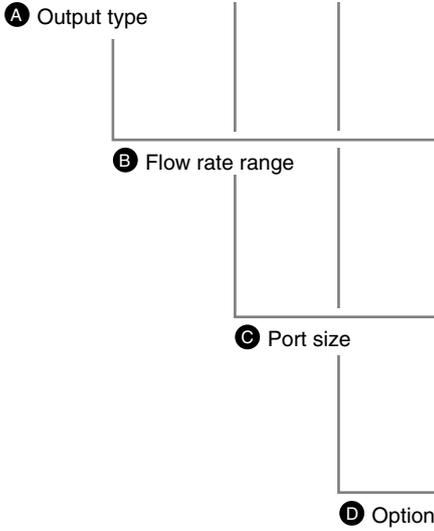
Separate indicator specifications (analog output type dedicated)

Model no.		Separate indicator			
Descriptions		FSM-H-D ^{NP} -005ML	FSM-H-D ^{NP} -010ML	FSM-H-D ^{NP} -050ML	FSM-H-D ^{NP} -100ML
Available analog output type model no.		FSM-H-A-005ML	FSM-H-A-010ML	FSM-H-A-050ML	FSM-H-A-100ML
Indicator	Type of display	Flow display (3.5-digit 7-segment display, orange), run and switch output display (orange)			
	Display min. unit Note 6	0.01mL/min. Note 1		0.1mL/min. Note 1	
Output		Switch output 2 points (NPN or PNP open collector output, 30 VDC and 50 mA or less, voltage drop of 2.4 V or less, PLC- and relay-compatible) Analog output 1 point (1-5V voltage output, connected load impedance 50KΩ and over)			
Power voltage		12/24 VDC (10.8 to 26.4V)			
Current consumption		50mA or less (only indicator)			
Lead wire		ø3.7 0.2mm ² × 5-conductor (1m)			
Functions		Flow display, flow display Peak hold function, switch output, analog output			
Ambient temperature/humidity		0 to 50°C, 85%RH or less (with no dew condensation)			
Protective structure		IEC standards IP40			
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8			
Weight g		Approx. 70 (including lead wire 1m)			

Refrigerating type dryer
 Desiccant type dryer
 High polymer membrane type dryer
 Air filter
 Auto. drain / others
 F.R.L. (Module unit)
 F.R.L. (Separate)
 Compact F.R.
 Precise regulator
 F.R.L. (Related products)
 Clean F.R.
 Electro pneumatic regulator
 Air booster
 Speed control valve
 Silencer
 Check valve / others
 Joint / tube
 Vacuum filter
 Vacuum regulator
 Suction plate
 Magnetic spring buffer
 Mechanical pressure SW
 Electronic pressure SW
 Contact / close contact cont. SW
 Air sensor
 Pressure SW for coolant
 Small flow sensor
 Small flow controller
 Flow sensor for air
 Flow sensor for water
 Total air system
 Total air system (Gamma)
 Ending
 Small Extremely small flow type Flow sensor

How to order

FSM-H - N - 005ML - 6A - K



Symbol	Descriptions
A Output type	
A	Analog output 1 point
N	NPN output 2 points, Analog output 1 point
P	PNP output 2 points, Analog output 1 point

B Flow rate range	
005ML	0.25 to 5m ℓ/min.
010ML	0.5 to 10m ℓ/min.
050ML	2.5 to 50m ℓ/min.
100ML	5 to 100m ℓ/min.

C Port size	
6A	Rc1/8 (Stainless steel body)
6G	G1/8 (Stainless steel body)

* Refer to page 1285 for model No. and dimensions of bracket (optional).

D Option	
Blank	None
K	With company certification
T (Note 1)	With traceability certificate

Note 1) Traceability certificate, inspection results, and traceability system diagram are included.

<Example of model number>

FSM-H-N-005ML-6A-K

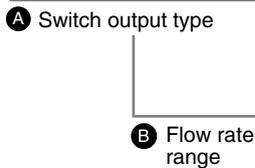
Model: FSM indicator type

- A** Switch output type : NPN output
- B** Flow rate range : 0.25 to 5m ℓ/min.
- C** Port size : Rc1/8 (Stainless steel body)
- D** Option : With company certification

● Separate indicator (analog output type dedicated)

FSM - H - D N - 010ML

Model no.



Symbol	Descriptions
A Output type	
N	NPN output 2 points, Analog output 1 point
P	PNP output 2 points, Analog output 1 point

B Flow rate range	
005ML	0.25 to 5m ℓ/min.
010ML	0.5 to 10m ℓ/min.
050ML	2.5 to 50m ℓ/min.
100ML	5 to 100m ℓ/min.

* Refer to pages 1348 to 1355 for the operation and dimensions, etc.

● Bracket for separate indicator

PPD3 - KL-D

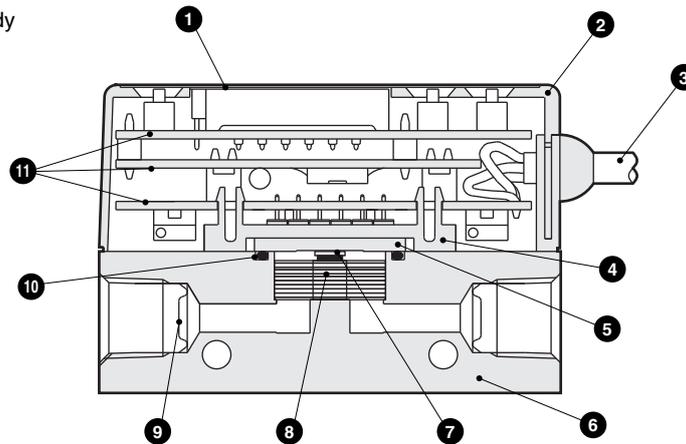
A Bracket kit

Symbol	Descriptions
A Bracket kit	
KL-D	Single foot bracket (L type)
KD-D	Both sides foot bracket (parallel)
KHS-D	Panel mount bracket set with cover
KC	Operation protective cover

* Refer to pages 1348 to 1349 for dimensions and size of bracket.

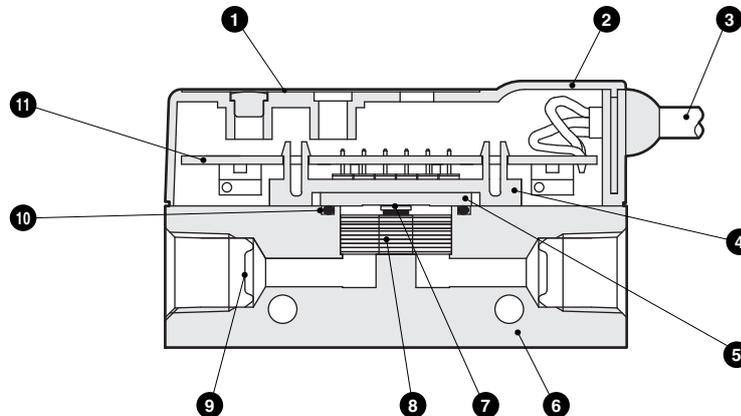
Internal structure and parts list

- FSM-H-N/P-*-*
Indicator type stainless steel body



No.	Parts name	Material	No.	Parts name	Material
1	Front seat	Polyester film	7	Sensor chip	Silicone
2	Case	ABS resin	8	Rectifier	Stainless steel
3	Lead wire with holder (5-conductor)	ABS resin/polyvinyl chloride	9	Port filter	Stainless steel
4	Module holder	Polyamide resin	10	Sensor gasket	Fluoro rubber
5	Sensor circuit board	Alumina	11	Electron circuit board	
6	Stainless steel body	Stainless steel			

- FSM-H-A-*-*
Analog type stainless steel body



No.	Parts name	Material	No.	Parts name	Material
1	Front seat	Polyester film	7	Sensor chip	Silicone
2	Case	ABS resin	8	Rectifier	Stainless steel
3	Lead wire with holder (3-conductor)	ABS resin/polyvinyl chloride	9	Port filter	Stainless steel
4	Module holder	Polyamide resin	10	Sensor gasket	Fluoro rubber
5	Sensor circuit board	Alumina	11	Electron circuit board	
6	Stainless steel body	Stainless steel			

- Separate indicator FSM-H-D-*-*

Refer to page 1348 for internal structure of a separate indicator.

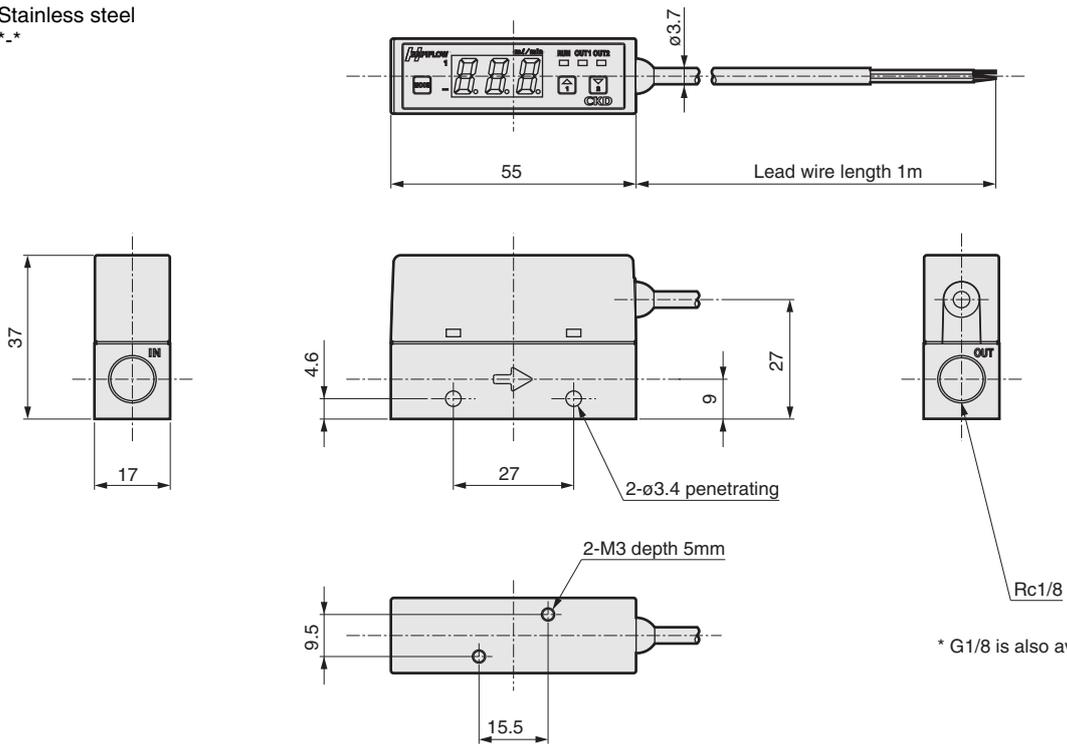
Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending
Small Extremely small flow type
Flow sensor

Dimensions (indicator type)



Body material: Stainless steel
 ● FSM-H-N/P-*-*

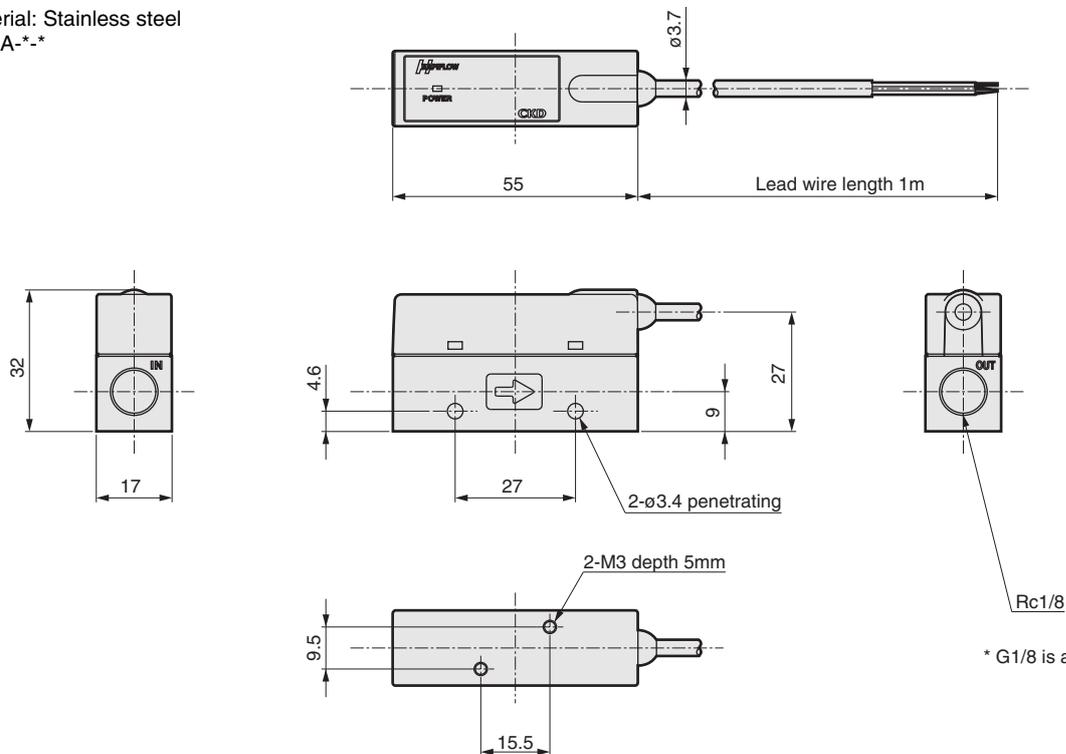


* G1/8 is also available.

Dimensions (analog output type)



Body material: Stainless steel
 ● FSM-H-A-*-*

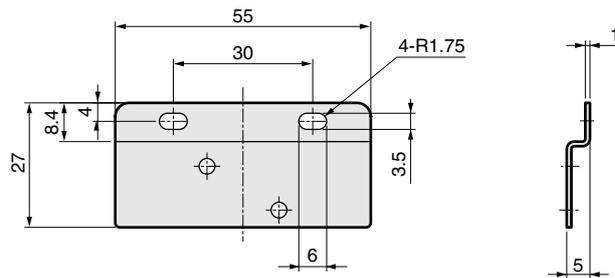


* G1/8 is also available.

* Refer to page 1348 for dimensions of a separate indicator FSM-H-D-*-*.

Dimensions (bracket)

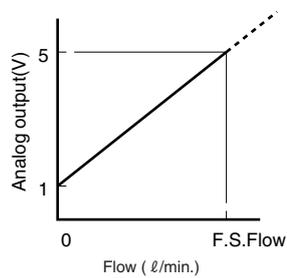
Model no.: FSM-LB1



Enclosed four M3 (length 6mm) setscrews for fixing

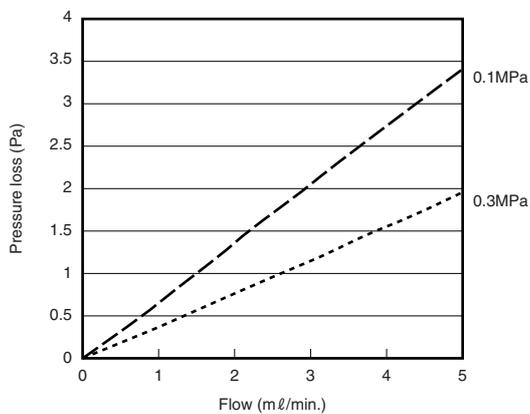
Analog output characteristics

● FSM-H-**-*

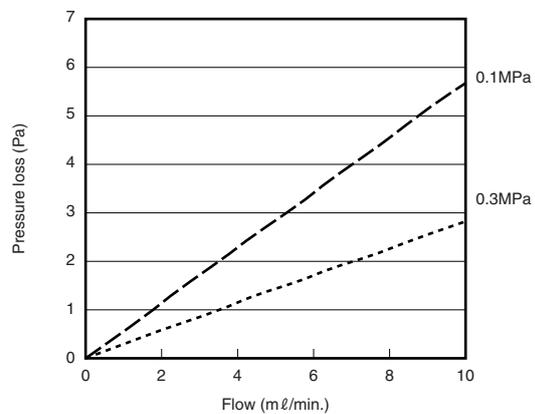


Pressure loss characteristics

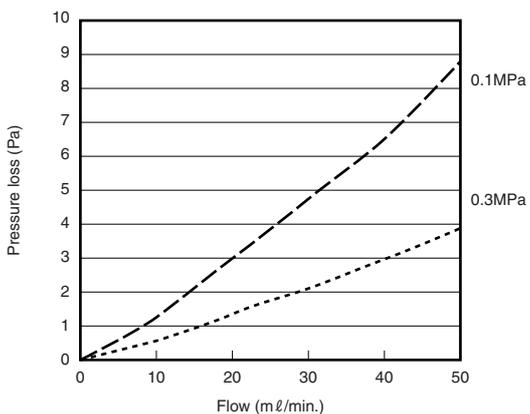
● FSM-H-*-005ML-*



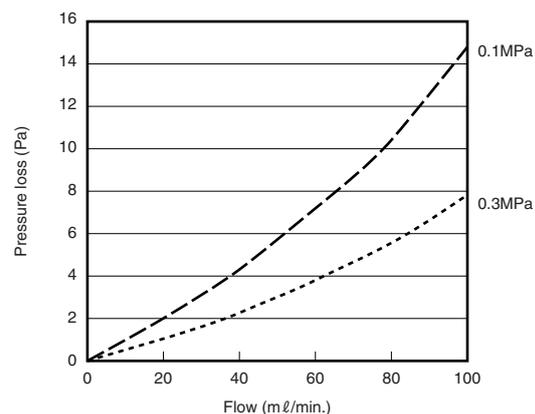
● FSM-H-*-010ML-*



● FSM-H-*-050ML-*



● FSM-H-*-100ML-*



For details on the display and operation section names, functions and operation methods, refer to page 1340 for integrated display and page 1352 for separated display.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)
Ending

Names and functions of display and operation section

● Display integrated type (FSM-H Series common)

Overflow display

- Lights and displays  when the 3-digit display is exceeded. (At 10.00 /min., this  turns on, and 0.00 is displayed on the 3-digit LED.)

RUN display

- Turns on when displaying flow.
- Blinks during peak hold function operation.
- Turns off during various setting modes.

Output (OUT1) display

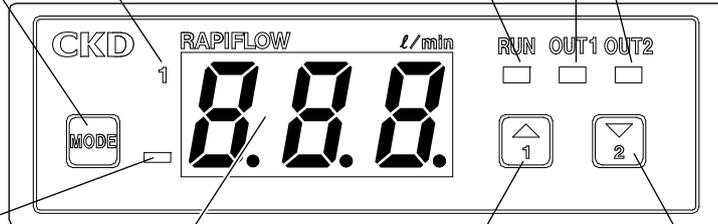
- Turns on when CH1 output is on.
- Blinks when overcurrent is detected.

Output (OUT2) display

- Turns on when CH2 output is on.
- Blinks when overcurrent is detected.

MODE key

- Use to enter each setting mode.
- Use to return to the flow display.
- Use to release the peak hold function operation.



Minus display

(Excluding FSM (air, nitrogen use))

- Lights when gas flows in reverse.

3-digit LED display

- Displays the flow rate and switch settings, etc.
-  is displayed for an overflow. (Hi display at approx. 10% or more of F.S.)
-  is displayed for overcurrent in reverse. (Lo display at approx. -10% or more of F.S.) (Excluding FSM (air, nitrogen use))

1 (UP) Key

- Sequentially displays CH1 data when the flow rate is displayed.
- Displays maximum during peak hold function operation.
- Sets the mode when the mode is selected.
- Used to increment values, etc., when data is set.

2 (DOWN) Key

- Sequentially displays CH2 data when the flow rate is displayed.
- Displays the minimum during peak hold function operation.
- Used to decrement the value, etc., when data is set.

* The design of the front sheet differs for the FSM-H Series, but display and operation section names and functions are the same.

● Separate indicator type

Refer to pages 1352 to 1355 for details on the display and operation section names, functions, and operation methods.

Operation

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending

Small Flow sensor

Small Flow sensor

Switch output function

Switch operation mode

Operation pattern name	LED display	Operation waveform
Window operation 1 (ON within specified range)		
Window operation 2 (ON out of specified range)		
Hysteresis operation 1 (Flow small side ON)		
Hysteresis operation 2 (Flow large side ON) (Note 6)		
Switch output OFF		

Note 1. When used for a winding operation, leave an interval of 3% F.S. or more between the two settings. 1% F.S. hysteresis is automatically added to the ON side and OFF side.

Note 2. When used for hysteresis operation, leave an interval of 1% F.S. or more between the two settings. If there is no difference between the two settings, operation may not take place or may be unstable.

Note 3. If switches are operated when flow is not stable, such as pulsating, operation may be unstable. In this case, provide sufficient margin between the two setting values. Confirm that switch operation is stable before use.

Note 4. The left side of the operation waveform indicates negative pressure, and the right side indicates positive pressure.

Note 5. The magnitude relationship of the ON and OFF settings is determined when the waveform is set, and a reverse magnitude relationship cannot be attained. With this product, however, operation of the designated operation pattern is the priority. When the two settings are input, the magnitude relationship is automatically determined, and each is judged and processed at the appropriate ON and OFF settings. In other words, even if ON and OFF settings are input reversed, input is recognized correctly as ON and OFF and operation occurs with the designated operation mode.

Note 6. The output is held even during the Hi display.

Set point confirmation method

CH1 data display

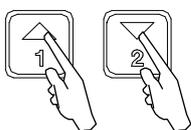


CH2 data display



Zero point adjustment value, model number display

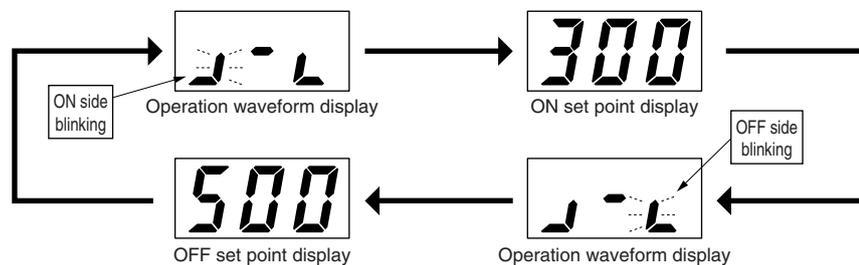
(FSM (air and nitrogen) is excluded.)



Press simultaneously

When a key is pressed while the flow is displayed, the switch data ON setting, OFF setting, operation waveform, zero adjustment, and model are displayed and confirmed.

Switch operation is not affected during the following operations:



0 point adjustment value and model number display are alternately shown.

Switch operation is not affected even during operation.

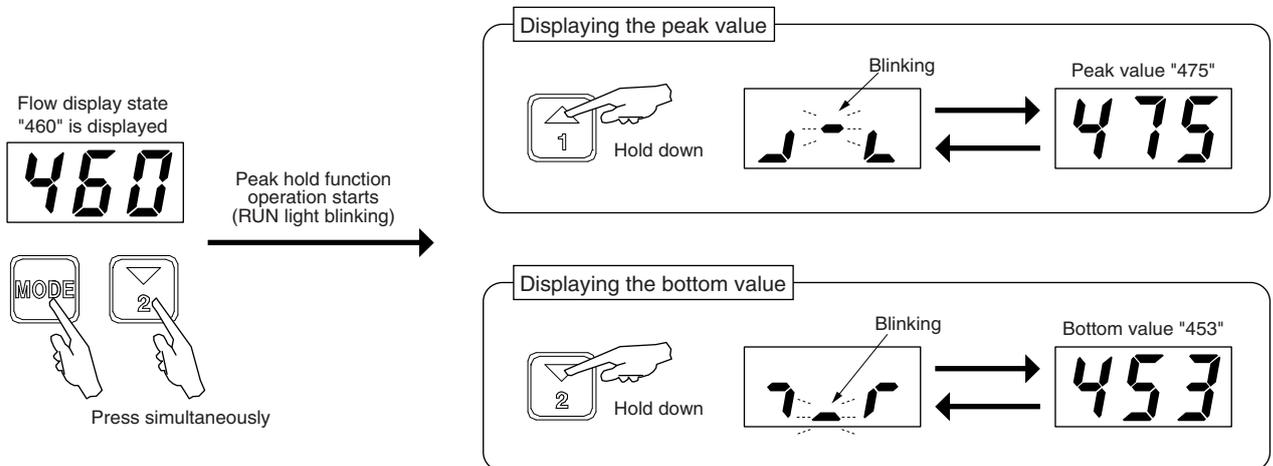


How to operate each function

Peak hold function

Maximum and minimum values for the flow rate within a set interval is displayed. Use for such as are the instantaneous flow change confirmation.

The peak hold operation does not affect this product's basic functions such as switch operations or pressure display.



Switch output function

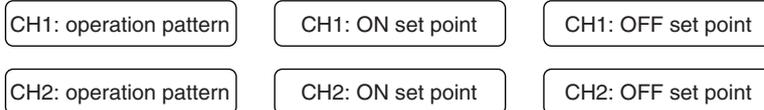
Refer to page 1339 for operation methods.

This product has 2-point switch output, and uses four operation modes and stopping.

The switch function is started by setting the required operation pattern and by setting two settings (ON and OFF) that specify the operation point.

Determine the required operation mode and on and off before setting.

Select and set the following data to operate the switch:



Forced output

Refer to page 1339 for operation methods.

Use this function to forcibly turn the switch output ON and confirm the wiring connection of initial operation of the input unit.

(Note) Use this test for operation checking of wiring and input unit.

Do not use this function instead of actual signals when executing the sequence program while the machine or device is operating.

Zero point adjustment function

Refer to page 1339 for operation methods.
(FSM [for air, nitrogen] is not equipped with the zero point adjustment function.)

Deviation of the display from zero is compensated for in the state with no flow rate.

If set incorrectly, readjust when no gas is flowing.

(Note) The above settings and testing greatly affect the output signal and display.

Be sure to stop the machine and devices using this product, and confirm that safety can be ensured even if problems or an incorrect display occurs before operating.

Using this function while the machine or device is operating could cause unforeseen problems or incorrect displays.

"Operation"

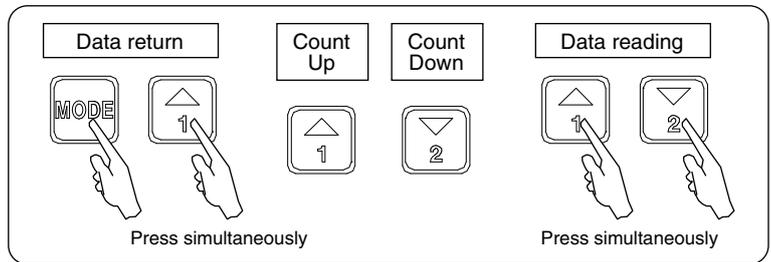
To return to the flow display during operations in any setting mode, turn power off and on. The flow display is redisplayed.

Switch output, forced output, 0 point adjustment operation

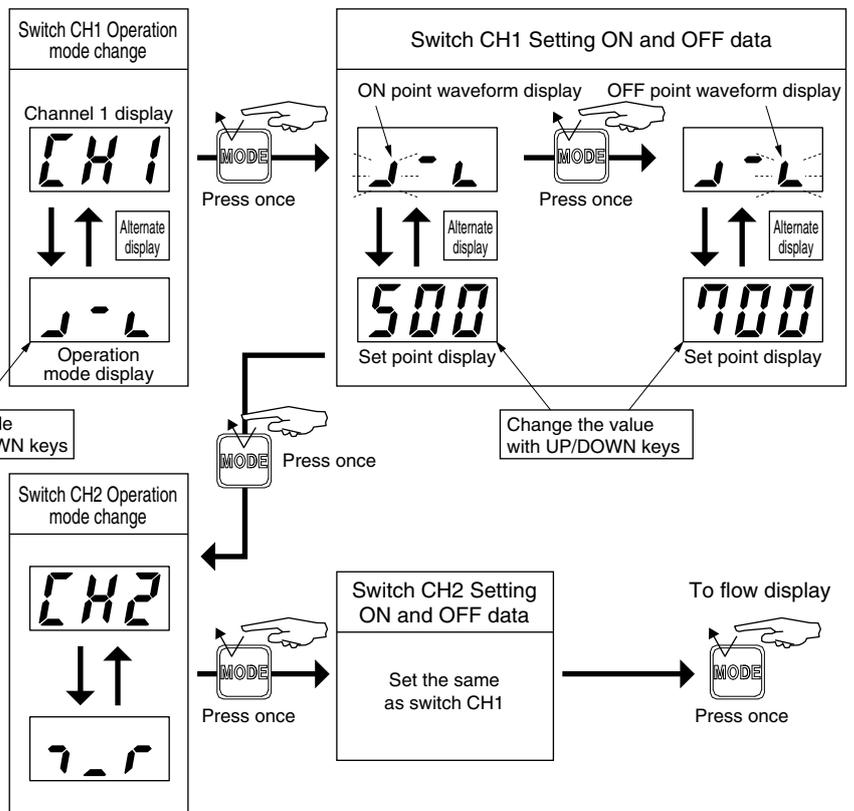
For safety, if the key is not operated for two seconds or more before the mode is set, the pressure display is redisplayed.

Basic key operation

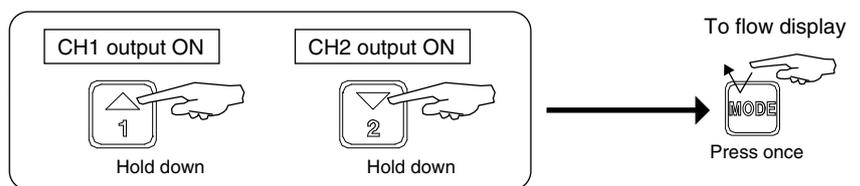
These key operations are valid in the switch operation pattern setting, ON/OFF set value setting, and zero point adjustment mode.



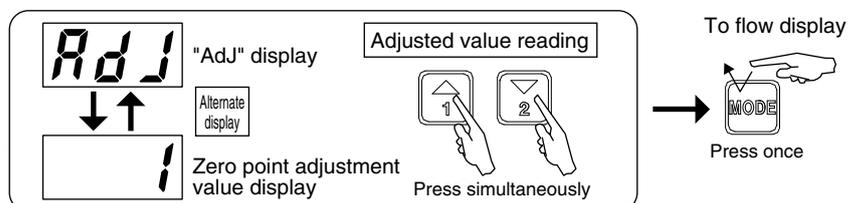
Setting data of switch output



Switch output forced ON mode



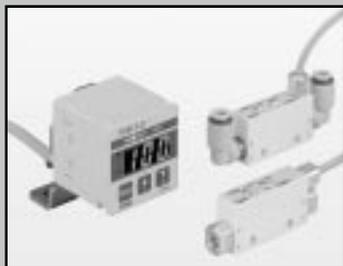
Zero point adjustment mode (FSM (air and nitrogen) is excluded.)



CAUTION Be sure no gas is flowing when adjusting zero.

- Refrigerating type dryer
- Desiccant type dryer
- High polymer membrane type dryer
- Air filter
- Auto. drain / others
- F.R.L. (Module unit)
- F.R.L. (Separate)
- Compact F.R.
- Precise regulator
- F.R.L. (Related products)
- Clean F.R.
- Electro pneumatic regulator
- Air booster
- Speed control valve
- Silencer
- Check valve / others
- Joint / tube
- Vacuum filter
- Vacuum regulator
- Suction plate
- Magnetic spring buffer
- Mechanical pressure SW
- Electronic pressure SW
- Contact / close contact cont. SW
- Air sensor
- Pressure SW for coolant
- Small flow sensor
- Small flow controller
- Flow sensor for air
- Flow sensor for water
- Total air system
- Total air system (Gamma)
- Ending

Small Flow sensor



Miniature flow sensor
Small size flow sensor
Analog output type/switch output type

FSM-V Series (air/nitrogen gas)

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



Sensor specifications

Model no.	Analog output type						Switch output type					
	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- ^{N/P} -R0005	FSM-V- ^{N/P} -R0010	FSM-V- ^{N/P} -R0050	FSM-V- ^{N/P} -R0100	FSM-V- ^{N/P} -R0500	FSM-V- ^{N/P} -R1000
Flow rate range (ℓ /min.) ^{Note 7}	-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
Ref.: Applicable nozzle for suction/ release applications	$\phi 0.1$ Nozzle		$\phi 0.2$ Nozzle	$\phi 0.3$ Nozzle	Collet Nozzle		$\phi 0.1$ Nozzle		$\phi 0.2$ Nozzle	$\phi 0.3$ Nozzle	Collet nozzle	
Working conditions	Working fluid											
	Clean air (JIS B 8392-1. 1. 1 to 5. 6. 2), compressed air (JIS B 8392-1. 1. 1 to 1. 6. 2) ^{Note 1} , nitrogen gas											
	Max. working pressure MPa											
	0.2											
	Min. working pressure MPa											
	-0.09											
Withstanding pressure MPa												
0.3												
Ambient temperature/humidity $^{\circ}\text{C}$												
0 to 50, 90%RH or less (with no dew condensation)												
Working fluid temperature $^{\circ}\text{C}$												
0 to 50												
Display			Power display (green)				Power display (green), switch output display (yellow)					
Output			Analog output 1 point ^{Note 2} (1-5V voltage output, connected load impedance 50K Ω and over)				Switch output 2 points ^{Note 3} (NPN or PNP open collector output, 30 VDC 50mA or less, PLC/rerally compatible)					
Analog output precision ^{Note 4}	Linearity											
	$\pm 5\%$ F.S. or less (0.1MPa, 25 $^{\circ}\text{C}$, Flow rate range $\pm 100\%$ F.S.)											
	Pressure characteristics											
	$\pm 5\%$ F.S. or less (-0.09 to 0.2MPa, where 0.1MPa is reference)											
Temperature characteristics												
$\pm 0.2\%$ F.S./ $^{\circ}\text{C}$ or less (15 to 35 $^{\circ}\text{C}$, where 25 $^{\circ}\text{C}$ is reference)												
Repeatability												
$\pm 1\%$ F.S. or less				$\pm 2\%$ F.S. or less				$\pm 2\%$ F.S. or less				
Responsiveness												
5ms or less (when discrete sensor is reaching 90% of ultimate output voltage) ^{Note 5}												
Power voltage												
12/24 VDC (10.8 to 26.4V)												
Current consumption												
30mA or less												
Lead wire												
$\phi 2.6$ 0.15mm 2 \times 3-conductor (3m)						$\phi 2.6$ 0.15mm 2 \times 4-conductor (3m)						
Installation ^{Note 4}	Installation attitude											
	Free											
Strait piping section												
Not required												
Protective structure												
IEC standards IP40												
Vibration resistance												
10 to 150 Hz, double amplitude 1.5 mm, maximum 10 G, two hours each in X, Y, Z directions												
EMC directive												
EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8												
Weight												
g												
Approx. 8 (excluding leads, joints)												

Note 1: Refer to the Compressed air quality classes according to JIS B 8392-1:2003 on page 1331.

Note 2: Analog output indicate 3 V when the flow is 0, and changes to the 5 V side when the lead when gas flows to the right looking at the unit with leads on the right.

Analog output changes to the 1 V side when the flow is reversed.

Note 3: The Fixed hysteresis 1 boundary value judgment type switch output is used. The Output can be set within the full flow range by turning the trimmer. OUT1 and OUT2 operation modes are opposite.

Note 4: F.S. (full scale) in these specifications indicates the flow range. For example, F.S. for flow rate -10 to +10 ℓ /min. is 20 ℓ /min..

Note 5: Response time varies depending on the piping conditions.

Note 6: 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 using compressed air, use clean air that complies to JIS B 8392-1: 2003 Class 1.1.1 to 1.6.2. Compressed air fed from a compressor contains drainage (water, oxidized oil, debris, etc.). To maintain the functions of this product, attach a filter to the primary side (upstream) of the product, an air dryer (minimum pressure dew point 10 $^{\circ}\text{C}$ or less), and an oil mist filter (maximum oil concentration 0.1mg/m 3). When using this product to confirm a pickup, always insert an air filter between the vacuum nozzle and this product.

Note 7: Converted to volumetric flow at 20 $^{\circ}\text{C}$ 1 barometric pressure (101 kPa).

Separated display specifications (analog output dedicated) Note 8

Model no.	Separate indicator					
Descriptions	FSM-V-D ^{NP} -R0005	FSM-V-D ^{NP} -R0010	FSM-V-D ^{NP} -R0050	FSM-V-D ^{NP} -R0100	FSM-V-D ^{NP} -R0500	FSM-V-D ^{NP} -R1000
Available analog output type 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	Type of display	Flow display (7-segment 3-digit, orange), run and switch output display (orange)				
	Display min. unit Note 9	0.1mL/min. Note 7	1mL/min. Note 7	0.01L/min. Note 7		0.1L/min. Note 7
Output	Switch output 2 points (NPN or PNP open collector output, 30 VDC and 50 mA or less, voltage drop of 2.4 V or less, PLC- and relay-compatible) Analog output 1 point (1-5V voltage output, connected load impedance 50KΩ and over)					
Power voltage	12/24 VDC (10.8 to 26.4V)					
Current consumption	50mA or less (only indicator)					
Lead wire	ø3.7 0.2mm ² × 5-conductor (1m)					
Functions	Flow display, flow display peak hold, switch output, analog output					
Ambient temperature/humidity	0 to 50°C, 85%RH or less (with no dew condensation)					
Protective structure	IEC standards IP40					
EMC directive	EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8					
Weight	g Approx. 70 (including lead wire 1m)					

Note 8: The separate display is dedicated to analog output type. It must not be connected to switch output.

Note 9: This indicates the minimum display for the flow, and does not guarantee display accuracy.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending

Miniature
Flow sensor

How to order

● Sensor

Model no. **FSM - V - A H 3 - R0005 - H2**

A Output type

B Lead wire direction

C Lead wire length

D Flow rate range

E Joint type

Symbol	Descriptions
A Output type	
A	Analog output
N	Switch output (NPN)
P	Switch output (PNP)
B Lead wire direction	
H	Axial
V	Radial
C Lead wire length	
3	3m
D Flow rate range	
R0005	±0.05 ℓ/min.
R0010	±0.1 ℓ/min.
R0050	±0.5 ℓ/min.
R0100	±1 ℓ/min.
R0500	±5 ℓ/min.
R1000	±10 ℓ/min.
E Joint type	
H2	Straight type ø1.8 air fiber ("D" R1000 type cannot be selected)
H4	Straight ø4 push-in
HL4	L type ø4 push-in
M5	Port size M5

● Separate indicator (analog output type dedicated)

Model no. **FSM - V - D N - R0050**

A Switch output type

B Flow rate range

Symbol	Descriptions
A Switch output type	
N	NPN output
P	PNP output
B Flow rate range	
R0005	±0.05 ℓ/min.
R0010	±0.1 ℓ/min.
R0050	±0.5 ℓ/min.
R0100	±1 ℓ/min.
R0500	±5 ℓ/min.
R1000	±10 ℓ/min.

* Refer to pages 1348 to 1355 for the operation dimensions, etc.

● Bracket for separate indicator

Model no. **PPD3 - KL-D**

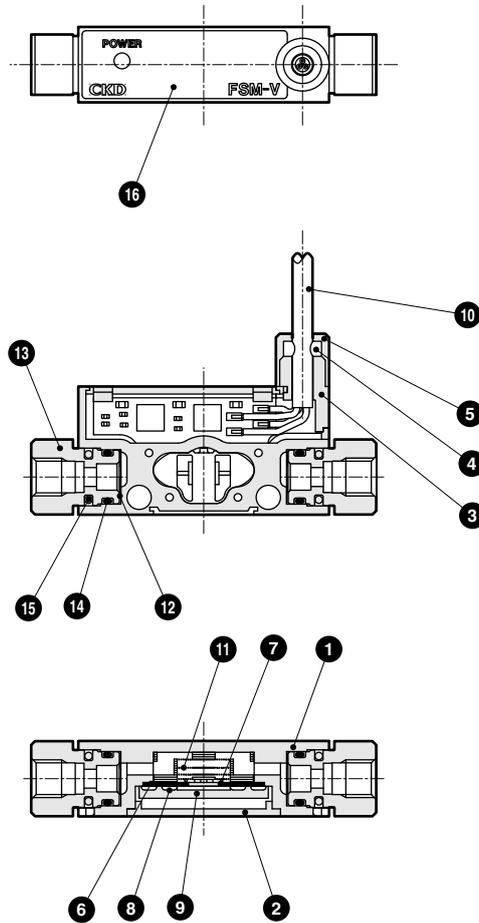
A Bracket kit

Symbol	Descriptions
A Bracket kit	
KL-D	Single foot bracket (L type)
KD-D	Both sides foot bracket (parallel)
KHS-D	Panel mount bracket set with cover
KC	Operation protective cover

* Refer to page 1348 and 1349 for dimensions and mounting size of bracket.

Internal structure and parts list

- For FSM-V-**3-R*-M5/analog output type
(The switch output type internal structure is also the same.)



No.	Parts name	Material	No.	Parts name	Material
1	Body	PBT	9	Electron circuit board	Glass epoxy resin
2	Case	PBT	10	Lead wire	Halogen-free polyethylene resin blended one
3	Lead wire holder	PBT	11	Rectifier	Stainless steel
4	Bush	Nitrile rubber	12	Filter	Stainless steel
5	Bush holder	Aluminum alloy	13	Cartridge joint (M5)	Aluminum alloy
6	Sensor gasket	Fluoro rubber	14	O ring	Nitrile rubber
7	Sensor chip	Silicone	15	Joint fixing pin	Stainless steel
8	P tight screw	Iron steel (zinc plating)	16	Front seat	Polyester film

Note 1: Appearances of a front seat section differ in an analog output type/switch output type.

- Separate indicator FSM-V-D*-R *

Refer to page 1348 for internal structure.

- Refrigerating type dryer
- Desiccant type dryer
- High polymer membrane type dryer
- Air filter
- Auto. drain / others
- F.R.L. (Module unit)
- F.R.L. (Separate)
- Compact F.R.
- Precise regulator
- F.R.L. (Related products)
- Clean F.R.
- Electro pneumatic regulator
- Air booster
- Speed control valve
- Silencer
- Check valve / others
- Joint / tube
- Vacuum filter
- Vacuum regulator
- Suction plate
- Magnetic spring buffer
- Mechanical pressure SW
- Electronic pressure SW
- Contact / close contact cont. SW
- Air sensor
- Pressure SW for coolant
- Small flow sensor
- Small flow controller
- Flow sensor for air
- Flow sensor for water
- Total air system
- Total air system (Gamma)

Ending

Miniature Flow sensor

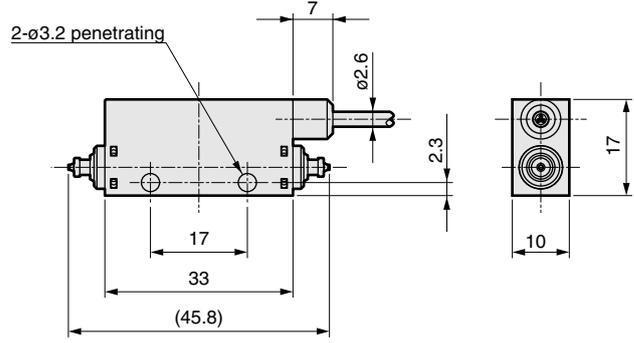
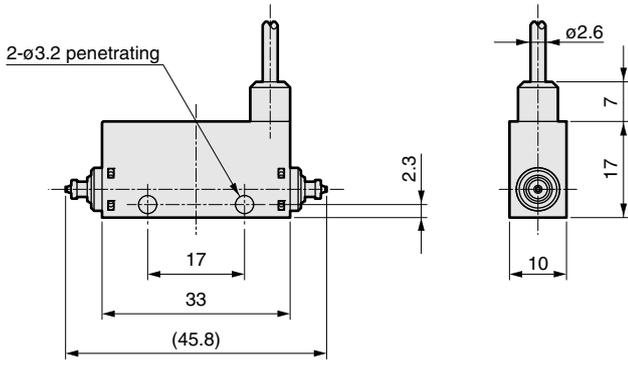
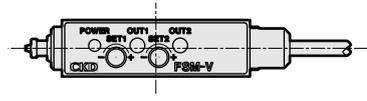
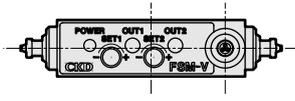


Dimensions (analog output type, switch output type common)

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)
Ending

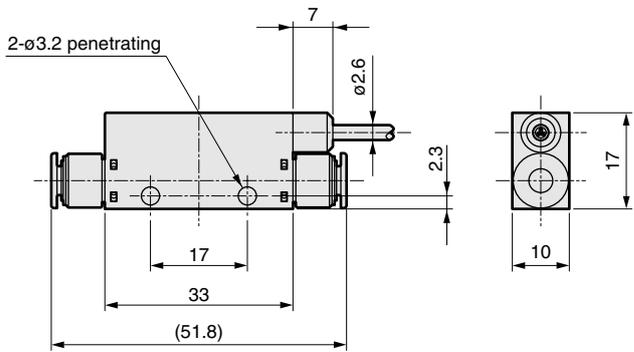
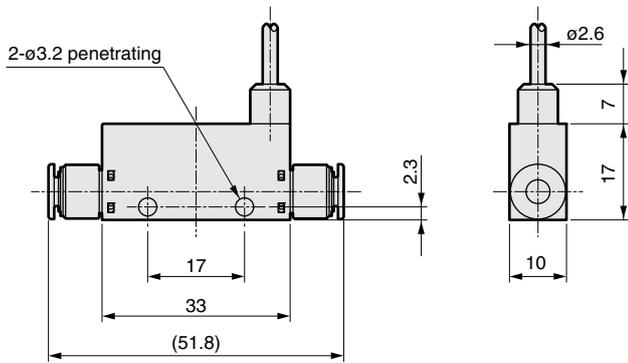
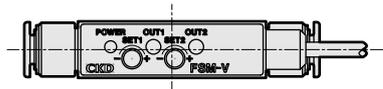
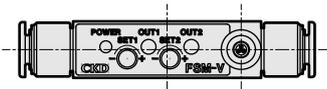
- FSM-V-*V3-R*-H2
(Radial lead wire, straight $\phi 1.8$ fiber tube)

- 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)

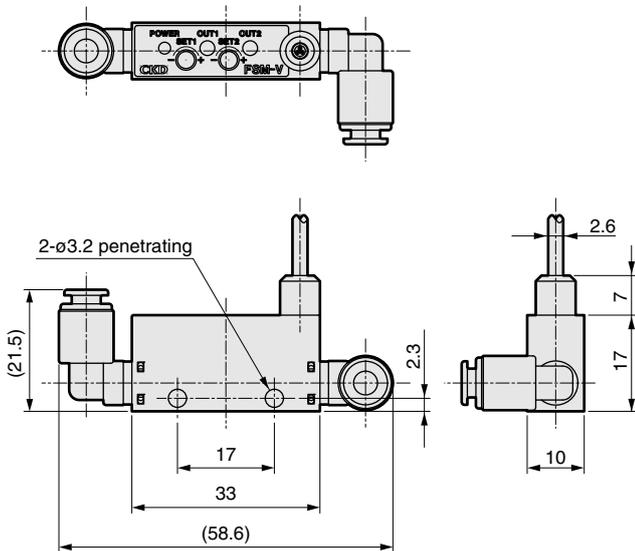


* Appearances of a front seat section differ in an analog output type/switch output type.

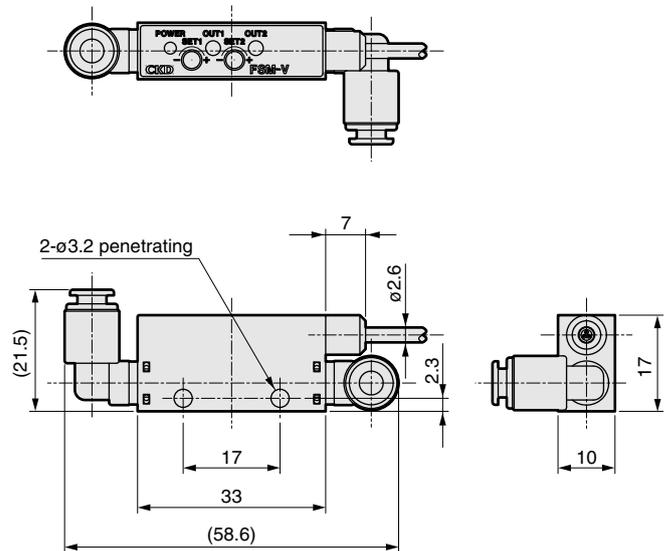
Dimensions



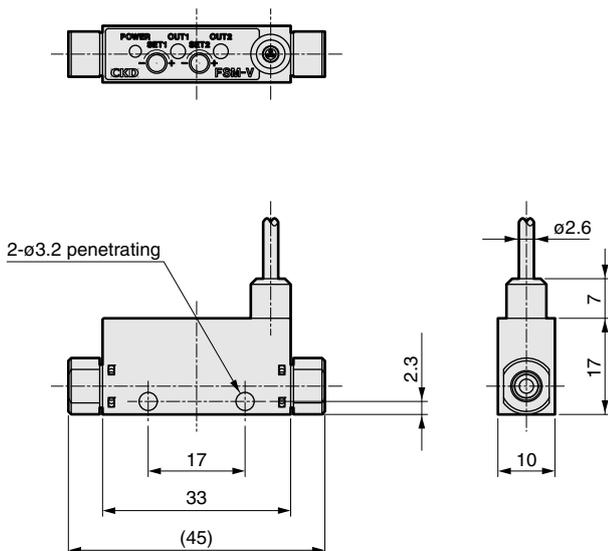
- FSM-V-*V3-R*-HL4
(Radial lead wire, L type $\phi 4$ push-in)



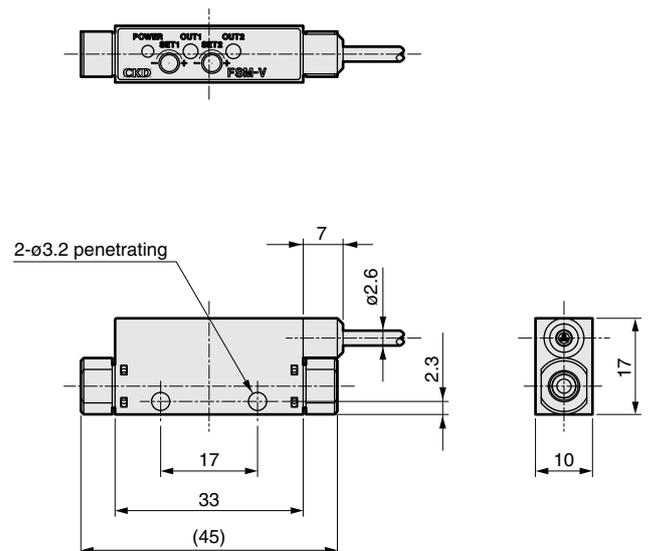
- FSM-V-*H3-R*-HL4
(Axial lead wire, L type $\phi 4$ push-in)



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



- FSM-V-*H3-R*-M5
(Axial lead wire, port size M5)



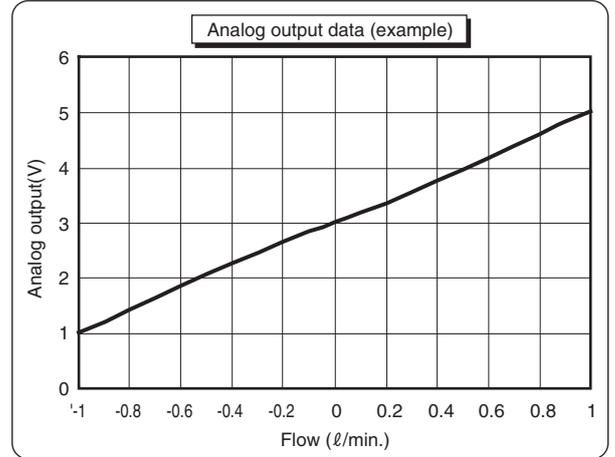
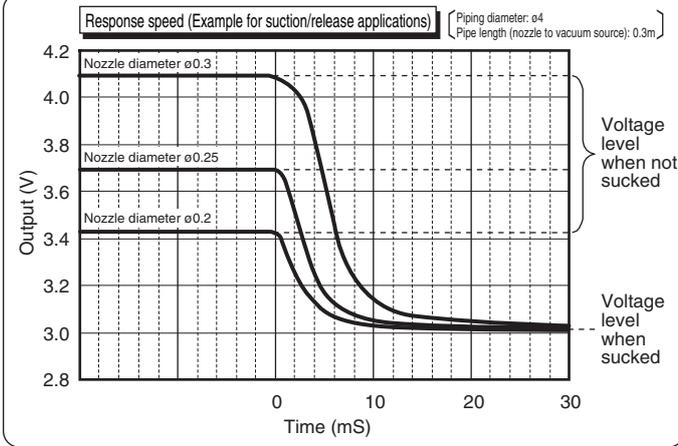
* Appearances of a front seat section differ in an analog output type/switch output type.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)
Ending

Miniature Flow sensor

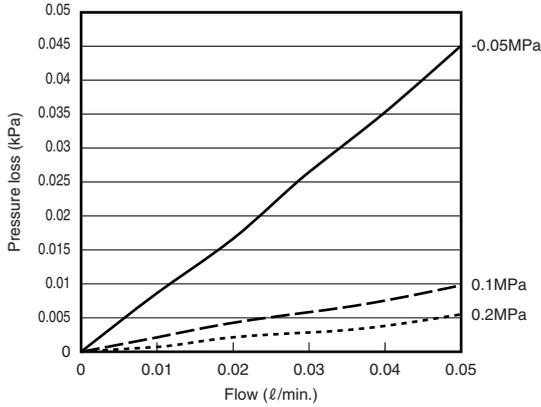
Analog output characteristics

● FSM-V-A-R0100

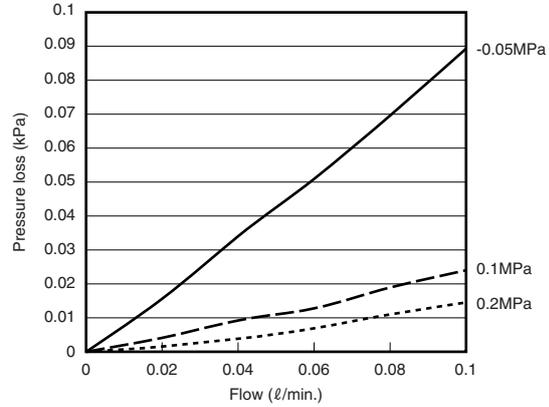


Pressure loss characteristics

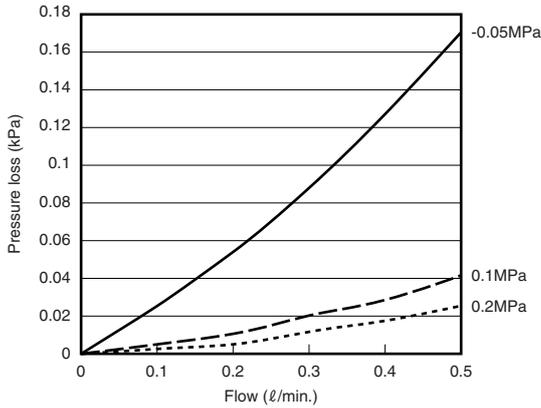
● FSM-V-*-R0005-H4



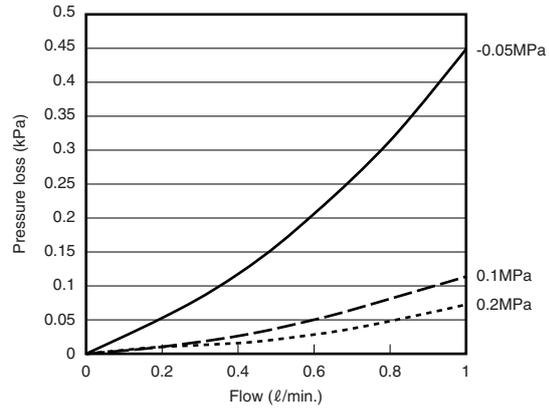
● FSM-V-*-R0010-H4



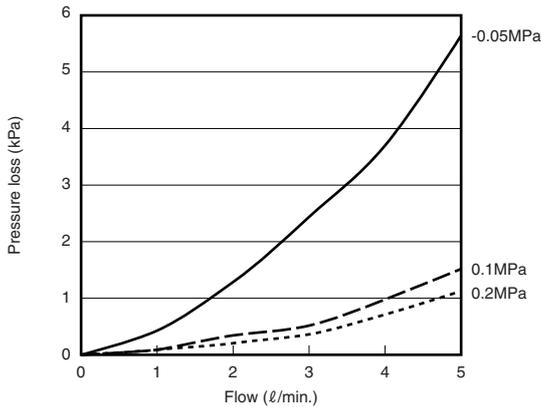
● FSM-V-*-R0050-H4



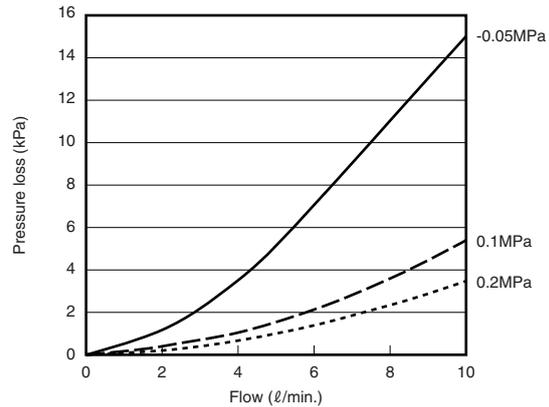
● FSM-V-*-R0100-H4



● FSM-V-*-R0500-H4



● FSM-V-*-R1000-H4

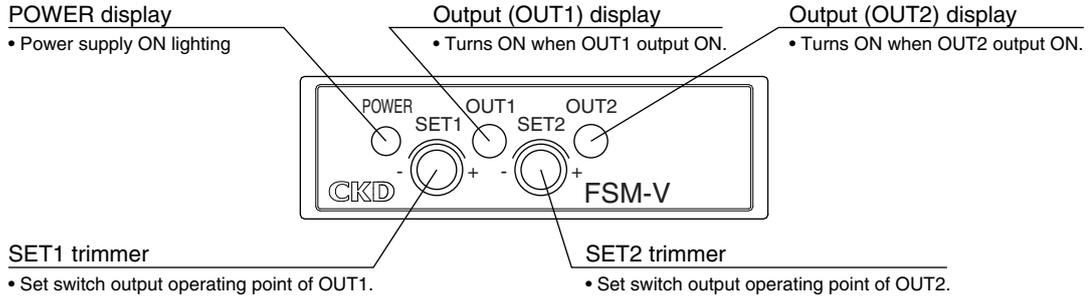


* When using the fiber tube, the pressure loss may increase depending on the piping conditions.

- Refrigerating type dryer
- Desiccant type dryer
- High polymer membrane type dryer
- Air filter
- Auto. drain / others
- F.R.L. (Module unit)
- F.R.L. (Separate)
- Compact F.R.
- Precise regulator
- F.R.L. (Related products)
- Clean F.R.
- Electro pneumatic regulator
- Air booster
- Speed control valve
- Silencer
- Check valve / others
- Joint / tube
- Vacuum filter
- Vacuum regulator
- Suction plate
- Magnetic spring buffer
- Mechanical pressure SW
- Electronic pressure SW
- Contact / close contact cont. SW
- Air sensor
- Pressure SW for coolant
- Small flow sensor
- Small flow controller
- Flow sensor for air
- Flow sensor for water
- Total air system
- Total air system (Gamma)
- Ending

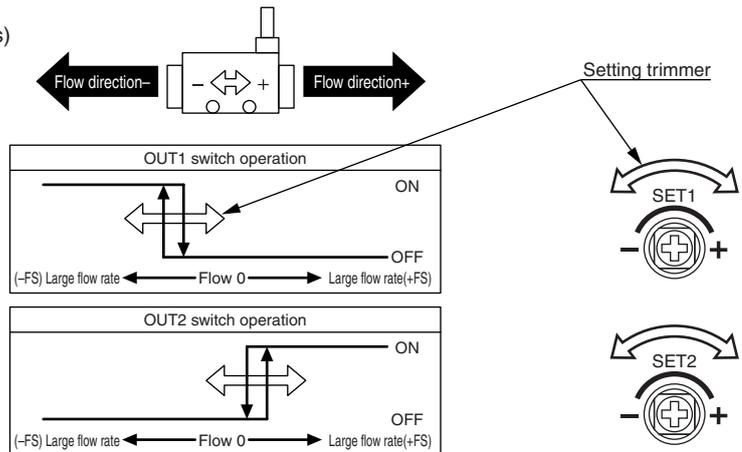
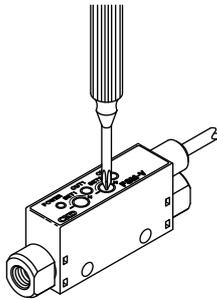
Operation section names / Functions and setting

● Switch output type



How to set switch (switch operation and fluid flow directions)

- Turn SET1 and SET2 trimmers to turn the two switch output points (OUT1 and OUT2) on or off. 2-point output has different switch operations as shown at right.
- Use 0 bit (+) driver.



(Cautions) • Switch output hysteresis is fixed (10%F.S. or less).

- Do not press the trimmer forcibly with a screwdriver. The trimmer could break.

● Separate indicator

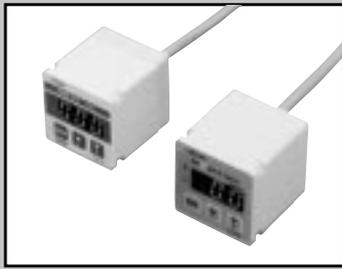
Refer to page 1352 for details on the separated display's display and operation section names, functions, and operation.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending

Miniature Flow sensor

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)
Ending



Separate indicator

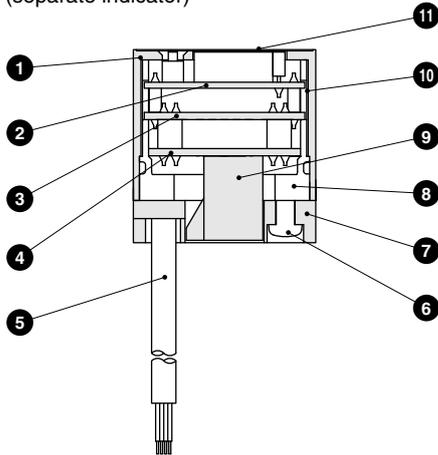
FSM-H-D* Series (FSM-H)

FSM-V-D* Series (FSM-V)



Internal structure and parts list

- FSM-H-D*-*
- FSM-V-D*-* (separate indicator)

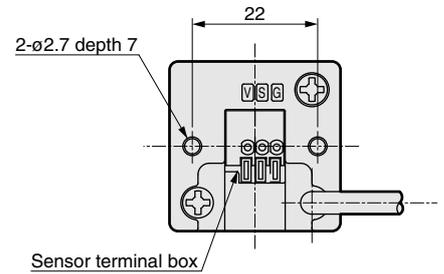
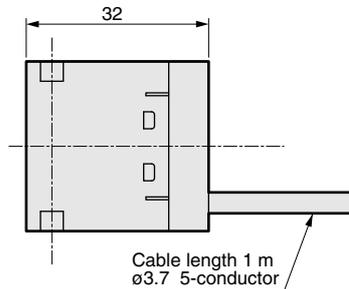
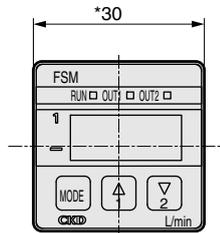


No.	Parts name	Material
1	Case top	PBT
2	Display circuit board	Glass epoxy resin
3	CPU circuit board	Glass epoxy resin
4	Sensor circuit board	Glass epoxy resin
5	Lead wire (1m)	Polyvinyl chloride
6	Screw	Brass/nickeling
7	Rear side guard	PBT
8	Inner case	PBT
9	Terminal box	Polyamide/copper alloy (plating)
10	Shield seat	Aluminum
11	Surface seat	Polyester film

Dimensions

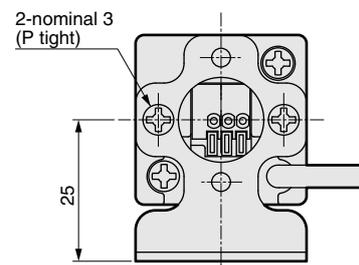
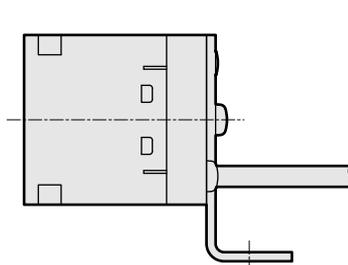
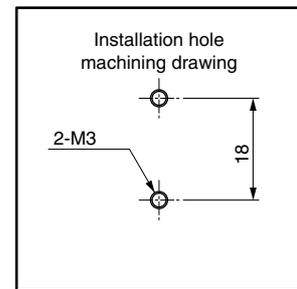
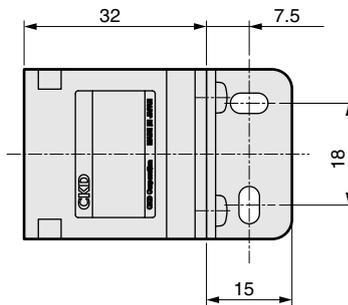


- FSM-H-D*-*
- FSM-V-D*-*



Bracket Dimensions

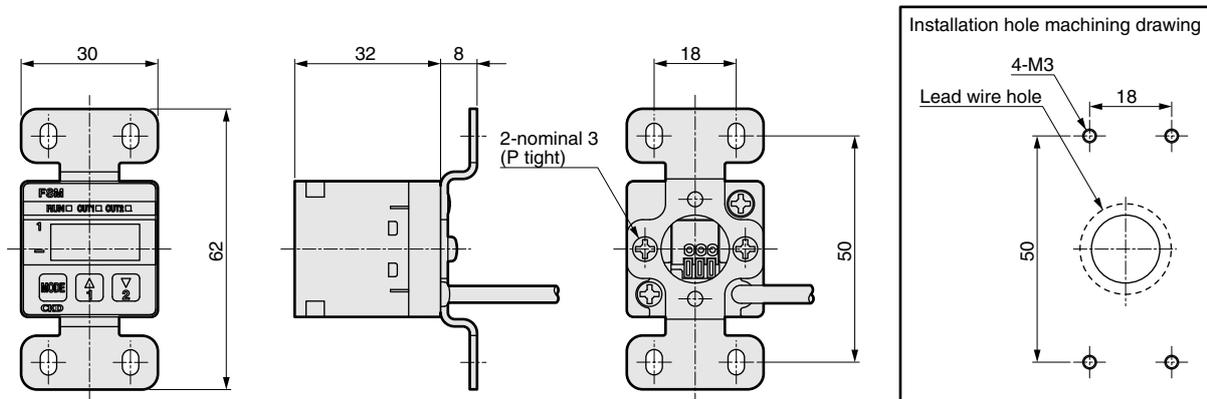
- With single foot bracket (PPD3-KL-D)
- * L type bracket, set screw 2 pieces



This installation bracket can be placed at 90° increments on the switch. Determine the installation direction based on where the display is installed.

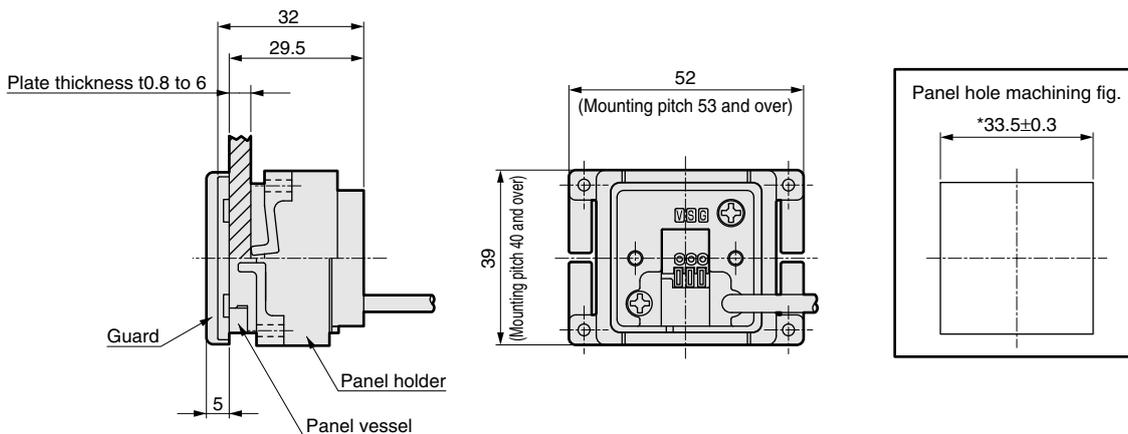
Bracket Dimensions

- With both sides foot bracket (PPD3-KD-D)
* D type bracket, set screw 2 pieces



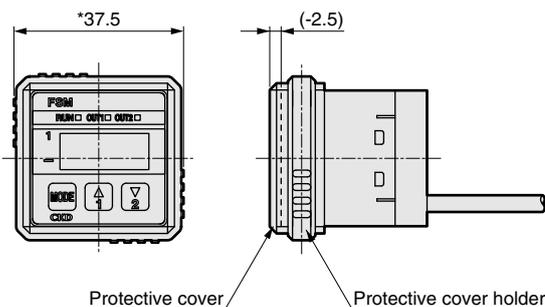
This installation bracket is installed 90° increments.
Determine the installation direction based on where the display is installed.

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



A panel holder changes 90° installation attitude.

- With operation protective cover (PPD3-KC)
* Protective cover, protective cover holder



Note: Combinations of PPD3-KHS-D can not be made.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)
Ending

Separate indicator
Flow sensor

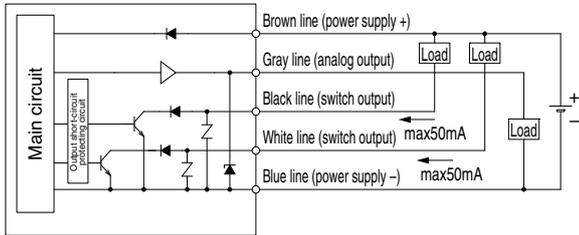
FSM-H/FSM Series common

Wiring methods

Internal circuit and examples of load connection

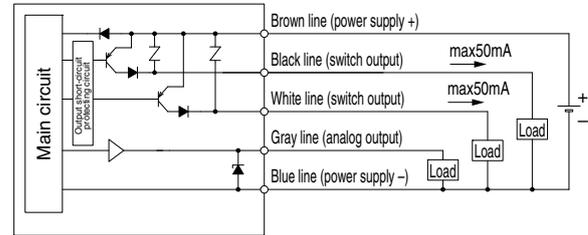
(FSM-H Series)

● FSM-H-N (indicator type NPN output)



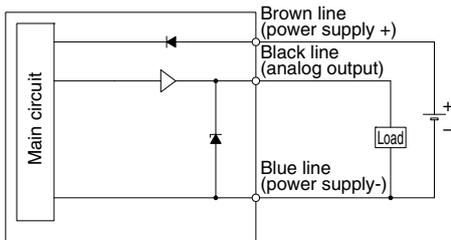
Line color	Descriptions
Brown	Power supply 12 to 24 VDC
Blue	0V (GND)
Gray	Analog output (1 to 5V)
Black	OUT1 (max50mA)
white	OUT2 (max50mA)

● FSM-H-P (indicator type PNP output)



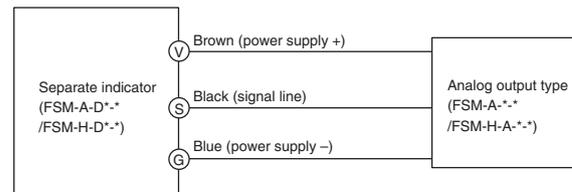
Line color	Descriptions
Brown	Power supply 12 to 24 VDC
Blue	0V (GND)
Gray	Analog output (1 to 5V)
Black	OUT1 (max50mA)
white	OUT2 (max50mA)

● FSM-H-A (analog output type)



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

● Connection methods of analog output type and separate indicator

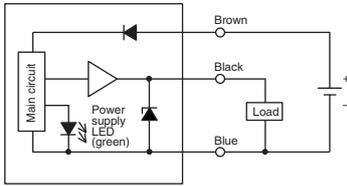


Note: When using a metal body (stainless steel body, aluminum body) type, connect the F.G. of the device connected to the plus or minus side of the power supply to the body. Do not conduct withstand voltage testing or insulation resistance testing when the F.G. is connected. These tests could cause damage or burning.

Internal circuit and examples of load connection

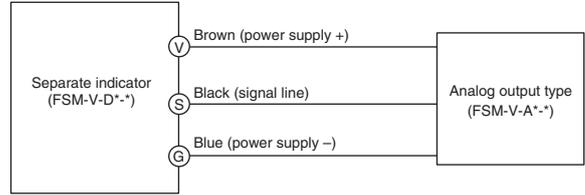
(FSM-V Series)

● FSM-V-A* (analog output type)



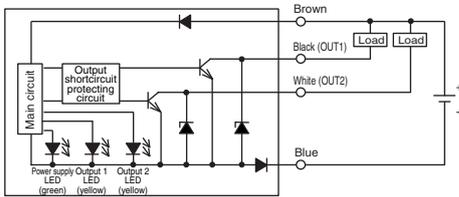
Line color	Descriptions
Brown	Power supply 12 to 24 VDC
Blue	0V (GND)
Black	Analog output (1 to 5V)

● Connection methods of analog output type and separate indicator



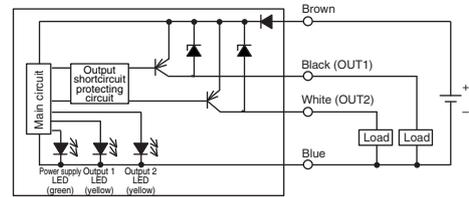
Note: Note: Switch output cannot be used with the separated display.

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



Line color	Descriptions
Brown	Power supply 12 to 24 VDC
Blue	0V (GND)
Black	OUT1 (max50mA)
white	OUT2 (max50mA)

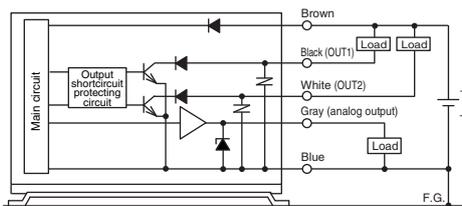
● FSM-V-P* (switch output type PNP output)



Line color	Descriptions
Brown	Power supply 12 to 24 VDC
Blue	0V (GND)
Black	OUT1 (max50mA)
white	OUT2 (max50mA)

(Separate indicator)

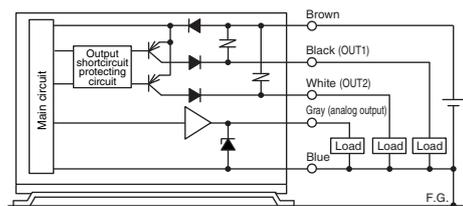
● FSM-*-DN* (separate indicator NPN output)



Line color	Descriptions
Brown	Power supply 12 to 24 VDC
Blue	0V (GND)
Gray	Analog output (1 to 5V)
Black	OUT1 (max50mA)
white	OUT2 (max50mA)

• To cancel short-circuit protection, turn power off once, correct wiring mistakes, etc., then turn power on again.

● FSM-*-DP* (separate indicator PNP output)



Line color	Descriptions
Brown	Power supply 12 to 24 VDC
Blue	0V (GND)
Gray	Analog output (1 to 5V)
Black	OUT1 (max50mA)
white	OUT2 (max50mA)

• To cancel short-circuit protection, turn power off once, correct wiring mistakes, etc., then turn power on again.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

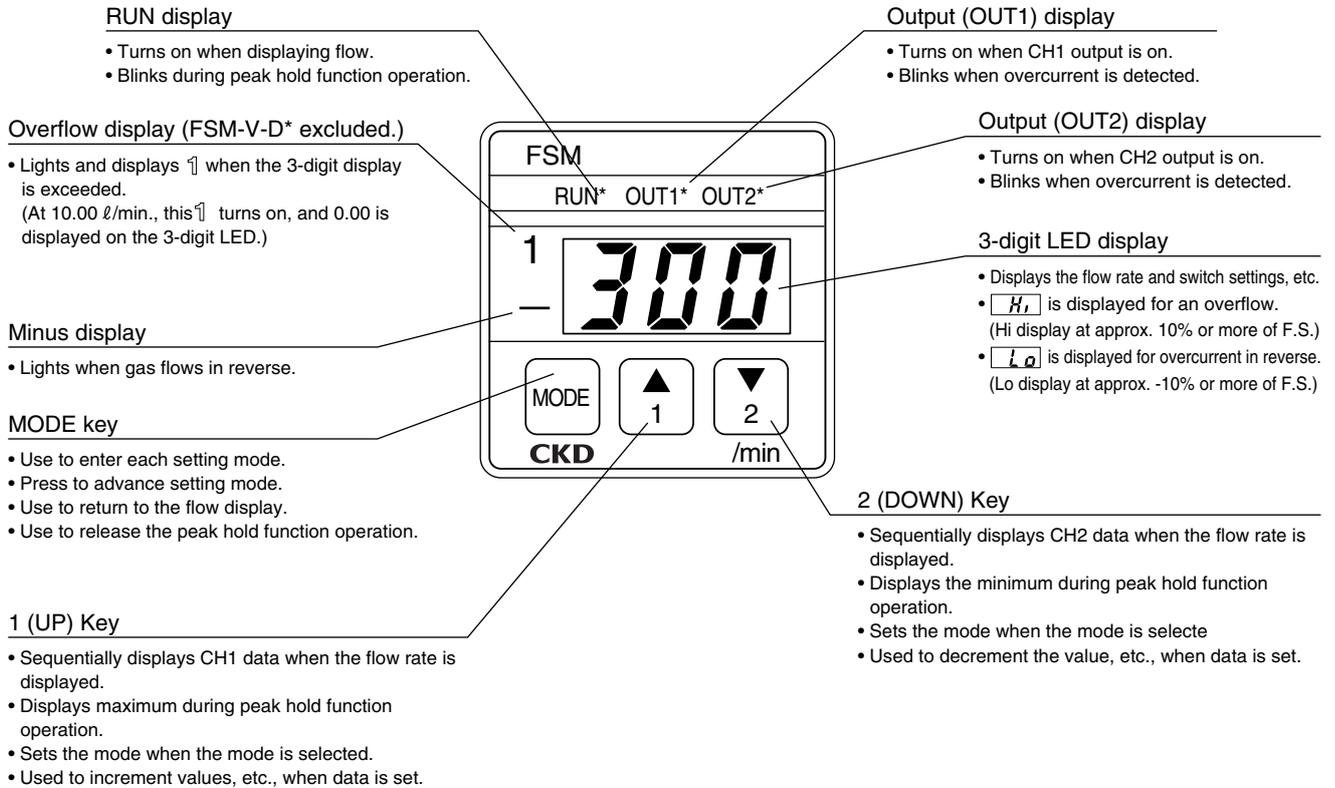
Ending

Small Flow sensor

FSM-H/FSM-V Series common

Names and functions of display and operation section

● Separate indicator type(FSM-H-D/FSM-V-D common)



* The design of the front sheet differs for the FSM-H Series, but display and operation section names and functions are the same.

Operation

Switch output function

Switch operation mode

Operation pattern name	LED display	Operation waveform
Window operation 1 (ON within specified range)		
Window operation 2 (ON out of specified range)		
Hysteresis operation 1 (Flow small side ON)		
Hysteresis operation 2 (Flow large side ON) (Note 6)		
Switch output OFF		

Note 1. When used for a winding operation, leave an interval of 3% F.S. or more between the two settings. 1% F.S. hysteresis is automatically added to the ON side and OFF side.

Note 2. When used for hysteresis operation, leave an interval of 1% F.S. or more between the two settings. If there is no difference between the two settings, operation may not take place or may be unstable.

Note 3. If switches are operated when flow is not stable, such as pulsating, operation may be unstable. In this case, provide sufficient margin between the two setting values. Confirm that switch operation is stable before use.

Note 4. The left side of the operation waveform indicates negative pressure, and the right side indicates positive pressure.

Note 5. The magnitude relationship of the ON and OFF settings is determined when the waveform is set, and a reverse magnitude relationship cannot be attained. With this product, however, operation of the designated operation pattern is the priority. When the two settings are input, the magnitude relationship is automatically determined, and each is judged and processed at the appropriate ON and OFF settings. In other words, even if ON and OFF settings are input reversed, input is recognized correctly as ON and OFF and operation occurs with the designated operation mode.

Note 6. The output is held even during the Hi display.

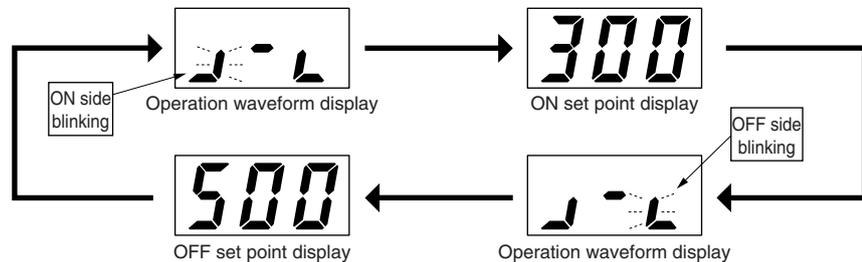
Set point confirmation method

CH1 data display

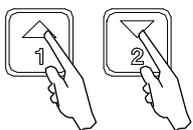


When a key is pressed while the flow is displayed, the switch data ON setting, OFF setting, operation waveform, zero adjustment, and model are displayed and confirmed. Switch operation is not affected during the following operations:

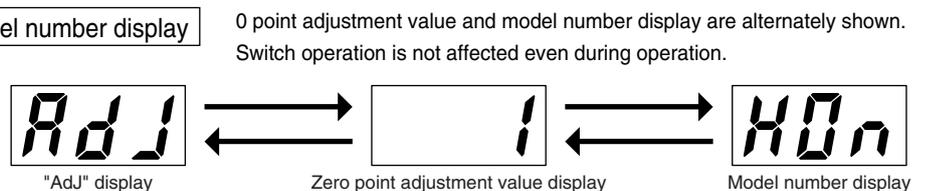
CH2 data display



Zero point adjustment value, model number display



Press simultaneously



Refrigerating type dryer

Desiccant type dryer

High polymer membrane type dryer

Air filter

Auto. drain / others

F.R.L. (Module unit)

F.R.L. (Separate)

Compact F.R.

Precise regulator

F.R.L. (Related products)

Clean F.R.

Electro pneumatic regulator

Air booster

Speed control valve

Silencer

Check valve / others

Joint / tube

Vacuum filter

Vacuum regulator

Suction plate

Magnetic spring buffer

Mechanical pressure SW

Electronic pressure SW

Contact / close contact cont. SW

Air sensor

Pressure SW for coolant

Small flow sensor

Small flow controller

Flow sensor for air

Flow sensor for water

Total air system

Total air system (Gamma)

Ending

Small Flow sensor

FSM-H/FSM-V Series common

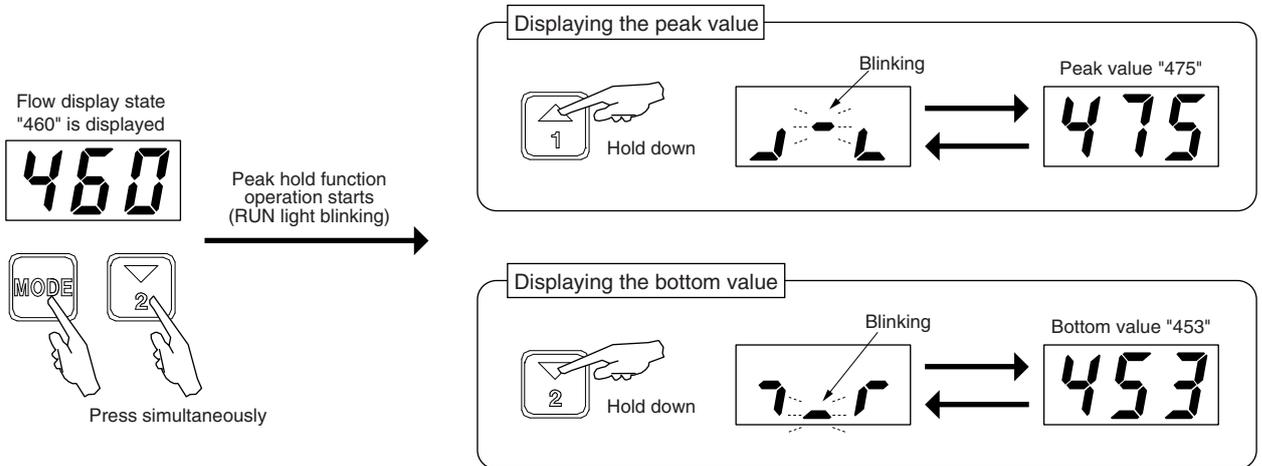
How to operate each function

Peak hold function

Maximum and minimum values for the flow rate within a set interval is displayed.

Use for such as are the instantaneous flow change confirmation.

The peak hold operation does not affect this product's basic functions such as switch operations or pressure display.



Switch output function

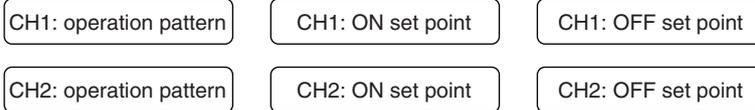
Refer to page 1355 for operation methods.

This product has 2-point switch output, and uses four operation modes and stopping.

The switch function is started by setting the required operation pattern and by setting two settings (ON and OFF) that specify the operation point.

Determine the required operation mode and on and off before setting.

Select and set the following data to operate the switch:



Forced output

Refer to page 1355 for operation methods.

Use this function to forcibly turn the switch output ON and confirm the wiring connection of initial operation of the input unit.

(Note) Use this test for operation checking of wiring and input unit.

Do not use this function instead of actual signals when executing the sequence program while the machine or device is operating.

Zero point adjustment function

Refer to page 1355 for operation methods.

Deviation of the display from zero is compensated for in the state with no flow rate.

If set incorrectly, readjust when no gas is flowing.

(Note) The above settings and testing greatly affect the output signal and display.

Be sure to stop the machine and devices using this product, and confirm that safety can be ensured even if problems or an incorrect display occurs before operating.

Using this function while the machine or device is operating could cause unforeseen problems or incorrect displays.

"Operation"

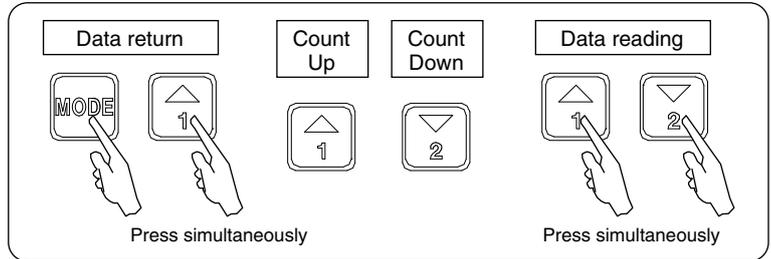
To return to the flow display during operations in any setting mode, turn power off and on. The flow display is redisplayed.

Switch output, forced output, 0 point adjustment operation

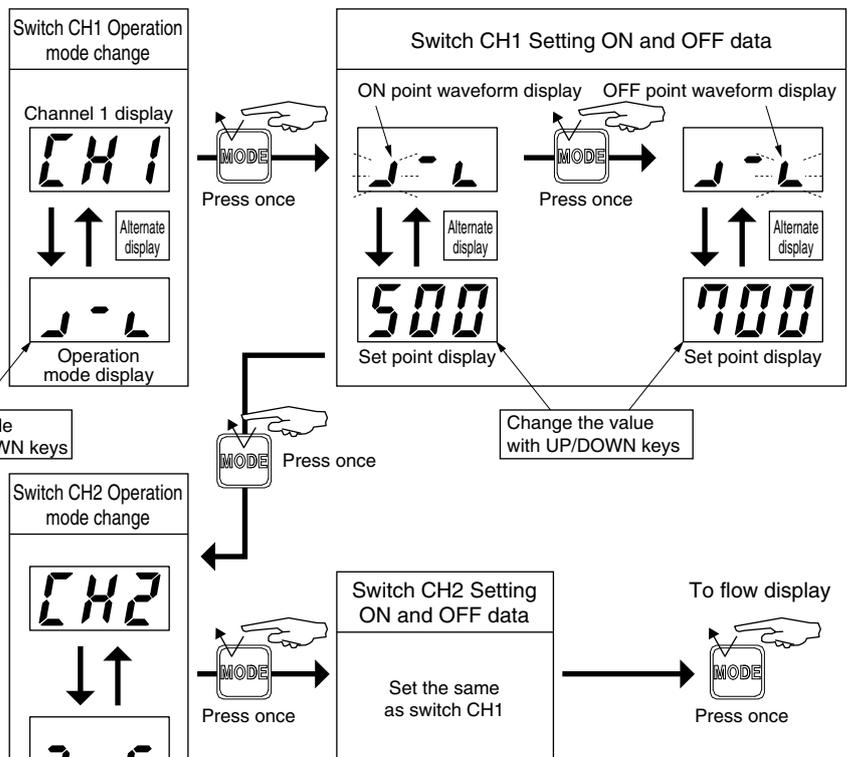
For safety, if the key is not operated for two seconds or more before the mode is set, the pressure display is redisplayed.

Basic key operation

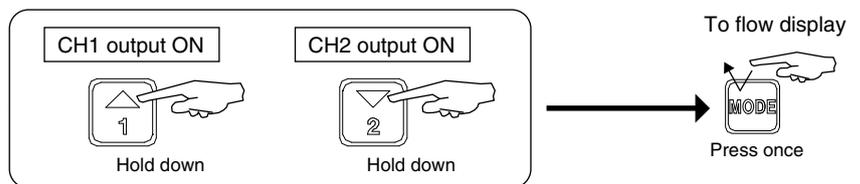
These key operations are valid in the switch operation pattern setting, ON/OFF set value setting, and zero point adjustment mode.



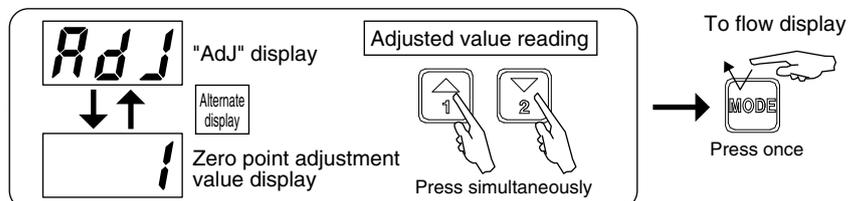
Setting data of switch output



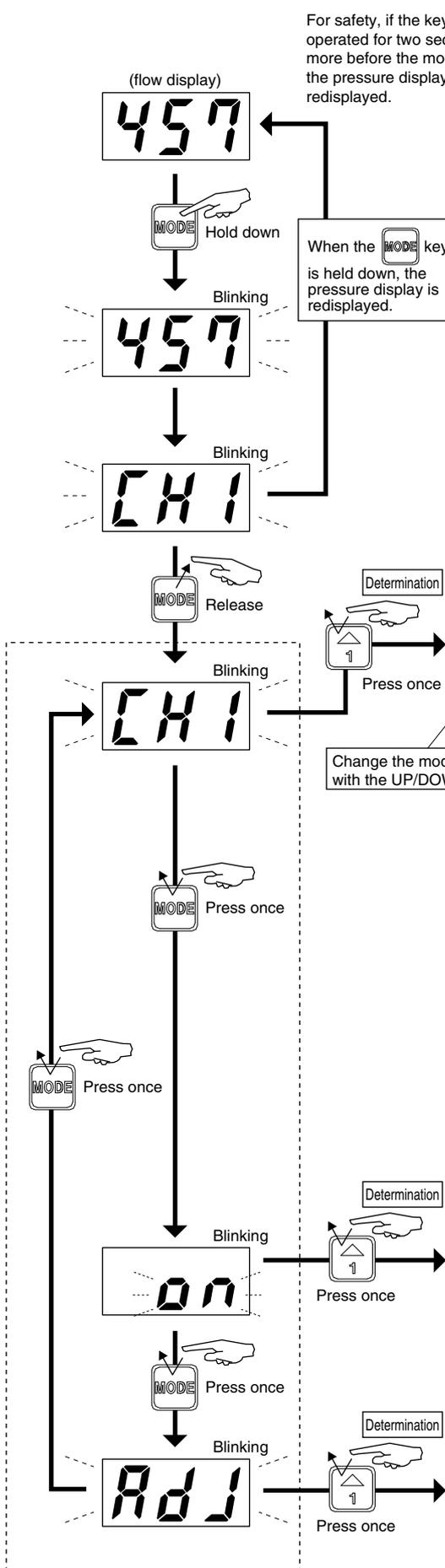
Switch output forced ON mode



Zero point adjustment mode



CAUTION Be sure no gas is flowing when adjusting zero.



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- Compact F.R.
- Precise regulator
- F.R.L. (Related products)
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- Silencer
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- Vacuum regulator
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- Mechanical pressure SW
- Electronic pressure SW
- Contact / close contact cont. SW
- Air sensor
- Pressure SW for coolant
- Small flow sensor
- Small flow controller
- Flow sensor for air
- Flow sensor for water
- Total air system
- Total air system (Gamma)
- Ending

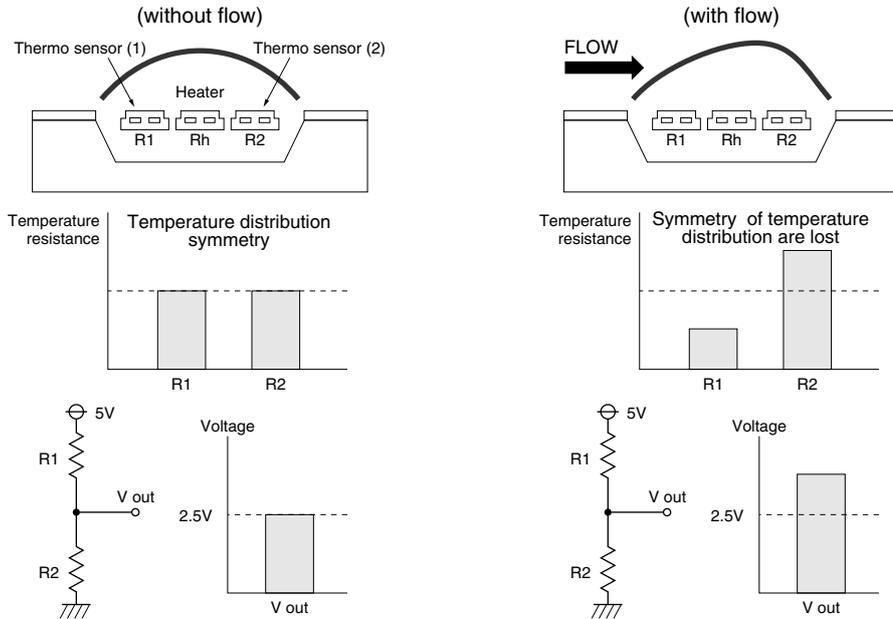
Small Flow sensor

FSM-H/FSM-V Series common

FSM-H, FSM-V Series Measurement Principle

FSM-H, FSM (argon and carbon dioxide) FSM-V Series incorporates a platinum sensor chip (3 mm x 3.5 mm) machined with silicon micro-machining. The sensor is thermally insulated from the silicon substrate. The heating capacity is extremely low, enabling high sensitivity with a high-speed response.

At the sensor, two temperature sensors are arranged with a heater in between. Platinum, which has a resistance that changes based on temperature, is used for the temperature sensor. When the heater is turned on and heated, the temperature distribution is symmetrical to the center of the heater if there is no flow. When flow is received, the symmetrical property of temperature distribution is lost, and temperature upstream from the heater drops, and that downstream rises. This temperature difference appears as the difference in temperature sensor resistance, and varies with the flow rate. If flow is reversed, the temperature difference (resistance value difference) is reversed. A bidirectional flow is thus detected. This is suitable for detecting relatively small flows.



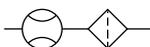
Refrigerating type dryer
Desiccant type dryer
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Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)
Ending

Custom

The following parts are available as custom order parts. Contact your CKD Sales representative for details.

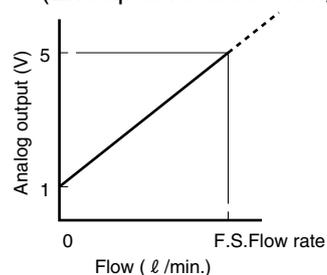
Type with filter

- Optimum filter for suction confirmation.
- Compatible with FSM-V Series



FSM-V One way detection type

- The standard uses bi-directional detection, but unidirectional detection is also possible.
(Example: Flow rate range ± 10 l/min. \rightarrow 0 to 10 l/min.)



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F.R.L. (Related products)
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Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending

Small Flow sensor

FSM all series common

1 How to select flow sensor

Use this as a guide to selecting the flow range when using a flow sensor to confirm suction and release with a suction nozzle or for leakage tests, etc.

The flow is calculated by the effective nozzle (pin hole) sectional area, and the pressure difference inside and outside the nozzle.

- When $P_1 \geq 1.89P_2$ (sonic)

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

- When $P_1 < 1.89P_2$ (subsonic)

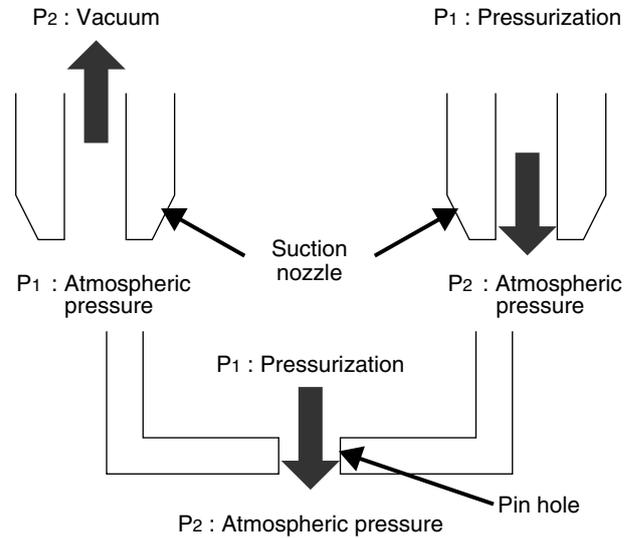
$$Q = 226.4 \times S \times \sqrt{P_2 (P_1 - P_2)}$$

Q : Flow rate ℓ/min.

P₁ : Primary absolute pressure MPa

P₂ : Secondary absolute pressure MPa

S : Effective sectional area of nozzle (pin hole) mm²



Example of calculation

The following table gives the flow calculation values when using ø0.1 to 2 nozzle diameter and variable P₂.

	P ₁ (MPa) Absolute pressure	P ₁ (MPa) Gauge pressure	P ₂ (MPa) Absolute pressure	P ₂ (MPa) Gauge pressure	Sonic/ subsonic	Calculated flow rate value (ℓ/min.)								
						ø0.1	ø0.2	ø0.3	ø0.4	ø0.5	ø0.7	ø1	ø1.5	ø2
Suction	0.1013	0	0.0313	-0.07	Sonic	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	Sonic	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	Sonic	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	0.088	0.352	0.792	1.408	2.200	4.312	8.800	17.249	35.202
	0.1013	0	0.0713	-0.03	Subsonic	0.082	0.329	0.740	1.315	2.055	4.028	8.220	16.110	32.878
	0.1013	0	0.0813	-0.02	Subsonic	0.072	0.287	0.645	1.147	1.792	3.512	7.166	14.046	28.666
	0.1013	0	0.0913	-0.01	Subsonic	0.054	0.215	0.483	0.859	1.343	2.631	5.370	10.525	21.480
Blow (leakage inspection)	0.1113	0.01	0.1013	0	Subsonic	0.057	0.226	0.509	0.905	1.414	2.772	5.657	11.087	22.626
	0.1213	0.02	0.1013	0	Subsonic	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	0.113	0.453	1.018	1.810	2.828	5.543	11.313	22.174	45.252
	0.1613	0.06	0.1013	0	Subsonic	0.139	0.554	1.247	2.217	3.464	6.789	13.856	27.157	55.423
	0.1813	0.08	0.1013	0	Subsonic	0.160	0.640	1.440	2.560	4.000	7.840	15.999	31.358	63.996
	0.2013	0.1	0.1013	0	Sonic	0.179	0.716	1.610	2.862	4.472	8.765	17.888	40.248	71.552
	0.3013	0.2	0.1013	0	Sonic	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	Sonic	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	Sonic	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	Sonic	0.534	2.137	4.809	8.549	13.358	26.182	53.433	120.224	213.731	

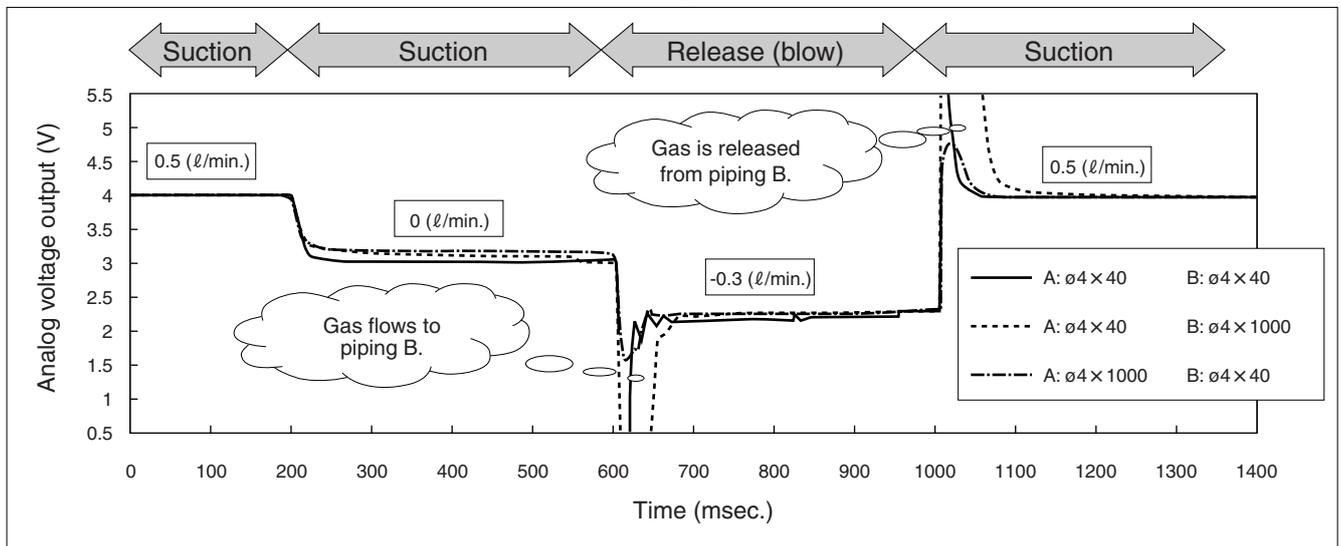
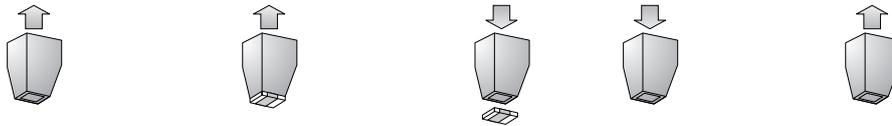
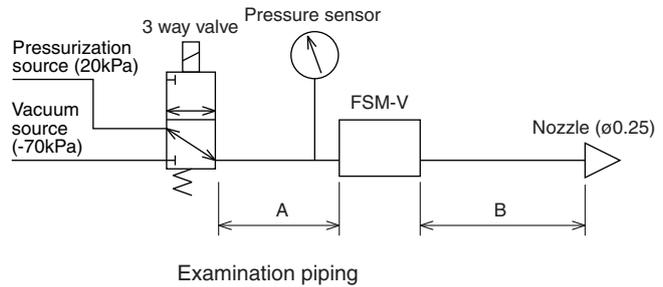
(CAUTION)

- If there is leakage in piping, etc., the actual flow exceeds the calculated flow. Take pipe leakage into account when selecting the flow.
- If a piping section is thinner in diameter than the suction nozzle, the flow is restricted, and may be less than the calculated value. It may also not be possible to check suction, etc.
- The effective sectional area is a guideline. If the nozzle is long and thin, the effective sectional area is smaller than the nozzle opening.
- Response speed is determined by piping volume between the flow sensor and suction nozzle (pin hole). During high-speed detection, set the flow sensor near the suction nozzle, or reduce the volume when possible.

Suction confirmation

1 Response time

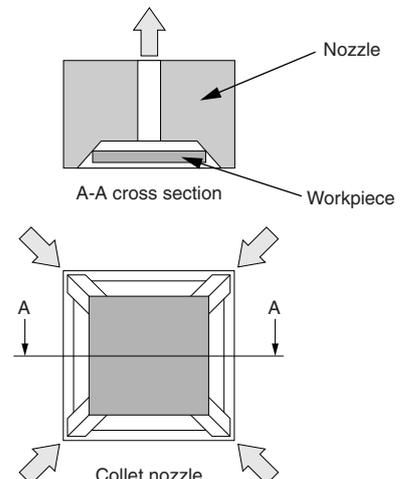
Response time during suction confirmation is determined by the piping's volume and the vacuum pump's exhaust capacity, etc. When using piping as shown at right, for example, response time depends on piping as shown below. Based on this, to shorten the response time, piping volume should be made as small as possible.



Dependency of response on piping

2 Using a collet nozzle

The collet nozzle is often used when the workpiece to be picked up should not be directly seated against the nozzle. The collet nozzle is triangular, so when the workpiece is picked up, a gap is created at the four corners. This causes leakage during pickup. If the effective area of piping, including valves and joints, etc., is too small compared to the collet nozzle and workpiece gap (effective sectional area), the flow is determined by the piping's effective sectional area, and the difference in flow during suction and without suction is small. In this case, suction is accurately confirmed by keeping the effective sectional area of the piping larger than the effective sectional area of the gap between the collet nozzle and workpiece.



Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)
Ending

Small Flow sensor

FSM all series common

Leakage inspection (Note 1)

1 How to calculate leakage amount

When changing from the pressure gauge, use the following formula to calculate leakage:

$$Q = V \times \frac{\Delta P}{1.013 \times 10^5} \times \frac{60}{T}$$

Q: Leakage amount (ml/min.), ΔP : Differential pressure (Pa), V: Workpiece inner volume (ml) T: Detection time (s)

Example: When the workpiece has an inner volume of 500 ml, leakage when a 20 Pa difference in pressure occurs at 5-second detection time is:

$$Q = 500 \times \frac{20}{1.013 \times 10^5} \times \frac{60}{5} \doteq 1.18 \text{ (ml/min.)}$$

2 Percent of leakage amount of gas and liquid

Use this as a reference when inspecting leaks in a workpiece for gas by using air.

This formula is based on the Hagen Poiseuille formula, and as a condition, the pinhole must be smooth-surfaced round tubing. Pinholes caused by welding faults, etc., may not fit the logical formula.

$$\frac{Ql}{Qa} = \frac{\eta a}{\eta l} \times \frac{101.3 \times Pl}{(101.3 + Pa/2) \times Pa}$$

Qa : Air leakage (ml/s)

Ql : Liquid leakage (ml/s)

ηa : Air viscosity (Pa·s)

ηl : Liquid viscosity (Pa·s)

Pa : Air test pressure (kPa)

Pl : Liquid test pressure (kPa)

● Viscosity coefficient(Pa·s × 10⁻³)

Temperature	Air (ηa)	Water (ηl)	Brake oil (ηl)
20°C	0.0181	1.00	26
50°C	0.0195	0.55	10
70°C	0.0204	0.40	7

● Ratio of air (20°C) and gas leak rate

Liquid	ηl , Pa·s	Pneumatics Pa	Liquid pressure Pl	Ql/Qa
Water 20°C	0.001	0.4MPa	0.4MPa	0.006
Brake oil 50°C	0.01	0.4MPa	0.4MPa	0.0006
Brake oil 50°C	0.01	0.4MPa	15MPa	0.02

Example: When inspecting a workpiece with water leakage of 0.1 ml/min. (test pressure of 0.4 MPa) with air (test pressure 0.4 MPa), leakage Qa is as follows:

$$\frac{Ql}{Qa} = 0.006 \quad Qa = \frac{0.1}{0.006} \doteq 16.7 \text{ (ml/min.)}$$



FSM, FSM-V dedicated series Miniature inline filter FSM-VFM Series



Features

This is an inline filter for the small flow sensor FSM and FSM-V Series. The content volume is small so high-speed response is not obstructed when suction is confirmed.

- Miniature, space-saving body does not get in the way
- Easy-to-replace element
- Polyamide resin with outstanding chemical resistance used for the case
- Transparent case enables element contamination to be checked from outside

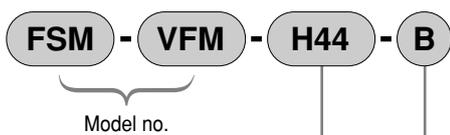
Specifications

Descriptions	FSM-VFM-H22	FSM-VFM-H44	FSM-VFM-M55
Working fluid	Clean air (JIS B 8392-1. 1. 1 to 5. 6. 2), compressed air (JIS B 8392-1. 1. 1 to 1. 6. 2) ^{Note 1}		
Applicable tube outer diameter	ø1.8 (Fiber tube)	ø4 (Push-in)	Port size M5
Withstanding pressure MPa	0.75		
Working pressure range MPa	-0.1 to 0.5		
Ambient temperature range °C	0 to 50		
Material	Case	Polyamide	
	Element	Polypropylene, polyethylene	
Filtration rating μm	10		
Product weight g	5.2	9.5	4.2
Recommended flow rate ℓ /min.	10 ^{Note 2}		

Note 1: Refer to a compressed air quality grade JIS B 8392-1: 2000 on page 1331.

Note 2: Pressure loss increases when flow exceeds 10 ℓ/min., so use at 10 ℓ/min. or less.

How to order



Symbol	Descriptions
A	Tube outer diameter
H22	ø1.8 (fiber tube)
H44	ø4 (push-in)
M55	Port size M5
B	Attached
Blank	Without bracket
B	Bracket attached

- Bracket part model no.



(Cross-headed flat tapping screw M2.5×6: 1pc.)

- Model no.



(Element: 5 pcs., joint fixing pin: 1 pc.)

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

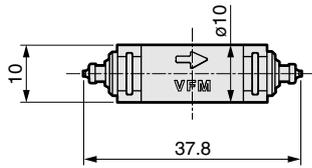
- Heat sealed into anti-static bag in clean bench (Class 1000 or more).

FSM-VFM-..... P70

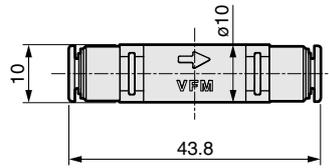
Dimensions



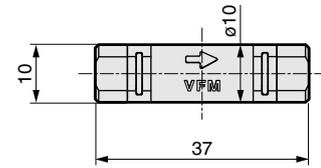
● FSM-VFM-H22



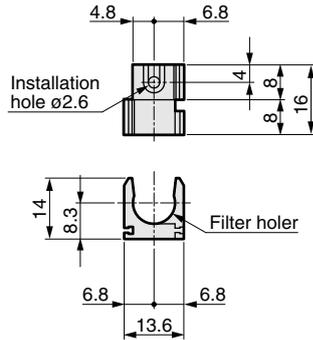
● FSM-VFM-H44



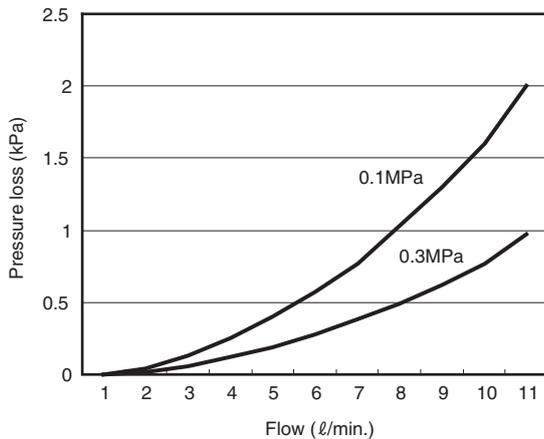
● FSM-VFM-M55



● FSM-VFM-B [Bracket]



Flow characteristics (FSM-VFM-H44)

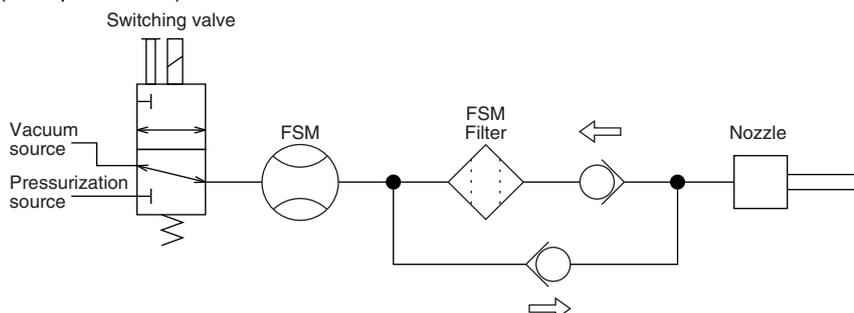


- When using fiber tubing, pressure loss may increase depending on piping conditions.

Cautions

- This filter has an orientation. When using this filter to confirm suction, etc., use a check valve to prevent the flow of dirt.

(Example of circuit)



- Refer to page 1329 for other precautions and details on replacing the element.

Refrigerating type dryer
Desiccant type dryer
High polymer membrane type dryer
Air filter
Auto. drain / others
F.R.L. (Module unit)
F.R.L. (Separate)
Compact F.R.
Precise regulator
F.R.L. (Related products)
Clean F.R.
Electro pneumatic regulator
Air booster
Speed control valve
Silencer
Check valve / others
Joint / tube
Vacuum filter
Vacuum regulator
Suction plate
Magnetic spring buffer
Mechanical pressure SW
Electronic pressure SW
Contact / close contact cont. SW
Air sensor
Pressure SW for coolant
Small flow sensor
Small flow controller
Flow sensor for air
Flow sensor for water
Total air system
Total air system (Gamma)

Ending

Small Flow sensor