CKD

High speed response and miniature size

Small flow sensor FSM series

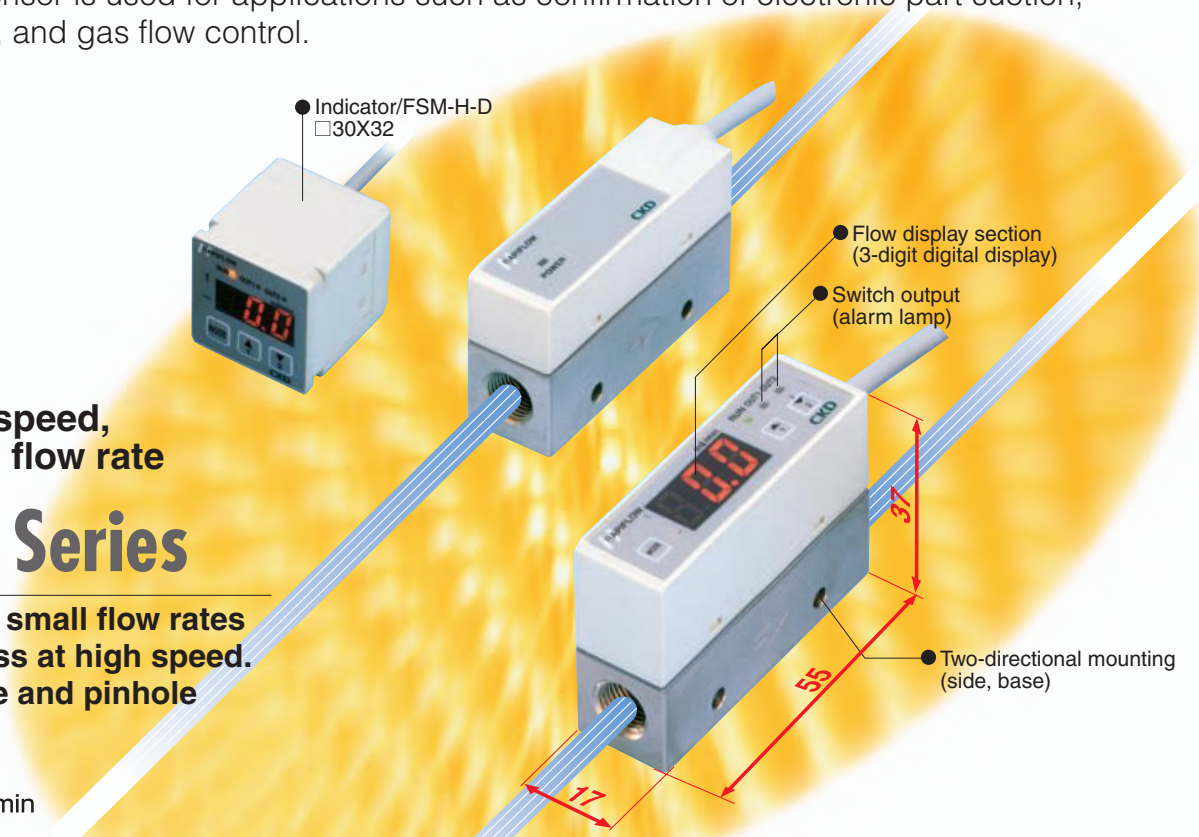
CKD Corporation

CC-687A 7

Miniature size and high-response

Three series of compact flow sensors to match different applications

Unprecedentedly compact size and high-speed response are realized using a platinum sensor chip incorporating silicon micromachining and a newly proposed rectifying mechanism.
The thermal flow sensor is used for applications such as confirmation of electronic part suction, leakage inspection, and gas flow control.



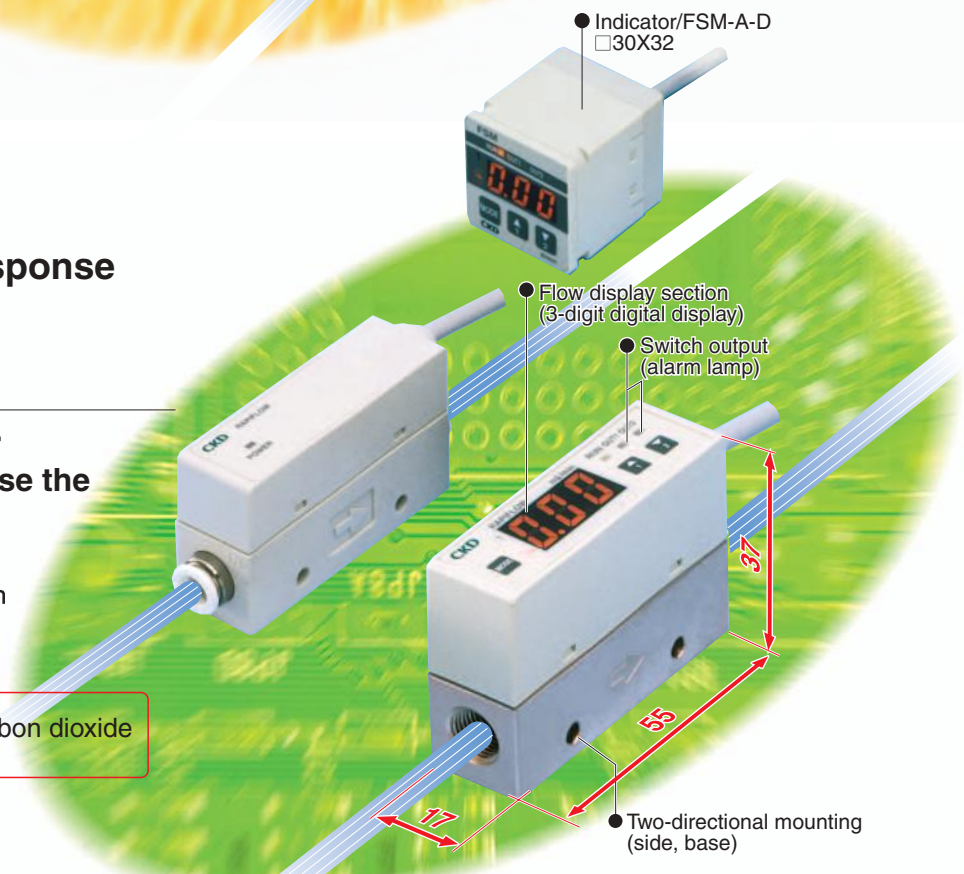
New

Compact, high-speed, extremely small flow rate

FSM-H Series

Detects extremely small flow rates of 1 mℓ/min or less at high speed. Perfect for leakage and pinhole inspections.

Flow range
5、10、50、100 mℓ/min



Compact, high-speed response

FSM Series

Select either an integrated or separated indicator to increase the range of applications.

Flow range
0.5、1、5、10、20、50、100 ℓ/min

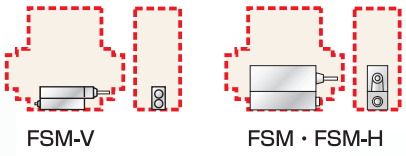
New

Compatible with argon (Ar) and carbon dioxide (CO_2). (Option)

Miniaturized, light-weight

This sensor can be installed in small spaces or on moving sections, facilitating downsizing and weight reduction.

Comparison of volume with conventional parts



FSM-V　　FSM・FSM-H

Usable with vacuums

Positive/negative pressure combination

Use this sensor even for vacuum applications, such as confirming the suction of the machine on which it is mounted.
The argon and carbon dioxide types are for positive pressure.

Control flow rates

Output includes analog output and digital display and switch output to detect errors visually and with switches.
Select the type suited to the application.

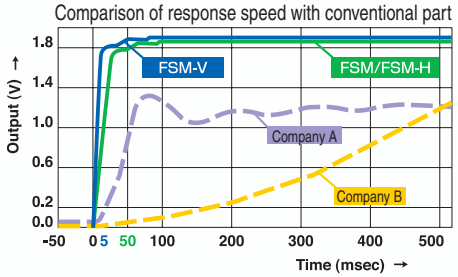
High-speed response

High-speed response is realized by incorporating a platinum sensor chip processed with silicon micromachining. Use this sensor with devices having a short cycle time, such as to check the suction of the machine on which it is mounted.

FSM-V　　FSM・FSM-H

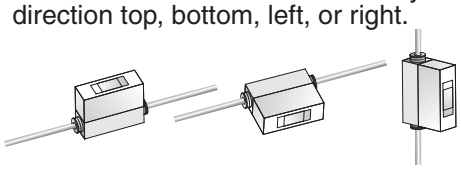
5msec or less　　**50**msec or less

Comparison of response speed with conventional part



Free installation position

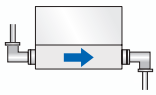
The sensor can be mounted in any direction top, bottom, left, or right.



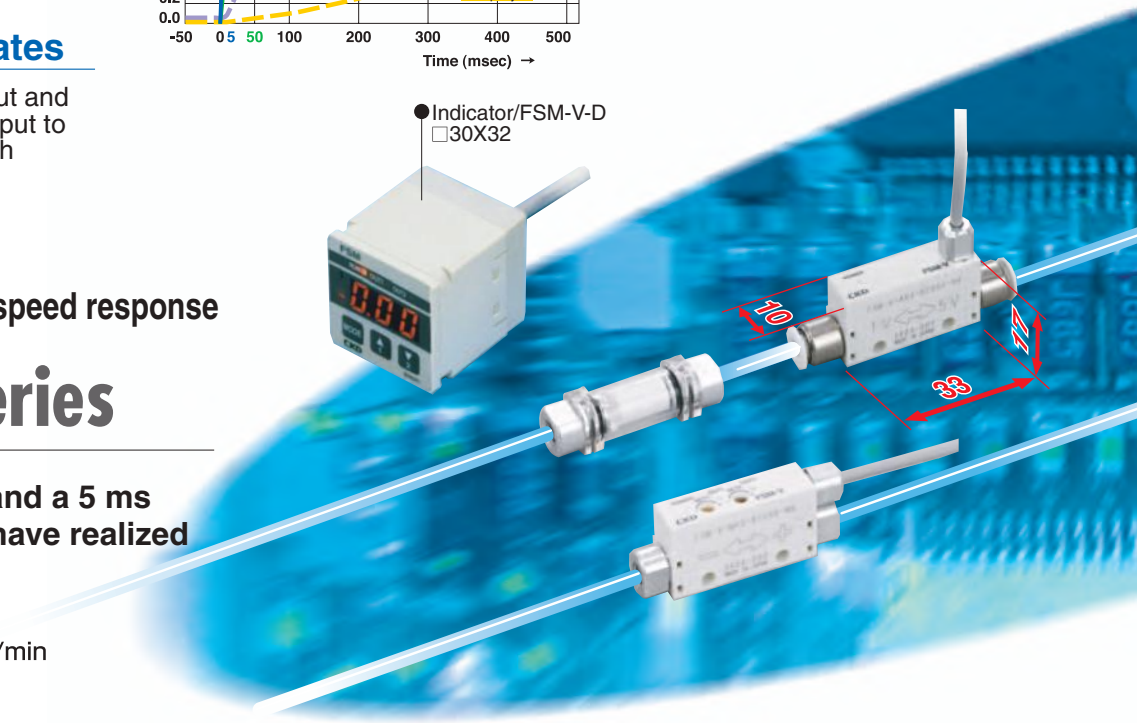
No straight piping section needed

The newly proposed rectifying structure eliminates the need for a straight piping section upstream or downstream.

Elbow can be used.



Indicator/FSM-V-D
□30X32



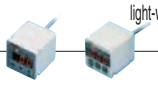
Miniaturized, ultra-high-speed response

FSM-V Series

Dramatic downsizing and a 5 ms high-speed response have realized a novel design.

Flow range
0.05、0.1、0.5、1、5、10ℓ/min

Ample variations

Series		Size	Response speed	Indicator	Material	Output	Interactive detection	Flow range	Page
FSM-H Series		Compact, light-weight	50 msec High-speed response	Separated, Integrated	SUS Material	NPN PNP Switch output, Analog output		5~100 mℓ/min Extremely small flow	1
FSM Series		Compact, light-weight	50 msec High-speed response	Separated, Integrated	PA, AℓSUS Material	NPN PNP Switch output, Analog output		0.5~100 ℓ/min Large flow	7
FSM-V Series		Miniaturized, light-weight	5 msec Instantaneous response	Separated	PBT Material	NPN PNP Switch output, Analog output	Interactive direction	0.05~10 ℓ/min Low flow	27
Separated indicator				35	Technical data				41

A miniaturized in-line filter for small flow sensor is available.

FSM-VFM Series　  　Maintain sensor performance and prevent problems.　46

See the next page for examples of applications and series variations. ➡

Examples of small flow sensor application

Active in different applications

This small flow sensor is used in fields such as machinery, automobiles, measuring instruments, and precision equipment; advanced fields such as semiconductors and biotechnology; and medicine and foodstuffs.

Life ↑

■ Applicable fluid

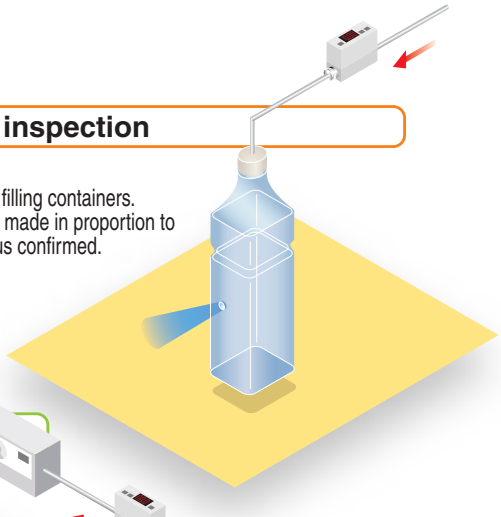
AIR N_2 Ar CO_2

■ Sensor applications

Leakage inspection
Pinhole inspection
Ionizer purge gas confirmation
Welding gas control
Purge gas flow control
Contact detection
Suction detection

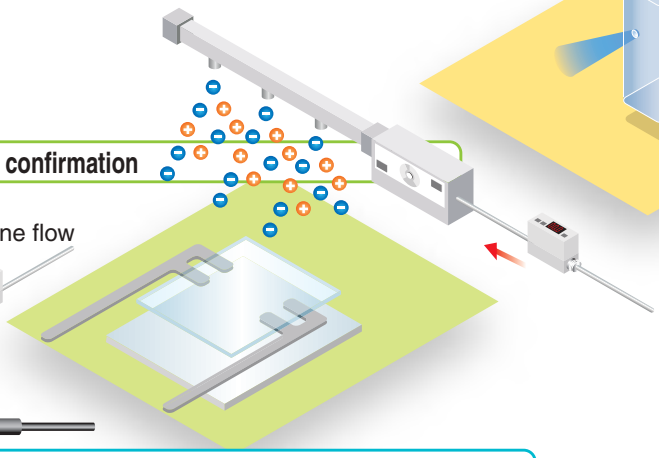
Foodstuff/medicine — **Leakage inspection**

The inspection cycle time can be shortened.
Measurements can be made immediately after filling containers.
Even when pressure is extremely low, output is made in proportion to the pinhole, so acceptability is judged and status confirmed.



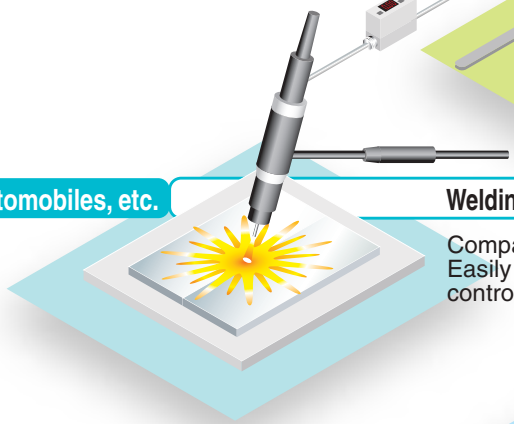
Liquid crystals — **Ionizer purge gas confirmation**

Compatible with different flow ranges.
Easily execute flow control with the in-line flow controller (customized order).



Automobiles, etc. — **Welding argon and carbon dioxide flow control**

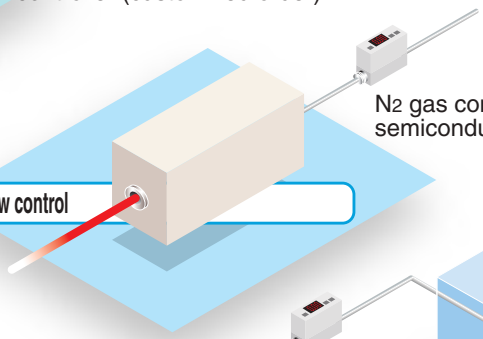
Compatible with different flow ranges.
Easily execute flow control with the in-line flow controller (customized order).

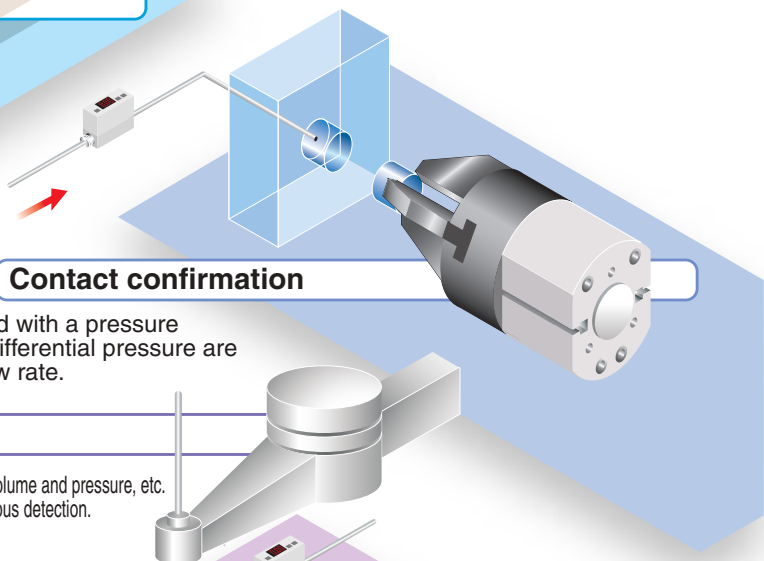


N_2 gas control for laser oscillators and semiconductor manufacturing equipment.

Semiconductors — **Semiconductors Purge gas flow control**

Control of purge gas is indispensable for maintaining device performance.
This miniature sensor is easily incorporated into devices.



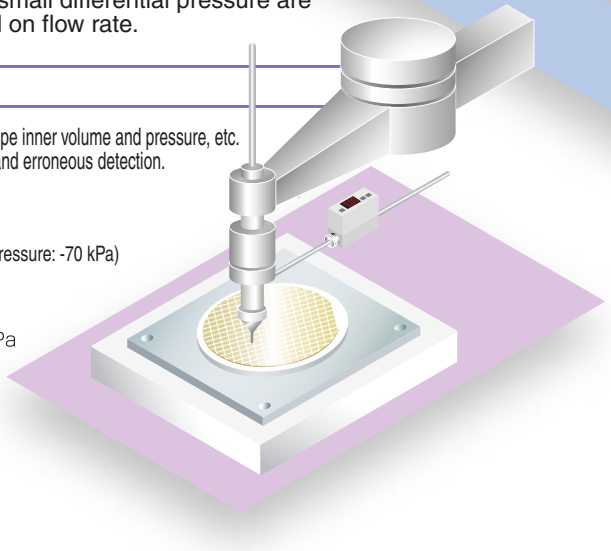


Machine manufacturing — **Contact confirmation**

Even judgments not completed with a pressure sensor because of the small differential pressure are accurately made based on flow rate.

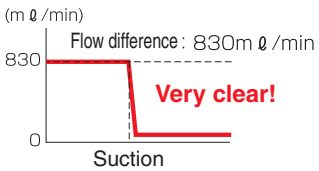
Electronic parts — **Suction confirmation**

① High-speed response comparable to pressure sensor. The response differs with pipe inner volume and pressure, etc.
② Flow detection eliminates the need for adjustment based on pressure fluctuation and erroneous detection.
③ Clogging of the nozzle and filter are detected.
④ Suction errors such as inclined suction are controlled with flow detection.

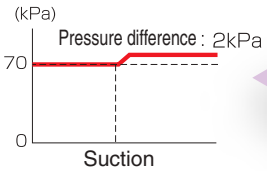


Comparison with pressure sensor (For nozzle diameter: ø0.3, vacuum pressure: -70 kPa)

■ Small flow sensor (using FSM-N-010)



■ Pressure sensor



↓ Industry

Small flow sensor series variation

Extremely small flow **FSM-H Series**				Compact, high-response **FSM Series**												Miniaturized, ultra-high-speed response **FSM-V Series**					
				Air, nitrogen gas							Argon, carbon dioxide (option)										
FSM-H-A-005ML	FSM-H-A-010ML	FSM-H-A-050ML	FSM-H-A-100ML	FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100	FSM-A-200	FSM-A-500	FSM-A-101	FSM-A-005-AR/CO2	FSM-A-010-AR/CO2	FSM-A-050-AR/CO2	FSM-A-100-AR/CO2	FSM-A-200-AR/CO2	FSM-A-500-AR/CO2	Single-point analog output Separated indicator (optional) 	Separated indicator	Analog output	Single-point analog output Separated indicator (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	FSM-N-005	FSM-N-010	FSM-N-050	FSM-N-100	FSM-N-200	FSM-N-500	FSM-N-101	FSM-N-005-AR/CO2	FSM-N-010-AR/CO2	FSM-N-050-AR/CO2	FSM-N-100-AR/CO2	FSM-N-200-AR/CO2	FSM-N-500-AR/CO2	Single-point analog output Switch output 2-point NPN output 	Integrated indicator	Switch output	2-point NPN output 	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	FSM-P-005	FSM-P-010	FSM-P-050	FSM-P-100	FSM-P-200	FSM-P-500	FSM-P-101	FSM-P-005-AR/CO2	FSM-P-010-AR/CO2	FSM-P-050-AR/CO2	FSM-P-100-AR/CO2	FSM-P-200-AR/CO2	FSM-P-500-AR/CO2	Single-point analog output Switch output 2-point PNP output 			2-point PIP output 	FSM-V-P-R0005	FSM-V-P-R0010	FSM-V-P-R0050	FSM-V-P-R0100	FSM-V-P-R0500	FSM-V-P-R1000
																	Material									
				●	●	●	●	●									Resin				●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Stainless steel									
									●	●	●	●	●	●	●	●	Aluminum									
																	Port size									
																	ø1.8 fiber tube				●	●	●	●	●	●
				●	●	●	●	●									ø4 Push-in joint				●	●	●	●	●	●
				●	●	●	●	●									ø6 Push-in joint									
				●	●	●	●	●			●	●	●	●			M5				●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	Rc1/8									
										●							Rc1/4									
●	●	●	●														G1/8									
																	Full-scale flow									
●																	5	mℓ/min								
	●																10									
		●															50				●					
			●														100					●				
				●							●						500						●			
					●							●					1	ℓ/min						●		
						●							●				5								●	
							●							●			10									●
								●							●		20									
									●							●	50									
										●							100									
±3%				±5%													**Accuracy (linearity)**	% F.S.			±5%					
Negative pressure | Positive pressure -0.09 | 1.0				Negative pressure | Positive pressure -0.07 | 0.7							Positive pressure 0.5							**Working pressure range** Negative pressure | Positive pressure	MPa			Negative pressure | Positive pressure -0.09 | 0.2				
																	Analog output (1~5V)									
				5V 1V 0 FS flow																	5V 3V 1V -FULL 0 +FULL					

Safety precautions

Always read this section before starting use.

When designing and/or manufacturing equipment using CKD products, the manufacturer is obligated to check that the device safety mechanism, pneumatic or hydraulic control circuits and electric controls that control these pieces of equipment be secured.
It is important to select, use, handle or maintain the product appropriately to ensure that CKD products be used safely.
Observe warning and cautions to ensure the safety of equipment.
Check that the safety of equipment be ensured, then manufacture safe equipment.

Warning

1 These products on this catalog are designed and manufactured as parts for general industrial machines.
Therefore, the person that has sufficient knowledge and experience must handle them.

2 Use the products in accordance of specifications.

Contact CKD when using the product outside the unique specifications range, when using it outdoors, and when using it under the conditions and environment below. Do not attempt to modify or additionally machine the product.

❶ Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, equipment or components directly contacting to beverage, food, etc., amusement equipment, emergency shutoff circuits, press machines, brake circuits, safeguard etc.
❷ Use for applications where life or assets could be adversely affected, and special safety measure are required.

3 For the safety on equipment design/control, etc., corporate standards and regulations, etc., must be observed.

ISO4414 and JIS B 8370 (pneumatic system rules), JIS B 8368 (pneumatic cylinder)
JPAS 005 (principles for use and selections of pneumatic cylinder)
High Pressure Gas Maintenance Law, Occupational Safety and Sanitation Laws, other safety regulations and corporate standards, etc.

4 Do not handle the products, pipe, nor remove components before confirming safety.

❶ Inspect and service the machines and devices after confirming safety of the entire system related this product.
❷ Care must be taken even after operation is stopped since there may be hot or charged section.
❸ When inspecting or servicing the device, turn off the energy source (pneumatic or hydraulic source), and turn off power to the facility. Discharge the residual pressure and pay special attention to possible leakages of water and electricity.
❹ When starting and restarting a machine or device using pneumatic components, make sure the system safety, such as popping-out prevention measures, etc. are secured.

5 Warning and cautions on the pages below must be observed to prevent accidents.

■Safety cautions are ranked by the safety cautions as [danger] [warning] [caution] in this section.

Danger: When a dangerous situation may occur, or when there is high urgency to a warning leading to fatal or serious injuries, if handling is mistaken.

Warning: When a dangerous situation may occur if handling is mistaken, leading to fatal or serious injuries.

Caution: When a dangerous situation may occur if handling is mistaken, leading to minor injuries or physical damages.

Note that some items described as [CAUTION] may lead to serious results depending on the situation.
In any case, the important description that must be observed is listed.

Pneumatic components: warning/cautions to secure safety

Always read this section before starting use.

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

⚠ Danger — Design & selection

Working fluid

- A flammable fluid must not be used.

Working environment

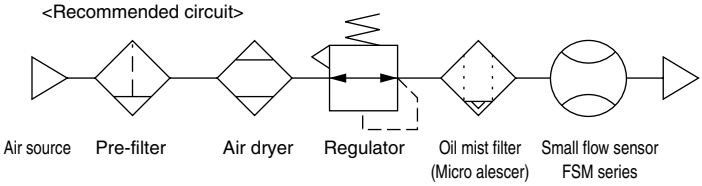
- Flammable environment
  Do not use the product in flammable gas environment. Since explosion-protection is not taken, explosion or fire may be caused.

⚠ Warning — Design & selection

Working fluid

- The product can not be used as a business mater.
  Not conformed to the Measurement Law, do not use the product for the commercial purpose. Use the product as an industrial sensor.
- Do not use the product with other than applicable working fluids, or the accuracy can not be guaranteed.
- Install a filter, an air dryer and an oil mist filter (micro alescer) onto the primary side (upstream) of the sensor since the compressed air from the compressor contains drain (water, oil oxide and foreign material, etc.) Mesh (wire net) in a sensor is used to rectify the flow in the pipe. Always install a filter since this mesh is not a filter to remove foreign materials, etc.

<Recommended circuit>



- When a valve is used in the primary side of the sensor, an oil-prohibited valve must be used. The sensor may malfunction or be destroyed by splash of grease and oil, etc.

Working environment

- Corrosive environment
  Do not use the product in an environment containing corrosive gas such as salphur dioxide, etc.
- Ambient temperature/fluid temperature
  Use the product within the ambient and fluid temperature ranges 0 to 50 ˚C. Even in the specified temperature range, do not use the product where ambient and fluid temperatures will change suddenly, and form dew condensations.
- Maximum working pressure/usage flow range
  Use the product in accordance with specifications. If used out of the maximum working pressure and working flow range, the product may result in failures.
- Drip proof environment
  The protective structure of this product is equivalent to IP40. Do not install the product where moisture, salt, dust or swarf is contained, or where pressurized, or depressurized, neither. The product can not be used where the temperature changes suddenly or has high humidity since a failure by dew condensation may be produced in the body.

⚠ Caution — Design & selection

Flow rate unit

- The flow rate of this product is measured by mass flow not depended with temperature and pressure. Unit is ℓ / min where mass flow is converted to volumetric flow at 20 ˚C and 1 atmospheric pressure (101kPa).

Withstanding pressure

- Withstanding pressure may vary per series. Care must be taken to select the product.

Overflow

- Even if twice as much overflow as each series measuring range is applied to the sensor, it is no problem, however, if dynamic pressure is applied near to the maximum working pressure, (when the pressure applied to the primary side with the secondary side released.), the sensor may fail. When feeding workpieces during leakage inspection, if dynamic pressure is applied, always provide a by-pass circuit or a needle valve to avoid dynamic pressure applying to the sensor.

Adsorption verification, etc.

- When using this product with adsorption verification, etc., select the flow rate range according to vacuum range and adsorption nozzle diameter. Refer to Page 42 on the attached sheet for [flow rate theory calculation method].
- When using this product with adsorption verification, etc., always install an air filter (filtration rating 30 μm or less) onto the upstream of suction side to prevent suction of foreign materials. (Use of miniature inline filter for FSM, FSM-V is recommended. Refer to Page 46 for details).
- In FSM-V series, if fiber tube model is used within flow rate range of ±5 ℓ /min or ±10 ℓ /min, pressure loss increases per working pressure, the required flow may not be reached. Care must be taken.
- When using this product with adsorption verification, etc., considering atmospheric dew point and ambient temperature of this product, use the product under the conditions that dew condensations will not be formed in the inside of pipe.
- When using this product with adsorption verification, etc., response time may delay per pipe volume between this product from adsorption nozzle. In that case, take countermeasures such as, reducing piping volume, etc.
- When using the product with vacuum applications such as air absorption, etc., do not bend the tube near the push-in joint section. If stress is applied to the tube near the push in joint, insert the tube into the push-in joint after inserting the insert ring.

Pneumatic components: warning/cautions to secure safety

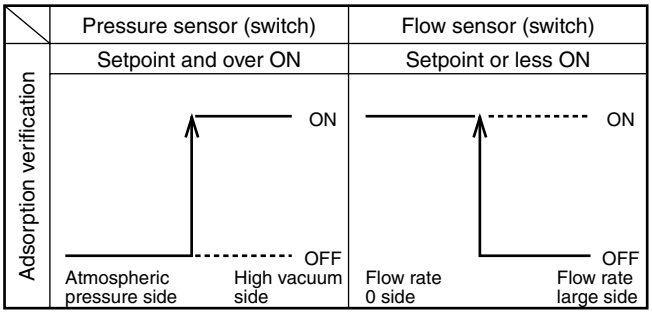
Always read this section before starting use.

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

⚠ Caution — Design & selection

Adsorption verification, etc.

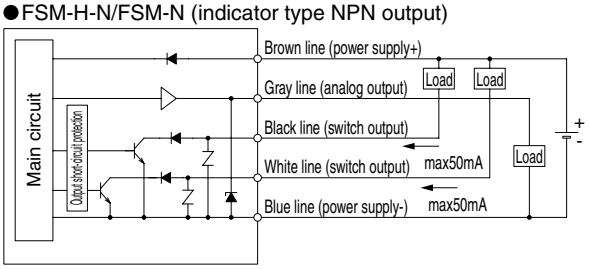
- When the sensor for adsorption verification is replaced from the pressure sensor (switch) to the flow sensor (switch), in the image (refer to right Fig.), the theory of sensor output (switch output) is reversed. Care must be taken since change and modification of sequence program of PLC are required. If source pressure/vacuum is not supplied especially when equipment power turned on, problems must not be created in sequence program, etc., of PLC since flow sensor (switch) maintains [flow rate 0]=[sensor output (switch output) ON].



Example of internal circuit and load connection

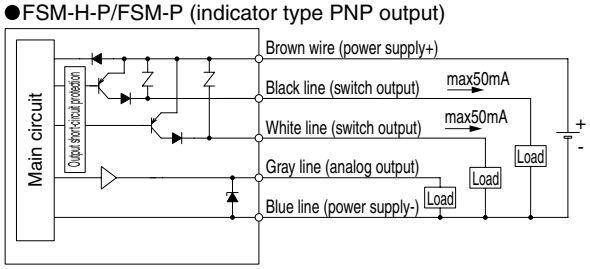
[FSM-H/FSM series]

●FSM-H-N/FSM-N (indicator type NPN output)



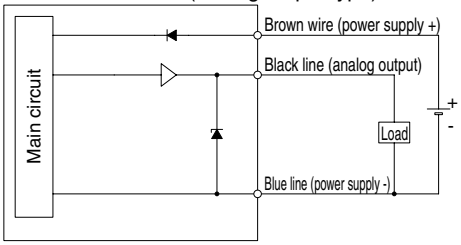
Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Gray	Analog output (1 to 5V)
Black	OUT1(max50mA)
White	OUT2(max50mA)

●FSM-H-P/FSM-P (indicator type PNP output)



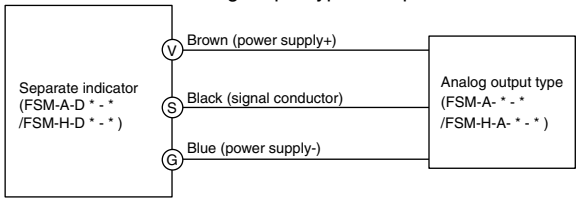
Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Gray	Analog output (1 to 5V)
Black	OUT1(max50mA)
White	OUT2(max50mA)

●FSM-H-A/FSM-A (analog output type)



Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Black	Analog output (1 to 5V)

●How to connect analog output type to separate indicator

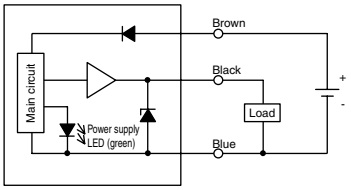


(Note) In metal body (stainless steel body and aluminum body) types, connect F.G. of equipment connected to - or + power supply to the body. Do not attempt insulation resistance and pressure tests while F.G. is connected, or may result in damage or burn.

Internal circuit and load example of connection

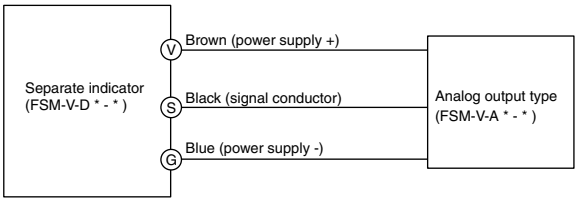
[FSM-V series]

● FSM-V-A * (analog output type)



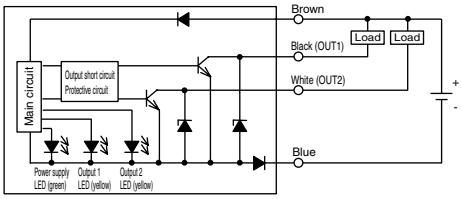
Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Black	Analog output (1 to 5V)

● How to connect analog output type to separate indicator



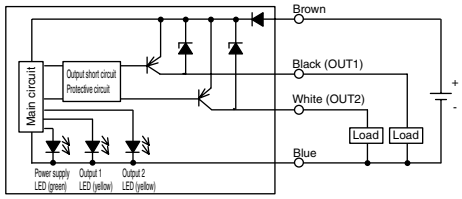
Note: For switch output type, the combination with a separate indicator is not available.

● FSM-V-N * (switch output type NPN)



Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Black	OUT1(max50mA)
White	OUT2(max50mA)

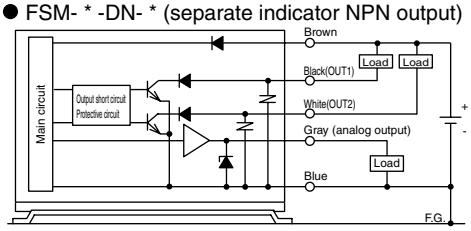
● FSM-V-P * (switch output type PNP)



Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Black	OUT1(max50mA)
White	OUT2(max50mA)

[Separate indicator]

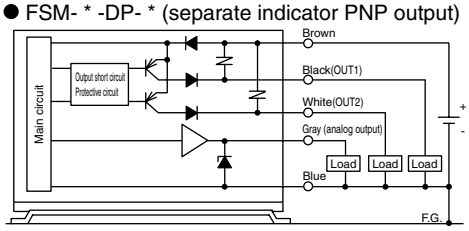
● FSM- * -DN- * (separate indicator NPN output)



Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Gray	Analog output (1 to 5V)
Black	OUT1(max50mA)
White	OUT2(max50mA)

• Turn off power supply to release phase fault protection at first, and re-start after correcting incorrect wiring, etc.

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



Line color	Content
Brown	Power supply DC12 to 24V
Blue	0V(GND)
Gray	Analog output (1 to 5V)
Black	OUT1(max50mA)
White	OUT2(max50mA)

• Turn off power supply to release phase fault protection at first, and re-start after correcting incorrect wiring, etc.

Pneumatic components: warning/cautions to secure safety

Always read this section before starting use.

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

Danger — Installation & adjustment

Wiring

- Power supply voltage and outputs must be used with the specified voltage. Applying the voltage more than specified voltage may cause malfunction, damage of sensor, electric shock or fire.

Do not apply load more than the rated output. Damage or fire of the output may be caused.

Warning — Installation & adjustment

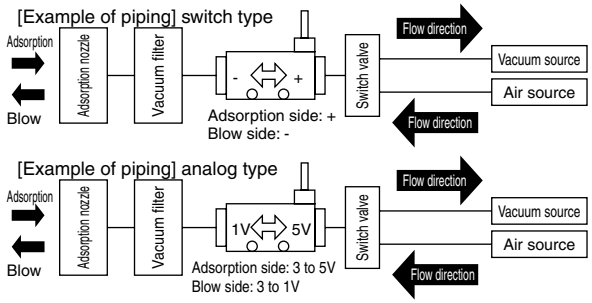
Wiring

- Line color must be checked when wiring. Check the wiring color with handling precaution, since improper wire connection may result in damage, failure or malfunction of the sensor.
- Insulation of wiring must be checked. Eliminate contact, ground fault and terminal insulation defective with other circuits, or overcurrent will be admitted into the sensor to damage.
- For the power supply to be used, use DC safety power supply insulated form alternating current power supply and in rated range. If power supply is not insulated, electric shock may be created. If power supply is not stabilized, the peak magnitude in summer may exceed the rated value, causing damage of this product, or reducing the accuracy.
- For wiring, stop control unit/machinery and equipment, and turn off the power supply.Sudden operation may create not anticipated motions, causing a danger. First, attempt energizing test, then set the desired switch data while control unit, machinery and equipment are stopped. Discharge static electricity built in body, tool and equipment before and during work. Use a wire with elasticity as wire for robot connection in the movable part.
- Do not use the product out of power supply voltage range. If voltage more than usage range is applied, or if alternating current power (AC100V) applied, causing damage or burn.
- This product and wiring must be installed as far away as possible from noise source such as strong electric line, etc. Take other countermeasures for a surge on the power supply line.
- Do not short-circuit a load, or causing damage or burn.
- Use DC safety power supply thoroughly insulated from the AC primary side for a power supply for the metal body (stainless steel and aluminum bodies) type, while connecting either + or - side on the power supply to F.G. Variable resistor (clamping voltage approximate 40V) is connected between the inside power circuit of metal body type and the metal body to prevent breakdown of the sensor. High potential and insulation resistance tests between the inside power circuit of metal body type and the metal body must not be done. If required, attempt these tests after wiring is disconnected. The excessive electric potential difference between power supply and metals body makes inside parts burn. When electric welding equipment or frame and when creating a short-circuit accident after metal body type installed, connected or wired, transient high and surge voltages may run in ground line or fluid path connected to the components above when welding current runs or when welding, causing a damage. Remove all F.G. connections of the product and electric wiring before work such as electric welding, etc.

⚠ Caution Installation & adjustment

Piping

- FSM-H/FSM must be piped, while matching the flow direction and direction specified on the body.
- For FSM-V, the direction of arrow on the body must be checked, considering the flows direction and switching operation, then install and pipe the product.

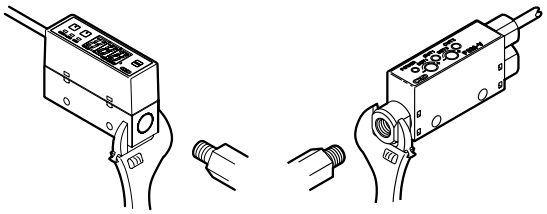


- When piping a sensor, refer to the torques below not to apply excessive screw-in and load torques to the port.

[Reference value]

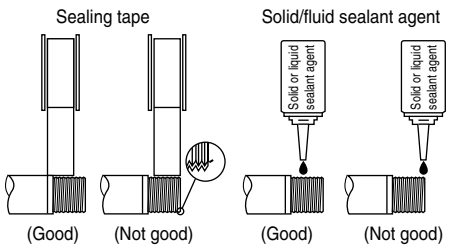
Set screw	Tightening torque N•m
M5	**0.5 to 1.0**
Rc1/8(G1/8)	**3 to 5**
Rc1/4	**6 to 8**

- Flash the pipe to remove foreign substances and swarf, etc., in inside of pipe before piping. If many foreign materials and swarf, etc. entrain into the inside, the rectifier and the sensor tip could be damaged.
- When piping, apply a spanner on the metal section not to apply forces onto the resin section.



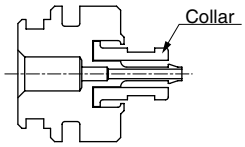
- When piping, care must be taken that sealing tape and adhesive must not enter into the inside.

When wrapping fluoro resin sealing tape on the screw section, wrap the tape once or twice while leaving 2 to 3 threads from the end, then hold down the tape with your nail top to contact the tape on the thread closely. When using liquid sealant, leave 1 to 2 threads from the screw end to apply the sealant, while watching too much sealant must not be applied. Do not apply sealant on the thread section of component.

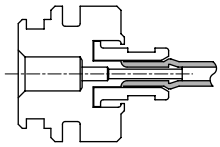


- When using the metal body with OUT side released, always connect a joint, or the port filter may be removed.
- If a push-in joint is used, the tube must be inserted certainly. Pulls the tube to check that the tube not be come out. Cut the tube at the right angle with the dedicating knife.
- Connect fiber tube as the following steps (① to ⑤).

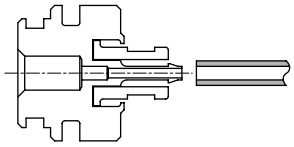
① Collar is set in the most deep position.



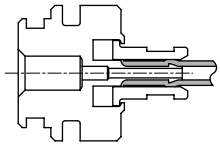
④ Insert air fiber until the end will reach wall.



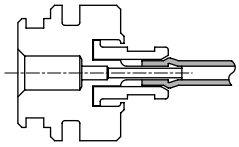
② Cut the end of fiber tube at the right angle.

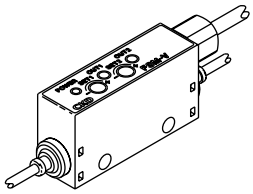


⑤ Pull the collar in the front to lock.



③ Connect while checking if fiber tube is properly inserted through the collar.





Adjustment

- If a switch is activated in unstable flow rate state such as a fluid pulsation, etc., unstable operation may be provided. In this case, maintain a sufficient difference between two setpoints, or avoid switch setting in the unstable area, then use the product after checking that switching operation be stabilized.
- When setting FSM-V series; switch output type setting, use a minus headed screw driver matching trimmer slit (0.5W X 1.9L X 0.45D) or a cross-point screwdriver for 0 bit. Also, revolution range of trimmer is 240 degrees. Further rotation or rotation while strongly held may result in damage.

Pneumatic components: warning/cautions to secure safety

Always read this section before starting use.

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

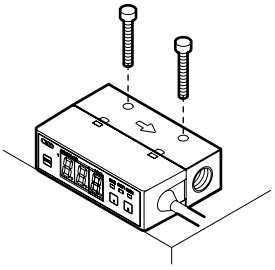
⚠ Caution Installation & adjustment

Installation

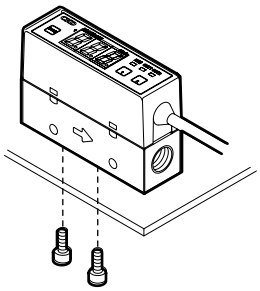
- This product can be installed with any attitude; vertical, horizontal, right or left.

■ FSM-H/FSM series

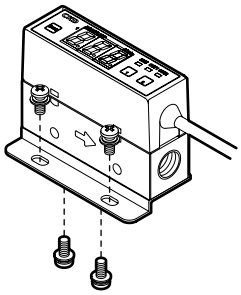
Horizontal (through hole)



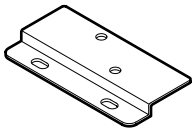
Vertical (female thread on the bottom)



Bracket installation (*bracket use)



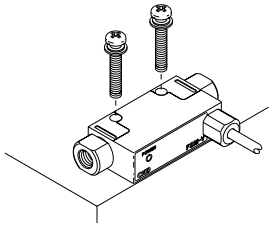
*Bracket (separate sales) is provided. (Model no.: FSM-LB1) (Refer to page 8)



M3 (length 6mm) set screw for fixing
4 pieces attached

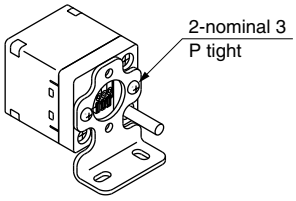
■ FSM-V series

- For miniature flow sensor discrete
  Using 2 through holes on the side (ø3.2), install the product.

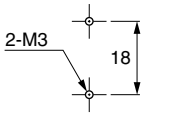


■ Separate indicator FSM-H-D * , FSM-A-D * and FSM-V-D * common
Bracket/kit (optional) are provided to install a separate indicator.

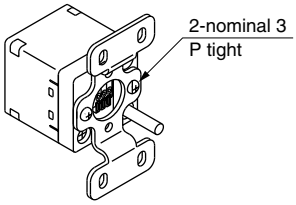
Bracket model no.: PPD3-KL-D : Single foot bracket (radial installation)



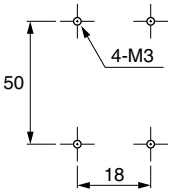
Mounting hole machining dimensions



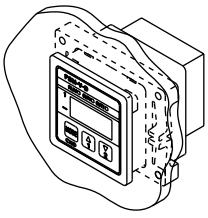
Bracket model no.: PPD3-KD-D : Both sides foot brackets (parallel)



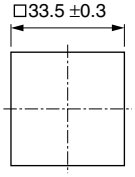
Mounting hole machining dimensions



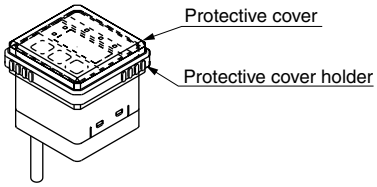
Bracket model no.: PPD3-KHS-D : Panel mount bracket set with panel cover



Mounting hole machining dimensions



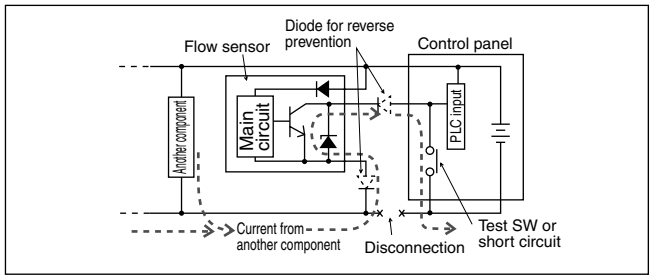
Bracket model no.: PPD3-KC : Operation protective cover



⚠ Caution — Usage & maintenance

- Output accuracy is affected by self exoergics caused by energizing other than temperature characteristics. When using, stand-by time (5 minutes and over after energizing) must be provided.
- When an error occurs during operation, turn off power supply immediately, and terminate the operation, and contact to the sales office.
- Use the product within range of rated flow.
- Use the product within range of working pressure.
- For self-diagnosis, this product does not conduct flow rate detecting switch operation for proximate 2 seconds immediately after energized. Make a control circuit and programs to ignore signals for approximate 2 seconds after energized.
- When changing setpoints of the output, stop the equipment, then change the setpoints, or an accident may occur.
- A periodic inspection should be done at least once a year, then make sure that the product be operated properly.
- Disassembly and modification must not be done or causing a failure.
- The material of case is resin. Solvent/alcohol/cleaner, etc., must not be used to remove contamination, etc., or causing a resin to be corroded. Wipe weakened neutral detergent with tightly squeezed waste cloth, etc.

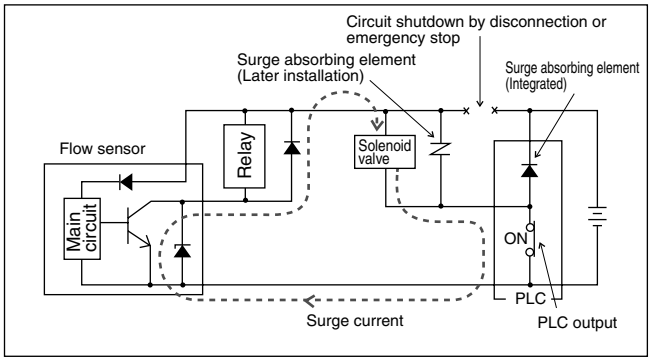
- Be careful of reverse current by disconnection/wiring resistance. If other components including another flow sensor are connected to the same power source of the sensor, when switch output line and - side of power line are short-circuited to check operation of input device in the control panel, or if - side of power line is disconnected, reverse flow in switch circuit may cause damage.



Preventing damage by reverse current, take the following countermeasures.

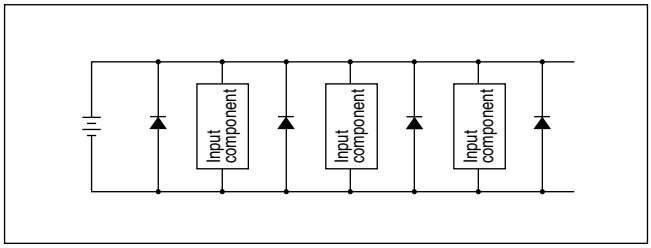
(1) Avoid concentration to - side power line, and use the wire as fat as possible.
(2) Narrow the number of components to connect to the same power source of the sensor.
(3) Provide a diode on the flow sensor output line in serial to prevent reverse current.
(4) Provide a diode on - side of flow sensor power line to prevent reverse current.

- Be careful of leading of surge current.
If the flow sensor shares the power source with inductive load forming surge of a solenoid valve or a relay, etc., when a circuit is disconnected with the inductive load activated, depended with surge absorbing element, surge current may lead to the switch output circuit, causing a damage.



Take the following countermeasures to prevent damage by surge current leading.

(1) Separate output system; inductive load such as solenoid valve and relay, and input system; flow sensor.
(2) If the power source can not be separated, provide surge suppressor elements to all inductive loads directly. Surge absorbing element connected PLC, etc., merely protect a single component connected.
(3) Furthermore, connect surge suppressor element per power line to protect the product from disconnection.



If components are connected with connectors, when the connector is removed while energized, the output circuit may be damaged. So, always mount or dismount the connector after the power is turned off.

- When out of flow rate range, analog output will be provided. [Hi] will be displayed.
However, accuracy is not guaranteed.

Pneumatic components: warning/cautions to secure safety

Always read this section before starting use.

Miniature inline filter FSM-VFM series

⚠ Caution Usage & maintenance

- Do not use the product where acid, alkaline, carboxylic acid, other organic compound, screw locking adhesive, solvent or alcohol liquid will adhere on the product nor in the vacuum circuit absorbing an air containing these subsistence, or the body may be damaged.
- Use the specified tube and plastic plugs.

  Tube outside diameter accuracy
  - Polyamide tube……Within ±0.1mm
  - Polyurethane rubber tube

    (~ø6)……Within ±0.1mm

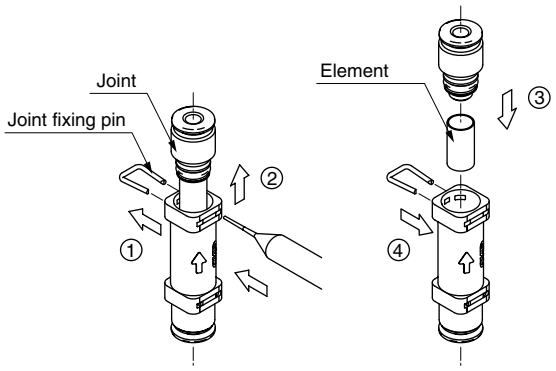
    (ø8~)……$^{+0.1}_{-0.15}$mm or less

  CKD recommended model no.

Plastic plug	GWP*-B series
Soft nylon tube	F15**series
Polyurethane rubber tube	U95**series
Urethane tube	NU-04, 06 series

- Refer to cautions on joint/tube in [pneumatic/vacuum/auxiliary components] No.CB-24S for cautions on push-in joint.
- Periodical inspection, cleaning and replacement must be done to check cracks on the polyamide case, flaw and other deterioration.
- Periodical inspection, cleaning and replacement of the element must be done, or clogged filter element may cause degradation of vacuum source.
- When removing the body to clean or change the filter element, always reduce the pressure in the vessel until atmospheric pressure before starting work. Also, check the arrow on the body before reassembling since the flow direction is specified. Make sure that the required degree of vacuum in the circuit is achieved after reassembling.
- Cleaning the body, use household neutral detergent then rinse them.

How to replace element



① Dislocate the joint fixing pin with a tool having shaped edge, etc. (Be careful that the fixing pin not be lost, since the pin will be reused.)
② Pull out the joint.
③ Replace the element, then insert the joint.
④ Insert the joint fixing pin, then fix the joint.

MEMO

Small flow sensor microflow type
Indicator type/analog output

FSM-H Series (Air/nitrogen gas)

●Flow rate range:0.25~5,0.5~10,2.5~50,5~100m 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 m ℓ /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 8392-1.1.2 to 5.6.2), compressed air (JIS B 8392-1.1.2 to 1.6.2) Note 2 and nitrogen gas Note 3			
	Maximum working pressure MPa	1.0			
	Minimum working pressure MPa	-0.09			
	Withstanding pressure MPa	1.5			
	Ambient temperature/humidity	0 to 50 ˚C and 90%RH or less			
	Working fluid temperature ˚C	0 to 50 (to be no dew condensation.)			
Accuracy	Linearity (display/analog output)	±3%F.S. or less (0.1MPa, 25 ˚C and flow rate range 5 to 100%F.S.)			
	Pressure characteristics	±3%F.S. or less (-0.09 to 1.0MPa, 0.1MPa criteria)			
	Temperature characteristics	±0.2%F.S./˚C or less (15 to 35 ˚C, 25 ˚C criteria)			
	Repeatability	±0.5%F.S. or less			
Response time		50ms or less Note 5			
Type of display		Flow rate display (7 segments 3 1/2 digits orange) and operation and switch output display (orange)			
Type of output		Switch output 2 points (NPN or PNP open collector output, 50mA or less, voltage drop 2.4V and PLC/relays) Analog output 1 point (1 to 5V voltage output and connected load impedance 50KΩ and over)			
Power supply voltage		DC12/24V (10.8 to 26.4V)			
Current consumption		60mA or less			
Lead wire		ø3.7 0.2mm^2 X 5-conductor 1 m			
Functions		Flow rate display, flow rate display - peak hold, switch output and analog output			
Installation	Installation attitude	Both vertical and horizontal			
	Strait piping section	Not required			
Protective structure		IEC standards IP40			
Protective circuit Note 4		Power supply and switch output reverse connection protections, and switch output load short-circuit protection			
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8			

Indicator type mass

Unit: g

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

Analog output type mass

Unit: g

Model no. / Port size (body material)		FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100
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 ℓ /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 8392-1.1.2 to 5.6.2) compressed air (JIS B 8392-1.1.2 to 1.6.2) Note 2 and N_2 gas Note 3			
	Maximum working pressure MPa	1.0			
	Minimum working pressure MPa	-0.09			
	Withstanding pressure MPa	1.5			
	Ambient temperature/humidity	0 to 50 ˚C and 90%RH or less			
	Working fluid temperature ˚C	0 to 50 (to be no dew condensation.)			
Accuracy	Linearity (analog output)	±3%F.S. or less (0.1MPa, 25 ˚C and flow rate range 5 to 100%F.S.)			
	Pressure characteristics	±3%F.S. or less (-0.09 to 1.0MPa, 0.1MPa criteria)			
	Temperature characteristics	±0.2%F.S./˚C or less (15 to 35 ˚C, 25 ˚C criteria)			
	Repeatability	±0.5%F.S. or less			
Response time		50ms or less Note 5			
Type of display		Power display (green)			
Type of output		Analog output 1 point (1 to 5V voltage output and connected load impedance 50KΩ and over)			
Power supply voltage		DC12/24V (10.8 to 26.4V)			
Current consumption		50mA or less			
Lead wire		ø3.7 0.2mm² X 3-conductor 1m			
Functions		Analog output			
Protective circuit Note 4		Power supply reverse connection protection			
Installation	Installation attitude	Both vertical and horizontal			
	Installation strait 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 and 1 atmospheric pressure (101kPa)

Note 2: **Compressed air quality grade according to JIS B 8392-1: 2000**

Class	Maximum particle diameter (μm)	Minimum pressure dew point (˚C)	Maximum oil content concentration (mg/m³)
1	0.1	-70	0.01
2	1	-40	0.1
3	5	-20	1.0
4	15	+3	5
5	40	+7	25
6	-	+10	-

For example, [Class 1.2.2] shows the grade of ...

Solid particle	0.1μm
Pressure dew point	-40˚C
Oil content concentration	0.1mg/m³

Note 3: **Consult with CKD for usage with a gas other than air and N_2.**

Note 4: The protective circuit of this product is effective for the specified incorrect wiring and load short circuits, but can not protect the product from all wrong connections.

Note 5: The response time may change depended with piping condition.

Separate indicator specifications (analog output type only)

Model no.	Separate indicator			
Descriptions	FSM-H-D$^{N}_{P}$-005ML	FSM-H-D$^{N}_{P}$-010ML	FSM-H-D$^{N}_{P}$-050ML	FSM-H-D$^{N}_{P}$-100ML
Available analog output type model no.	FSM-H-A-005ML	FSM-H-A-010ML	FSM-H-A-050ML	FSM-H-A-100ML
Display	Flow rate display (7 segments 3 digits 1/2 and orange), operation and switch output (orange)			
Output	Switch output 2 points (NPN or PNP open collector output, load current 50mA or less voltage drop 2.4V and PLC/relays) Analog output 1 point (1-5V voltage output and connected load impedance 50KΩ and over)			
Power supply voltage	DC12/24V (10.8 to 26.4V)			
Current consumption	50mA or less (indicator only)			
Lead wire	ø3.7 0.2mm² X 5-conductor (1m)			
Functions	Flow rate display, flow rate - peak hold, switch output and analog output			
Ambient temperature/humidity	0 to 50 ˚C and 85%RH or less (to be no dew condensation.)			
Protective structure	IEC standards IP40			
EMC directive	EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8			
Mass g	Approximate 70 (including lead wire 1m)			

How to order

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

Ⓐ Output type
Ⓑ Flow rate range
Ⓒ Port size
Ⓓ Option

Symbol	Content
Ⓐ Output type	
A	Analog output 1 point
N	NPN output 2 points and analog output 1 point
P	PNP output 2 points and analog output 1 point
Ⓑ 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
Ⓒ Port size	
6A	Rc1/8 (stainless steel body)
6G	G1/8 (stainless steel body)

*Refer to Page 6 for model no. and dimensions of bracket (separate sales).

Symbol	Content
Ⓓ Option	
Blank	None
K	Company Certification attached
T (Note 1)	Traceability attestation attached

Note 1) 3 pieces; traceability attestation, company certification and traceability system configuration are attached.

[Example of model number]
FSM-H-N-005ML-6A-K

Model: FSM indicator type
Ⓐ Switch output type : NPN output
Ⓑ Flow rate range : 0.25 to 5m ℓ /min
Ⓒ Port size : Rc1/8 (stainless steel body)
Ⓓ Option : company certification attached

● Separate indicator (analog output type only)

FSM - H - D N - 010ML

Model no.
Ⓐ Switch output type
Ⓑ Flow rate range

Symbol	Content
Ⓐ Output type	
N	NPN output 2 points and analog output 1 point
P	PNP output 2 points and analog output 1 point
Ⓑ 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 Page 35 to 40 for the operation and dimensions, etc.

● Bracket for separate indicator

PPD3 - KL-D

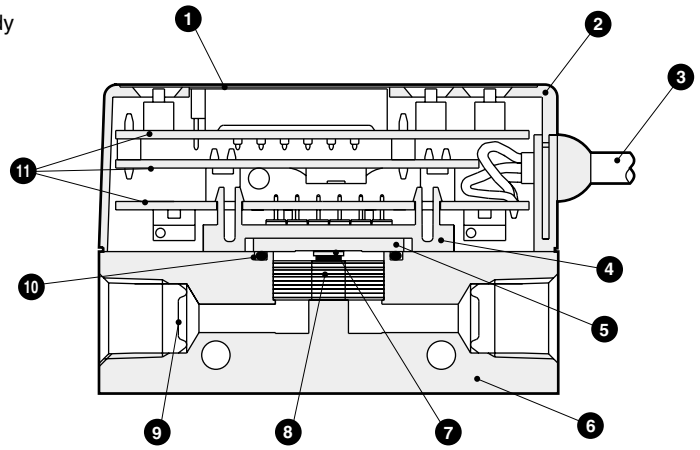
Ⓐ Bracket kit

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

*Refer to Page 35 and 36 for bracket dimensions and installation dimensions.

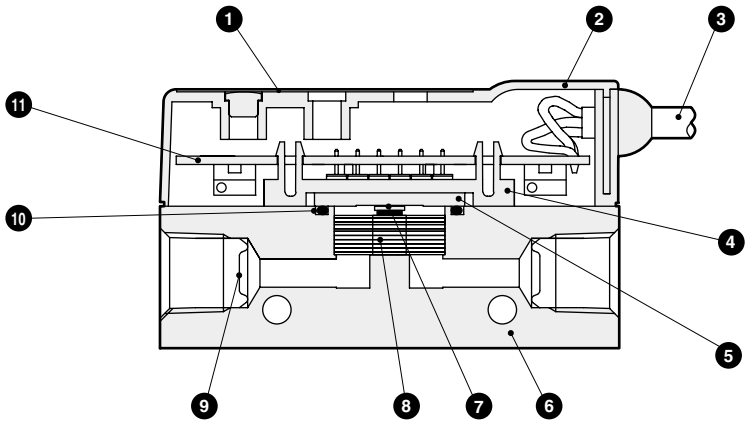
Internal structure and parts list

● FSM-H- * -100ML-6A
Indicator type stainless steel body



No.	Parts name	Material	No.	Parts name	Material
1	Front sheet	Polyester film	7	Sensor tip	Silicon
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-005ML-6GA
Analog type stainless steel body



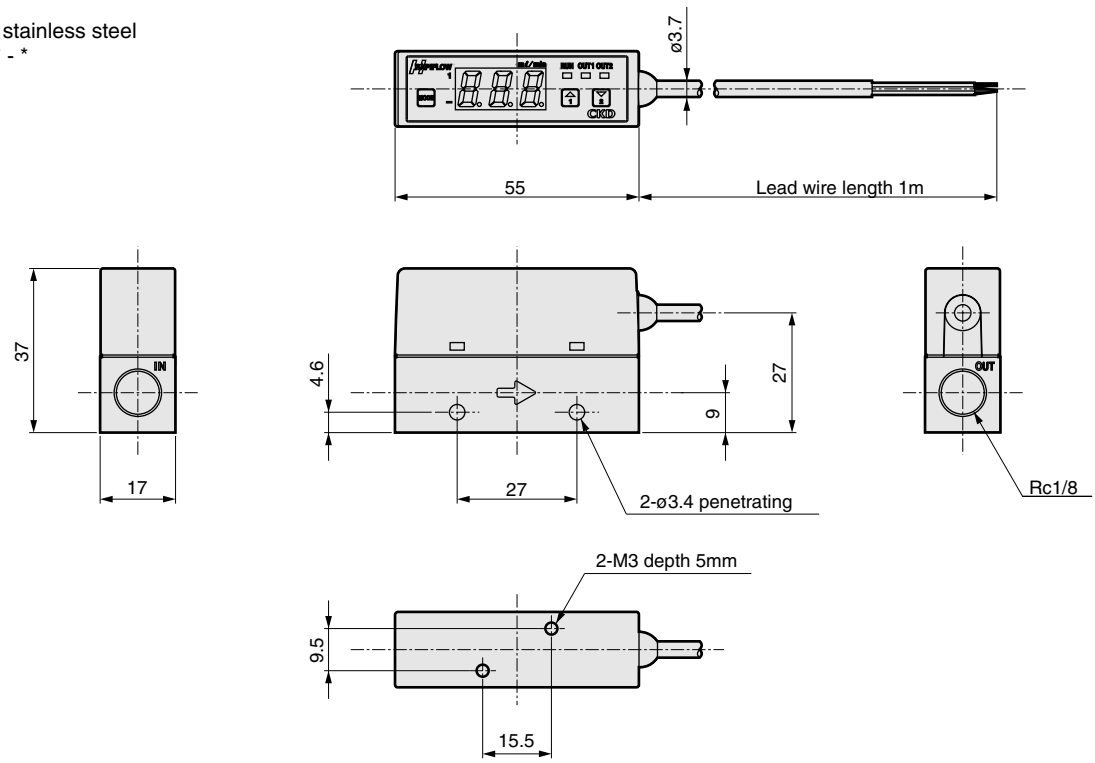
No.	Parts name	Material	No.	Parts name	Material
1	Front sheet	Polyester film	7	Sensor tip	Silicon
2	Case	ABS resin	8	Rectifier	Stainless steel
3	Lead wire with holder (3-conductor)	ABS resin/polyvinyl chloride	9	Port filter	Stainless steel
4	Module holder	Polyamide resin	10	Sensor gasket	Fluoro rubber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

● Separate indicator FSM-H-D * - *

Refer to Page 35 for internal structure drawing of a separate indicator.

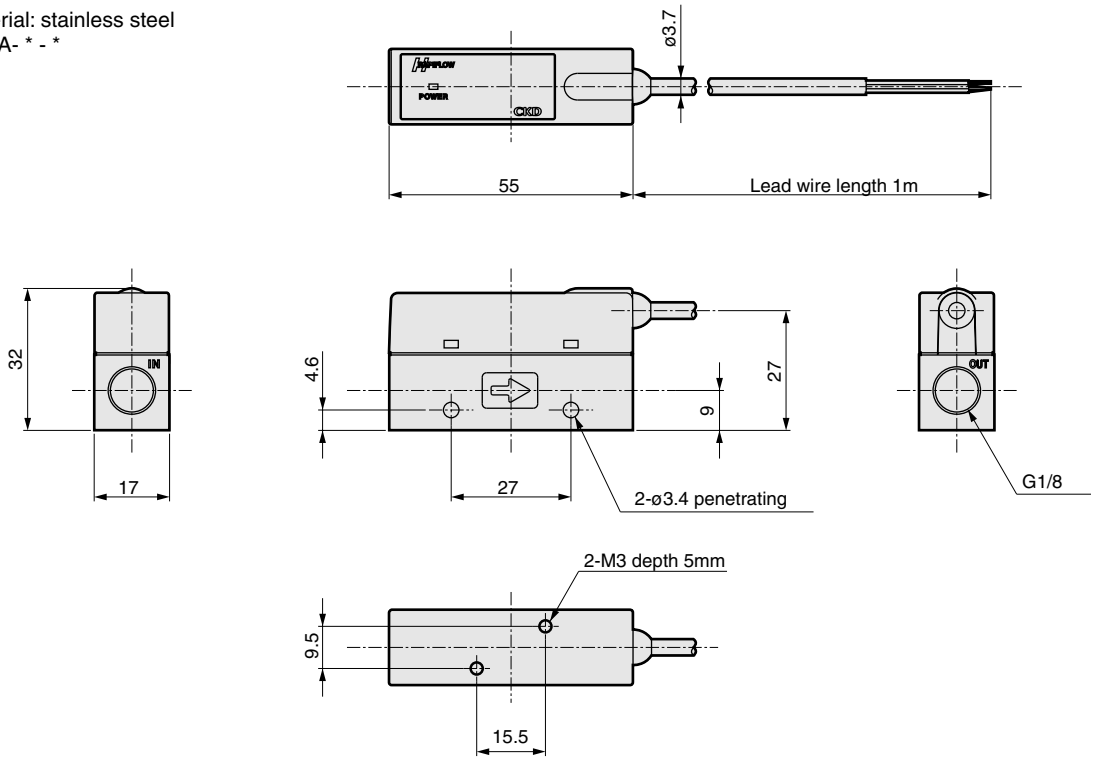
Dimensions (indicator type)

Body material: stainless steel
● FSM-H- * - * - *



Dimensions (analog output type)

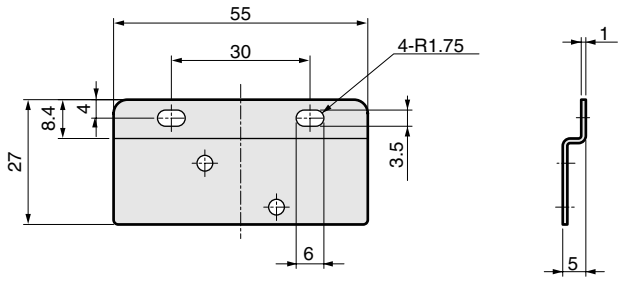
Body material: stainless steel
● FSM-H-A- * - *



*Refer to Page 35 for dimensions of a separate indicator FSM-H-D * - * .

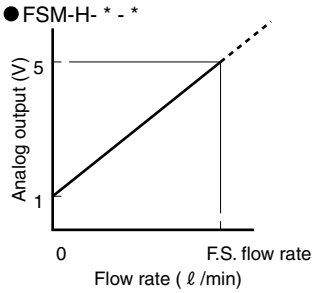
Dimensions (bracket)

Model no.: **FSM-LB1**



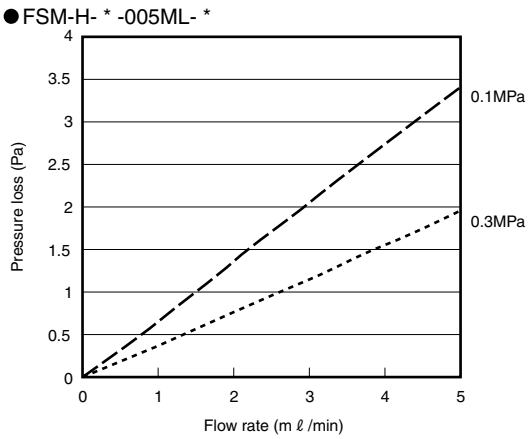
With M3 (length 6mm) 4 set screws for fixing

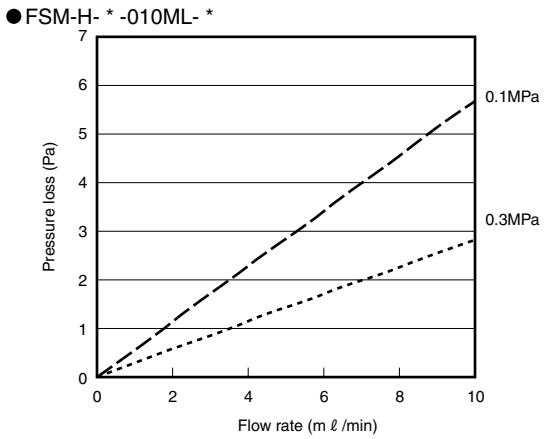
Analog output properties

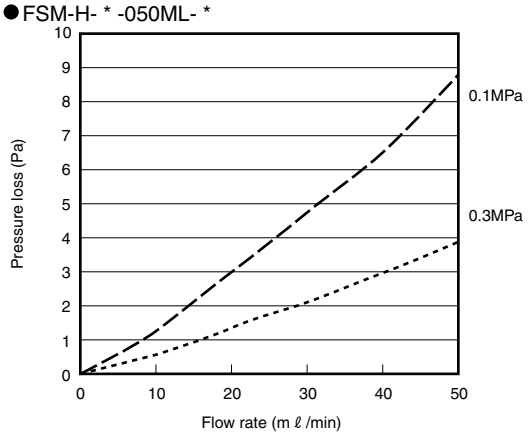


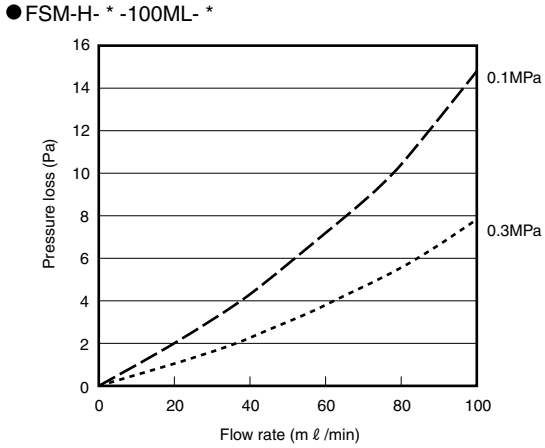
(Note) If flow rate range is exceeded, output will reach up to max8V.

Pressure loss properties









For name, functions and operation of display/controls,
refer to Page 23 for display integrated type, while to Page 37 for a separate indicator.

Small flow sensor
Indicator type/analog output

FSM Series

■ Air and nitrogen gas (Flow rate range: 0.05~100 ℓ /min)
■ Argon and carbon oxide (Flow rate range: 0.05~50 ℓ /min)

■ FSM series for air and nitrogen gas

Indicator type specifications

Descriptions		Indicator type						
		FSM-N/P-005	FSM-N/P-010	FSM-N/P-050	FSM-N/P-100	FSM-N/P-200	FSM-N/P-500	FSM-N/P-101
Flow rate range ℓ /min Note 1		0.05 to 0.5	0.1 to 1	0.5 to 5	1 to 10	2 to 20	5 to 50	10 to 100
Working conditions	Working fluid	Clean air (JIS B 8392-1.1.2 to 5.6.2), compressed air (JIS B 8392-1.1.2 to 1.6.2) Note 2 and nitrogen gas						
	Maximum working pressure MPa	0.7						
	Minimum working pressure MPa	-0.07						
	Withstanding pressure MPa	1.0						
	Ambient temperature/humidity	0 to 50 ˚C and 90%RH or less						
	Working fluid temperature ˚C	0 to 50 (to be no dew condensation.)						
Accuracy	Linearity (display/analog output)	±5%F.S. or less (0.1MPa, 25 ˚C and flow rate range 10 to 100%F.S.)						
	Pressure characteristics	±5%F.S. or less (-0.07 to 0.5MPa, 0.1MPa criteria)						
	Temperature characteristics	±0.2%F.S./˚C or less (15 to 35 ˚C, 25 ˚C criteria)						
	Repeatability	±1%F.S. or less				±3%F.S. or less (If flow rate 50%F.S. or less, ±2%F.S. or less)		
Response time		50ms or less Note 4						
Type of display		Flow rate display (7 segments 3 1/2 digits orange) and operation and switch output display (orange)						
Type of output		Switch output 2 points (NPN or PNP open collector output, 50mA or less, voltage drop 2.4V or less, PLC/relays) Analog output 1 point (1 to 5V voltage output and connected load impedance 50KΩ and over)						
Power supply voltage		DC12/24V (10.8 to 26.4V)						
Current consumption		60mA or less						
Lead wire		ø3.7 0.2mm² X 5-conductor 1 m						
Functions		Flow rate display, flow rate display-peak hold, switch output and analog output						
Installation	Installation attitude	Both vertical and horizontal						
	Strait piping section	Not required						
Protective structure		IEC standards IP40						
Protective circuit Note 3		Power supply and switch output reverse connection protections, and switch output load short-circuit protection						
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8						

Indicator type mass (air and nitrogen gas)

Unit: g

Model no. / Port size (body material)		FSM-N/P-005	FSM-N/P-010	FSM-N/P-050	FSM-N/P-100	FSM-N/P-200	FSM-N/P-500	FSM-N/P-101
H4	ø4 push-in (nylon)	70	70	70	70	70	-	-
H6	ø6 push-in (nylon)	67	67	67	67	67	-	-
6A	Rc1/8 (stainless steel)	150	150	150	150	150	170	-
6AA	Rc1/8 (aluminum)	-	-	-	-	-	90	-
M5	M5 (stainless steel)	160	160	160	160	160	-	-
8A	Rc1/4 (stainless steel)	-	-	-	-	-	-	205
8AA	Rc1/4 (aluminum)	-	-	-	-	-	-	105

Analog output type mass (air and nitrogen gas)

Unit: g

Model no. / Port size (body material)		FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100	FSM-A-200	FSM-A-500	FSM-A-101
H4	ø4 push-in (nylon)	63	63	63	63	63	-	-
H6	ø6 push-in (nylon)	60	60	60	60	60	-	-
6A	Rc1/8 (stainless steel)	140	140	140	140	140	160	-
6AA	Rc1/8 (aluminum)	-	-	-	-	-	80	-
M5	M5 (stainless steel)	150	150	150	150	150	-	-
8A	Rc1/4 (stainless steel)	-	-	-	-	-	-	195
8AA	Rc1/4 (aluminum)	-	-	-	-	-	-	95

Analog output type specifications (for air or nitrogen gas, without display)

Descriptions		Analog output type						
		FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100	FSM-A-200	FSM-A-500	FSM-A-101
Flow rate range ℓ/min Note 1		0.05 to 0.5	0.1 to 1	0.5 to 5	1 to 10	2 to 20	5 to 50	10 to 100
Working conditions	Working fluid	Clean air (JIS B 8392-1.1.2 to 5.6.2), compressed air (JIS B 8392-1.1.2 to 1.6.2) Note 2 and nitrogen gas						
	Maximum working pressure MPa	0.7						
	Minimum working pressure MPa	-0.07						
	Withstanding pressure MPa	1.0						
	Ambient temperature/humidity	0 to 50 ˚C and 90%RH or less						
	Working fluid temperature ˚C	0 to 50 (to be no dew condensation.)						
Accuracy	Linearity (analog output)	±5%F.S. or less (0.1MPa, 25 ˚C and flow rate range 10 to 100%F.S.)						
	Pressure characteristics	±5%F.S. or less (-0.07 to 0.5MPa, 0.1MPa criteria)						
	Temperature characteristics	±0.2%F.S./˚C or less (15 to 35 ˚C, 25 ˚C criteria)						
	Repeatability	±1%F.S. or less				±3%F.S. or less (If flow rate 50%F.S. or less, ±2%F.S. or less)		
Response time		50ms or less Note 4						
Type of display		Power display (green)						
Type of output		Analog output 1 point (1 to 5V voltage output and connected load impedance 50KΩ and over)						
Power supply voltage		DC12/24V (10.8 to 26.4V)						
Current consumption		50mA or less						
Lead wire		ø3.7 0.2mm² X 3-conductor 1m						
Functions		Analog output						
Protective circuit Note 3		Power supply reverse connection protection						
Installation	Installation attitude	Both vertical and horizontal						
	Installation strait 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 and 1 atmospheric pressure (101kPa)

Note 2: **Compressed air quality grade according to JIS B 8392-1: 2000**

Class	Maximum particle diameter (μm)	Minimum pressure dew point (˚C)	Maximum oil content concentration (mg/m³)
1	0.1	-70	0.01
2	1	-40	0.1
3	5	-20	1.0
4	15	+3	5
5	40	+7	25
6	-	+10	-

For example, [Class 1.2.2] shows the grade of ...

Solid particle	0.1μm
Pressure dew point	-40˚C
Oil content concentration	0.1mg/m³

Note 3: The protective circuit of this product is effective for the specified wrong connection and load short circuit, but can not protect from all wrong connection.

Note 4: The response time may change depended with piping condition.

Separate indicator specifications (analog output type only)

Model no.	Separate indicator						
Descriptions	FSM-A-D$^{N}_{P}$-005	FSM-A-D$^{N}_{P}$-010	FSM-A-D$^{N}_{P}$-050	FSM-A-D$^{N}_{P}$-100	FSM-A-D$^{N}_{P}$-200	FSM-A-D$^{N}_{P}$-500	FSM-A-D$^{N}_{P}$-101
Available analog output type model no.	FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100	FSM-A-200	FSM-A-500	FSM-A-101
Display	Flow rate display (7 segments 3 digits 1/2 and orange) and operation switch output (orange)						
Output	Switch output 2 points (NPN or PNP open collector output, load current 50mA or less voltage drop 2.4V and PLC/relays) Analog output 1 point (1-5V voltage output and connected load impedance 50KΩ and over)						
Power supply voltage	DC12/24V (10.8 to 26.4V)						
Current consumption	50mA or less (indicator only)						
Lead wire	ø3.7 0.2mm² X 5-conductor (1m)						
Functions	Flow rate display, flow rate display-peak hold, switch output and analog output						
Ambient temperature/humidity	0 to 50 ˚C and 85%RH or less (to be no dew condensation.)						
Protective structure	IEC standards IP40						
EMC directive	EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8						
Mass g	Approximate 70 (including lead wire 1m)						

■FSM series for argon and carbon dioxide

Indicator type specifications

Descriptions		Indicator type (argon and carbon oxide)					
		FSM-N/P-005	FSM-N/P-010	FSM-N/P-050	FSM-N/P-100	FSM-N/P-200	FSM-N/P-500
Flow rate range ℓ/min Note 1		0.05 to 0.5	0.1 to 1	0.5 to 5	1 to 10	2 to 20	5 to 50
Working conditions	Working fluid	Argon and carbon dioxide Note 2					
	Working pressure MPa	0 to 0.5 Note 3					
	Withstanding pressure MPa	0.75					
	Ambient temperature/humidity	0 to 50 ˚C and 90%RH or less					
	Working fluid temperature ˚C	0 to 50 (to be no dew condensation.)					
Accuracy	Linearity (display/analog output)	±5%F.S. or less (0.1MPa, 25 ˚C and flow rate range 10 to 100%F.S.)					
	Pressure characteristics	±5%F.S. or less (0 to 0.5MPa, 0.1MPa criteria)					
	Temperature characteristics	±0.2%F.S./˚C or less (15 to 35 ˚C, 25 ˚C criteria)					
	Repeatability	±1%F.S. or less				±3%F.S. or less (If flow rate 50%F.S. or less, ±2%F.S. or less)	
Response time		50ms or less Note 4					
Type of display		Flow rate display (7 segments 3 1/2 digits orange) and operation and switch output display (orange)					
Type of output		Switch output 2 points (NPN or PNP open collector output, 50mA or less, voltage drop 2.4V, PLC/relays) Analog output 1 point (1 to 5V voltage output and connected load impedance 50KΩ and over)					
Power supply voltage		DC12/24V (10.8 to 26.4V)					
Current consumption		60mA or less					
Lead wire		ø3.7 0.2mm^2 X 5-conductor 1 m					
Functions		Flow rate display, peak hold, switch output and analog output					
Installation	Installation attitude	Both vertical and horizontal					
	Strait piping section	Not required					
Protective structure		IEC standards IP40					
Protective circuit Note 5		Power supply and switch output reverse connection protections, and switch output load short-circuit protection					
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8					

*All pressures are gauge pressure.

Indicator type mass (argon and carbon oxide)

Unit: g

Model no. / Port size (body material)		FSM-N/P-005	FSM-N/P-010	FSM-N/P-050	FSM-N/P-100	FSM-N/P-200	FSM-N/P-500
6A	Rc1/8 (stainless steel)	150	150	150	150	170	170
6AA	Rc1/8 (aluminum)	80	80	80	80	90	90
M5	M5 (stainless steel)	160	160	160	160	-	-
M5A	M5 (aluminum)	85	85	85	85	-	-

Analog output type mass (argon and carbon oxide)

Unit: g

Model no. / Port size (body material)		FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100	FSM-A-200	FSM-A-500
6A	Rc1/8 (stainless steel)	140	140	140	140	160	160
6AA	Rc1/8 (aluminum)	70	70	70	70	80	80
M5	M5 (stainless steel)	150	150	150	150	-	-
M5A	M5 (aluminum)	75	75	75	75	-	-

Analog output type specifications (for argon or carbon dioxide, without display)

Descriptions		Analog output type (argon and carbon oxide)					
		FSM-A-005	FSM-A-010	FSM-A-050	FSM-A-100	FSM-A-200	FSM-A-500
Flow rate range ℓ/min Note 1		0.05 to 0.5	0.1 to 1	0.5 to 5	1 to 10	2 to 20	5 to 50
Working conditions	Working fluid	Argon and carbon dioxide Note 2					
	Working pressure MPa	0 to 0.5 Note 3					
	Withstanding pressure MPa	0.75					
	Ambient temperature/humidity	0 to 50 ˚C and 90%RH or less					
	Working fluid temperature ˚C	0 to 50 (to be no dew condensation.)					
Accuracy	Linearity (analog output)	±5%F.S. or less (0.1MPa, 25 ˚C and flow rate range 10 to 100%F.S.)					
	Pressure characteristics	±5%F.S. or less (0 to 0.5MPa, 0.1MPa criteria)					
	Temperature characteristics	±0.2%F.S./˚C or less (15 to 35 ˚C, 25 ˚C criteria)					
	Repeatability	±1%F.S. or less				±3%F.S. or less (If flow rate 50%F.S. or less, ±2%F.S. or less)	
Response time		50ms or less Note 4					
Type of display		Power display (green)					
Type of output		Analog output 1 point (1 to 5V voltage output and connected load impedance 50KΩ and over)					
Power supply voltage		DC12/24V (10.8 to 26.4V)					
Current consumption		50mA or less					
Lead wire		ø3.7 0.2mm^2 X 3-conductor 1m					
Functions		Analog output					
Protective circuit Note 5		Power supply reverse connection protection					
Installation	Installation attitude	Both vertical and horizontal					
	Installation strait piping section	Not required					
Protective structure		IEC standards IP40					
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8					

*All pressures are gauge pressure.

Note 1: Converted to volumetric flow at 20 ˚C and 1 atmospheric pressure (101kPa)

Note 2: It is to be dry gas (minimum pressure dew point -40 ˚C or less) without corrosion components (chlorine, sulphur and acid, etc.) Also, it is to be purity gas (solid particle 0.1 μ m or less and oil content concentration 0.1mg/m^3 or less) without dust and oil mist.

Note 3: Argon and carbon oxide model is used for positive pressure. If used with negative pressure (vacuum), care must be taken since the specified accuracy may not be satisfied. If used with vacuum equipment, etc., always install a needle valve onto the secondary side of this product to avoid a situation as this product is under negative pressure.

Note 4: The response time may change depended with piping condition.

Note 5: The protective circuit of this product is effective for the specified wrong connection and load short circuit, can not protect the product from all wrong connections.

*Refer to Page 8 for the specifications of a separate indicator.

■ Air and nitrogen gas

How to order

FSM - N - 005 - H4

Ⓐ Output type

Ⓑ Flow rate range

Ⓒ Port size

Symbol	Content
Ⓐ Output type	
A	Analog output 1 point
N	NPN output 2 points and analog output 1 point
P	PNP output 2 points and analog output 1 point
Ⓑ Flow rate range	
005	0.05 to 0.5 ℓ /min
010	0.1 to 1 ℓ /min
050	0.5 to 5 ℓ /min
100	1 to 10 ℓ /min
200	2 to 20 ℓ /min
500	5 to 50 ℓ /min
101	10 to 100 ℓ /min
Ⓒ Port size	
H4	ø4 push-in joint (resin body) *Excluding flow rate range 500 and 101
H6	ø6 push-in joint (resin body) *Excluding flow rate range 500 and 101
6A	Rc1/8 (stainless steel body) *Excluding flow rate range 101
6AA	Rc1/8 (aluminum body) *Only for flow rate range 500
8A	Rc1/4 (stainless steel body) *Only for flow rate range 101
8AA	Rc1/4 (aluminum body) *Only for flow rate range 101
M5	M5 (stainless steel body) *Excluding flow rate range 500 and 101

[Example of model number]
FSM-N-005-H4

Model: FSM indicator type
Ⓐ Switch output type : NPN
Ⓑ Flow rate range : 0.05 to 0.5 ℓ /min
Ⓒ Port size : ø4 push-in joint (resin body)

*Refer to Page 19 for model no. and dimensions of bracket (separate sales).

● Separate indicator (only for analog output type, common for air, nitrogen gas, argon and carbon oxide)

FSM - A - D N - 010

Model no.

Ⓐ Switch output type

Ⓑ Flow rate range

Symbol	Content
Ⓐ Output type	
N	NPN output 2 points and analog output 1
P	PNP output 2 points and analog output 1
Ⓑ Flow rate range	
005	0.05 to 0.5 ℓ /min
010	0.1 to 1 ℓ /min
050	0.5 to 5 ℓ /min
100	1 to 10 ℓ /min
200	2 to 20 ℓ /min
500	5 to 50 ℓ /min
101	10 to 100 ℓ /min

*Refer to Page 35 to 40 for the operation dimensions, etc.

■ Argon and carbon dioxide

How to order

FSM - N - 100 - 6A - AR

Ⓐ Output type
Ⓑ Flow rate range
Ⓒ Port size
Ⓓ Working fluid

Symbol	Content
Ⓐ Output type	
A	Analog output 1 point
N	NPN output 2 points and analog output 1 point
P	PNP output 2 points and analog output 1 point
Ⓑ Flow rate range	
005	0.05 to 0.5 ℓ /min
010	0.1 to 1 ℓ /min
050	0.5 to 5 ℓ /min
100	1 to 10 ℓ /min
200	2 to 20 ℓ /min
500	5 to 50 ℓ /min
Ⓒ Port size	
6A	Rc1/8 (stainless steel body)
6AA	Rc1/8 (aluminum body)
M5	M5 (stainless steel body) *Excluding flow rate range 100 (CO2) 200 and 500
M5A	M5 (aluminum body) *Excluding flow rate range 100 (CO2) 200 and 500
Ⓓ Working fluid	
AR	Argon
CO2	Carbon oxide

*Refer to Page 19 for model no. and dimensions of bracket (separate sales).

[Example of model number]
FSM-N-100-6A-AR

Model: FSM indicator type
Ⓐ Switch output type : NPN
Ⓑ Flow rate range : 1 to 10 ℓ /min
Ⓒ Port size : Rc1/8 (stainless steel body)
Ⓓ Working fluid : argon

● Bracket for separate indicator

PPD3 - KL-D

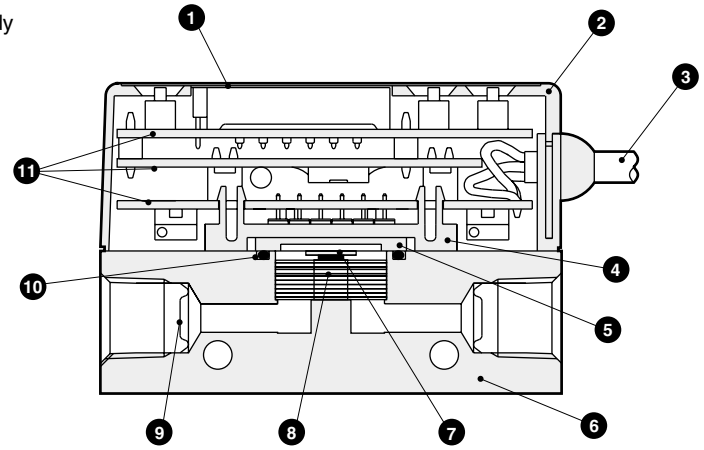
Ⓐ Bracket kit

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

*Refer to Page 35 and 36 for bracket and installation dimensions.

Internal structure and parts list

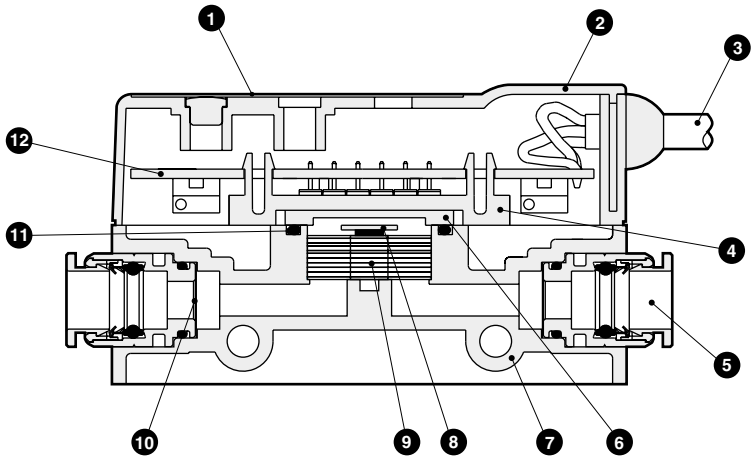
●FSM- * -100-6A- *
Indicator type stainless steel body



No.	Parts name	Material	No.	Parts name	Material
1	Front sheet	Polyester film	7	Sensor tip	Silicon
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			

Internal structure and parts list

●FSM-A-005-H6
Analog type resin body



No.	Parts name	Material	No.	Parts name	Material
1	Front sheet	Polyester film	7	Resin body	Polyamide resin
2	Case	ABS resin	8	Sensor tip	Silicon
3	Lead wire with holder (3-conductor)	ABS resin/polyvinyl chloride	9	Rectifier	Stainless steel
4	Module holder	Polyamide resin	10	Port filter	Stainless steel
5	Push in cartridge joint ø6		11	Sensor gasket	Fluoro rubber
6	Sensor circuit board	Alumina	12	Electron circuit board	

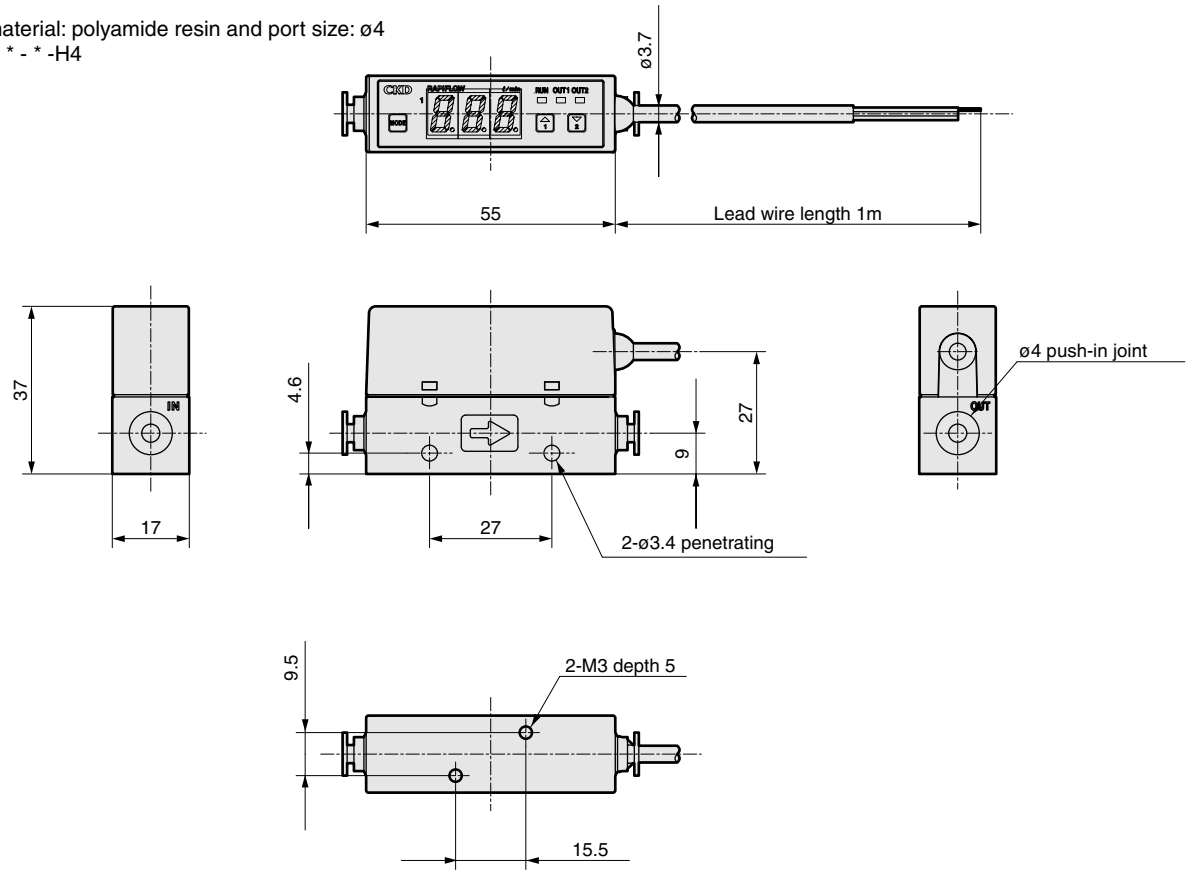
●Separate indicator FSM-A-D * - *

Refer to Page 35 for internal structure drawing.

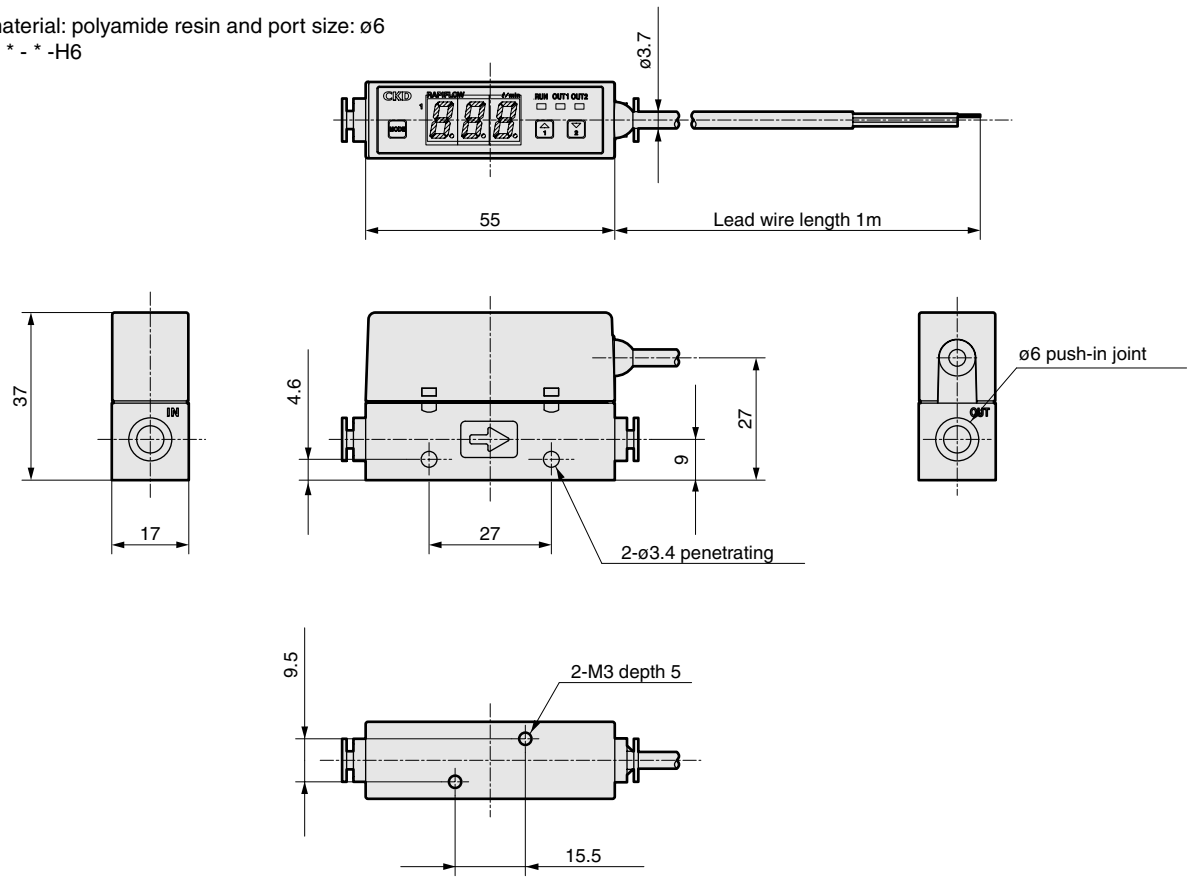
MEMO

Dimensions (indicator type)

Body material: polyamide resin and port size: ø4
●FSM- * - * -H4

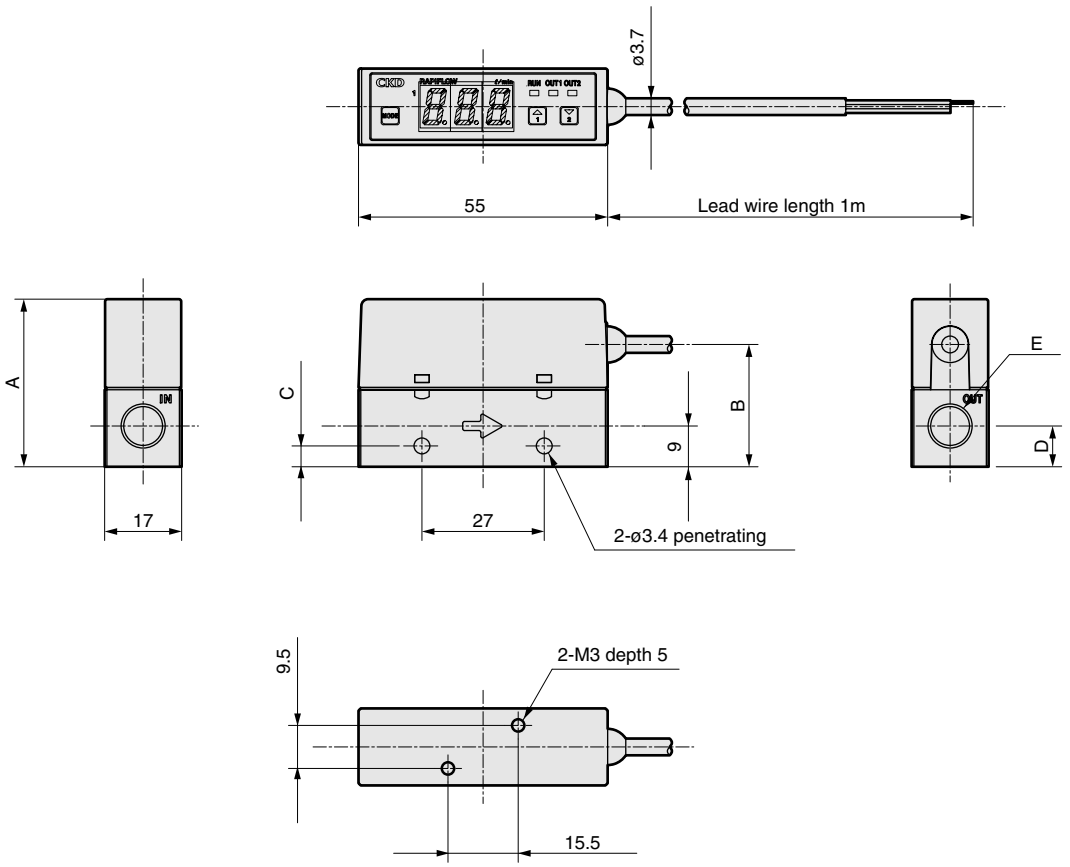


Body material: polyamide resin and port size: ø6
●FSM- * - * -H6



Dimensions (indicator type)

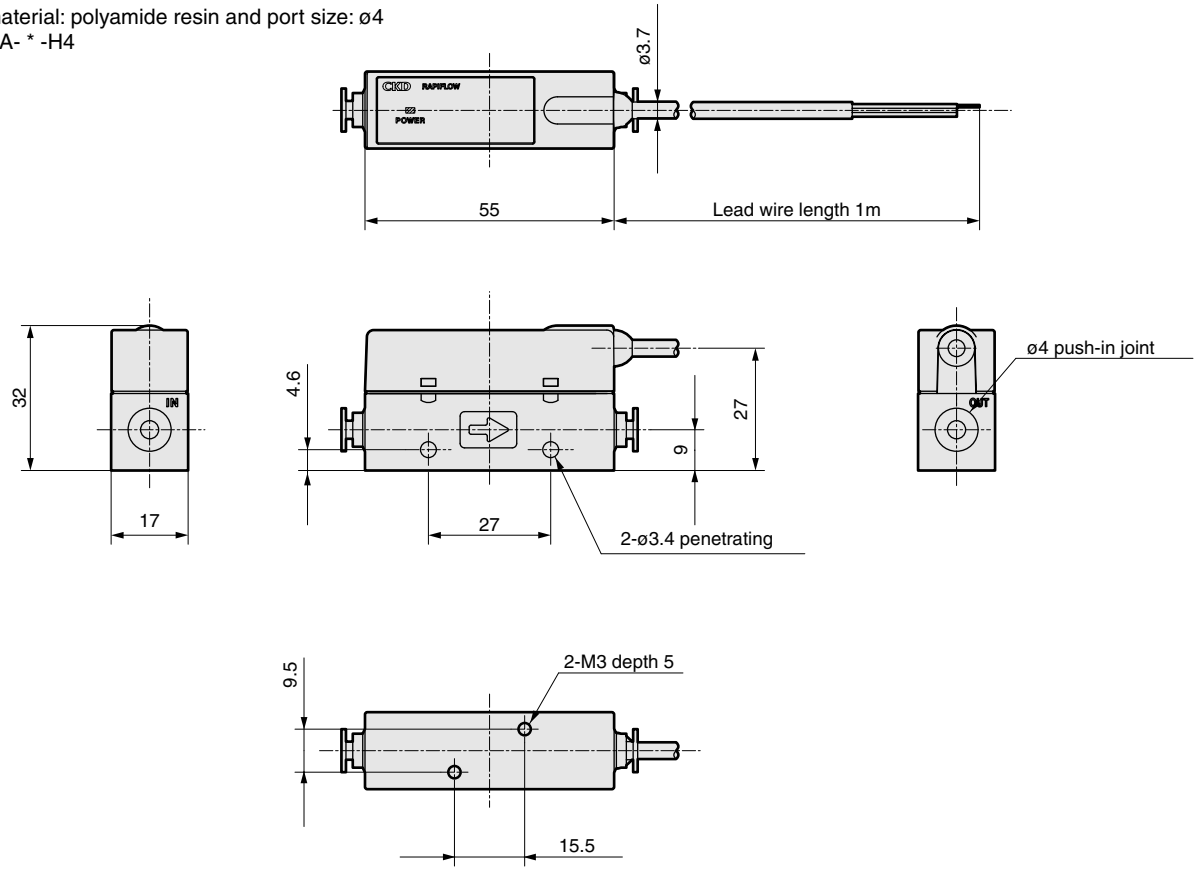
Body material: stainless steel and aluminum
●FSM- * - * - *



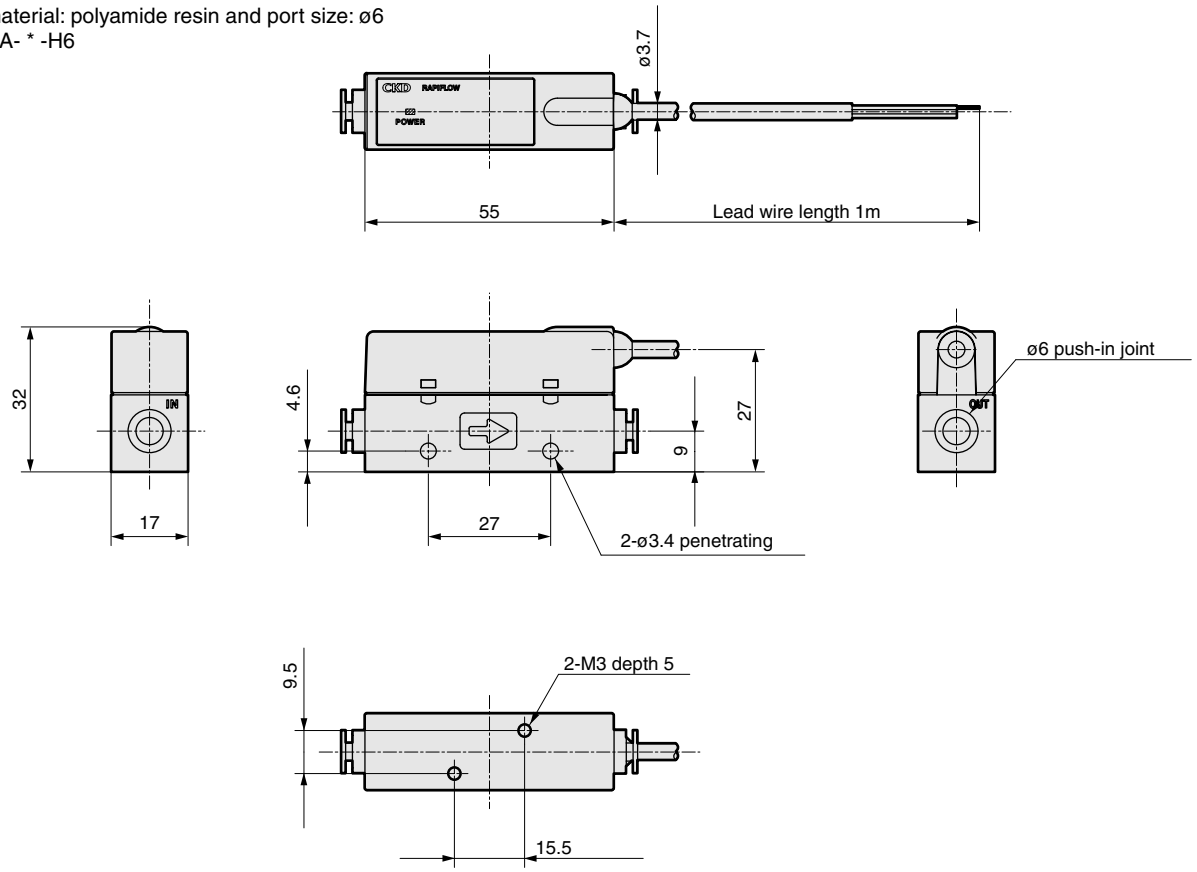
	Model no.	Flow rate range ℓ /min	A	B	C	D	E
Air and nitrogen gas	FSM-N/P-005-6A	0.05 to 0.5	37	27	4.6	9	Rc1/8
	FSM-N/P-005-M5						M5
	FSM-N/P-010-6A	0.1 to 1	37	27	4.6	9	Rc1/8
	FSM-N/P-010-M5						M5
	FSM-N/P-050-6A	0.5 to 5	37	27	4.6	9	Rc1/8
	FSM-N/P-050-M5						M5
	FSM-N/P-100-6A	1 to 10	37	27	4.6	9	Rc1/8
	FSM-N/P-100-M5						M5
	FSM-N/P-200-6A	2 to 20	37	27	4.6	9	Rc1/8
	FSM-N/P-200-M5						M5
	FSM-N/P-500-6A/6AA	5 to 50	39.5	29.5	4.6	9	Rc1/8
	FSM-N/P-101-8A/8AA	10 to 100	47	37	4.6	14	Rc1/4
Argon and carbon dioxide	FSM-N/P-005-6A/6AA-AR/CO2	0.05 to 0.5	37	27	4.6	9	Rc1/8
	FSM-N/P-005-M5/M5A-AR/CO2						M5
	FSM-N/P-010-6A/6AA-AR/CO2	0.1 to 1	37	27	4.6	9	Rc1/8
	FSM-N/P-010-M5/M5A-AR/CO2						M5
	FSM-N/P-050-6A/6AA-AR/CO2	0.5 to 5	37	27	4.6	9	Rc1/8
	FSM-N/P-050-M5/M5A-AR/CO2						M5
	FSM-N/P-100-6A/6AA-AR	1 to 10	37	27	4.6	9	Rc1/8
	FSM-N/P-100-M5/M5A-AR						M5
	FSM-N/P-100-6A/6AA-CO2	1 to 10	39.5	29.5	4.6	9	Rc1/8
	FSM-N/P-200-6A/6AA-AR/CO2	2 to 20	39.5	29.5	4.6	9	Rc1/8
	FSM-N/P-500-6A/6AA-AR/CO2	5 to 50	39.5	29.5	4.6	9	Rc1/8

Dimensions (analog output type)

Body material: polyamide resin and port size: ø4
●FSM-A- * -H4

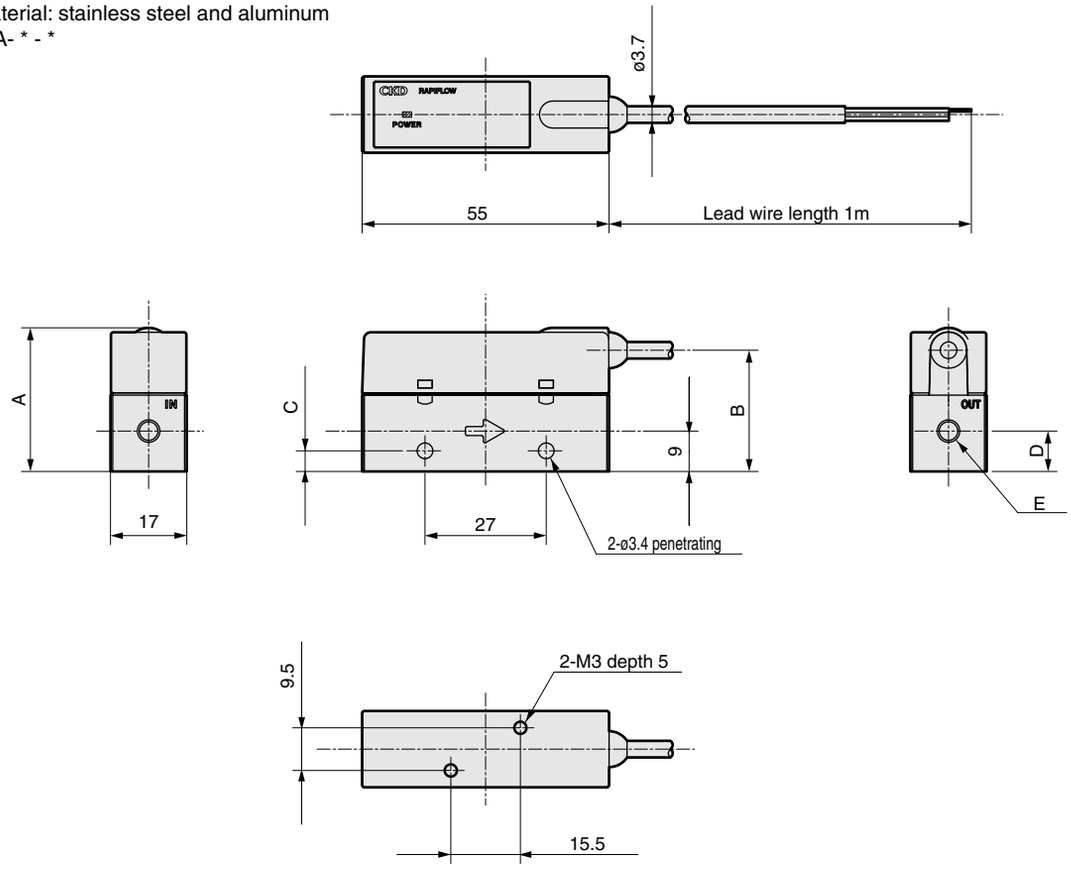


Body material: polyamide resin and port size: ø6
●FSM-A- * -H6



Dimensions (analog output type)

Body material: stainless steel and aluminum
● FSM-A- * - *

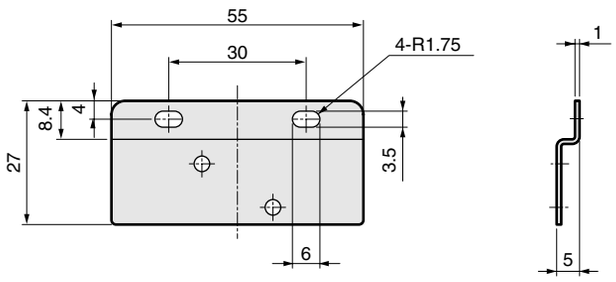


	Model no.	Flow rate range ℓ /min	A	B	C	D	E
Air and nitrogen gas	FSM-A-005-6A	0.05 to 0.5	32	27	4.6	9	Rc1/8
	FSM-A-005-M5						M5
	FSM-A-010-6A	0.1 to 1	32	27	4.6	9	Rc1/8
	FSM-A-010-M5						M5
	FSM-A-050-6A	0.5 to 5	32	27	4.6	9	Rc1/8
	FSM-A-050-M5						M5
	FSM-A-100-6A	1 to 10	32	27	4.6	9	Rc1/8
	FSM-A-100-M5						M5
	FSM-A-200-6A	2 to 20	32	27	4.6	9	Rc1/8
	FSM-A-200-M5						M5
	FSM-A-500-6A/6AA	5 to 50	34.5	29.5	4.6	9	Rc1/8
	FSM-A-101-8A/8AA	10 to 100	42	37	4.6	14	Rc1/4
Argon and carbon dioxide	FSM-A-005-6A/6AA-AR/CO2	0.05 to 0.5	32	27	4.6	9	Rc1/8
	FSM-A-005-M5/M5A-AR/CO2						M5
	FSM-A-010-6A/6AA-AR/CO2	0.1 to 1	32	27	4.6	9	Rc1/8
	FSM-A-010-M5/M5A-AR/CO2						M5
	FSM-A-050-6A/6AA-AR/CO2	0.5 to 5	32	27	4.6	9	Rc1/8
	FSM-A-050-M5/M5A-AR/CO2						M5
	FSM-A-100-6A/6AA-AR	1 to 10	32	27	4.6	9	Rc1/8
	FSM-A-100-M5/M5A-AR						M5
	FSM-A-100-6A/6AA-CO2	1 to 10	34.5	29.5	4.6	9	Rc1/8
	FSM-A-200-6A/6AA-AR/CO2	2 to 20	34.5	29.5	4.6	9	Rc1/8
	FSM-A-500-6A/6AA-AR/CO2	5 to 50	34.5	29.5	4.6	9	Rc1/8

*Dimensions of a separate indicator FSM-A-D * - * are same as FSM-V-D * - * . Refer to Page 35.

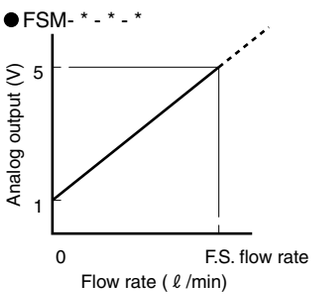
Dimensions (bracket)

Model no.: **FSM-LB1**



With M3 (length 6mm) 4 set screws for fixing

Analog output characteristics

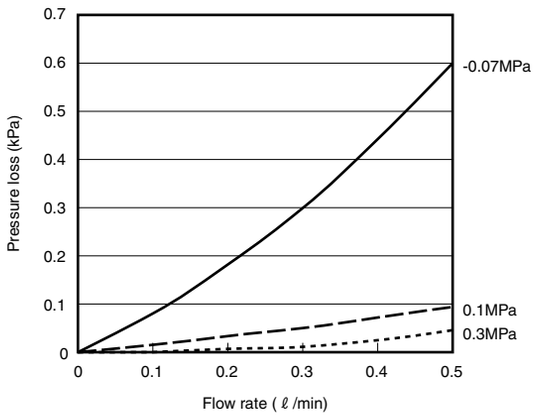


(Note) If out of flow rate range, the output will reach up to max8V.

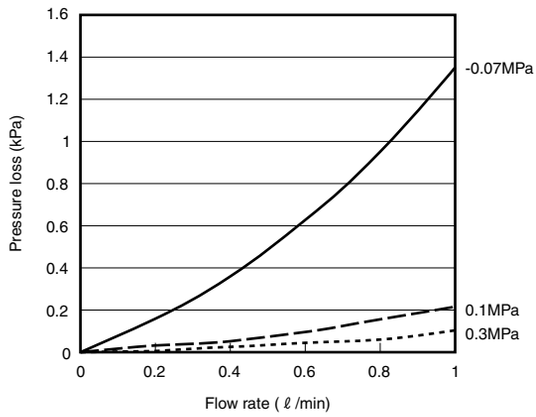
For name, functions and operation of display/controls,
refer to Page 23 for display integrated type, while to Page 35 for a separate indicator type.

Pressure loss properties (air and nitrogen gas)

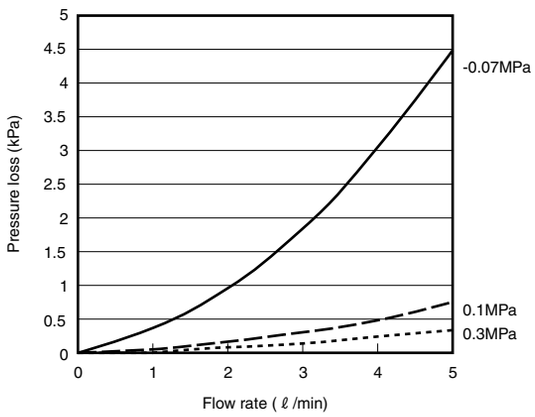
● FSM- * -005- *



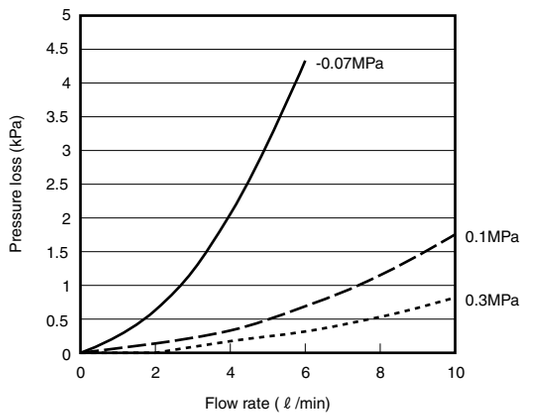
● FSM- * -010- *



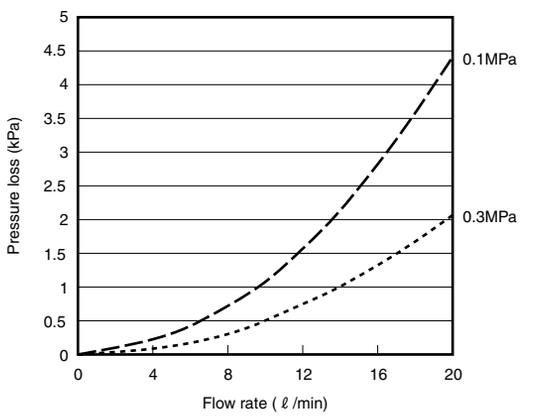
● FSM- * -050- *



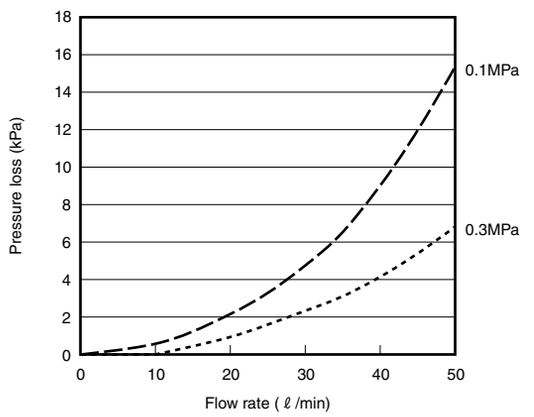
● FSM- * -100- *



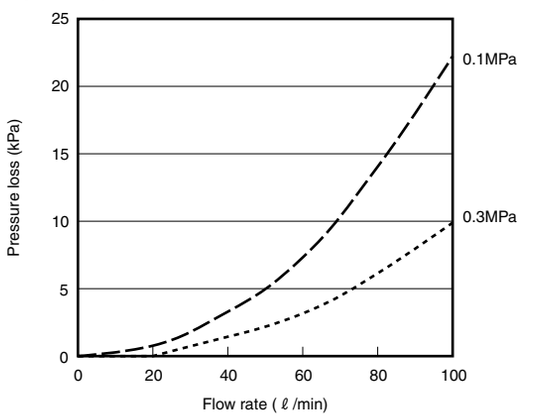
● FSM- * -200- *



● FSM- * -500- *

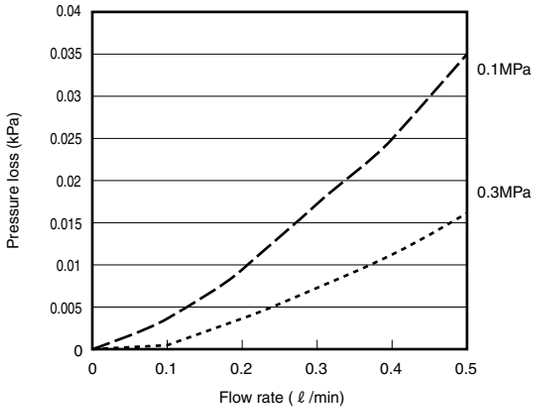


● FSM- * -101- *

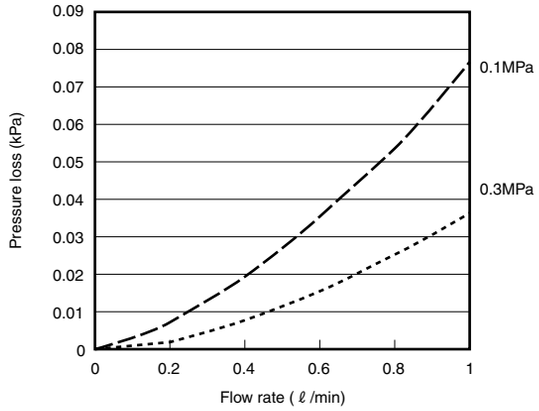


Pressure loss characteristics (argon)

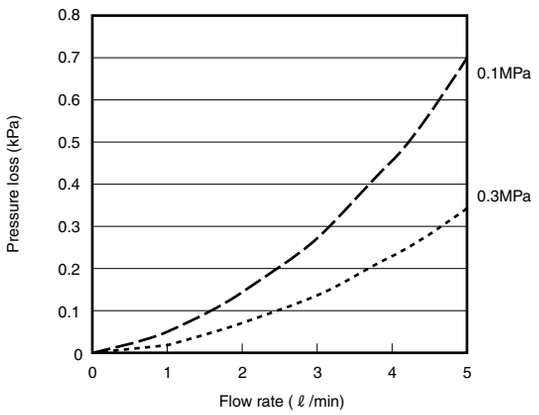
●FSM- * -005- * -AR



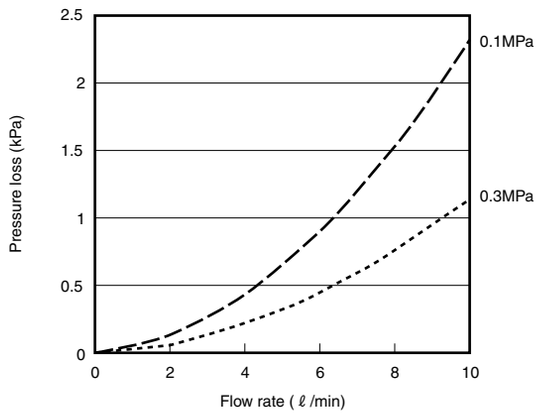
●FSM- * -010- * -AR



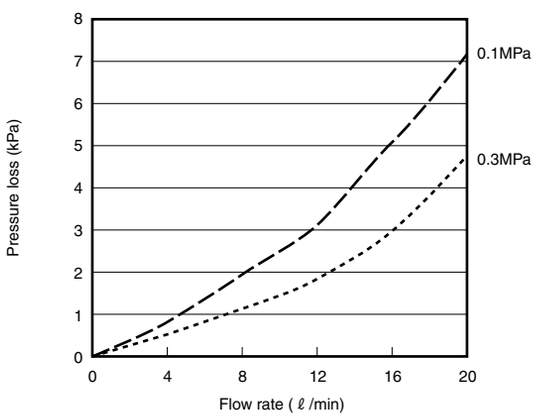
●FSM- * -050- * -AR



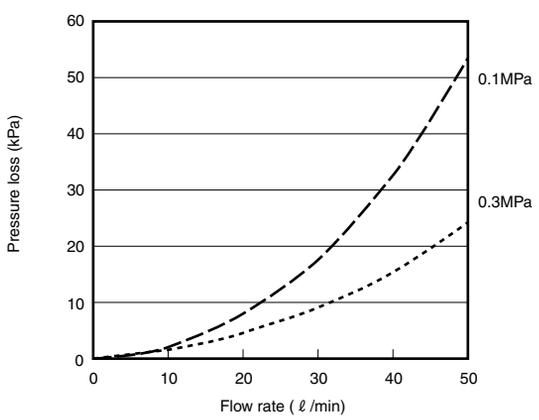
●FSM- * -100- * -AR



●FSM- * -200- * -AR

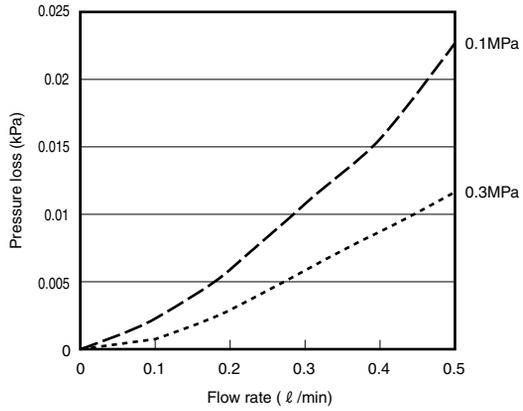


●FSM- * -500- * -AR

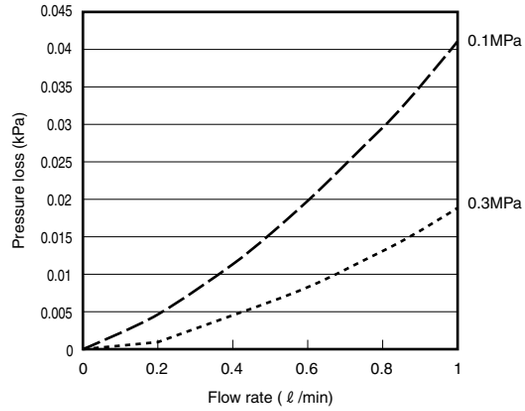


Pressure loss characteristics (carbon dioxide)

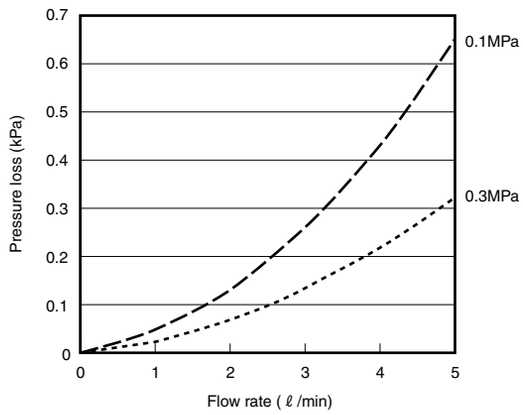
●FSM- * -005- * -CO2



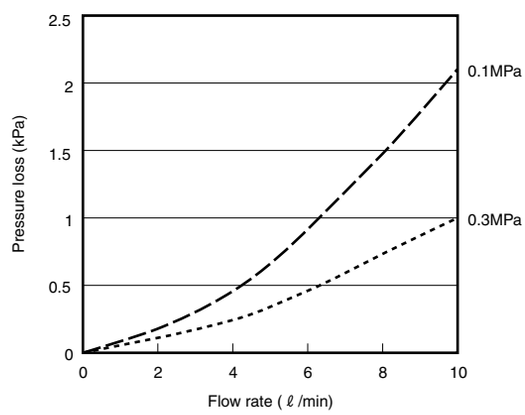
●FSM- * -010- * -CO2



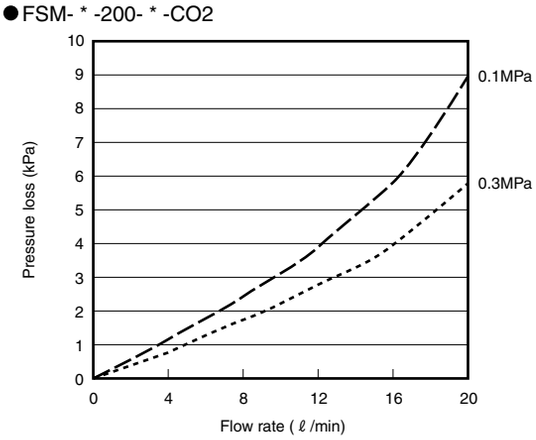
●FSM- * -050- * -CO2



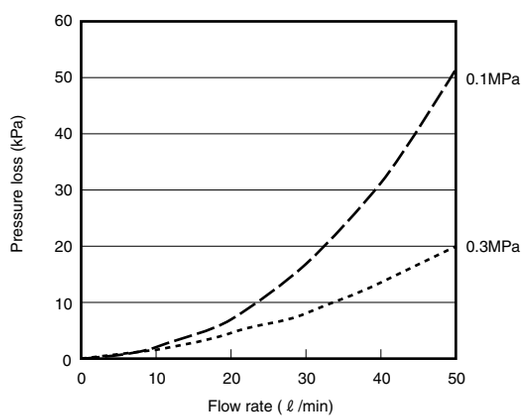
●FSM- * -100- * -CO2



●FSM- * -200- * -CO2

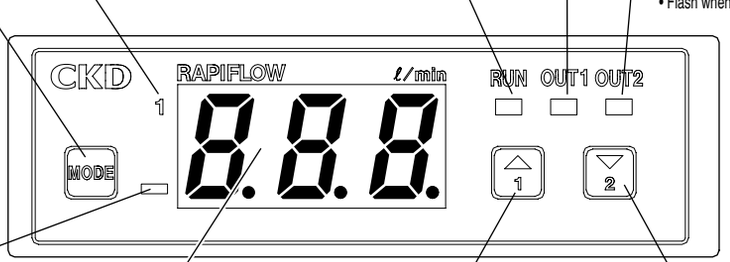


●FSM- * -500- * -CO2



Name and functions of display/controls

● Display integrated type (common for FSM-H/FSM series)



Overflow indication
- If the limit of 3-digit display is reached, the display will be lighted to show " 1 ". (This " 1 " will be lighted when 10.00 ℓ /min, then 3-digit LED show 0.00.)

RUN display
- Light turned on when displaying flow rate.
- Flash when peak hold operation.
- Light turned off depending on setting mode.

Output (OUT1) display
- Light turned on when CH1 output turned on
- Flash when overcurrent detected

Output (OUT2) display
- Light turned on when CH2 output turned on
- Flash when overcurrent detected

MODE key
- Used when entering various setting modes.
- Used when returning to flow rate display.
- Used when releasing peak hold operation.

Minus display [excluding FSM (for compressed air or nitrogen)]
- Light turned on when flowing reversely

3-digit LED display
- The flow rate/various switches' setpoints, etc., are displayed.
- If of overflow, H 0 is displayed.
- If of the reverse direction overflow, L 0 is displayed. (FSM [for compressed air or nitrogen] excluded)

1 (UP) key
- Data of CH1 is displayed in turn when displaying flow rate.
- The maximum value is displayed during peak hold operation.
- A mode is determined when selecting the mode.
- Used for count-up when setting each data.

2 (DOWN) key
- Data of CH2 is displayed in turn when displaying flow rate.
- The minimum value is displayed during peak hold operation.
- Used for count down when setting each data.

*In FSM-H series, the design of front sheet differs. Same names and functions of display/controls are used.

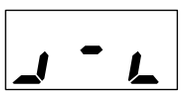
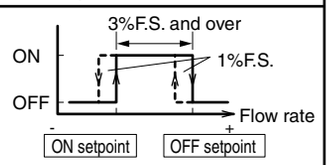
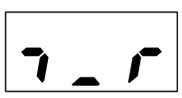
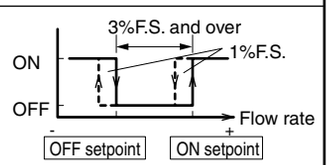
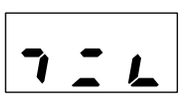
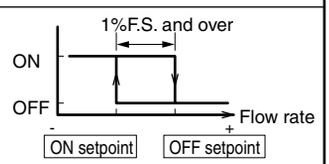
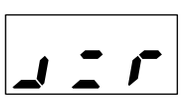
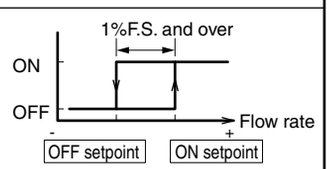
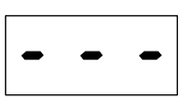
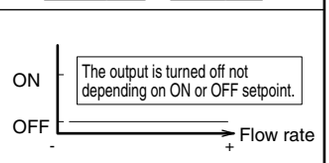
● Separate indicator type

Refer to Page 37 to 40 for names, functions and operations of display/controls.

Operation

Switch output function

Switching mode

Operation pattern name	LED display	Operation waveform
Window operation 1 (Range inside ON)		
Window operation 2 (Range out ON)		
Hysteresis operation 1 (Flow rate small side ON)		
Hysteresis operation 2 (Flow rate large side ON)		
Switch output OFF		

Note 1. Maintain intervals more than 3%F.S. between two setpoints during window operation.
Hysteresis of 1%F.S. is provided on both ON and OFF sides automatically.

Note 2. Maintain intervals more than 1%F.S. between two setpoints when hysteresis operation.
If the differential between 2 setpoints above is not maintained, it may result in not operated or unstable operation.

Note 3. If a switch is activated in unstable flow rate state such as a fluid pulsation, etc., unstable operation may be provided.
In this case, maintain the difference between two setpoints satisfactorily, use the product after checking that switching is stabilized.

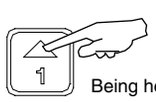
Note 4. In operation waveform, left shows the minus side, while, right shows the plus side.

Note 5. If waveform pattern is decided, magnitude of ON and OFF setpoints is decided, and the reverse magnitude is not allowed.
However, in this product, operation with the specified operation pattern has precedence over all things.
When the two setpoints are inputted, the magnitude is identified automatically, processing each identification properly as ON or OFF setpoint.
As result, even if ON or OFF setpoint is inputted reversely, re-recognized as correct ON or OFF setpoint, always operating with the specified operation pattern.

Setpoint verification method

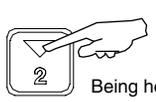
CH1 data display

If each key is pressed down with flow rate displayed, switch data ON or OFF setpoint/operation waveform, zero adjust value and the model are displayed to check.
Switching is not affected during this operation.

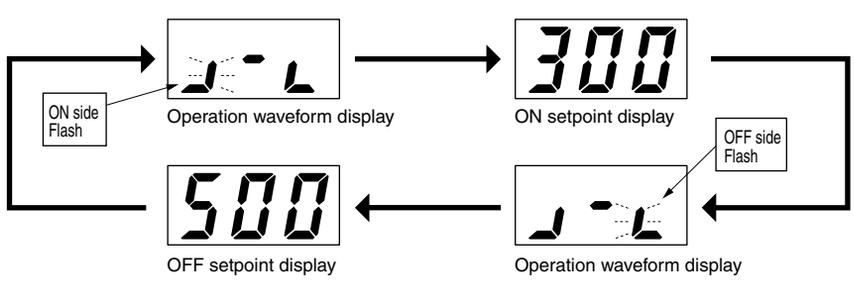


Being held down.

CH2 data display



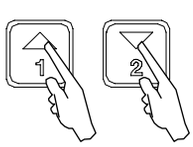
Being held down.



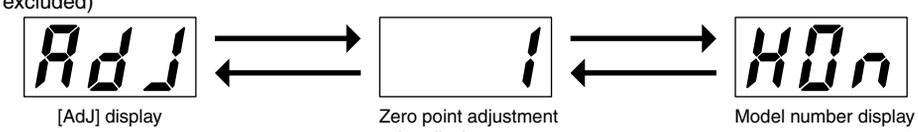
Zero point adjustment value/model number display

(FSM [for compressed air or nitrogen] excluded)

Zero point adjustment value and model number display are displayed alternately.
Switching is not affected even during operation.



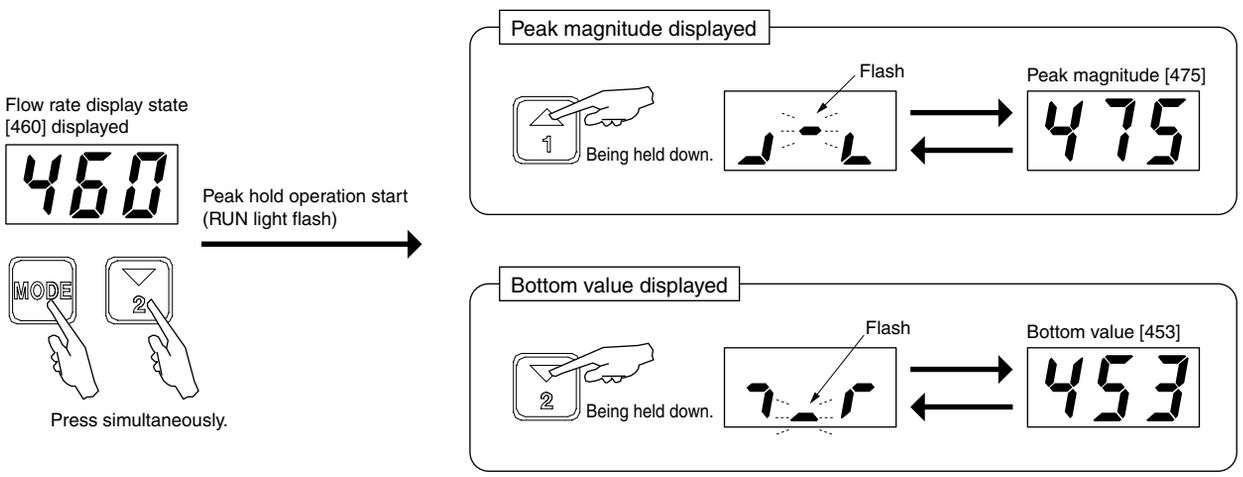
Press simultaneously.



How to operate each function

Peak hold function

Maximum and minimum flow rate values during the specified period can be read.
Use this setpoint when checking instantaneous flow rate change.
Also, peak hold operation never affects the basic function of this product such as switching and flow rate display, etc.



Switch output function

Refer to Page 26 for the operation.

Having 2 pieces of switch output, 4 operation patterns and stop of operation can be set.
Setting the required operation pattern and the two setpoints (ON and OFF setpoints) defining operating points allows the switch function to start.
First determine operation pattern and ON and OFF setpoints to be used before setting work.
Select and set next data to operate a switch.

CH1: operation pattern	CH1: ON setpoint	CH1: OFF setpoint
CH2: operation pattern	CH2: ON setpoint	CH2: OFF setpoint

Forcible output function

Refer to Page 26 for the operation.

Switch output is turned on forcibly to check wiring connection and initial operation of input unit.
(Note) This test function is to be used to check wiring and operation of input unit.
Avoid using this function to run sequence program instead of actual signals, while machinery and equipment are being operated.

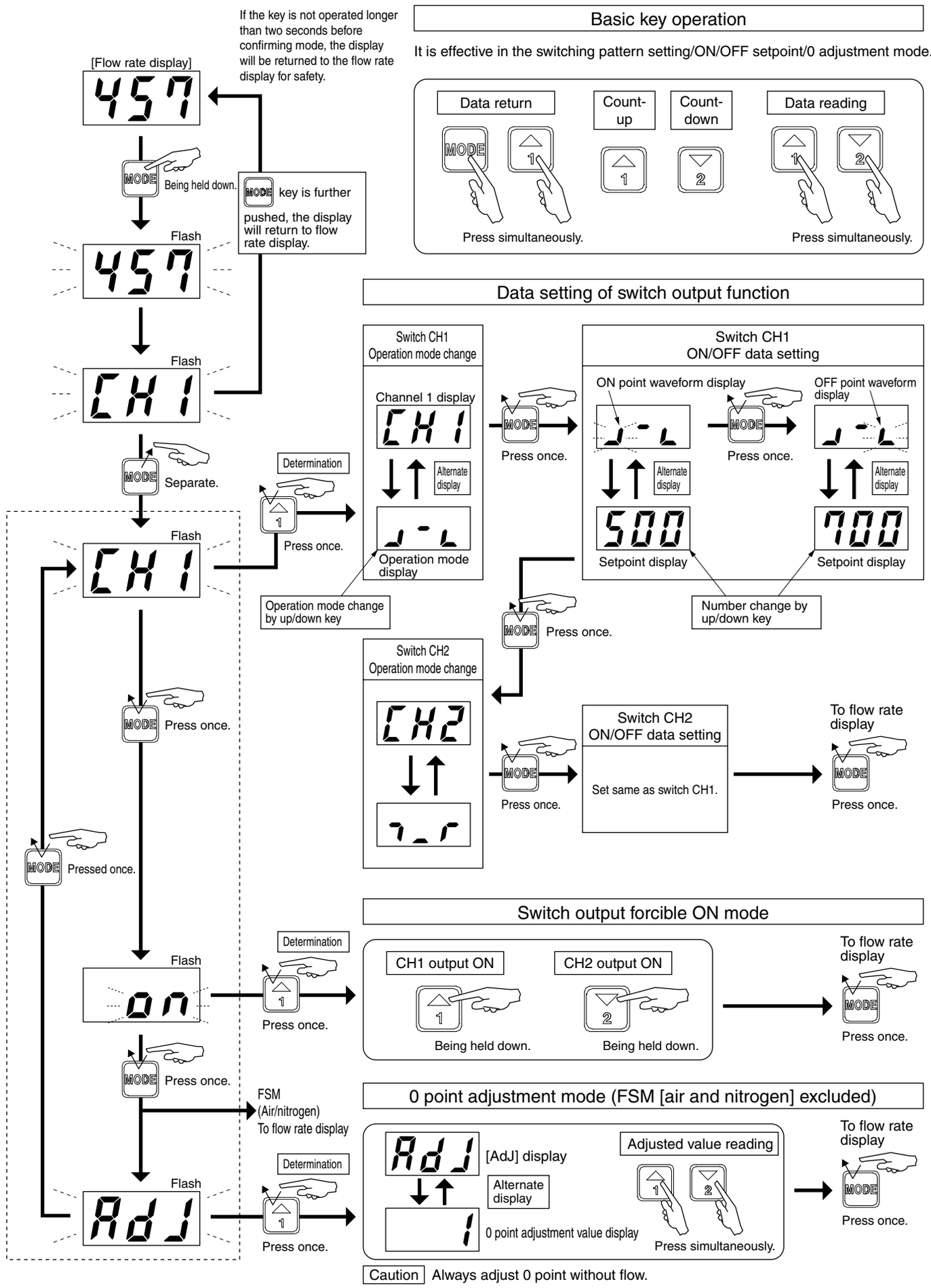
0 point adjustment function

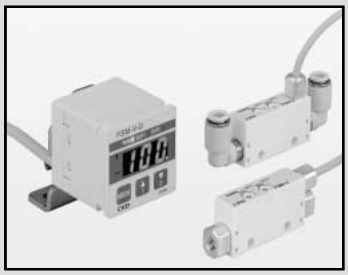
Refer to Page 26 for the operation (FSM [for compressed air or nitrogen] excluded).

Deviation of the display from 0 is corrected without flow.

(Note) Above setting and tests affect output signals and indicated values seriously.
Always stop machinery and equipment using this product, then check that the safety is secured, even if malfunction or wrong display is occurred, before starting operation.
Handling during operation may produce an accident, malfunction and wrong display, causing a danger.

Switch output function/forcible output function/0 point adjustment operation





Miniature flow sensor
Analog output type/switch output

FSM-V Series (Air/nitrogen gas)

●Flow rate range:±0.05, ±0.1, ±0.5, ±1, ±5, ±10 ℓ /min

Sensor body specifications

Model no.		Analog output type						Switch output type					
Descriptions		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)		-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
(References) Applicable nozzle of suction-separation application		ø0.1 nozzle		ø0.2 nozzle	ø0.3 nozzle	Collet nozzle		ø0.1 nozzle		ø0.2 nozzle	ø0.3 nozzle	Collet nozzle	
Working conditions	Working fluid	Clean air (JIS B 8392-1.1.2 to 5.6.2), compressed air (JIS B 8392-1.1.2 to 1.6.2) Note 1 and nitrogen gas											
	Maximum working pressure MPa	0.2											
	Minimum working pressure MPa	-0.1											
	Withstanding pressure MPa	0.3											
	Ambient temperature/humidity ˚C	0 to 50 and 90%RH or less (to be no dew condensation.)											
	Working fluid temperature ˚C	0 to 50											
Display		Power display (green)						Power display (green) and switch output (yellow)					
Output		Analog output 1 point Note 2 (1-5V voltage output and connected load impedance 50K Ω and over)						Switch output 2 points Note 3 (NPN or PNP open collector output and PLC/relay)					
Analog output accuracy Note 4	Linearity	±5%F.S. or less (0.1MPa, 25 ˚C and flow rate range ±100%F.S.)						———					
	Pressure characteristics	±5%F.S. or less (-0.09 to 0.2MPa, 0.1MPa criteria)						———					
	Temperature characteristics	±0.2%F.S./˚C or less (15 to 35 ˚C, 25 ˚C criteria)						———					
	Repeatability	±1%F.S. or less				±2%F.S. or less		±2%F.S. or less					
Response time		5ms or less (when sensor discrete/final arrival output voltage reaches 90%.) Note 5											
Power supply voltage		DC12/24V (10.8 to 26.4V)											
Current consumption		30mA or less											
Lead wire		ø2.6 0.15mm² X 3-conductor (3m)						ø2.6 0.15mm² X 4-conductor (3m)					
Installation	Installation attitude	Both vertical and horizontal											
	Installation strait piping section	Not required											
Protective structure		IEC standards IP40											
Vibration resistance		10 to 150Hz, compound amplitude 1.5mm, maximum 10G and each XYZ directions 2 hours											
EMC directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8											
Mass g		Approximate 8 (excluding lead wire and joint)											

Note 1: Refer to Page 2 for compressed air quality class in accordance with JIS B 8392-1: 2000.
Note 2: Analog output shows 3V when flow 0, while viewing the body with lead wire on the right side, the output will shift to 5V sides. If of reverse flow, the output shift to 1V side.
Note 3: Switch output is 1 boundary value identification method with fixed hysteresis, and can be set by turning trimmer within the total flow rate range. Also, operation modes of OUT1 and OUT2 are reverse.
Note 4: The specified F.S. (full scale) shows flow rate range. For example, F.S. with flow rate range: -10 to +10 ℓ /min, shows 20 ℓ /min.
Note 5: The response time may change depended with piping condition.
Note 6: When using this product for adsorption verification, always install an air filter (filtration rating 30 μ m or less) to prevent suction of foreign materials between adsorption nozzle and this product. Also, when compressed air is used, always install a filter (for drain removing) on the primary side (upstream).

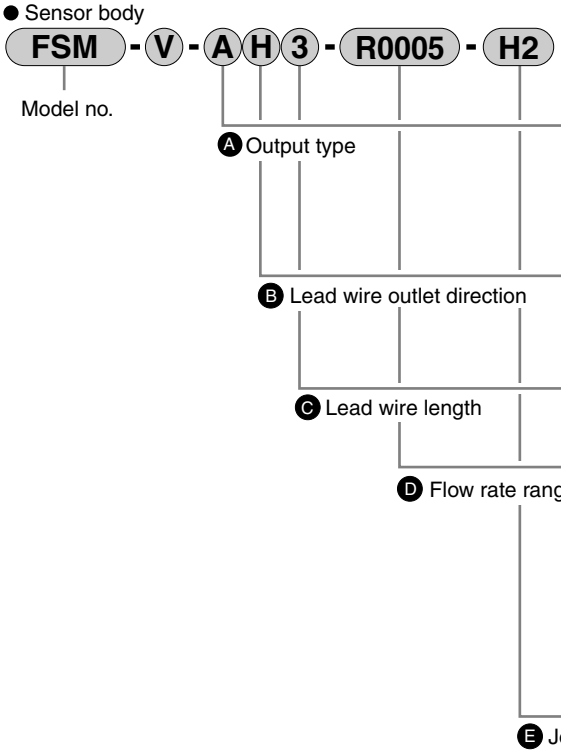
Separate indicator specifications (analog output type only) Note 7

Model no.	Separate indicator					
Descriptions	FSM-V-D$^{N}/_{P}$-R0005	FSM-V-D$^{N}/_{P}$-R0010	FSM-V-D$^{N}/_{P}$-R0050	FSM-V-D$^{N}/_{P}$-R0100	FSM-V-D$^{N}/_{P}$-R0500	FSM-V-D$^{N}/_{P}$-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
Display	Flow rate display (7 segments 3-digit orange) and operation switch output (orange)					
Output	Switch output 2 points (NPN or PNP open collector output, load current 50mA or less voltage drop 2.4V and PLC/relays) Analog output 1 point (1-5V voltage output and connected load impedance 50KΩ and over)					
Power supply voltage	DC12/24V (10.8 to 26.4V)					
Current consumption	50mA or less (indicator only)					
Lead wire	ø3.7 0.2mm² X 5-conductor (1m)					
Functions	Flow rate display, flow rate display- peak hold, switch output and analog output					
Ambient temperature/humidity	0 to 50 ˚C and 85%RH or less (to be no dew condensation.)					
Protective structure	IEC standards IP40					
EMC directive	EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8					
Mass g	Approximate 70 (including lead wire 1m)					

Note 7: A separate indicator is analog output type only. Care must be taken since switch output type can not be connected.

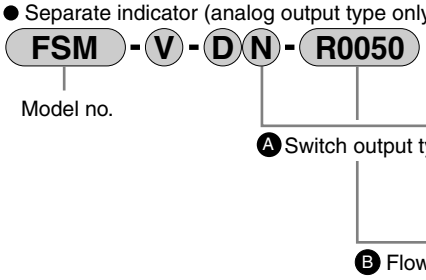
How to order

● Sensor body



Symbol	Content
A Output type	
A	Analog output
N	Switch output (NPN)
P	Switch output (PNP)
B Lead wire outlet 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	Axial ø1.8 fiber tube
H4	Axial ø4 push in
HL4	Radial ø4 push in
M5	Port size M5

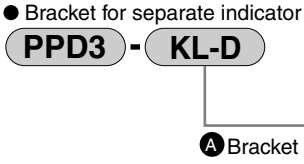
● Separate indicator (analog output type only)



Symbol	Content
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 Page 35 to 40 for the operation dimensions, etc.

● Bracket for separate indicator

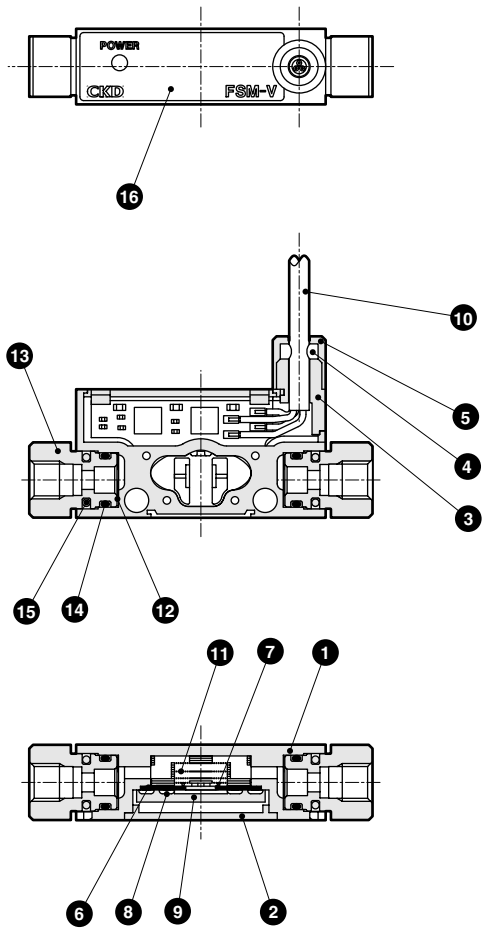


Symbol	Content
A Bracket kit	
KL-D	Single foot bracket (radial installation)
KD-D	Both sides foot brackets (parallel)
KHS-D	Panel mount bracket set cover attached
KC	Operation protective cover

*Refer to Page 35 and 36 for bracket dimensions and installation dimensions.

Internal structure and parts list

●FSM-V-**3-R*-M5/analog output type
(Switch output type uses same internal structure.)



No.	Parts name	Material	No.	Parts name	Material
1	Body	PBT (glass fiber 30%)	9	Electron circuit board	Glass epoxy resin
2	Case	PBT (glass fiber 30%)	10	Lead wire	Halogen-free polyethylene resin mixture
3	Lead wire holder	PBT (glass fiber 30%)	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	Nitrile rubber	14	O ring	Nitrile rubber
7	Sensor tip	Silicon	15	Joint fixing pin	Stainless steel
8	P tight screw	Iron steel (galvanization)	16	Front sheet	Polyester film

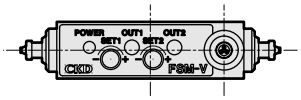
●Separate indicator FSM-V-D * -R *

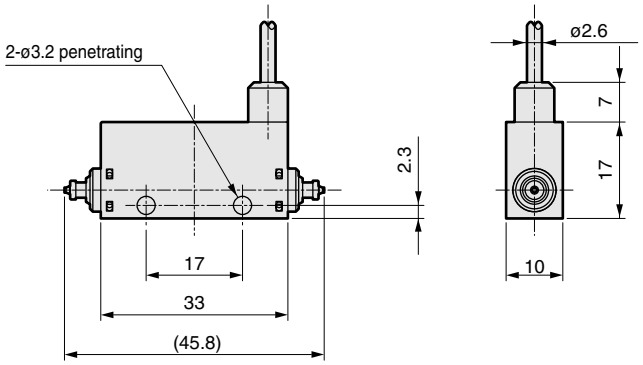
Refer to Page 35 for internal structure drawing.

MEMO

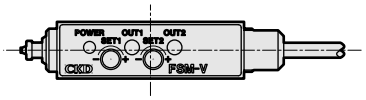
Dimensions (common for analog and switch output types)

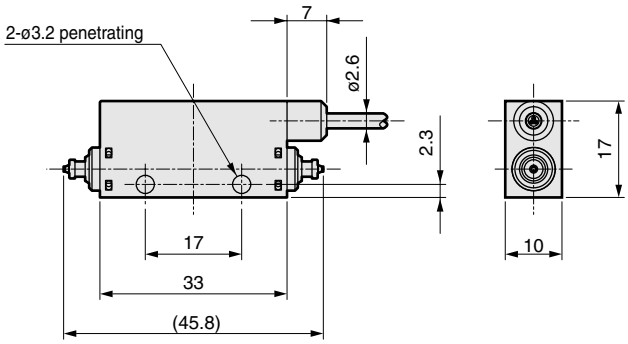
●FSM-V- * V3-R * -H2
(Radial lead wire and axial ø1.8 fiber tube)



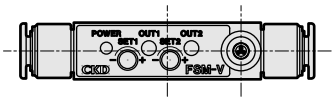


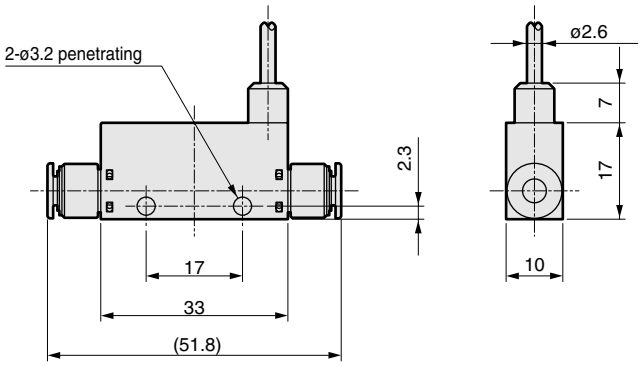
●FSM-V- * H3-R * -H2
(Axial lead wire and axial ø1.8 fiber tube)



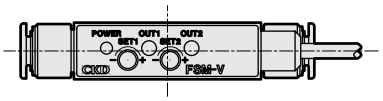


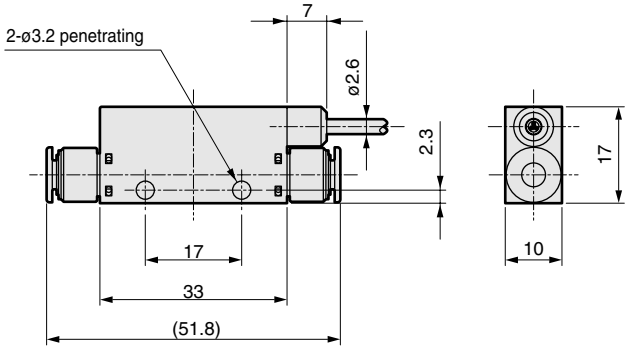
●FSM-V- * V3-R * -H4
(Radial lead wire and axial ø4 push in)





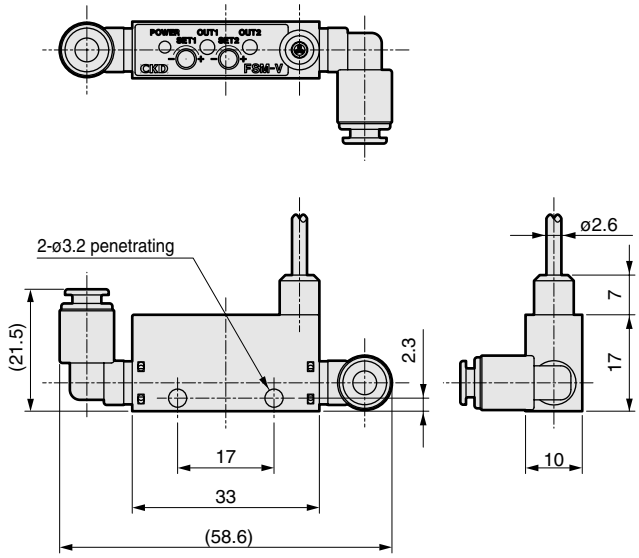
●FSM-V- * H3-R * -H4
(Axial lead wire and axial ø4 push in)



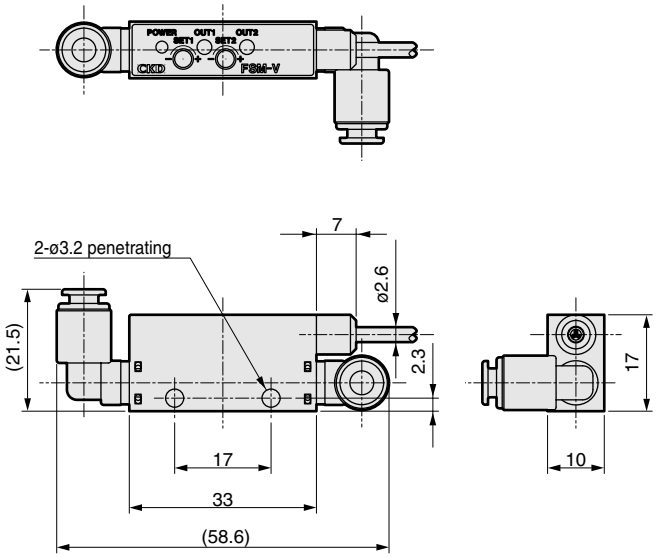


Dimensions

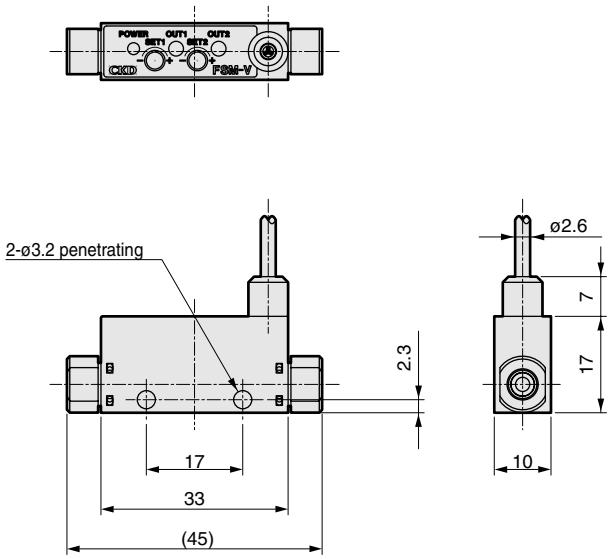
● FSM-V- * V3-R * -HL4
(Radial lead wire and radial ø4 push in)



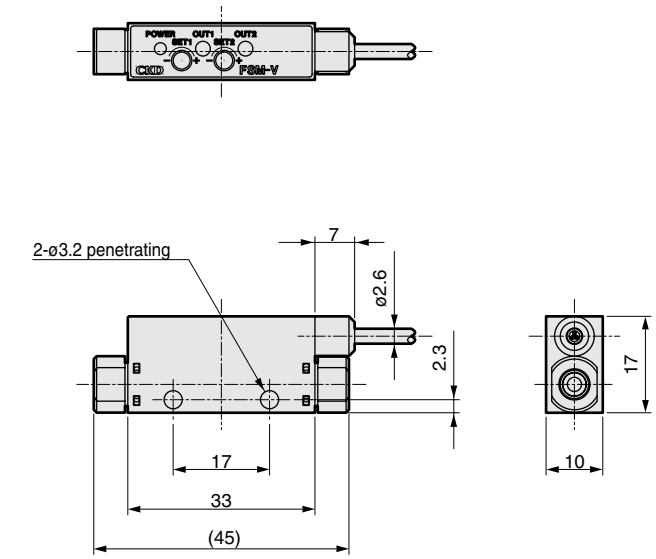
● FSM-V- * H3-R * -HL4
(Axial lead wire and radial ø4 push in)



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

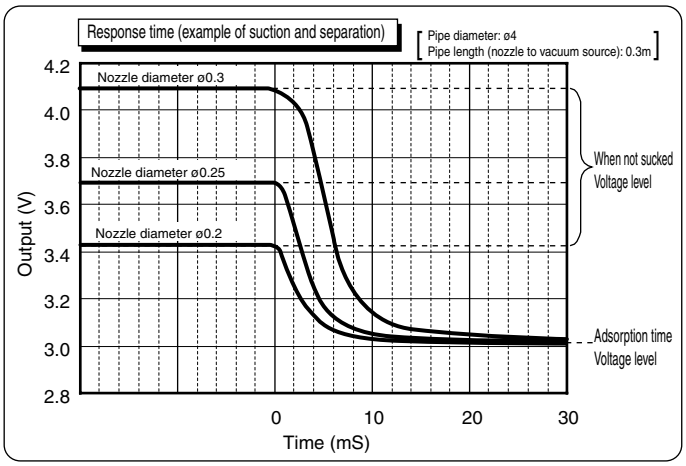


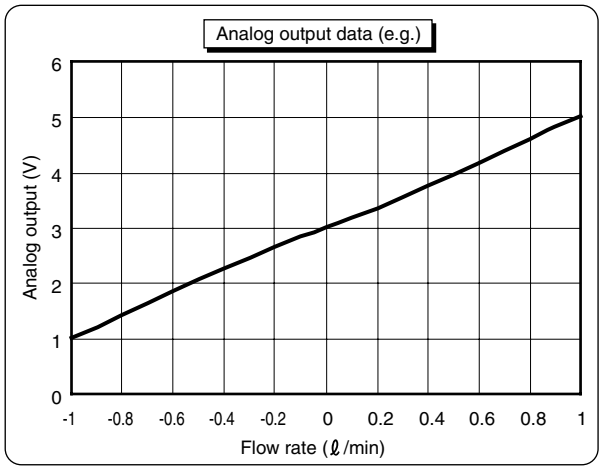
● FSM-V- * H3-R * -M5
(Axial lead wire and port size M5)



Analog output characteristics

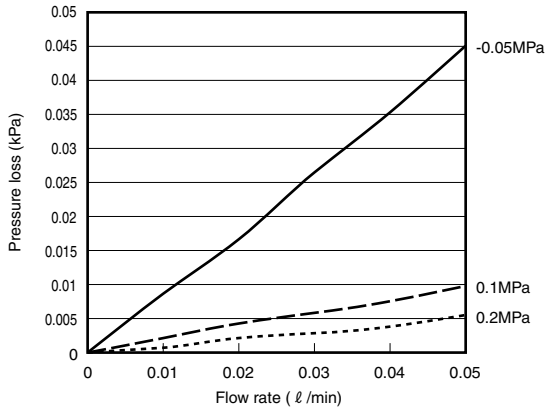
●FSM-V-A-R0100



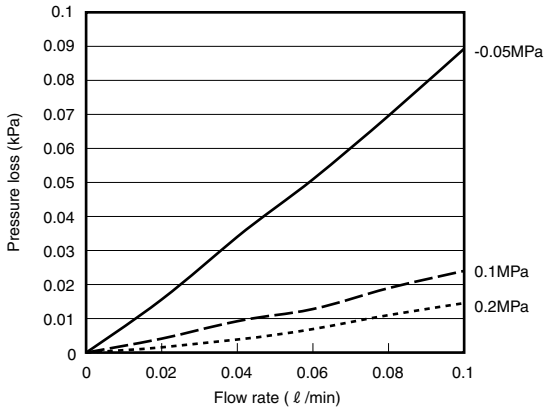


Pressure loss characteristics

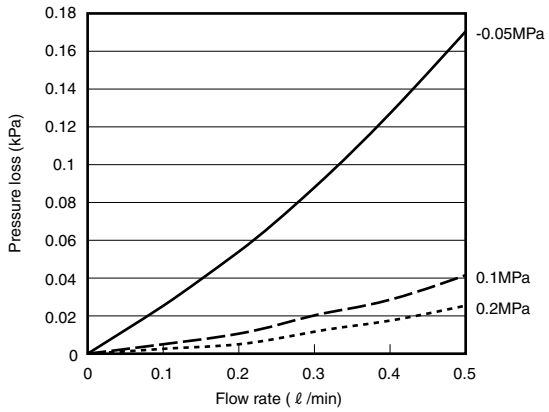
●FSM-V- * -R0005-H4



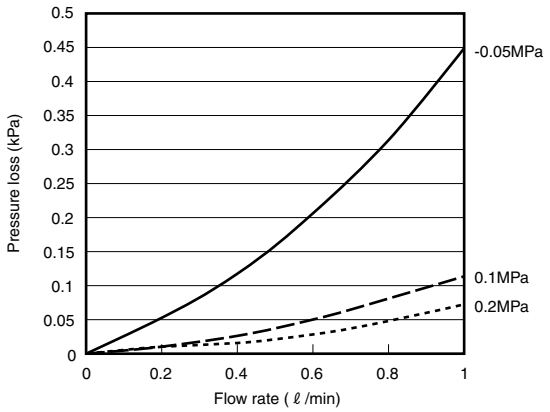
●FSM-V- * -R0010-H4



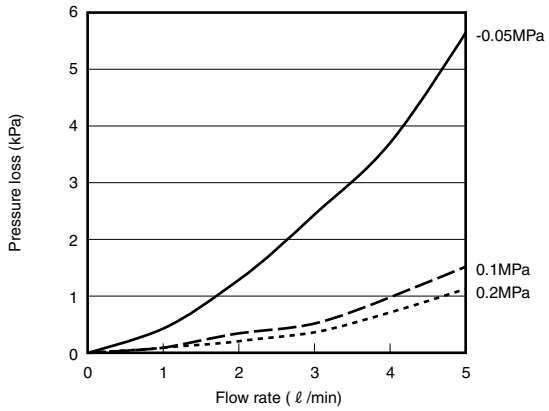
●FSM-V- * -R0050-H4



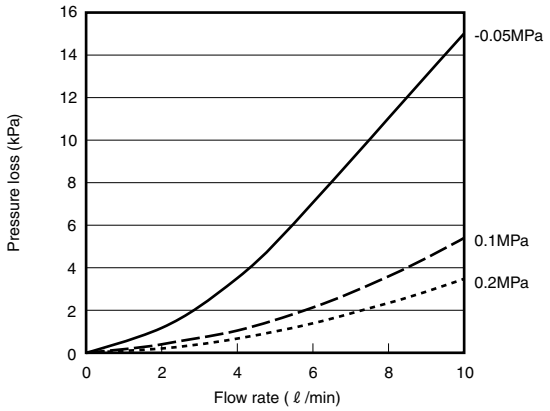
●FSM-V- * -R0100-H4



●FSM-V- * -R0500-H4



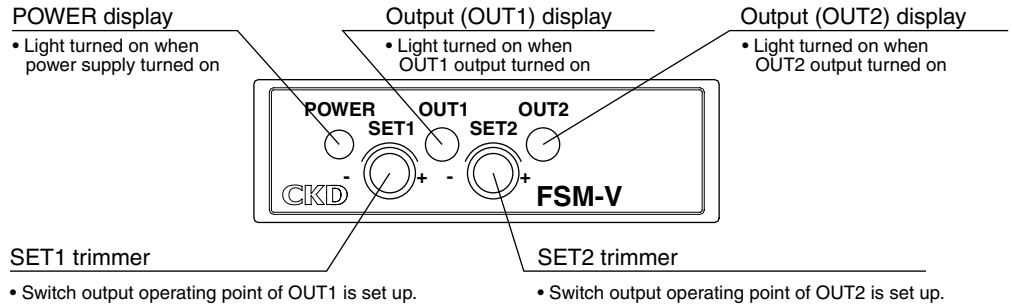
●FSM-V- * -R1000-H4



*If fiber tube is used, pressure loss may increase depending on piping condition.

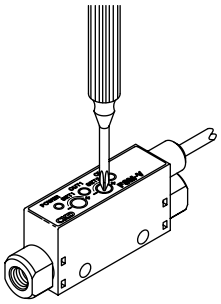
Name/function and setting methods of controls

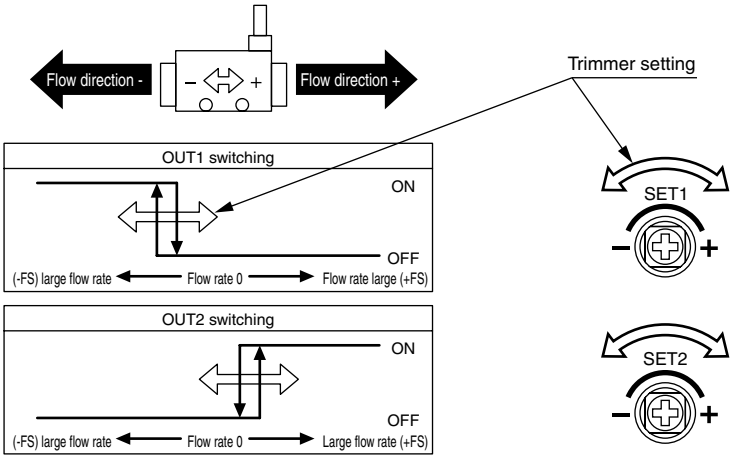
● Switch output type



Switch setting method (switching and fluid flow direction)

- Turn trimmer of SET1 and SET2 to set ON/OFF of two switch outputs (OUT1/OUT2). Care must be taken since different switching operations as shown right are applied to 2 points output.
- Use (+) screwdriver for 0 bit.

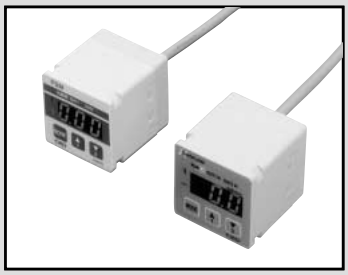




(Cautions) • Hysteresis of switch output is fixing value (10%FS or less).
• Do not hold down the trimmer by a screwdriver strongly, or trimmer may be damaged.

● Separate indicator

Refer to Page 37 for the name and functions operation of display controls of a separate indicator.

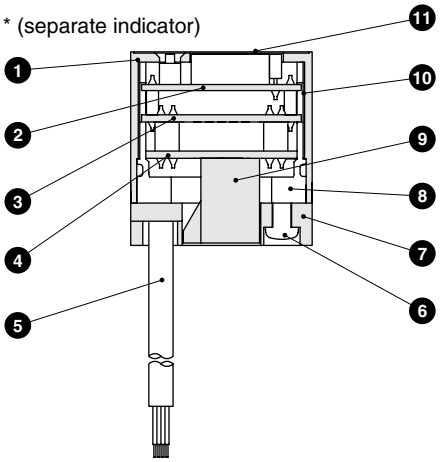


Separate indicator

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

Internal structure and parts list

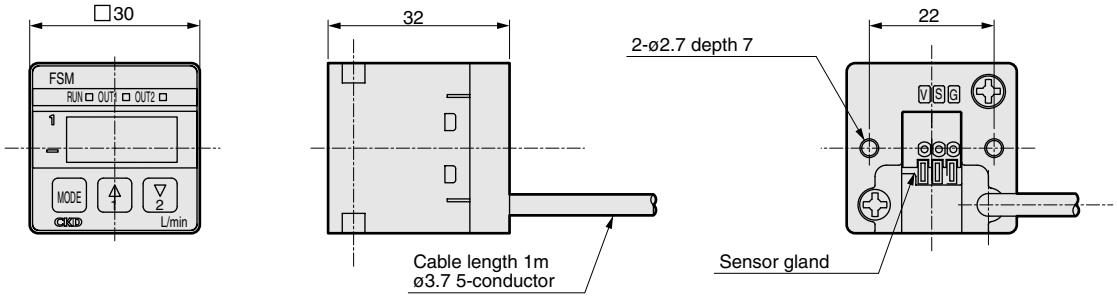
● FSM-H-D * - *
FSM-A-D * - *
FSM-V-D * - * (separate indicator)



No.	Parts name	Material
1	Case top	PBT (glass fiber 30%)
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 cover	PBT (glass fiber 15%)
8	Case medium	PBT (glass fiber 30%)
9	Gland	Polyamide/copper alloy (plating)
10	Shield sheet	Aluminum
11	Surface sheet	Polyester film

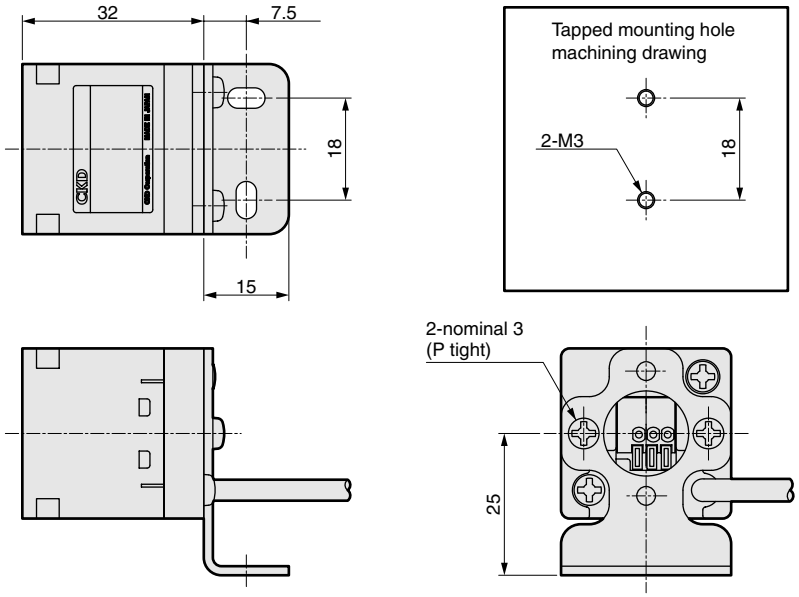
Dimensions

● FSM-H-D * - *
FSM-A-D * - *
FSM-V-D * - *



Bracket dimensions

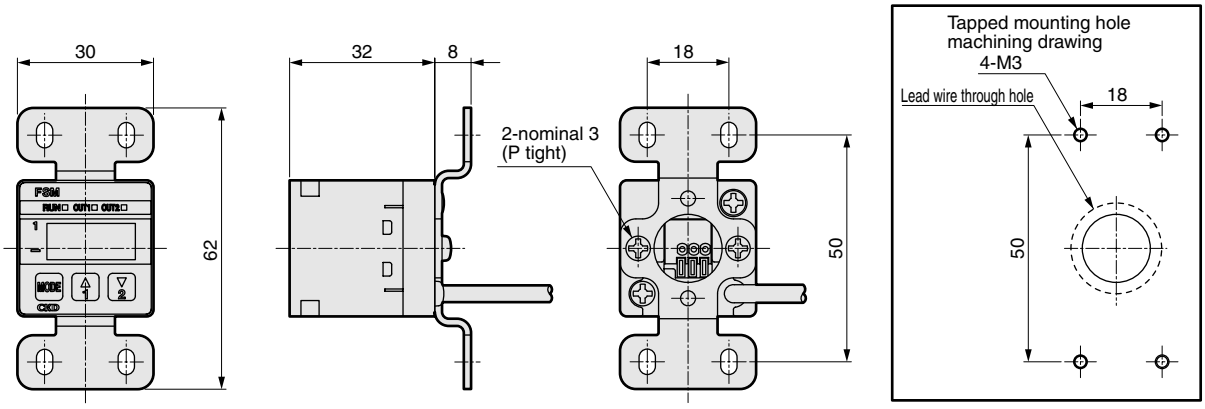
● Single foot bracket attached (PPD3-KL-D)
*L type bracket and 2 setscrews



This bracket can be installed per 90 deg. increment against the switch body.
Determine the installation attitude according to the location.

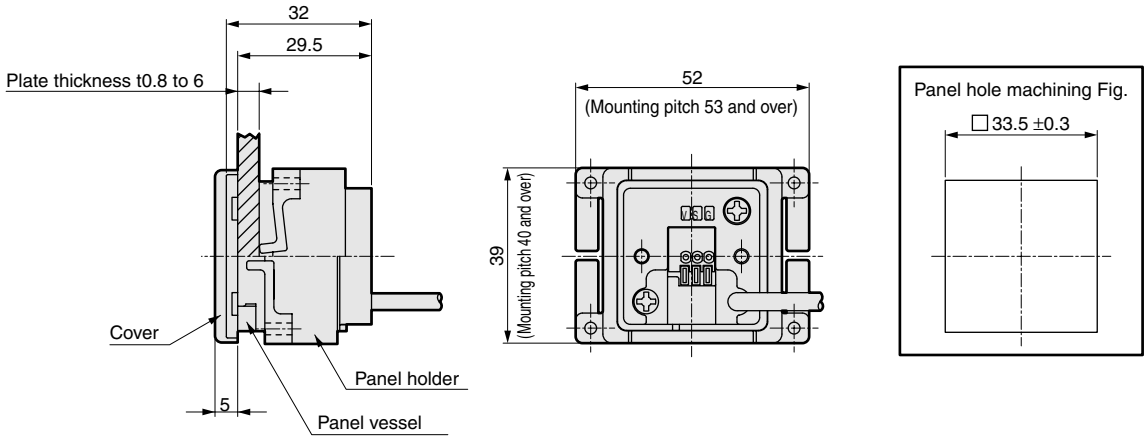
Bracket dimensions

● Both sides foot brackets attached (PPD3-KD-D)
*D type bracket and 2 setscrews



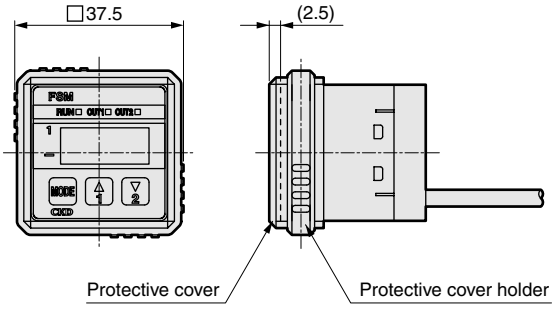
This bracket can be installed per 90 deg. increment.
Determine the installation attitude according to the location.

● Panel mount bracket set with cover (PPD3-KHS-D)
*Panel vessel, holder, key and cover.



For panel holder, the installation attitude can be changed
per 90 deg. increment.

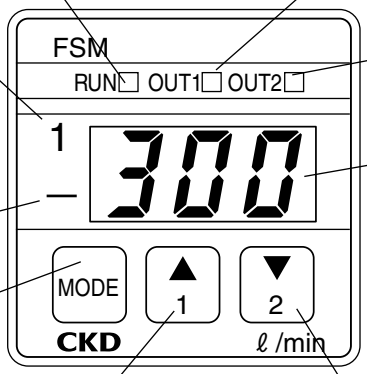
● Operation protective cover attached (PPD3-KC)
*Protective cover and its holder



Note: A combination with PPD3-KHS-D is not available.

Name and functions of display/controls

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



RUN display
- Light turned on when displaying flow rate.
- Flash when peak hold operation.

Overflow indication (excluding FSM-V-D *)
- If the limit of 3-digit display is reached, light will be turned on and 1 be shown. (In 10.00 ℓ /min, this 1 is turned on to display 0.00 with 3-digit LED.)

Minus display
- Light turned on when flowing reversely

MODE key
- Used when entering various setting modes.
- Used when advancing setting mode.
- Used when returning to flow rate display.
- Used when releasing peak hold operation.

1 (UP) key
- Data of CH1 is displayed in turn when displaying flow rate.
- The maximum value is displayed during peak hold operation.
- Determine the mode when selecting the mode.
- Used for count-up when setting each data

Output (OUT1) display
- Light turned on when CH1 output turned on
- Flash when overcurrent detected

Output (OUT2) display
- Light turned on when CH2 output turned on
- Flash when overcurrent detected

3-digit LED display
- Flow rate, various switches setpoints, etc or status are displayed.
- If of overflow, [H,] will be displayed.
- If of the reverse direction overflow, [Lo] will be displayed.

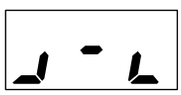
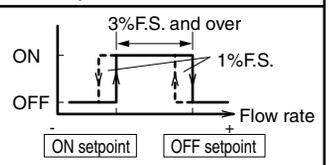
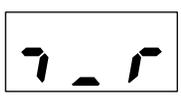
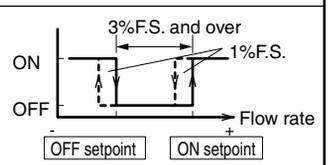
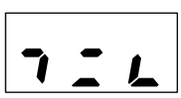
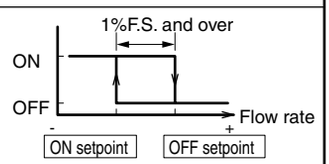
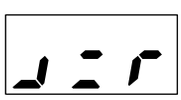
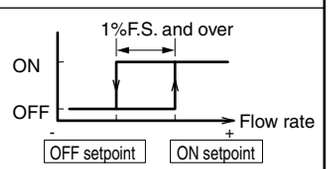
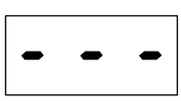
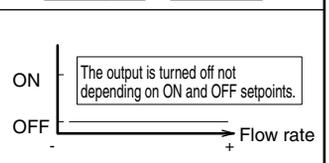
2 (DOWN) key
- Data of CH2 is displayed in turn when displaying flow rate.
- The minimum value is displayed during peak hold operation.
- Determine a mode when selecting the mode.
- Used for count-down when setting each data

*In FSM-H series, the design of front sheet differs. Name and functions of same display/controls are used.

Operation

Switch output function

Switching mode

Operation pattern name	LED display	Operation waveform
Window operation 1 (Range inside ON)		
Window operation 2 (Range out ON)		
Hysteresis operation 1 (Flow rate small side ON)		
Hysteresis operation 2 (Flow rate large side ON)		
Switch output OFF		

Note 1.Maintain intervals more than 3%F.S. between two setpoints during window operation. Hysteresis of 1%F.S. is provided on each ON and OFF sides automatically.

Note 2.Maintain intervals more than 1%F.S. between two setpoints when hysteresis operation.

Note 3.If the differential between above 2 setpoints is not satisfied, it may result in not operated or unstable operation.
If a switch is activated in unstable flow rate state such as a fluid pulsation, etc., unstable operation may be provided.
In this case, maintain the difference between two setpoints satisfactorily, use the product after checking that switching is stabilized.

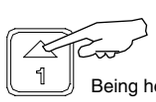
Note 4.In operation waveform, left side shows minus side, while, right shows plus side.

Note 5.If waveform pattern is decided, magnitude of ON and OFF setpoints is decided, and the reverse magnitude is not allowed.
However, in this product, operation with the specified operation pattern has precedence over all things.
When the two setpoints are inputted, the magnitude is identified automatically, processing the proper identification as ON and OFF setpoints.
As result, even if ON and OFF setpoints are inputted reversely, re-recognized as correct ON and OFF setpoints, always operating with the specified operation pattern.

Setpoint verification method

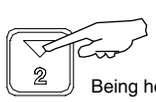
CH1 data display

If each key in flow rate display state is pressed down, switch data ON and OFF setpoints, operation waveform, zero adjust value and models are displayed to check.
Switching is not affected during this operation.

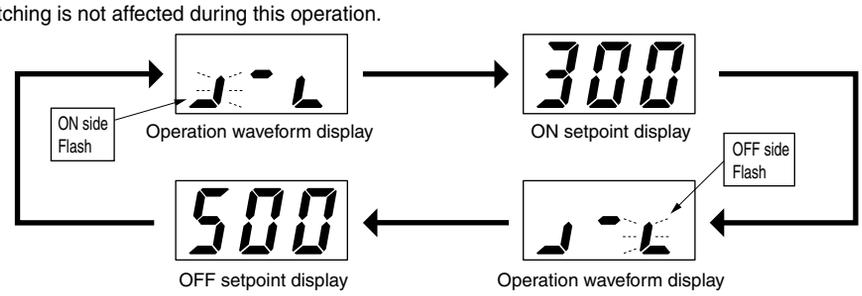


Being held down.

CH2 data display

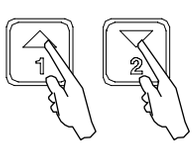


Being held down.

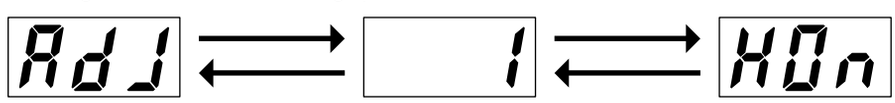


0 point adjustment value/model number display

Zero point adjustment value and model number display are displayed alternately.
Switching is not affected even during operation.



Press simultaneously.

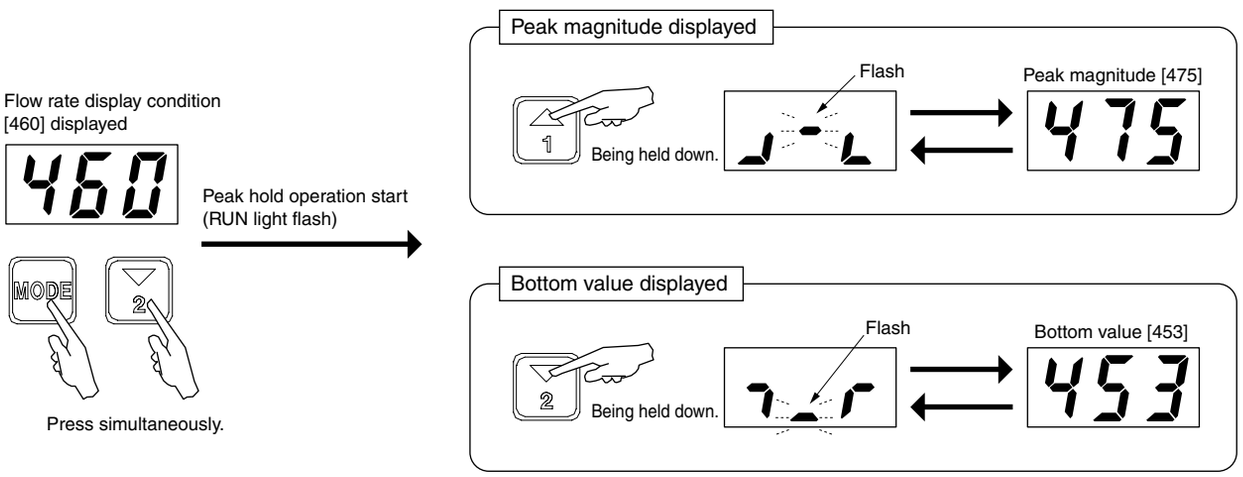


[AdJ] display　0 point adjustment value display　Model number display

Operation of each function

Peak hold function

Maximum and minimum values indicated with flow rate value can be read during the specified period.
Use this function when checking instantaneous flow rate change.
Also, peak hold operation never affects the basic function of this product such as switching and flow rate display, etc.



Switch output function

Refer to Page 40 for the operation.

Having 2 pieces of switch output, 4 operation patterns and stop of operation can be set.
Setting the required operation pattern and two setpoints (ON and OFF setpoints) that defines operating points allows the switch function to start.
First determine operation pattern and ON and OFF setpoints to be used before setting work.
Select and set next data to operate a switch.

CH1: Operation pattern	CH1: ON setpoint	CH1: OFF setpoint
CH2: Operation pattern	CH2: ON setpoint	CH2: OFF setpoint

Forcible output function

Refer to Page 40 for the operation.

Switch output ON forcibly, used for initial operation checking of wiring and input unit.
(Note) Use this test function for confirming wiring and action of input unit.
Avoid using this function instead of actual signals to run sequence program, while machinery and equipment are operated.

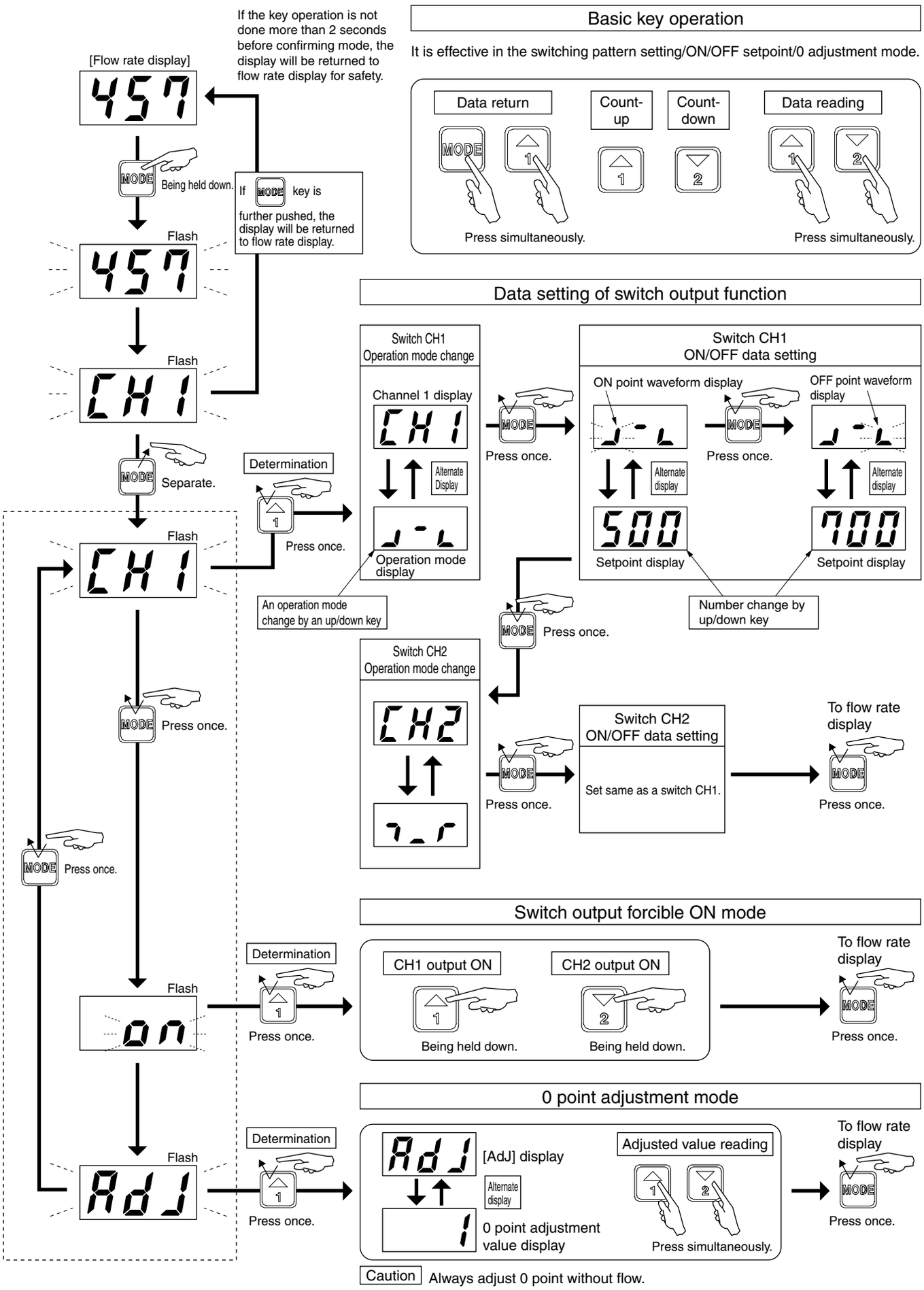
0 point adjustment function

Refer to Page 40 for the operation.

Deviation of the display from 0 is corrected without flow.

(Note) Above setting and tests affect output signal and indicated value seriously.
Always stop machinery and equipment using this product, and check that the safety is secured, even if malfunction/wrong display could be produced, then start the operation.
Handling during operation may produce an accident, malfunction and wrong display, causing a danger.

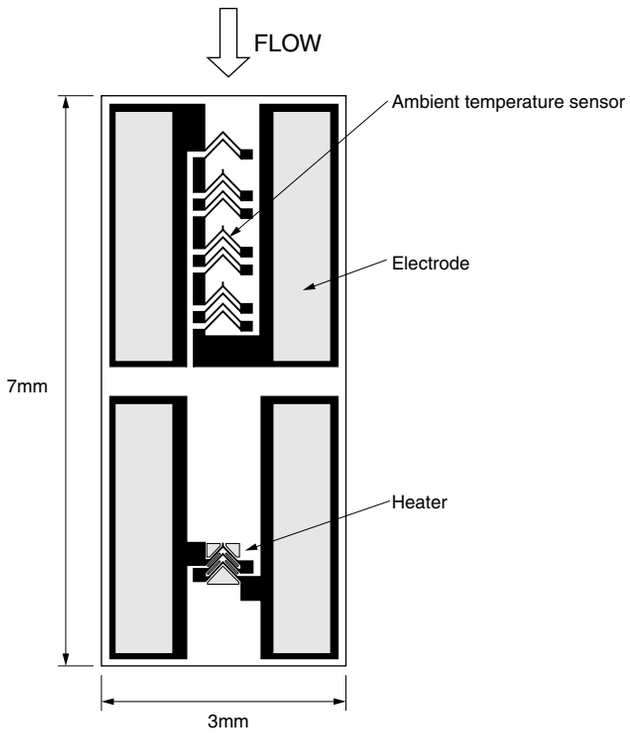
Switch output function/forcible output function/0 point adjustment operation



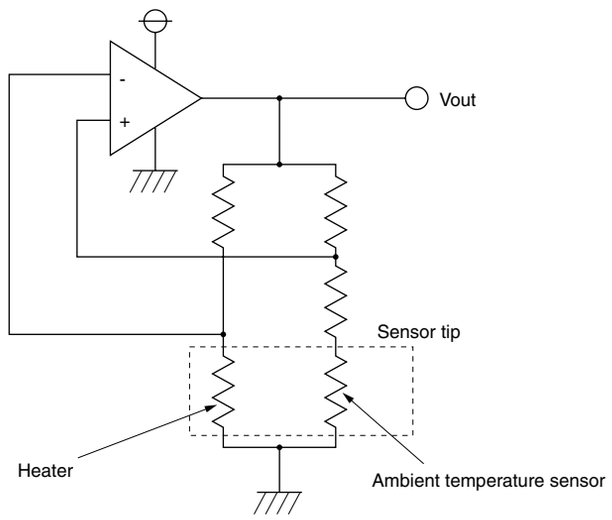
Technical data

Measurement principle of FSM (air and nitrogen gas) series

In FSM (air and nitrogen gas) series, applying silicon micro machining technology, platinum sensor tip (3mm X 7mm) is used. Heater section is insulated from the silicon substrate thermally to achieve quick response and high sensitive since heat capacity is very small.
Building the bridge that includes heater and ambient temperature sensors as figures, the temperature is controlled as the temperature difference between ambient temperature sensor and heater is constant. Platinum is used as a material of heater, changing value of resistance in proportion to temperature change. If an gas flows, output of bridge circuit increases in proportion to flow rate to compensate the heat lost from the heater (to maintain the constant temperature difference). Using this control method, the detection not affected with temperature or pressure change is possible. This control method is appropriate for the detection of relatively large flow rate.



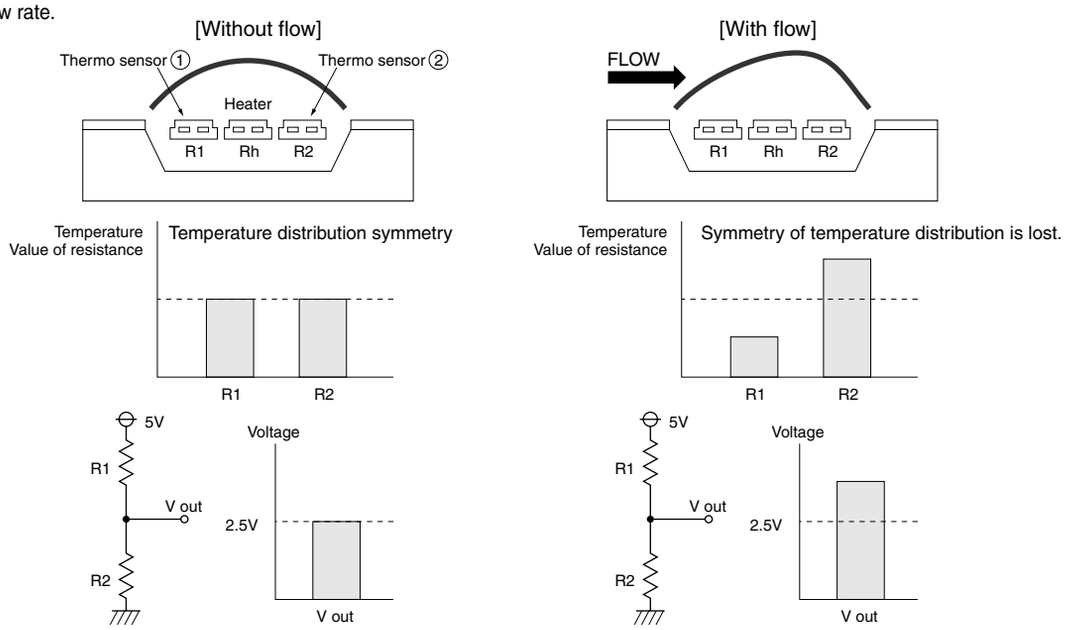
Platinum sensor tip



Bridge circuit

Measurement principle of FSM-H, FSM (argon and carbon dioxide) and FSM-V series

In FSM-H, FSM (argon and carbon dioxide) and FSM-V series, applying silicon micro machining technology, platinum sensor tip (3mm X 3.5mm) is used. Sensor section is insulated from the silicon substrate thermally, and quick response and high sensitivity are achieved since heat capacity is very small.
In sensor section, two thermo sensors are located over the heater. Platinum is used as the material of thermo sensor, changing value of resistance in accordance with temperature. Energizing the heater, if there is no flow, temperature distribution will be spreaded as symmetry from the center of the heater. If there is flow, the symmetry will be lost and the temperature of upstream will decrease, and the temperature of downstream will increase. This difference of temperature will be converted as difference of resistance of the thermo sensor, changing per flow rate. If of reverse flow, the difference of temperature (the difference of resistance) will be reverse. If this method is used, the flow rate in both directions can be detected. This method is appropriate for detection of relatively small flow rate.



1 How to select flow sensor

This is a guide of flow rate range when using a flow sensor as the adsorption/separation verification with adsorption nozzle and leakage inspection, etc.

The flow rate can be calculated according to effective sectional area of a nozzle (pinhole) and differential pressure between inside and outside of nozzle.

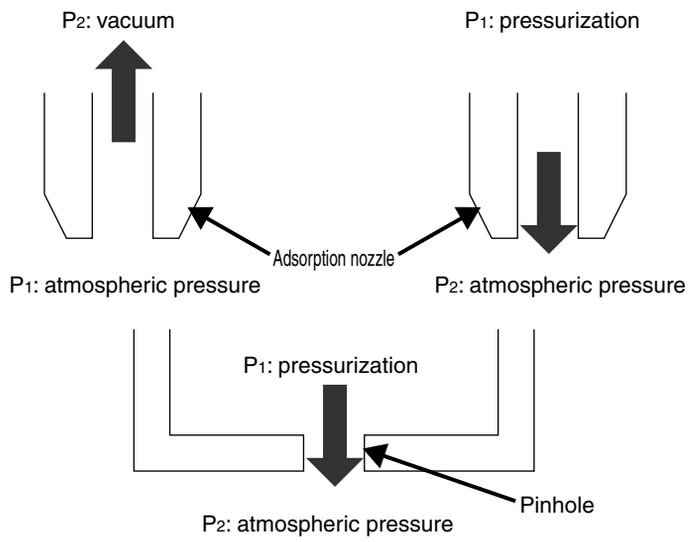
● For $P_1 \geqq 1.89P_2$ (acoustic velocity)

$Q=113.2 \times S \times P_1$

● For $P_1 < 1.89P_2$ (subsonic)

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

Q : flow rate ℓ /min
P_1 : primary side absolute pressure MPa
P_2 : secondary side absolute pressure MPa
S : Ef. sec. area mm^2 of nozzle (pinhole)



■ Example of calculation

When diameter of a nozzle is between 0.1 to 2 and P_2 is variable, the calculated flow rate values are shown as followings.

	P_1(MPa) Absolute pressure	P_1(MPa) Gauge pressure	P_2(MPa) Absolute pressure	P_2(MPa) Gauge pressure	Acoustic/subsonic velocity	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	Acoustic	0.090	0.360	0.810	1.440	2.2500	4.4110	9.0020	20.2540	36.0070
	0.1013	0	0.0413	-0.06	Acoustic	0.090	0.360	0.810	1.440	2.2500	4.4110	9.0020	20.2540	36.0070
	0.1013	0	0.0513	-0.05	Acoustic	0.090	0.360	0.810	1.440	2.2500	4.4110	9.0020	20.2540	36.0070
	0.1013	0	0.0613	-0.04	Subsonic	0.088	0.352	0.792	1.408	2.2000	4.3120	8.8000	17.2490	35.2020
	0.1013	0	0.0713	-0.03	Subsonic	0.082	0.329	0.740	1.315	2.0550	4.0280	8.2200	16.1100	32.8780
	0.1013	0	0.0813	-0.02	Subsonic	0.072	0.287	0.645	1.147	1.7920	3.5120	7.1660	14.0460	28.6660
	0.1013	0	0.0913	-0.01	Subsonic	0.054	0.215	0.483	0.859	1.3430	2.6310	5.3700	10.5250	21.4800
Blow (leakage inspection)	0.1113	0.01	0.1013	0	Subsonic	0.057	0.226	0.509	0.905	1.4140	2.7720	5.6570	11.0870	22.6260
	0.1213	0.02	0.1013	0	Subsonic	0.080	0.320	0.720	1.280	2.0000	3.9200	8.0000	15.6790	31.9980
	0.1413	0.04	0.1013	0	Subsonic	0.113	0.453	1.018	1.810	2.8280	5.5430	11.313	22.1740	45.2520
	0.1613	0.06	0.1013	0	Subsonic	0.139	0.554	1.247	2.217	3.4640	6.7890	13.856	27.1570	55.4230
	0.1813	0.08	0.1013	0	Subsonic	0.160	0.640	1.440	2.560	4.0000	7.8400	15.999	31.3580	63.9960
	0.2013	0.1	0.1013	0	Acoustic	0.179	0.716	1.610	2.862	4.4720	8.7650	17.888	40.2480	71.5520
	0.3013	0.2	0.1013	0	Acoustic	0.268	1.071	2.410	4.284	6.6940	13.119	26.774	60.2420	107.096
	0.4013	0.3	0.1013	0	Acoustic	0.357	1.426	3.209	5.706	8.9150	17.474	35.660	80.2360	142.641
	0.5013	0.4	0.1013	0	Acoustic	0.445	1.782	4.009	7.127	11.137	21.828	44.547	100.230	178.186
	0.6013	0.5	0.1013	0	Acoustic	0.534	2.137	4.809	8.549	13.358	26.182	53.433	120.224	213.731

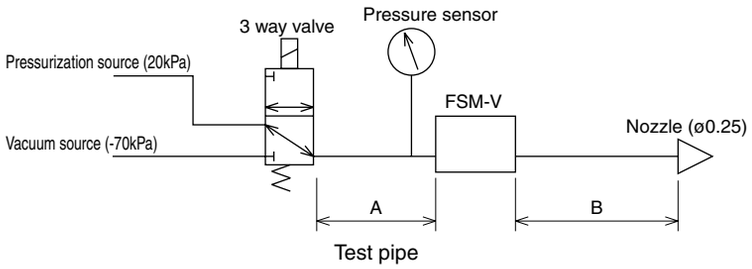
(Caution)

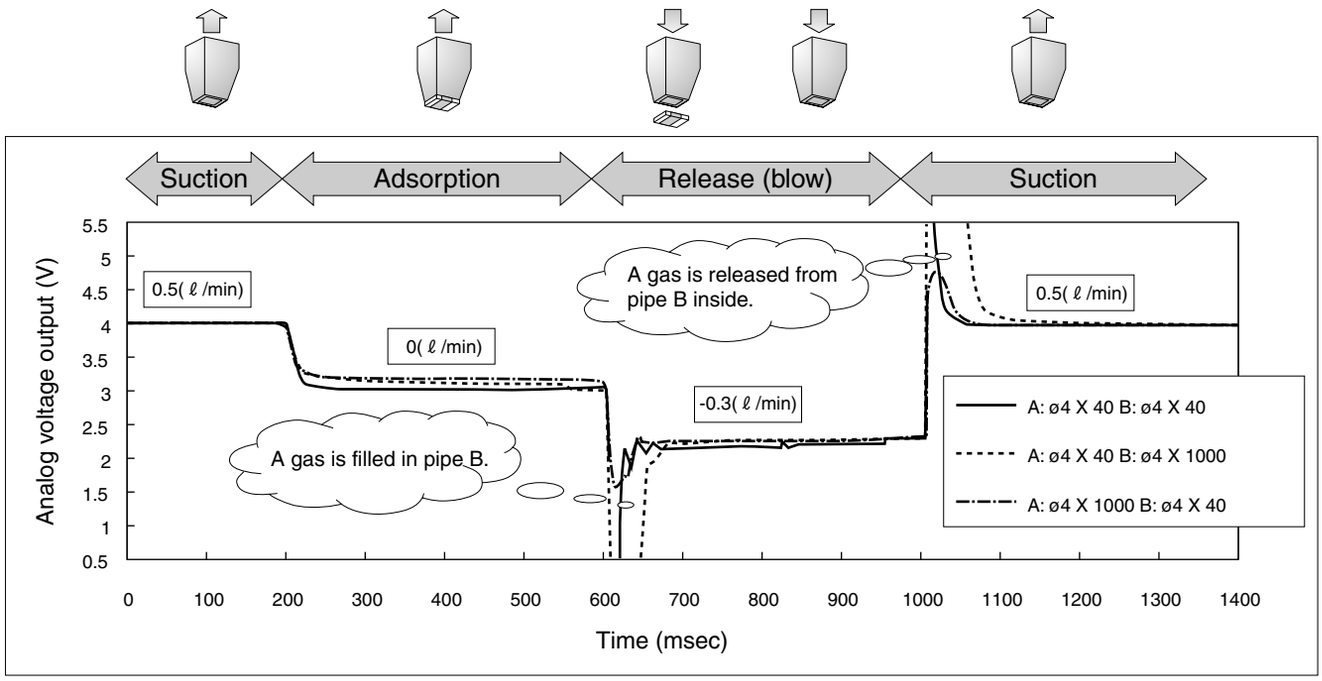
- If piping has a leakage, the actual flow will be larger than the calculated value. Please consider the leakage when selecting flow rate.
- If there is a narrower section than adsorption nozzle diameter in the midway of piping, flow rate will be restricted, so the value will be smaller than the calculated value.
  Also, adsorption verification, etc., could not be done.
- The effective sectional area is just reference. If the nozzle is elongated, the effective sectional area will be smaller than opening area of the nozzle.
- Response time is decided by capacity of pipe from adsorption nozzle (pinhole) to flow sensor. When detecting with high speed, reduce capacity in pipe as placing a flow sensor near the adsorption nozzle.

Adsorption verification

1 Response time

The response time of adsorption verification time is decided by capacity of pipe and exhaust performance of vacuum pump, etc.
For example, if of piping as right, pipe dependence of response time is as the following. As the result, to reduce the response time, it is effective that the inner pipe volume from adsorption nozzle to the sensor is reduced as small as possible.

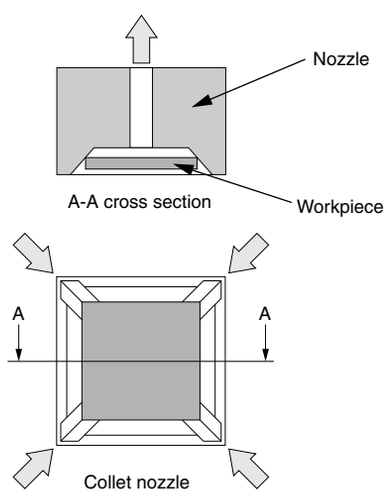




Pipe dependence of response

2 If collet nozzle is used.

Collet nozzle is widely used to avoid direct contact of an absorbed workpiece to the nozzle. The inside of collet nozzle is as a pyramid. When absorbing a workpiece, as structure, some clearances are created in four corners, creating a leakage. If the effective sectional area of pipe (including valve and joint, etc.) is smaller than the gap (effective sectional area) between collet nozzle and workpiece, the flow rate is decided according to effective sectional area of pipe, so flow rate differential when adsorption or non-adsorption will be reduced. In this case, if the effective sectional area of pipe is increased as large as possible than the effective sectional area of gap between collet nozzle and workpiece, the adsorption verification is done certainly.



Leakage inspection

1 How to calculate leakage

When converted form a pressure gauge method, use the equation below to calculate leakage.

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

Q: leakage (m ℓ /min) △P: differential pressure (Pa) V: capacity of workpiece (m ℓ) T: detecting time (s)

E.g.) Where capacity of workpiece is 500m ℓ , detecting time is 5sec., 20Pa of differential pressure is created, the leakage is ...

$$Q=500 \times \frac{20}{1.013 \times 10^5} \times \frac{60}{5} \fallingdotseq 1.18 \text{ (m } \ell \text{ /min)}$$

2 Comparing to gas and liquid leakage

Use this ratio as reference when the leakage inspection is done with air to a workpiece for liquid.
However, this equation is led from the Hagen Poiseuille's equation where the pinhole is a round tube, and the surface is smooth.
Pinholes such as welding defective, etc., are not always applied to a logic equitation.

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

Qa : air leakage (m ℓ /s)
Ql : liquid leakage (m ℓ /s)
ηa : air viscosity (Pa•s)
ηl : liquid viscosity (Pa•s)
Pa : air applied pressure (kPa)
Pl : liquid applied pressure (kPa)

● Coefficient of viscosity (Pa•s X 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

● Comparing to leakage of air (20 ˚C) and liquids

Liquid		ηl , Pa•s	Air pressure 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

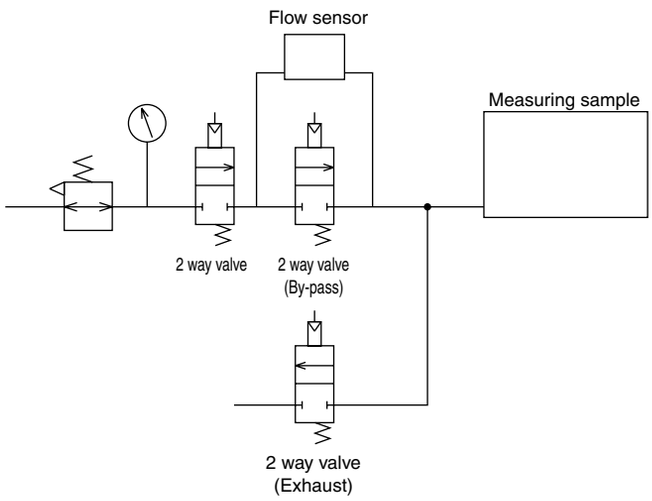
E.g.) When workpiece of water leakage 0.1m ℓ /min (applied pressure 0.4MPa) is tested with compressed air (applied pressure 0.4MPa), the leakage Qa is ...

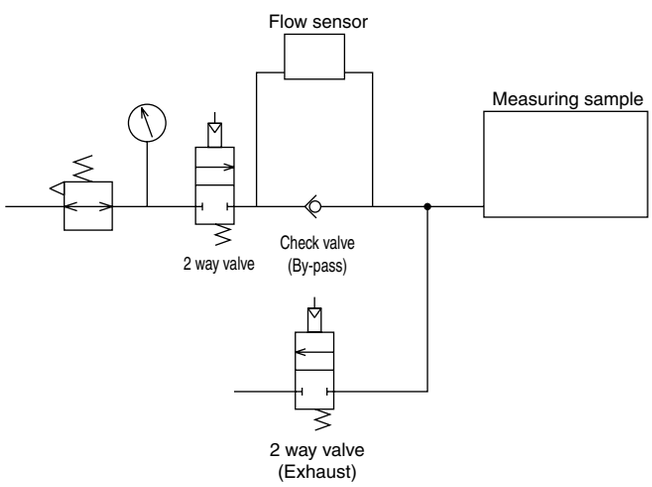
$$\frac{Q\ell}{Qa} = 0.006 \qquad Qa = \frac{0.1}{0.006} \fallingdotseq 16.7 \text{ (m } \ell \text{ /min)}$$

3 Filling time of workpiece

If the content volume of a workpiece is large, time is consumed to fill air until test pressure (TP) of the leakage inspection is reached. In this case, filling time can be reduced by by-pass circuit using 2 way or check valve, etc., as shown right.
When a 2 way valve is used, a 2 way valve can be open and closed according to the flow rate of flow sensor. Filling is started, and workpiece internal pressure is approaching to test pressure (TP), causing flow rate to decrease. Closing a 2 way valve for by-pass with this flow signal, measurement of a leakage is started.
When check valve is used, using a check valve with low cracking pressure, the check valve opens until near test pressure (TP), reducing filling time.

[Example of system configuration]





FSM and FSM-V series only

Miniature inline filter

FSM-VFM Series

Features

This is the inline filter for small flow sensor FSM,FSM-V series. Small capacity does not prevent high speed response when adsorption verification.

- Miniature and space saving size
- Easy element replacement
- Case materials using polyamide resin with excellent chemical resistance.
- Due to transparent case, contamination of element can be checked from outside

Specifications

Descriptions		FSM-VFM-H22	FSM-VFM-H44	FSM-VFM-M55
Working fluid		Clean air (JIS B 8392-1.1.2 to 5.6.2) and compressed air (JIS B 8392-1.1.2 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 and polyethylene		
Filtration rating micron µm		10		
Product mass g		5.2	9.5	4.2
Recommended flow rate ℓ/min		10 Note 2		

Note 1: Refer to Page 2 for compressed air quality class in accordance with JIS B 8392-1: 2000.

Note 2: If the flow rate reaches 10 ℓ/min, pressure loss increases, so use the product below 10 ℓ/min.

How to order

FSM - **VFM** - **H44** - **B**

Model no.

Ⓐ Tube outside diameter

Ⓑ Attached

Symbol	Content
Ⓐ Tube outside diameter	
H22	ø1.8 (fiber tube)
H44	ø4 (push in)
M55	Port size M5
Ⓑ Attached	
Blank	No brackets
B	Bracket attached

- Bracket part model no.

FSM - **VFM** - **B**

(Cross headed bowl tapping screw M2.5 X 6: 1 piece)

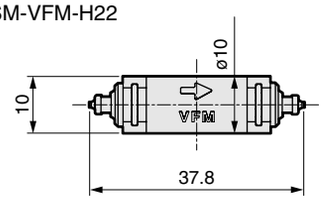
- Maintenance part model no.

FSM - **VFM** - **E**

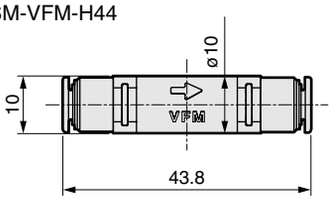
(Element: 5 pieces and joint fixing pin: 1 piece)

Dimensions

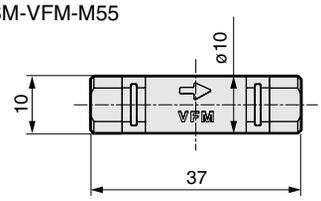
● FSM-VFM-H22



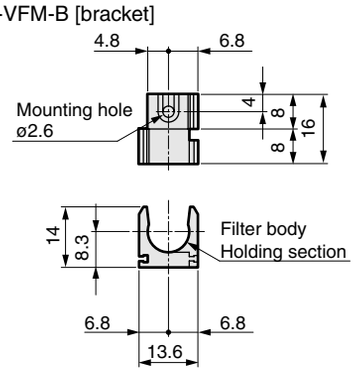
● FSM-VFM-H44



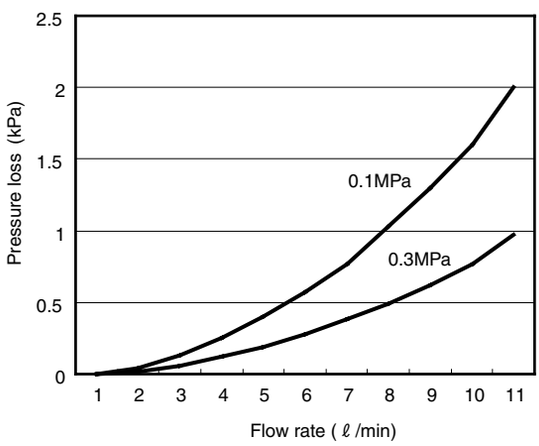
● FSM-VFM-M55



● FSM-VFM-B [bracket]



Flow characteristics (FSM-VFM-H44)

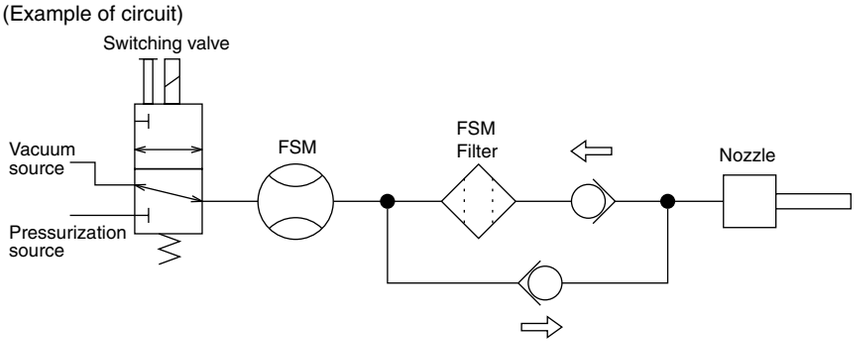


● If fiber tube is used, pressure loss may increase depended with piping condition. Care must be taken.

Cautions

● In this filter, the flow direction is already decided.
When used as adsorption verification, etc., a check valve is used to prevent spill of foreign matter.

(Example of circuit)

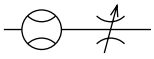


● Refer to Intro 11 for the other cautions and how to replace element.

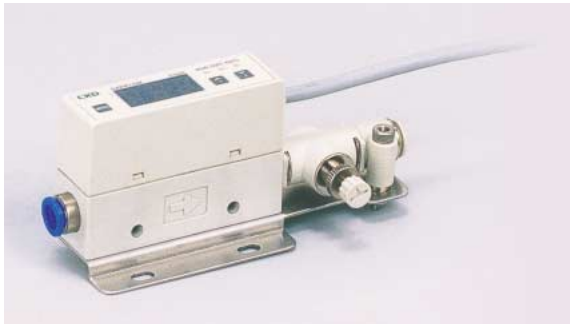
Custom order

This is available as custom order. Contact to our sales office for details.

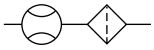
Type with flow control valve



- SCL2-N with needle valve integrated
- Available for FSM and FSM-V series
- A needle valve can be selected according to working flow range.



Type with filter



- Optimum with filter for adsorption verification
- Available for FSM and FSM-V series

Related products

Inline clean filter FCS500/FCS1000 series

Catalog no. CC-722

Appropriate for final filter of various clean applications

- **High precision filtration 0.01 μ m and removal efficiency 99.99%**
  Using hollow fiber membrane element, filtration 0.01 μ m and removal efficiency 99.99% are realized.
- **Long service life**
  Service life is improved dramatically; 5-fold increased comparing to flat membrane type.
- **Small/light weight/large flow rate**
  Large flow rate and low pressure loss since filtration area is 3 to 10 folds larger than flat membrane type in the same volume. If flow rate is same, downsizing is possible.
- **Oil-prohibition specifications**
  Degreasing and cleaning are done for all parts. Furthermore, assembling to packing are done in the clean room.
- **Easy maintenance**
  Using transparent case for resin type, contamination of element can be checked visually.
- **Wide variation**
  2 series of flow rate 500 and 1000, materials of resin and stainless, furthermore, push-in joint, male and female threads are available.

● FCS500 series

Model no.	Port size	Ambient temperature range	Working pressure range	Filtration rating
Resin type FCS500	ø4, ø6, ø8, R1/8, R1/4	5 to 50 deg.	-0.095 to 0.99MPa	0.01 micron m (Removal efficiency 99.99%)
Stainless steel type FCS500-P9*	Rc1/8,Rc1/4	5 to 45 deg.	-0.095 to 1.5MPa (compressed air) -0.095 to 0.99MPa (N_2)	

● FCS1000 series

Model no.	Port size	Ambient temperature range	Working pressure range	Filtration rating
Resin type FCS1000	ø8, ø10, ø12, R1/4, R3/8, Rc1/4, Rc3/8	5 to 45 deg.	-0.095 to 0.99MPa	0.01 micron m (Removal efficiency 99.99%)
Stainless steel type FCS1000-P9*	Rc1/4, Rc3/8		-0.095 to 1.5MPa (compressed air) -0.095 to 0.99MPa (N_2)	

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