CKD

Quick response with miniature size

New Product

Small size flow sensor FSM2 Series

SMALL SIZE FLOW SENSOR FSM2 SERIES

CKD Corporation

CC-886A 2

Diverse lineup to meet your needs.

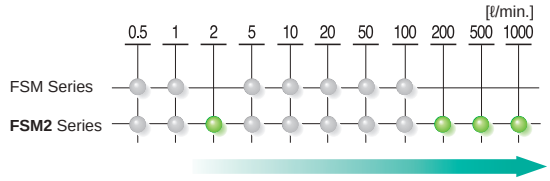
The FSM Series has been added to this new advanced series.
The range has been expanded to 1000 ℓ/min. while maintaining outstanding responsiveness.
Usability has been greatly improved with the twin and bicolor indicator that enhances operability and the auto reference function.
Value is further increased with the capability of bidirectional measurement.

Small size flow sensor

FSM2 Series

Enlarged flow range

2, 200, 500, and 1000 ℓ/min. types have been added to conventional flow ranges -- 0.5, 1, 5, 10, 20, 50, and 100 ℓ/min.



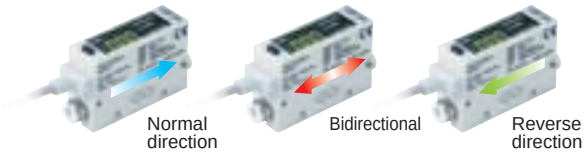
Large flow yet compact

The volume of the 500 and 1000 ℓ/min. types is 1/3 compared to the conventional type, realizing the industry's top class compact size.
Equipment is downsized and lightened with this new series.

Measure fluids bidirectionally

With the integrated bidirectional display, the flow direction is set in either direction and measured.
This increases the freedom of piping installation and detects backflows.

Refer to page 29 for details.



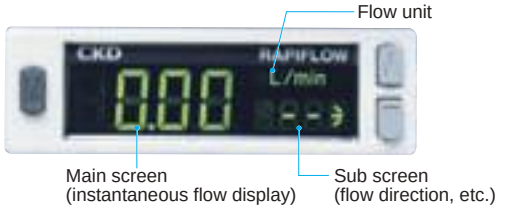
Accuracy increased by ±3% F.S. or less

±3% F.S. accuracy is realized, enabling fluids to be measured more precisely.

Twin indicator/bicolor indicator

With the integrated display, main and subscreens improve operability.
The bicolor display makes it easy to spot problems quickly.

Refer to page 25 for details.

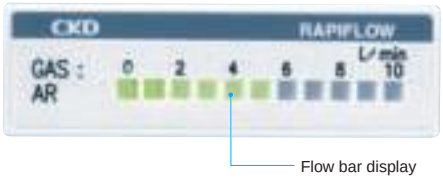


<Bicolor display>

Bar display

With the separated display, the reference flow is easily grasped with a flow bar display.

Refer to page 25 for details.



Auto-reference

Switch output settings are automatically retrieved with buttons and external input, eliminating the need for troublesome settings.

Refer to page 28 for details.

High-speed response of 50 msec. or less

The silicon-micromachined platinum sensor chip realizes high-speed response and shortens tact time.

Diverse FSM Series

Model variations	Size	Response speed	Display	Material	Output method	Flow direction	Flow range
FSM2 Series	Miniature and lightweight	50 msec Quick response	Separated / Integrated	PA / Aℓ / SUS (Body material)	NPN PNP Switch output / Analog output	Reverse direction / Normal direction / Bidirectional	0.5~1000 ℓ/min. Large flow type

Miniature inline filter dedicated to FSM2 Series

FSM-VFM Series — Maintains sensor performance and prevents problems. Page 34

Technical data Page 19

FSM-H Series / **FSM-V Series** — Catalog No. CC-687

Refer to the next page for examples of applications and the series system. ➡

Examples of FSM2 Series applications

■ Active in a wide variety of fields

FSM2 Series is used for machines, automobiles, measuring instruments and precision devices, etc., in advanced fields such as semiconductors and biomechanics, and in applications for medical materials and foods.

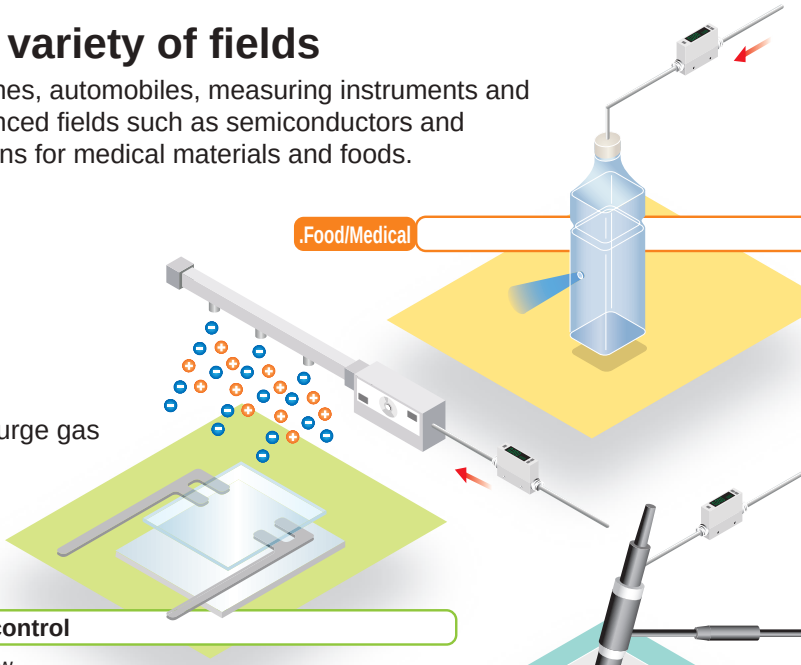
Amenity→

■ Working fluid

AIR N_2 Ar CO_2

■ Sensor applications

Leakage inspection
Pinhole inspection
Confirmation of ionizer purge gas
Welding gas control
Purge gas flow control
Seating confirmation
Suction confirmation

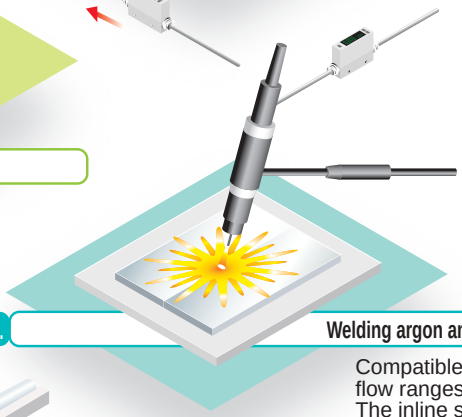


.Food/Medical **Leakage inspections**

Leakage is measured directly. Even if pressure is extremely low, acceptability or status is precisely confirmed with the output proportional to the pinhole.

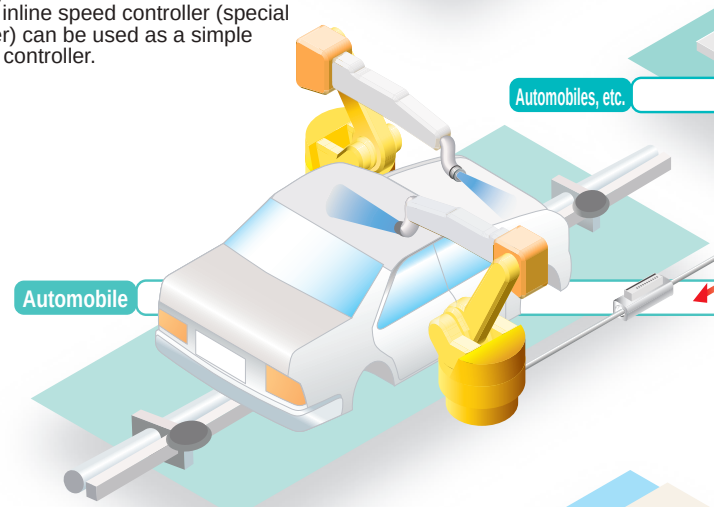
Liquid crystal **Ionizer flow control**

Compatible with a variety of flow ranges.
The inline speed controller (special order) can be used as a simple flow controller.



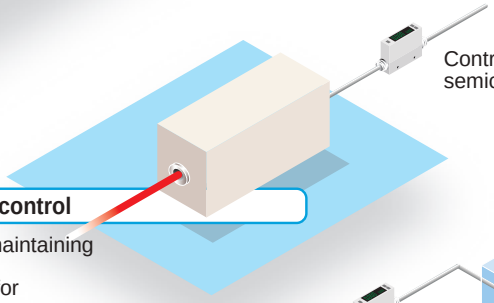
Automobiles, etc. **Welding argon and carbon gas flow control**

Compatible with a variety of flow ranges.
The inline speed controller (special order) can be used as a simple flow controller.



Automobile **Painting air flow control**

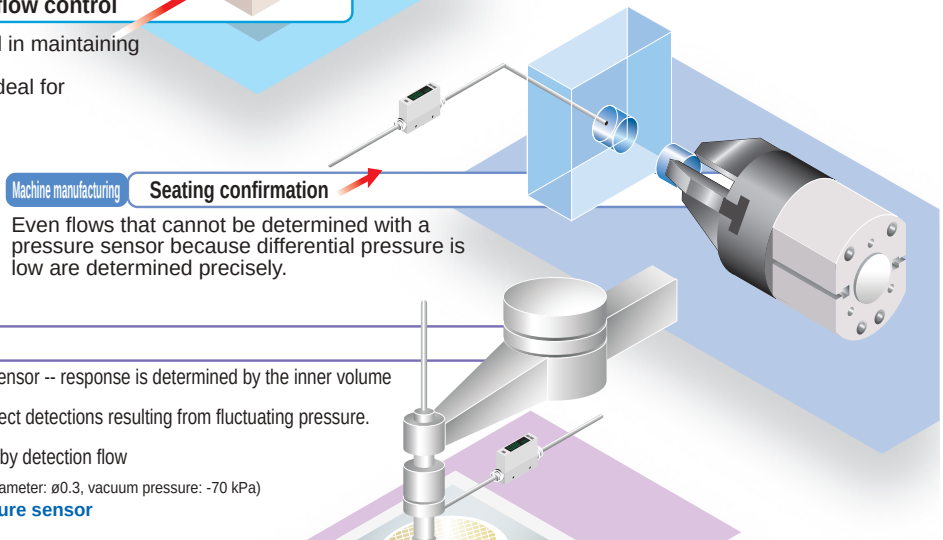
Compatible with a variety of flow ranges



Control of N2 gas for laser oscillator and semiconductor manufacturing equipment

Semiconductors **Purge gas flow control**

Control of purge gas is vital in maintaining system performance.
Miniature size makes this ideal for assembly into the device.



Machine manufacturing **Seating confirmation**

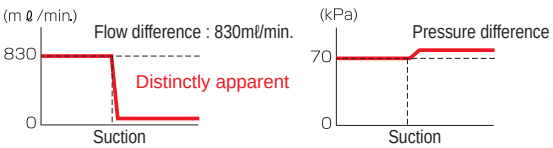
Even flows that cannot be determined with a pressure sensor because differential pressure is low are determined precisely.

Electronic parts **Suction confirmation**

1. High-speed response comparable to pressure sensor -- response is determined by the inner volume of piping and pressure, etc.
2. Flow detection eliminates adjustment and incorrect detections resulting from fluctuating pressure.
3. Nozzle and filter clogging is detected.
4. Control suction errors, such as inclined suction, by detection flow

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

■FSM Series (using FSM-N-010) ■Pressure sensor



←Industry

FSM2 Series variation

FSM2 Series

Display integrated type

2-point switch output NPN/PNP
1-point analog output

Display separated type

1-point analog output

	Air, nitrogen gas applications											Argon, carbon gas applications							
	FSM2-N/P□□005-□	FSM2-N/P□□010-□	FSM2-N/P□□020-□	FSM2-N/P□□050-□	FSM2-N/P□□100-□	FSM2-N/P□□200-□	FSM2-N/P□□500-□	FSM2-N/P□□101-□	FSM2-N/P□□201-□	FSM2-N/P□□501-□	FSM2-N/P□□102-□	FSM2-N/P□□005-□AR/C2	FSM2-N/P□□010-□AR/C2	FSM2-N/P□□020-□AR/C2	FSM2-N/P□□050-□AR/C2	FSM2-N/P□□100-□AR/C2	FSM2-N/P□□200-□AR/C2	FSM2-N/P□□500-□AR/C2	FSM2-N/P□□101-□AR/C2
	FSM2-A□□005-□	FSM2-A□□010-□	FSM2-A□□020-□	FSM2-A□□050-□	FSM2-A□□100-□	FSM2-A□□200-□	FSM2-A□□500-□	FSM2-A□□101-□	FSM2-A□□201-□	FSM2-A□□501-□	FSM2-A□□102-□	FSM2-A□□005-□AR/C2	FSM2-A□□010-□AR/C2	FSM2-A□□020-□AR/C2	FSM2-A□□050-□AR/C2	FSM2-A□□100-□AR/C2	FSM2-A□□200-□AR/C2	FSM2-A□□500-□AR/C2	FSM2-A□□101-□AR/C2
Body material																			
Resin body	●	●	●	●	●	●	●	●	●										
Stainless steel body	●	●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●
Aluminum body										●	●								
Port size																			
ø4 push-in joint	●	●	●	●	●	●													
ø6 push-in joint	●	●	●	●	●	●	●												
ø8 push-in joint							●	●	●										
ø10 push-in joint								●	●										
Rc1/8	●	●	●	●	●	●	●					●	●	●	●	●	●	● (AR only)	
Rc1/4							●	●	●									●	●
Rc1/2										●	●								
M5 (custom order)	●	●	●	●	●	●						●	●	●	●	●	● (AR only)		
Full scale flow																			
0.5 ℓ/min.	●											●							
1		●											●						
2			●											●					
5				●											●				
10					●											●			
20						●											●		
50							●											●	
100								●											●
200									●										
500										●									
1000											●								

	Display integrated type	Display separated type
Flow direction	**Bidirectional or single direction** (Select according to type. Bidirectional type's flow direction can be selected by pressing a button.)  Single direction Bidirectional	**Bidirectional or single direction** (Select according to type.)  Single direction Bidirectional
Output type	**2-point switch output** NPN or PNP output (Select according to type.) **1-point analog output** 1 to 5V or 4 to 20mA (Select according to type.)	**1-point analog output** 1 to 5V or 4 to 20mA (Select according to type.)

Safety precautions

Always read this section before starting use.

When designing and manufacturing a device using CKD products, the manufacturer is obligated to check that device safety mechanism, pneumatic control circuit, or water control circuit and the system operated by electrical control that controls the devices is secured.It is important to select, use, handle, and maintain the product appropriately to ensure that the CKD product is used safely.
Observe warnings and precautions to ensure device safety.Check that device safety is ensured, and manufacture a safe device.

⚠WARNING

1 This product is designed and manufactured as a general industrial machine part. It must be handled by an operator having sufficient knowledge and experience in handling.

2 Use this product in accordance of specifications.

This product must be used within its stated specifications. It must not be modified or machined.This product is intended for use as a general-purpose industrial device or part. It is not intended for use outdoors, under the following conditions or environment. (Note that this product can be used when CKD is consulted prior to use and the customer consents to CKD product specifications. The customer must provide safety measures to avoid risks in the event of problems.)

❶ Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, equipment or applications coming into contact with beverage or food, amusement equipment, emergency shut off circuits, press machine, brake circuits, or for safeguard.
❷ Use for applications where life or assets could be adversely affected, and special safety measures are required.

3 Observe corporate standards and regulations, etc., related to the safety of device design and control, etc.

ISO4414, JIS B8370 (pneumatic system rules)
JFPS2008 (principles for pneumatic cylinder selection and use)
Including High Pressure Gas Maintenance Law, Occupational Safety and Sanitation Laws, other safety rules, body standards and regulations, etc.

4 Do not handle, pipe, or remove devices before confirming safety.

❶ Inspect and maintain the machine and devices after confirming safety of the entire system related to this product.
❷ Note that there may be hot or charged sections even after operation is stopped.
❸ When inspecting or servicing the device, turn off the energy source (air supply or water supply), and turn off power to the facility. Discharge any compressed air from the system, and pay enough attention to possible water leakage and leakage of electricity.
❹ When starting or restarting a machine or device that incorporates pneumatic components, make sure that the system safety, such as pop-out prevention measures, is secured.
❺ Provide a fail-safe mechanism if faults with this product could lead to serious accidents.

5 Observe warnings and cautions on the pages below to prevent accidents.

■ The safety cautions are ranked as "DANGER", "WARNING" and "CAUTION" in this section.

⚠ **DANGER:** When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries, or when there is a high degree of emergency to a warning.
⚠ **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 damage.

Note that some items described as “CAUTION” may lead to serious results depending on the situation. In any case, important information that must be observed is explained.

Disclaimer

1. CKD cannot be held liable for any business interruption, loss of profit, personal injury, delay cost, or any other ancillary or indirect loss, cost, or damage resulting from the use of or faults in the use of CKD products.
2. CKD cannot be held responsible for the following damage:
   (1) Damage resulting from disaster or failure of CKD parts due to fire from reasons not attributable to CKD, or by intentional or negligence of a third party or customer.
   (2) When a CKD product is assembled into customer equipment, damage that could have been avoided if customer equipment were provided with functions and structure, etc., generally accepted in the industry.
   (3) Damage resulting from use exceeding the scope of specifications provided in CKD catalogs or instruction manuals, etc., or from actions not following precautions for installation, adjustment, or maintenance, etc.
   (4) Damage resulting from product modifications not approved by CKD, or from faults due to combination with other software or other connected devices.

To secure safety

Pneumatic components: warning, cautions

Always read this section before starting use.

Small size flow sensor FSM2 Series

Design & Selection

Working fluid

DANGER

■ **Do not use this product with flammable fluids.**

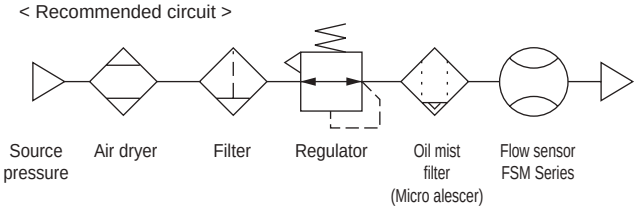
WARNING

■ **This product cannot be used as a business meter.**
This product does not conform to measurement laws, and cannot be used for commercial purposes. Use this sensor for factory applications.

■ **Do not use fluids other than the applicable fluid because accuracy cannot be guaranteed.**

■ **Compressed air from the compressor contains drainage (water, oxidized oil, foreign substances, etc.), so install a filter, air dryer, and oil mist filter (micro alescer) on the primary side (upstream) of the sensor. The sensor's mesh rectifies the flow in the pipe. It is not a filter for removing foreign substances, so provide a filter.**

< Recommended circuit >



■ **When using a valve on the primary side of this product, use only an oil-prohibit specification valve. This sensor could malfunction or fail if exposed to splattering grease, oil, etc.**

■ **When this product is used for liquefied gas such as carbon dioxide, evaporate gas. This product could fail if processing liquefied gas.**

Working Environment

DANGER

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

WARNING

■ **Corrosive environment**
Do not use this product in an environment containing corrosive gases such as sulfurous acid.

■ **Ambient temperature, fluid temperature**
Keep the ambient temperature and fluid temperature within 0 to 50°C. Even if the temperature is within the specified range, do not use it if the ambient temperature and fluid temperature could suddenly change and cause dew to condense.

■ **Maximum working pressure and working flow rate range**
Use this product within the specified range, because use exceeding the maximum working pressure and working flow rate range could result in failure.

■ **Drip-proof environment**
This product's protective structure is IP40 or equivalent. Do not install it where it could be exposed to water, salt, dust, or cutting chips, or a compressed or decompressed environment. This product cannot be used where the temperature changes sharply or in a highly humid environment where internal damage could be caused by dew condensation.

Flow unit

CAUTION

■ **This product's flow rate is measured at a mass flow unaffected by temperature or pressure. The unit is ℓ/min., but this is the display when the mass flow is converted to volumetric flow at 20°C 1 barometric pressure (101 kPa).**

Withstand pressure

CAUTION

■ **Withstand pressure differs for each series. Note this when selecting the series.**

Overflow

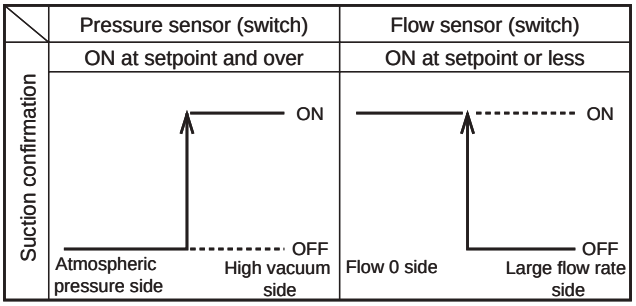
CAUTION

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

Use for vacuum confirmation, etc.

⚠CAUTION

- When this product is used to confirm vacuum, etc., select the flow range based on the working vacuum pressure and vacuum nozzle. Refer to "Methods for calculating theoretic flow" on page 32 for details.
- When this product is used to confirm vacuum, etc., provide an air filter (filtration 10 μm or less) upstream from suction to prevent the entry of foreign matter.
- When this product is used to confirm vacuum, etc., consider the atmospheric dew point and this product's ambient temperature, and use under conditions in which dew does not condense in pipes.
- When this product is used to confirm vacuum, etc., response speed may be delayed by the capacity of the pipe between the vacuum nozzle and this product. In this case, take measures to reduce piping capacity.
- When this product is used for vacuum applications such as air supply, do not bend the tube near the push in joint. If stress is applied to the tube near the push in joint, insert an insert ring into the tube, and connect the tube to the push in joint.
- When the vacuum confirmation sensor is switched from a pressure sensor (switch) to a flow sensor (switch), sensor output (switch output) logic will be reversed. See the drawing below.
  Note that the PLC sequence program must be changed or revised.
  If source pressure or vacuum source is not supplied when device power is turned on, "flow 0" = "sensor output (switch output) on" status is set at the flow sensor (switch). Check that this is not a problem with the PLC sequence program, etc.



Installation & Adjustment

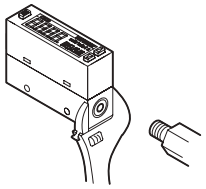
Piping

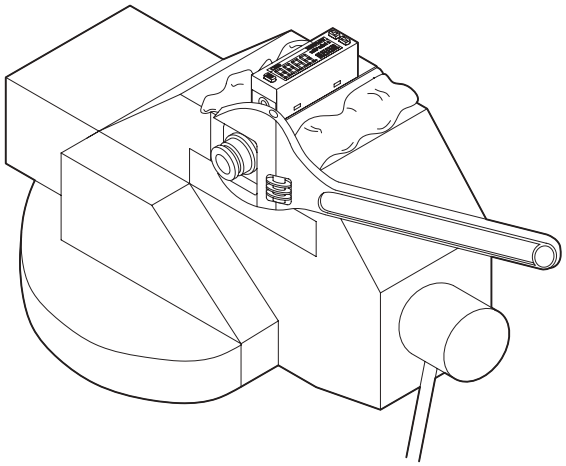
⚠CAUTION

- Complete piping and installation before starting wiring.
- When piping, check that the fluid's direction matches the direction indicated on the component.
- When installing the sensor on piping, see the torque below so that excessive screw-in torque or load torque is not applied to the connection port.
  (Reference value)

Port thread	Tightening torque N•m
M5	0.5 to 1.0
Rc1/8(G1/8)	3 to 5
Rc1/4	6 to 8
Rc1/2	16 to 18

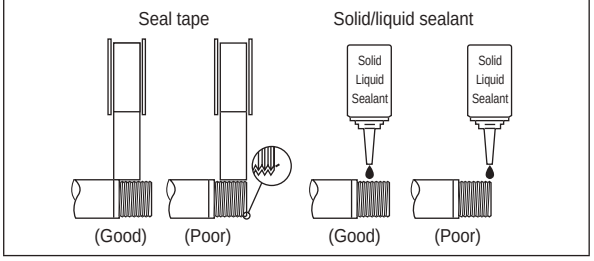
- Clean out pipe with air blow to remove foreign substances, swarf, etc., before piping. The rectifier or sensor chip could be damaged if a large amount of foreign matter, swarf, etc., occurs.
- Attach a wrench to metal sections when tightening pipes so that pressure is not applied to the resin section.





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

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



Installation & Adjustment

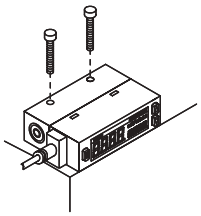
- Connect a joint even when using the metal body type with the out side opened. The port filter could come off.
- When using a push in joint, accurately insert tube and confirm that it does not become dislocated even when pulled. Cut tube at a right angle with a dedicated cutter before use.

Installation

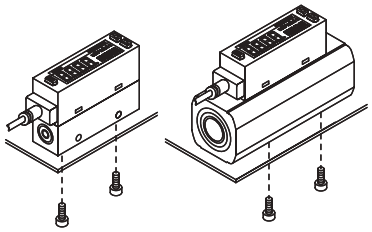
⚠CAUTION

- The integrated display flow meter has an LCD display. It may be difficult to read depending on the angle.
- This product can be installed in any direction; top, bottom, left, or right.

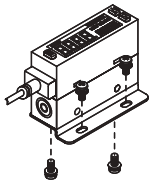
Horizontal installation (through hole used)



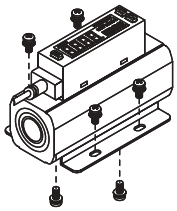
Vertical installation (bottom side female thread used)



Bracket installation (special bracket used)



Port size: Push-in Φ4, Φ6, Φ8, Φ10
Rc1/8, Rc1/4, M5
Discrete bracket model no.: FSM2-LB1



Port size: Rc1/2
Discrete bracket model no.: FSM2-LB2

Wiring

⚠DANGER

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

⚠WARNING

- Check wire colors when wiring. Incorrect connections could result in sensor damage, problems, and malfunctions, so check wire colors against the instruction manual before wiring.
- Check wiring insulation.
  Check that lines do not contact other circuits, and that no ground faults or insulation faults occur across terminals. An over current could flow in and damage the sensor.
- Use a DC stabilized power supply, within the specified rating, insulated from the AC power supply. Failure to insulate the power supply could result in electrical shock. If power is not stabilized, the peak value could be exceeded. This could damage the product or impair accuracy.
- Attach a connector cover after connecting connectors.
- Check that stress is not directly applied to cable leadout or connector sections.
- Stop the control device and machine devices, and turn the power off before wiring. Starting operation suddenly could result in unpredictable operation and hazards. Conduct an energized test with control devices and machine devices stopped, and set target switch data. Discharge electrostatic accumulated in personnel or tools before and during work. Connect and wire bend-resistant material, such as robot wire material, for movable sections.
- Do not use this product at levels exceeding the power voltage range. If voltage exceeding this range is applied or if AC power is applied, the controller could rupture or burn.
- Separate this product and its wiring as far away as possible from sources of noise such as high-voltage lines. Provide separate measures for surge applied to the power cable. The display or output could fluctuate.
- Do not short-circuit the load. This product could rupture or burn.
- For metal body (stainless steel, aluminum) power supplies, use DC-stabilized power separated from the AC primary side. Connect either the plus or minus side of the power supply to the F.G. A varistor (limit voltage 40 V) is connected between the metal body internal power circuit and metal body to prevent dielectric breakdown of the sensor. Do not conduct a withstand voltage test or insulation resistance test between the internal power circuit and metal body. Disconnect wiring if this testing is required. An excessive potential difference between power and metal body will burn internal parts. After installation, connecting and wiring the metal body, electrical welding of the device or frame, or short-circuit accidents, etc., could cause welding current, excessive high voltage caused by welding, or surge voltage, etc., to run through wiring or ground line connected between such devices, damaging lines or devices. Conduct work such as electrical welding after removing this device and disconnecting all electric lines connected to the F.G.

Adjustment

⚠CAUTION

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

During Use & Maintenance

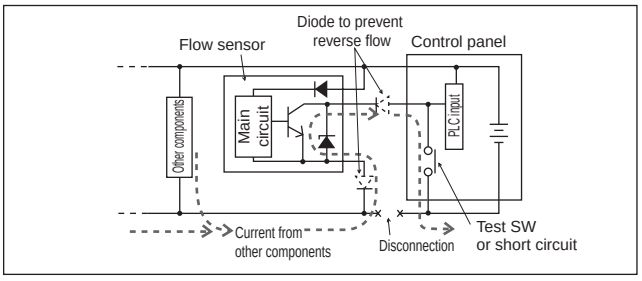
⚠WARNING

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

⚠CAUTION

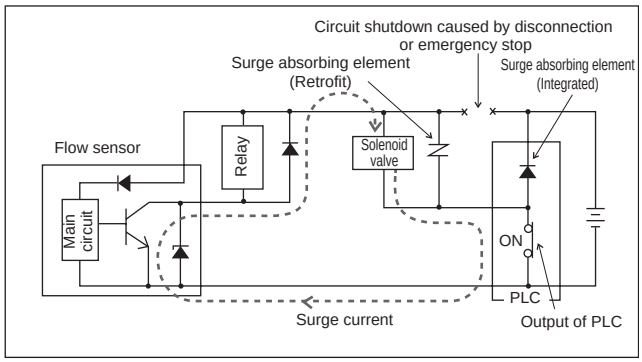
- If a problem occurs during operation, immediately turn power off, stop use, and contact your dealer.
- Keep this product's flow within the rated flow range.
- Use this product within the working pressure range.
- If the output setting value is changed, control system devices could operate unintentionally. Stop devices before changing settings.
- Regularly inspect the product at least once a year or more, and confirm that it is operating correctly.
- Do not disassemble or modify this product. Doing so could result in faults.
- This case is made of resin. Do not use solvent, alcohol or detergent to remove any dirt, etc., as the resin could be impregnated. Wipe off any dirt with a rag soaked in a diluted neutral detergent solution and wrung out well.

- Check backflow currents caused by broken wiring or wiring resistance. If other devices, including a flow sensor, are connected to the same power as the flow sensor, and the switch output wire and power line's minus side are temporarily short circuited to check the operation of the control panel's input unit, or if the power line's minus side is broken, a backflow current could flow to and damage the flow sensor switch output circuit.

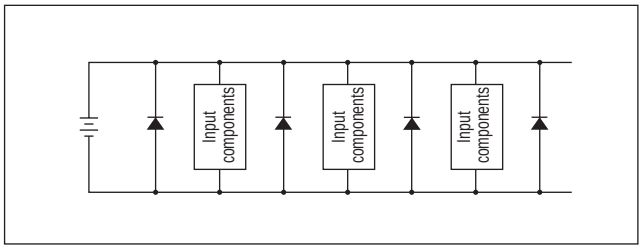


- Take the following measures to prevent damage from backflow current.
  ① Avoid concentrating power lines, and especially current to power lines on the minus side. Use lines as thick as possible.
  ② Limit the number of devices connected to the same power source as the flow sensor.
  ③ Insert a diode parallel to the flow sensor's output line to prevent current backflow.
  ④ Insert a diode parallel to the flow sensor power line's minus side to prevent current backflow.

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



Take countermeasures as followings to prevent damage caused by surge current leading.
① Separate the power supply for output including the inductive load, such as the solenoid valve and relay, and input, such as the flow controller.
② If power supplies cannot be separated, directly install a surge absorption element for all inductive loads. Note that the surge absorption element connected to the PLC, etc., protects only that device.
③ Connect a surge absorption element on power lines, as shown below, prepare against disconnections in unspecified areas.



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

- Even if the flow range is exceeded, analog output will continue. If an integrated display is used, "Hi" or "Lo" is displayed. When using a separate display, the bar display will blink.
  Note that this is outside guaranteed precision.
- When an integrated display, do not press the display section. It could be damaged.

Miniature inline filter FSM-VFM series

During Use & Maintenance

⚠CAUTION

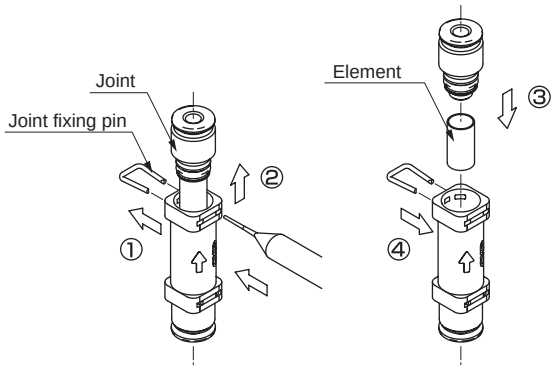
- **Do not use this product for vacuum circuits that could come in contact with acids, alkalines, carboxlyic acid, other organic compounds, screw-lock agent, solvent, or alcohol solutions, or air containing these substances.**
  The body could be damaged, and cause a hazardous situation.
- **Use designated tubing and plastic plugs.**
  - **Tube outer diameter precision**
    - **Polyamide tube..... Within ±0.1mm**
    - **Polyurethane rubber tube**
      (to Φ6)..... Within ±0.1mm
      (Φ8 to)..... Within $^{+0.1}_{-0.15}$ mm
  - **CKD recommended model**

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

- **Refer to the "Pneumatic, Vacuum and Auxiliary Components" No. CB-24SA "Precautions for joints and tubes" for precautions for the push in joint.**
- **Regularly inspect the polyamide case for cracks, damage, and other deterioration. Clean and replace as necessary.**
- **Filter element clogging will decrease vacuum source conductance. Regularly inspect, clean, and replace the element.**
- **Return the container to atmospheric pressure before removing the body to clean or replace, etc., the filter element.**
  The flow direction is oriented. Check the arrow on the body during reassembly.
  Check that the required vacuum degree is attained in the circuit after reassembly.
- **Use a household-grade neutral detergent to clean the body, then rinse with water.**

Replacing the element

⚠CAUTION



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

Small size flow sensor
Display integrated type/display separate type

FSM2 Series

- Resin body type (flow range: 500 mℓ/min. to 200 ℓ/min.)
- Aluminum body type (flow range: 500 ℓ/min., 1000 ℓ/min.)
- Stainless steel body type (flow range: 500 mℓ/min. to 200 ℓ/min.) RoHS

Display integrated type (resin/aluminum body type) specifications

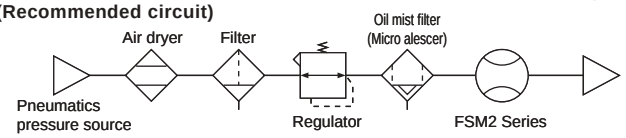
Descriptions			Display integrated type (resin/aluminum body) FSM2- (*1) (*2) (*3) (*4) - (*5)											
			Full scale flow	005	010	020	050	100	200	500	101	201	501	102
Flow range Note 1	*4	005	500 mℓ/min.	●										
		010	1 ℓ/min.		●									
		020	2 ℓ/min.			●								
		050	5 ℓ/min.				●							
		100	10 ℓ/min.					●						
		200	20 ℓ/min.						●					
		500	50 ℓ/min.							●				
		101	100 ℓ/min.								●			
		201	200 ℓ/min.									●		
		501	500 ℓ/min.										●	
		102	1000 ℓ/min.											●
Port size/body material	*5	H04	Φ4 push-in/resin	●	●	●	●	●	●					
		H06	Φ6 push-in/resin	●	●	●	●	●	●	●				
		H08	Φ8 push-in/resin							●	●	●		
		H10	Φ10 push-in/resin								●	●		
		A15	Rc1/2, aluminum										●	●
Flow display			Type of display	4 digits + 4 digits 2 color LCD										
	Display range	*3	F	0 to 500 mℓ/min.	0 to 1000 mℓ/min.	0 to 2.00 ℓ/min.	0 to 5.00 ℓ/min.	0 to 10.00 ℓ/min.	0 to 20.0 ℓ/min.	0 to 50.0 ℓ/min.	0 to 100.0 ℓ/min.	0 to 200 ℓ/min.	0 to 500 ℓ/min.	0 to 1000 ℓ/min.
			R	-500 to 500 mℓ/min.	-1000 to 1000 mℓ/min.	-2.00 to 2.00 ℓ/min.	-5.00 to 5.00 ℓ/min.	-10.00 to 10.00 ℓ/min.	-20.0 to 20.0 ℓ/min.	-50.0 to 50.0 ℓ/min.	-100.0 to 100.0 ℓ/min.	-200 to 200 ℓ/min.	-500 to 500 ℓ/min.	-1000 to 1000 ℓ/min.
	Display resolution			1 mℓ/min.		0.01 ℓ/min.			0.1 ℓ/min.			1 ℓ/min.		
Integration	Display range			9999999 mℓ		99999.99 ℓ			999999.9 ℓ			9999999 ℓ		
	Display resolution			1mℓ		0.01ℓ			0.1ℓ			1ℓ		
	Pulse output rate			5 mℓ	10 mℓ	0.02 ℓ	0.05 ℓ	0.1 ℓ	0.2 ℓ	0.5 ℓ	1 ℓ	2 ℓ	5 ℓ	10 ℓ
Working conditions	Working fluid		Note 2	Clean air (JIS B 8392-1.1.1 to 5.6.2), compressed air (JIS B 8392-1.1.1 to 1.6.2) , nitrogen gas										
	Max. working pressure			0.7MPa										
	Min. working pressure			-0.09MPa										
	Withstanding pressure			1MPa										
	Ambient temperature/humidity			0 to 50°C, 90%RH or less										
	Working fluid temperature			0 to 50°C (with no dew condensation)										
Precision	Precision scope of guarantee			3 to 100% F.S.										
	Linearity (display and analog output)			±3% F.S. or less (secondary atmospheric release, 25°C)										
	Pressure characteristics			±5% F.S. or less (-0.09 to 0.7MPa , where reference for secondary atmospheric release)										
	Temperature characteristics			±0.2% F.S./°C or less (15 to 35°C, where 25°C is reference)										
	Repeatability			±1% F.S. or less										
Response time			Note 3	50ms or less										
Output	Switch output	*1	N	2 outputs (NPN open collector output, 50mA or less, voltage drop 2.4V or less)										
			P	2 outputs (PNP open collector output, 50mA or less, voltage drop 2.4V or less)										
	Analog output	*2	V	1 to 5V voltage output 1 point (connected load impedance 50kΩ or more)										
			A	4 to 20mA current output 1 point (connected load impedance 0 to 300Ω)										
Power voltage Note 4		*2	V	12 to 24 VDC (10.8 to 26.4V)										
			A	24 VDC (21.6 to 26.4V)										
Current consumption			Note 6	50mA or less										
Lead wire				Φ3.7 AWG26 or equivalent x 5-conductor (connector connection)										
Functions				Flow display, flow display peak hold, switch output, analog output, etc.										
Installation	Installation attitude			Free										
	Strait piping section			Not required										
Protective structure				IEC standards IP40										
Protective circuit			Note 5	Power reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection										
EMC directive				Conforming product										
Weight		*5	H04	50g										
			H06	50g										
			H08	70g										
			H10	75g										
			A15	155g										

Display integrated type (stainless steel body type) specifications

Descriptions			Display integrated type (stainless steel body) FSM2- (*1) (*2) (*3) (*4) - (*5) (*6)									
			Full scale flow	005	010	020	050	100	200	500	101	201
Flow range Note 1	*4	005	500 mℓ/min.	●								
		010	1 ℓ/min.		●							
		020	2 ℓ/min.			●						
		050	5 ℓ/min.				●					
		100	10 ℓ/min.					●				
		200	20 ℓ/min.						●			
		500	50 ℓ/min.							●		
		101	100 ℓ/min.								●	
		201	200 ℓ/min.									●
Port size/body material	*5	S06	Rc1/8 stainless steel	●	●	●	●	●	●	● (No carbon dioxide)		
		S08	Rc1/4 stainless steel							●	●	● Air only
		SM5	M5 stainless steel (Custom order)	●	●	●	●	●	● (No carbon dioxide)			
Flow display			Type of display	4 digits + 4 digits 2 color LCD								
		Display range *3 F		0 to 500 mℓ/min.	0 to 1000 mℓ/min.	0 to 2.00 ℓ/min.	0 to 5.00 ℓ/min.	0 to 10.00 ℓ/min.	0 to 20.0 ℓ/min.	0 to 50.0 ℓ/min.	0 to 100.0 ℓ/min.	0 to 200 ℓ/min.
		Display range *3 R		-500 to 500 mℓ/min.	-1000 to 1000 mℓ/min.	-2.00 to 2.00 ℓ/min.	-5.00 to 5.00 ℓ/min.	-10.00 to 10.00 ℓ/min.	-20.0 to 20.0 ℓ/min.	-50.0 to 50.0 ℓ/min.	-100.0 to 100.0 ℓ/min.	-200 to 200 ℓ/min.
		Display resolution		1 mℓ/min.		0.01 ℓ/min.			0.1 ℓ/min.			1 ℓ/min.
Integration		Display range		9999999 mℓ		99999.99 ℓ			999999.9 ℓ			9999999 ℓ
		Display resolution		1 mℓ		0.01 ℓ			0.1 ℓ			1 ℓ
		Pulse output rate		5 mℓ	10 mℓ	0.02 ℓ	0.05 ℓ	0.1 ℓ	0.2 ℓ	0.5 ℓ	1 ℓ	2 ℓ
Working conditions	Working fluid Note 2	*6	Blank	Clean air (JIS B 8392-1.1.1 to 5.6.2), compressed air (JIS B 8392-1.1.1 to 1.6.2) , nitrogen gas								
			AR	Argon								
			C2	Carbon dioxide								
	Max. working pressure			1.0MPa								
	Min. working pressure			-0.09MPa								
	Withstanding pressure			1.5MPa								
	Ambient temperature/humidity			0 to 50°C, 90%RH or less								
	Working fluid temperature			0 to 50°C (with no dew condensation)								
Precision	Precision scope of guarantee			3 to 100% F.S.								
	Linearity (display and analog output)			±3% F.S. or less (secondary atmospheric release, 25°C)								
	Pressure characteristics			±5% F.S. or less (-0.09 to 0.7MPa , where reference for secondary atmospheric release)								
	Temperature characteristics			±0.2% F.S./°C or less (15 to 35°C, where 25°C is reference)								
	Repeatability			±1% F.S. or less								
Response time			Note 3	50ms or less								
Output	Switch output	*1	N	2 outputs (NPN open collector output, 50mA or less, voltage drop 2.4V or less)								
			P	2 outputs (PNP open collector output, 50mA or less, voltage drop 2.4 V or less)								
	Analog output	*2	V	1 to 5V voltage output 1 point (connected load impedance 50kΩ or more)								
			A	4 to 20mA current output 1 point (connected load impedance 0 to 300Ω)								
Power voltage Note 4		*2	V	12 to 24 VDC (10.8 to 26.4V)								
			A	24 VDC (21.6 to 26.4V)								
Current consumption			Note 6	50mA or less								
Lead wire				Φ3.7 AWG26 or equivalent x 5-conductor (connector connection)								
Functions				Flow display, flow display peak hold, switch output, analog output, etc.								
Installation	Installation attitude			Free								
	Strait piping section			Not required								
Protective structure				IEC standards IP40								
Protective circuit			Note 5	Power reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection								
EMC directive				Conforming product								
Weight		*5	S06	95g								
			S08	115g								
			SM5	140g								

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

Note 2: When using compressed air, use clean air that complies to JIS B 8392-1:2003 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration: 5 μm), air dryer (minimum pressure dew point: 10°C or colder), and oil mist filter (maximum oil concentration: 0.1 mg/m^3) on the primary side of this product to maintain product functions. (Recommended circuit)



< Recommended component >
Air filter: F Series
Oil mist filter: M Series

When using for other than compressed air, use dry gas that does not contain corrosive elements such as chlorine, sulfur, or acids, and clean gas that does not contain dust or oil mist.

Note 3: Response time is set in seven stages from 50 ms or less to 1.5 s.

Note 4: Power voltage specifications differ for the voltage output and current output.

Note 5: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.

Note 6: Current for 24 VDC connection with no load connected. Consumed current varies with the load connection.

Display separate type (resin/aluminum body type) specifications

Descriptions			Display separate type (resin/aluminum body) FSM2-A (*1) (*2) (*3) - (*4)											
			Full scale flow	005	010	020	050	100	200	500	101	201	501	102
Flow range Note 1	*3	005	500 mℓ/min.	●										
		010	1 ℓ/min.		●									
		020	2 ℓ/min.			●								
		050	5 ℓ/min.				●							
		100	10 ℓ/min.					●						
		200	20 ℓ/min.						●					
		500	50 ℓ/min.							●				
		101	100 ℓ/min.								●			
		201	200 ℓ/min.									●		
		501	500 ℓ/min.										●	
		102	1000 ℓ/min.											●
Port size/body material	*4	H04	Φ4 push-in/resin	●	●	●	●	●	●					
		H06	Φ6 push-in/resin	●	●	●	●	●	●	●				
		H08	Φ8 push-in/resin							●	●	●		
		H10	Φ10 push-in/resin								●	●		
		A15	Rc1/2, aluminum										●	●

Flow direction		*2	F	Unidirectional
			R	Bidirectional
Working conditions	Working fluid		Note 2	Clean air (JIS B 8392-1.1.1 to 5.6.2), compressed air (JIS B 8392-1.1.1 to 1.6.2) , nitrogen gas
	Max. working pressure			0.7MPa
	Min. working pressure			-0.09MPa
	Withstanding pressure			1MPa
	Ambient temperature/humidity			0 to 50°C, 90%RH or less
	Working fluid temperature			0 to 50°C (with no dew condensation)
Precision	Precision scope of guarantee			3 to 100% F.S.
	Linearity (display and analog output)			±3% F.S. or less (secondary atmospheric release, 25°C)
	Pressure characteristics			±5% F.S. or less (-0.09 to 0.7MPa , where reference for secondary atmospheric release)
	Temperature characteristics			±0.2% F.S./°C or less (15 to 35°C, where 25°C is reference)
	Repeatability			±1% F.S. or less
Response time				50ms or less
Type of display				Flow bar display
Output	Analog output	*1	V	1 to 5V voltage 1 output (connected load impedance 50kΩ or more)
			A	4 to 20mA current 1 output (connected load impedance 0 to 300Ω)
Power voltage Note 3		*1	V	12 to 24 VDC (10.8 to 26.4V)
			A	24 VDC (21.6 to 26.4V)
Current consumption			Note 5	50mA or less
Lead wire				Φ3.7 AWG26 or equivalent x 4-conductor (connector)
Functions				Analog output, flow bar display, error display
Installation	Installation attitude			Free
	Strait piping section			Not required
Protective structure				IEC standards IP40
Protective circuit			Note 4	Power reverse connection protection
EMC directive				Conforming product
Weight		*4	H04	40g
			H06	40g
			H08	60g
			H10	65g
			A15	145g

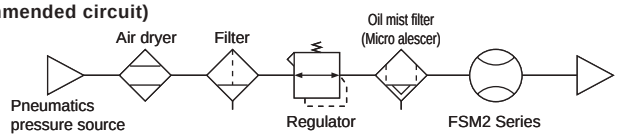
Display separate type (stainless steel body type) specifications

Descriptions			Separate type display (stainless steel body) FSM2- A (*1) (*2) (*3) - (*4) (*5)									
			Full scale flow	005	010	020	050	100	200	500	101	201
Flow range Note 1	*3	005	500 mℓ/min.	●								
		010	1 ℓ/min.		●							
		020	2 ℓ/min.			●						
		050	5 ℓ/min.				●					
		100	10 ℓ/min.					●				
		200	20 ℓ/min.						●			
		500	50 ℓ/min.							●		
		101	100 ℓ/min.								●	
		201	200 ℓ/min.									●
Port size/body material	*4	S06	Rc1/8 stainless steel	●	●	●	●	●	●	● (No carbon dioxide)		
		S08	Rc1/4 stainless steel							●	●	● Air only
		SM5	M5 stainless steel (Custom order)	●	●	●	●	●	● (No carbon dioxide)			

Flow direction		*2	F	Unidirectional
			R	Bidirectional
Working conditions	Working fluid Note 2	*5	Blank	Clean air (JIS B 8392-1.1.1 to 5.6.2), compressed air (JIS B 8392-1.1.1 to 1.6.2) , nitrogen gas
			AR	Argon
			C2	Carbon dioxide
	Max. working pressure			1.0MPa
	Min. working pressure			-0.09MPa
	Withstanding pressure			1.5MPa
	Ambient temperature/humidity			0 to 50°C, 90%RH or less
	Working fluid temperature			0 to 50°C (with no dew condensation)
Precision	Precision scope of guarantee			3 to 100% F.S.
	Linearity (display and analog output)			±3% F.S. or less (secondary atmospheric release, 25°C)
	Pressure characteristics			±5% F.S. or less (-0.09 to 0.7MPa , where reference for secondary atmospheric release)
	Temperature characteristics			±0.2% F.S./°C or less (15 to 35°C, where 25°C is reference)
	Repeatability			±1% F.S. or less
Response time				50ms or less
Type of display				Flow bar display
Output	Analog output	*1	V	1 to 5V voltage 1 output (connected load impedance 50kΩ or more)
			A	4 to 20mA current 1 output (connected load impedance 0 to 300Ω)
Power voltage Note 3		*1	V	12 to 24 VDC (10.8 to 26.4V)
			A	24 VDC (21.6 to 26.4V)
Current consumption Note 5				50mA or less
Lead wire				Φ3.7 AWG26 or equivalent x 4-conductor (connector)
Functions				Analog output, flow bar display, error display
Installation	Installation attitude			Free
	Strait piping section			Not required
Protective structure				IEC standards IP40
Protective circuit Note 4				Power reverse connection protection
EMC directive				Conforming product
Weight		*4	S06	85g
			S08	105g
			SM5	130g

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

Note 2: When using compressed air, use clean air that complies to JIS B 8392-1:2003 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration: 5 μm), air dryer (minimum pressure dew point: 10°C or colder), and oil mist filter (maximum oil concentration: 0.1 mg/m^3) on the primary side of this product to maintain product functions. (Recommended circuit)



< Recommended component >
Air filter: F Series
Oil mist filter: M Series

When using for other than compressed air, use dry gas that does not contain corrosive elements such as chlorine, sulfur, or acids, and clean gas that does not contain dust or oil mist.

Note 3: Power voltage specifications differ for voltage output and current output.

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

Note 5: Current for 24 VDC connection with no load connected. Consumed current varies with the load connection.

*** Contact CKD for separate displays.**

How to order

FSM2 - A V R 005 - S06 AR 1 B K

Symbol	Descriptions
A Output type	
A	Display separate type (only 1 analog output)
N	Display integrated type (2 switch outputs (NPN), 1 analog output)
P	Display integrated type (2 switch outputs (PNP), 1 analog output)
B Analog output type	
V	Voltage output (1 to 5V)
A	Current output (4 to 20mA)
C Flow direction	
F	Unidirectional
R	Bidirectional
D Flow range (full scale flow)	
005	500 mℓ/min.
010	1 ℓ/min.
020	2 ℓ/min.
050	5 ℓ/min.
100	10 ℓ/min.
200	20 ℓ/min.
500	50 ℓ/min.
101	100 ℓ/min.
201	200 ℓ/min.
501	500 ℓ/min.
102	1000 ℓ/min.
E Port size (body material)	
H04	Push-in Φ4 (resin)
H06	Push-in Φ6 (resin)
H08	Push-in Φ8 (resin)
H10	Push-in Φ10 (resin)
S06	Rc1/8 (stainless steel)
S08	Rc1/4 (stainless steel)
A15	Rc1/2 (aluminum)
SM5	M5 (stainless steel) (custom order)
F Gas type	
Blank	Air, nitrogen gas
AR	Argon
C2	Carbon dioxide
G Cable	
Blank	None
1	1m
3	3m
H Bracket	
Blank	None
B	With bracket
I Traceability	
Blank	None
T	With traceability certificate, system configuration, company certification
K	With company certification

A Output type

B Analog output type

C Flow direction

D Flow range

* Refer to table on the following page for the combinations of the flow range, port size (body material) and gas type.

E Port size (Body material)

F Gas type

G Cable

H Bracket

I Traceability

* Consult with CKD for the separate indicator.

<Example of model number>

FSM2-AVR005-S06AR1BK

Model: Small size flow sensor FSM2

A Output type	: Display separate type
B Analog output type	: Voltage output (1 to 5V)
C Flow direction	: Bidirectional
D Flow range	: 500 mℓ/min.
E Port size (body material)	: Rc1/8 (stainless steel)
F Gas type	: Argon
G Cable	: 1m
H Bracket	: With bracket
I Traceability	: With company certification

Discrete option model No.

FSM2 - LB1

Symbol	Descriptions
LB1	Bracket (Φ4, Φ6, Φ8, Φ10, Rc1/8, Rc1/4, M5)
LB2	Bracket (Rc1/2)
C51	Cable for display integrated type 1 m
C53	Cable for display integrated type 3 m
C41	Cable for display separate type 1 m
C43	Cable for display separate type 3 m

●Combinations of flow range, port size (body material), gas type

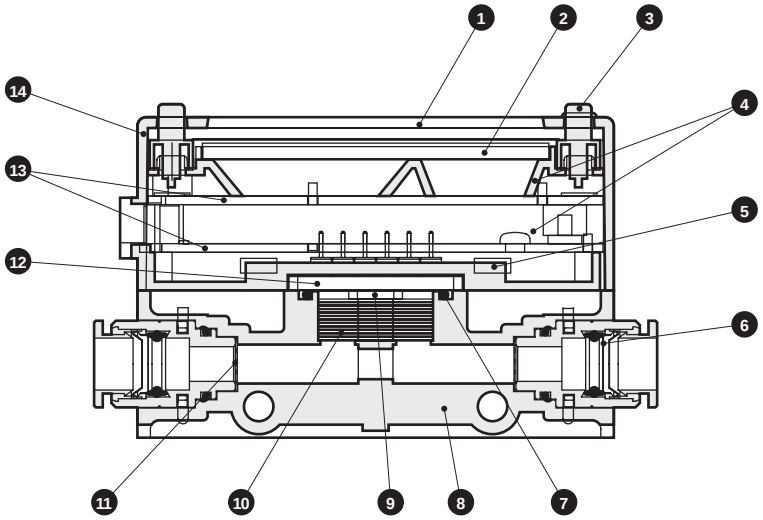
Ⓓ Flow range	Ⓔ Port size (body material)							
	H04	H06	H08	H10	S06	S08	A15	SM5
005	●	●			●○△			●○△
010	●	●			●○△			●○△
020	●	●			●○△			●○△
050	●	●			●○△			●○△
100	●	●			●○△			●○△
200	●	●			●○△			●○
500		●	●		●○	●○△		
101			●	●		●○△		
201			●	●		●		
501							●	
102							●	

Ⓕ Gas type

● : Air, nitrogen gas
○ : Argon
△ : Carbon dioxide
: Not available

Internal structure and parts list

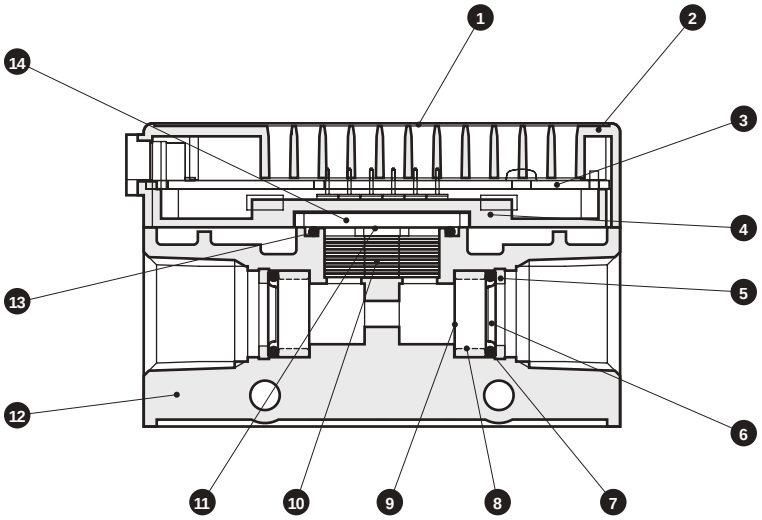
●Display integrated type, resin body, port size: push-in Φ6



Main parts list

No.	Parts name	Material	No.	Parts name	Material
1	Liquid crystal guard	Acryl resin	8	Resin body	Polyamide resin
2	Liquid crystal	–	9	Sensor chip	Semiconductor chip
3	Switch	EPDM	10	Rectification plate	Stainless steel
4	Circuit board spacer	Polycarbonate resin	11	Port filter	Stainless steel
5	Module holder	Polyamide resin	12	Sensor circuit board	Almina
6	Push-in joint	–	13	Electronic circuit board	–
7	Sensor gasket	Fluoro rubber	14	Case	ABS resin

●Display separate type Stainless steel body Port size : Rc1/4

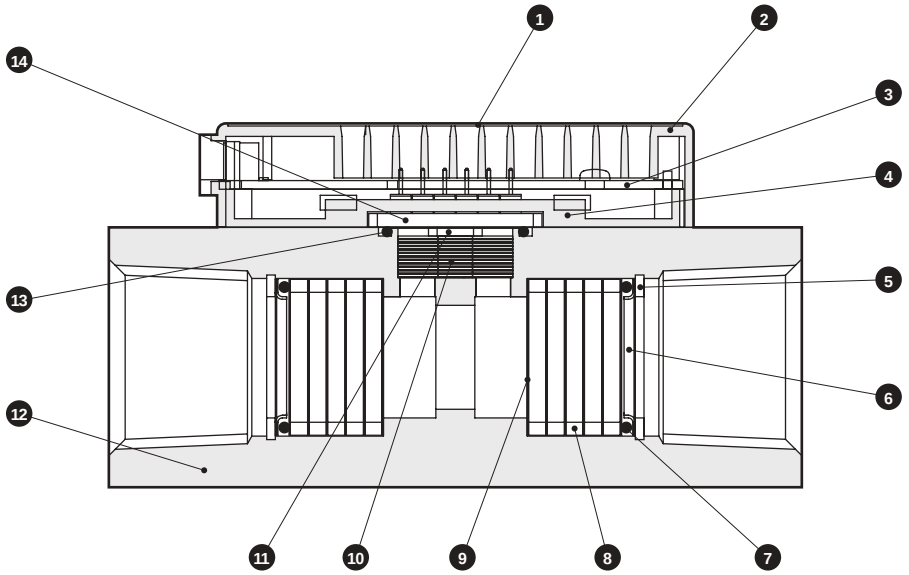


Main parts list

No.	Parts name	Material	No.	Parts name	Material
1	Front seat	PET film	8	Spacer	Stainless steel
2	Case	ABS resin	9	Port filter	Stainless steel
3	Electronic circuit board	–	10	Rectification plate	Stainless steel
4	Module holder	Polyamide resin	11	Sensor chip	Semiconductor chip
5	C ring	Stainless steel	12	Stainless steel body	Stainless steel
6	O ring holder	Stainless steel	13	Sensor gasket	Fluoro rubber
7	O ring	Fluoro rubber	14	Sensor circuit board	Almina

Internal structure and parts list

●Display separate type, aluminum body, port size: Rc1/2



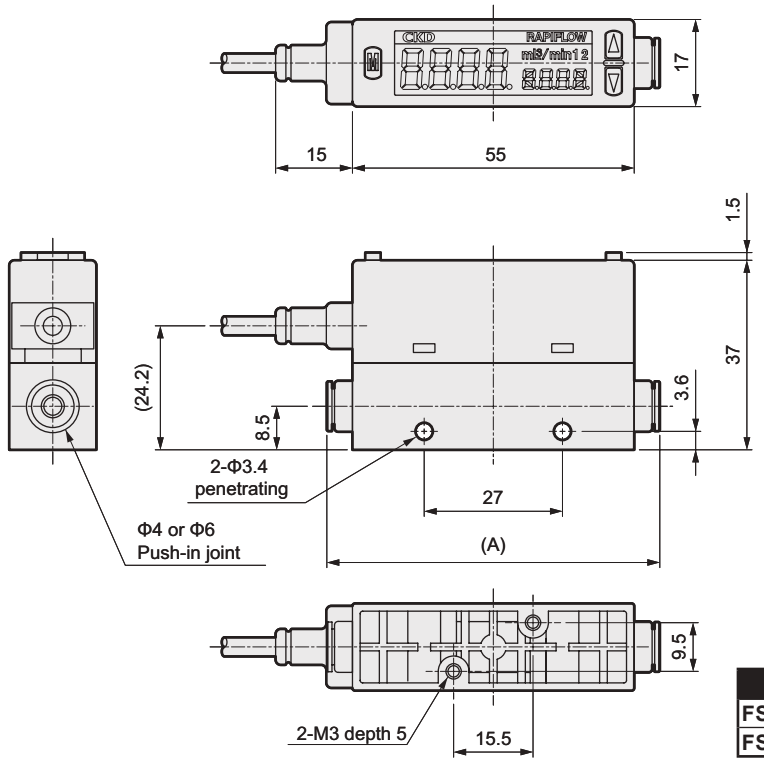
Main parts list

No.	Parts name	Material	No.	Parts name	Material
1	Front seat	PET film	8	Spacer	Aluminum
2	Case	ABS resin	9	Port filter	Stainless steel
3	Electronic circuit board	–	10	Rectification plate	Stainless steel
4	Module holder	Polyamide resin	11	Sensor chip	Semiconductor chip
5	C ring	Stainless steel	12	Aluminum body	Aluminum
6	O ring holder	Stainless steel	13	Sensor gasket	Fluoro rubber
7	O ring	Fluoro rubber	14	Sensor circuit board	Almina

Dimensions (display integrated type)

Display integrated type, port size: Push-in Φ4, Φ6

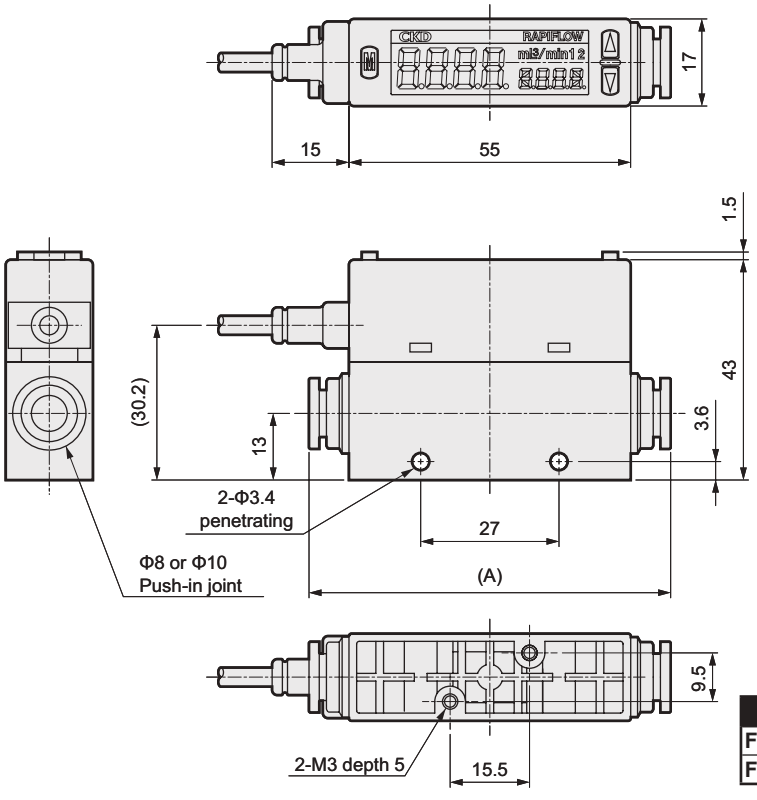
●FSM2-N/P*-H04/H06* (full scale flow: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min.)



Model No.	Joint	(A) dimensions
FSM2-N/P*-H04*	Push-in Φ4	64
FSM2-N/P*-H06*	Push-in Φ6	65

Display integrated type, port size: Push-in Φ8, Φ10

●FSM2-N/P*-H08/H10* (full scale flow: 50, 100, 200 ℓ/min.)

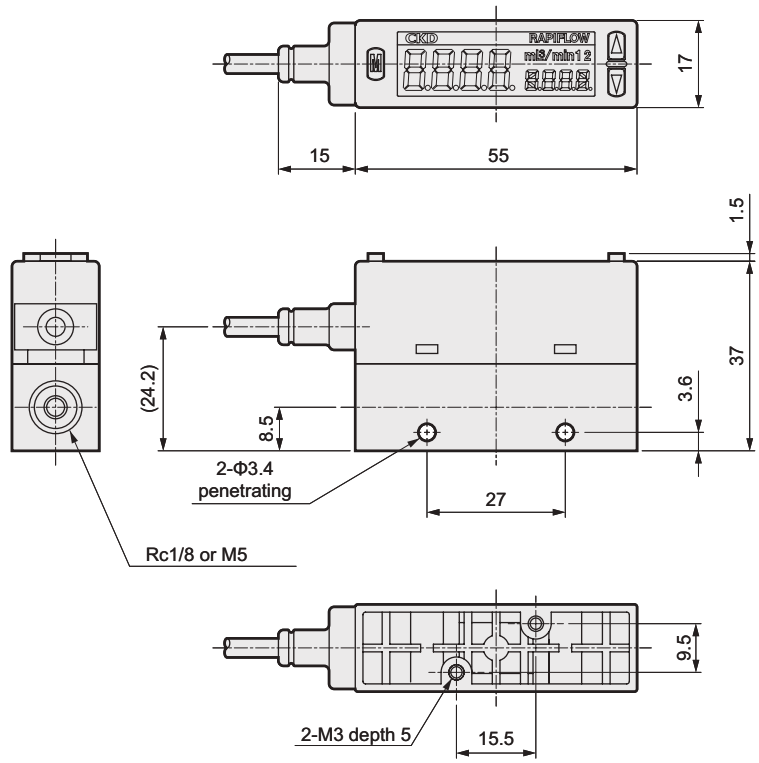


Model No.	Joint	(A) dimensions
FSM2-N/P*-H08*	Push-in Φ8	70.6
FSM2-N/P*-H10*	Push-in Φ10	82.1

Dimensions (display integrated type)

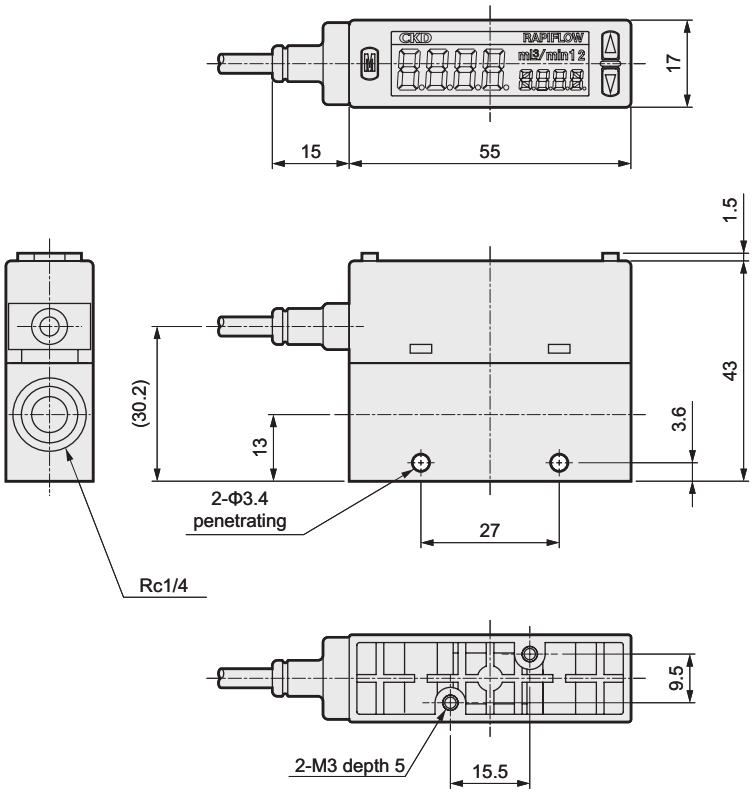
Display integrated type, port size: Rc1/8, M5

●**FSM2-N/P*-S06/SM5* (full scale flow: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min.)**



Display integrated type, port size: Rc1/4

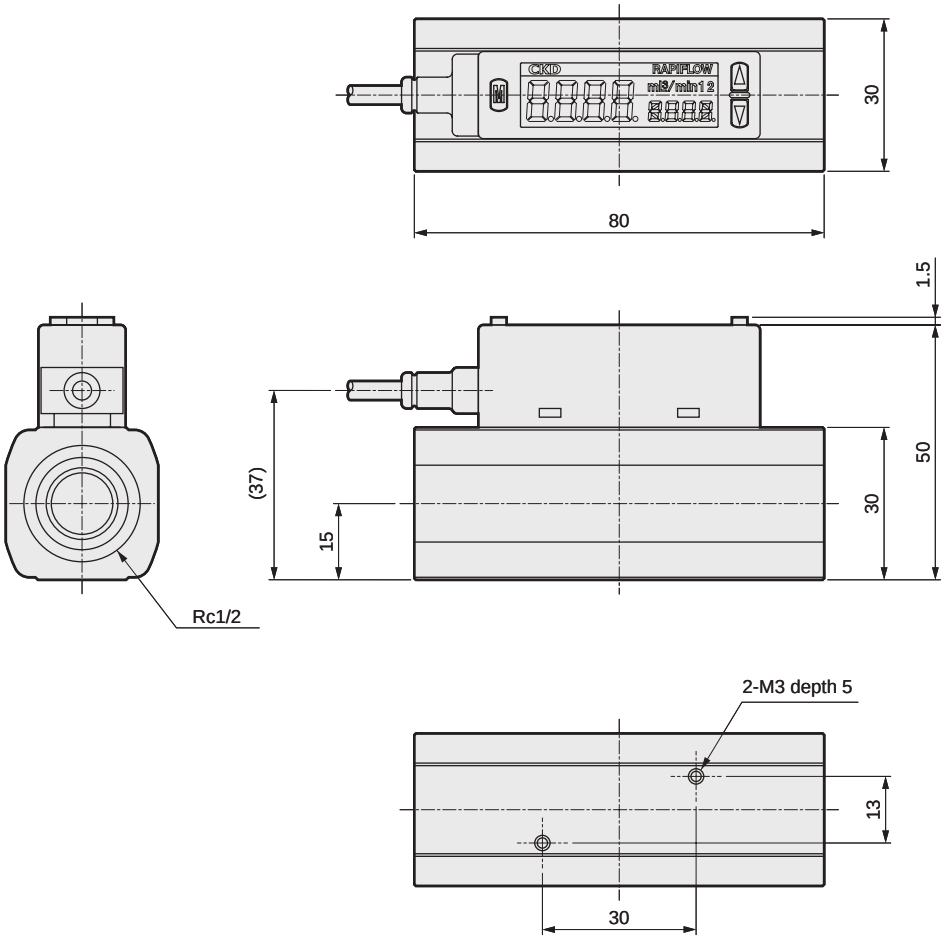
●**FSM2-N/P*-S08* (full scale flow: 50, 100, 200 ℓ/min.)**



Dimensions (display integrated type)

Display integrated type, port size: Rc1/2

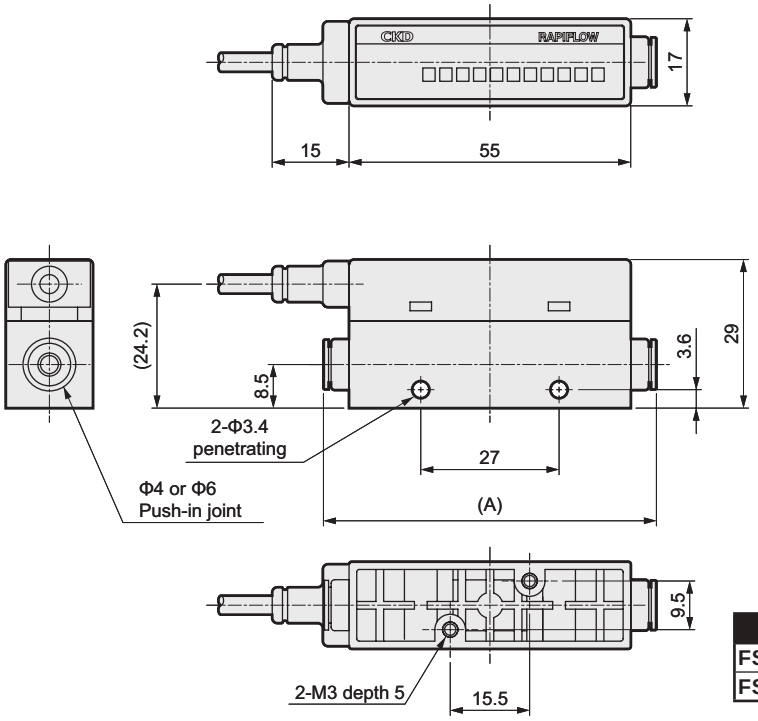
● **FSM2-N/P*-A15* (full scale flow: 500, 1000 ℓ/min.)**



Dimensions (display separate type)

Display separate type, port size: Push-in Φ4, Φ6

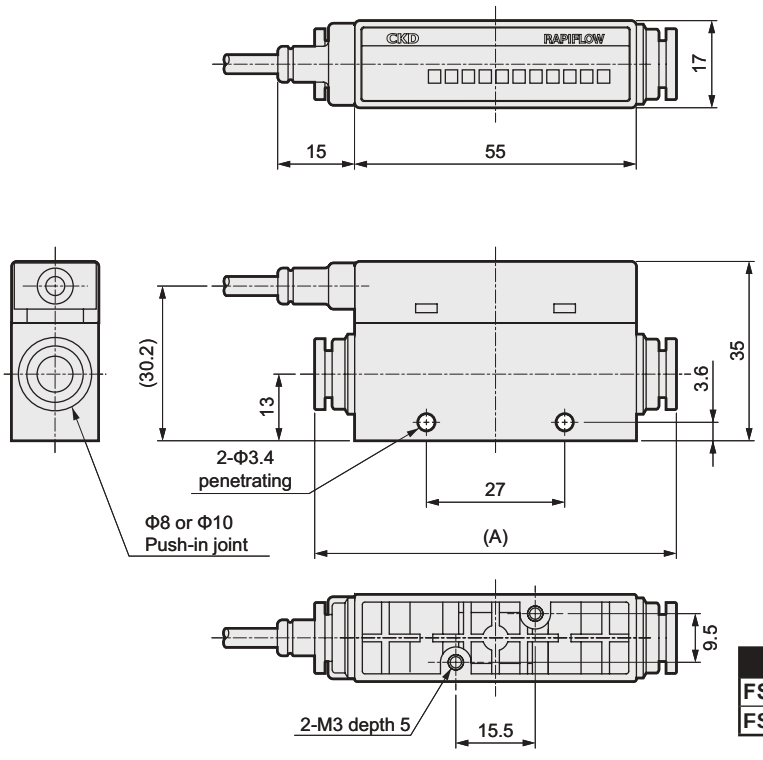
● **FSM2-A*-H04/H06* (full scale flow: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min.)**



Model No.	Joint	(A) dimensions
FSM2-A*-H04*	Push-in Φ4	64
FSM2-A*-H06*	Push-in Φ6	65

Display separate type, port size: Push-in Φ8, Φ10

● **FSM2-A*-H08/H10* (full scale flow: 50, 100, 200 ℓ/min.)**

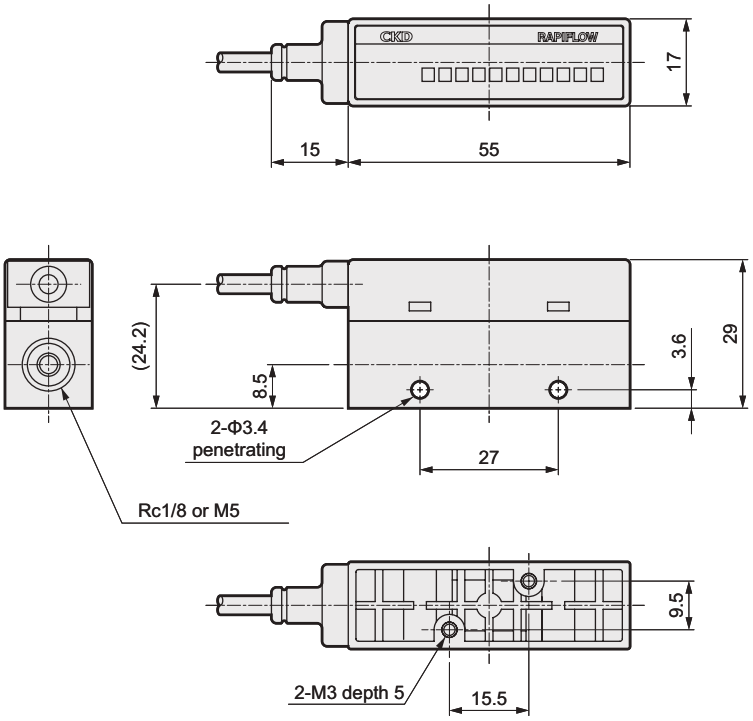


Model No.	Joint	(A) dimensions
FSM2-A*-H08*	Push-in Φ8	70.6
FSM2-A*-H10*	Push-in Φ10	82.1

Dimensions (display separate type)

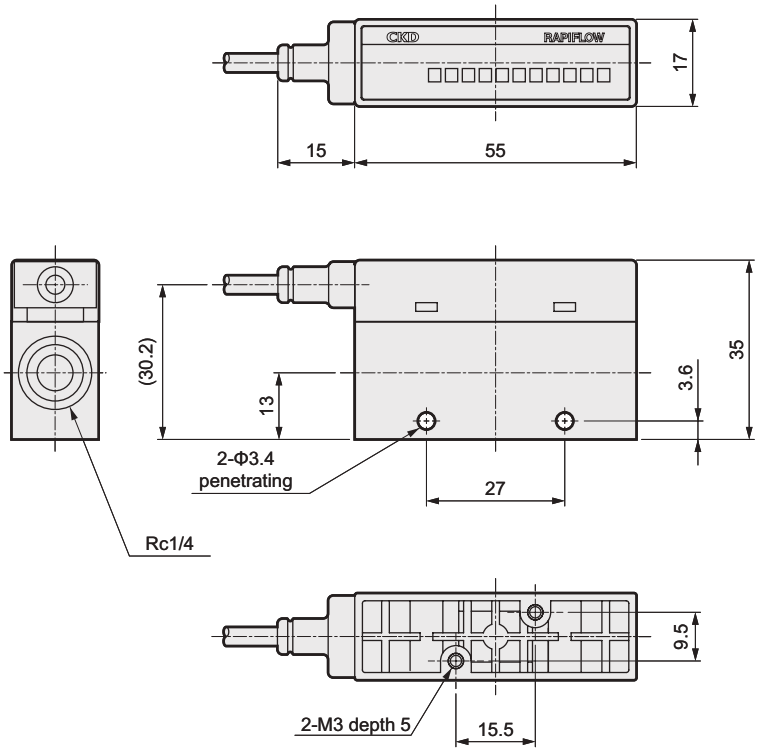
Display separate type, port size: Rc1/8, M5

●FSM2-A*-S06/SM5* (full scale flow: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min.)



Display separate type, port size: Rc1/4

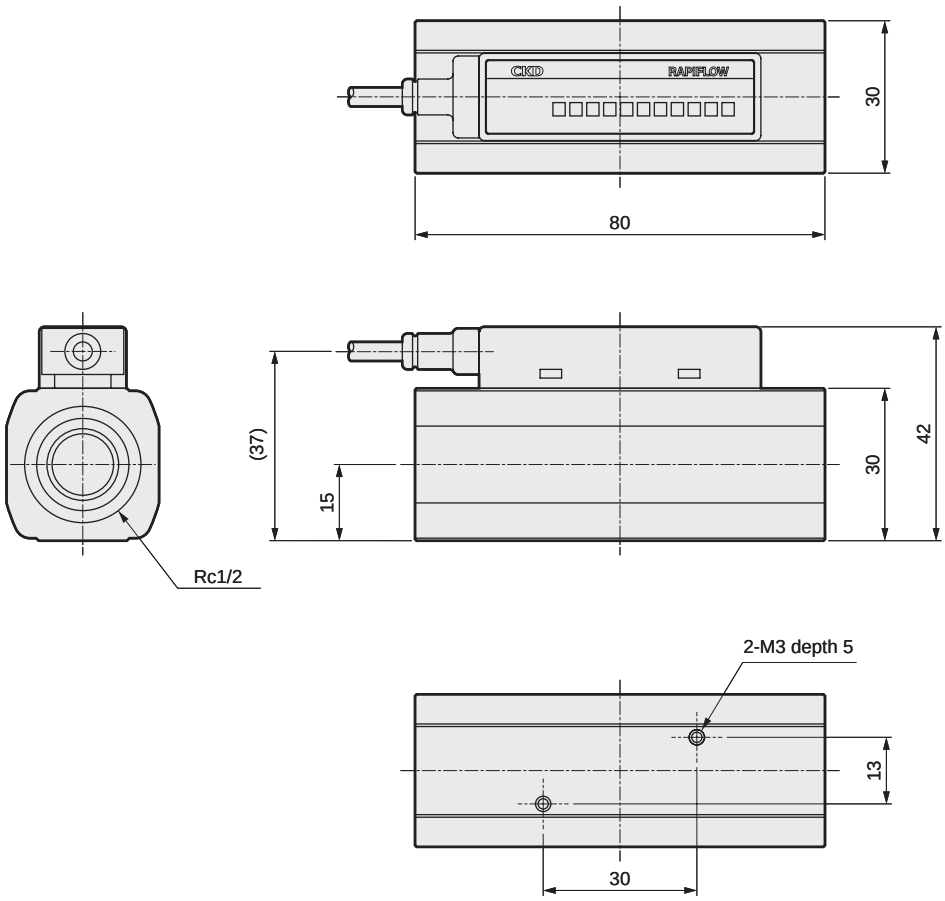
●FSM2-A*-S08* (full scale flow: 50, 100, 200 ℓ/min.)



Dimensions (display separate type)

Display separate type, port size: Rc1/2

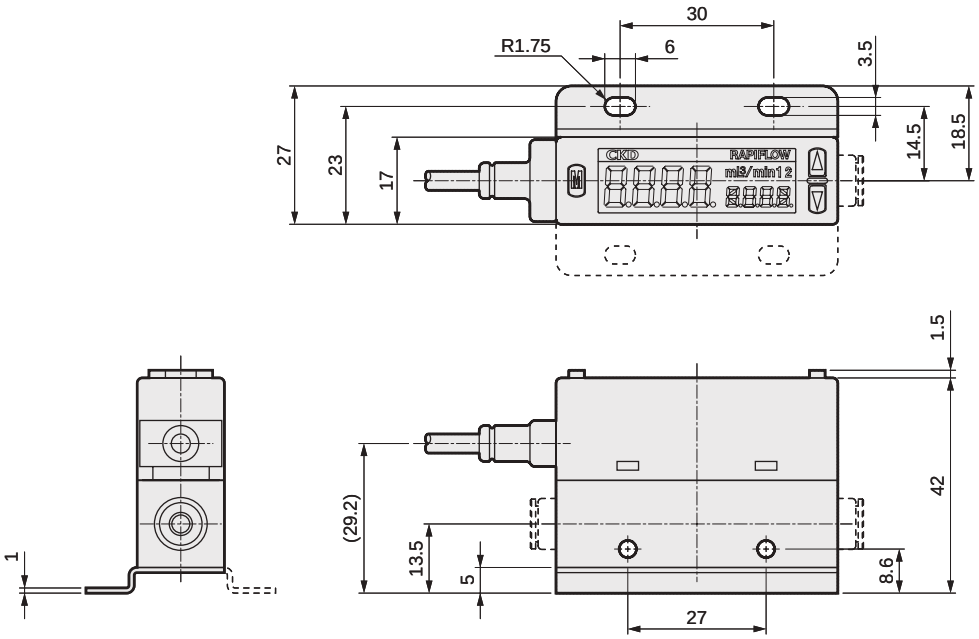
● **FSM2-A*-A15* (full scale flow: 500, 1000 ℓ/min.)**



Dimensions with options (B: with bracket)

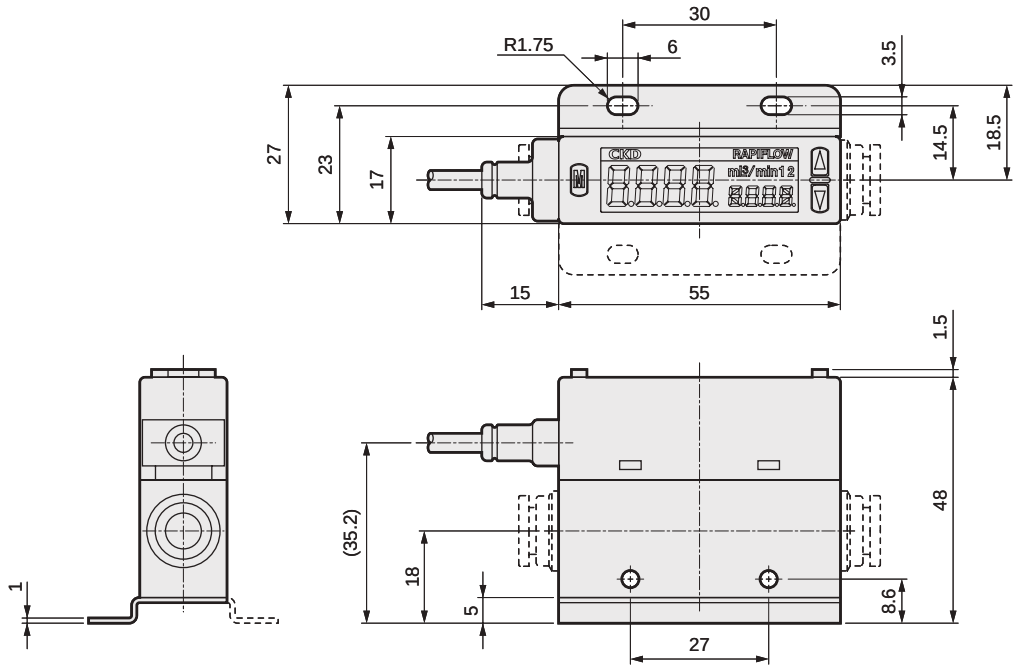
Display integrated type, port size: Push-in Φ4, Φ6, Rc1/8, M5

● **FSM2-N/P*-H04/H06/S06/SM5*B (full scale flow: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min.)**



Display integrated type, port size: Push-in Φ8, Φ10, Rc1/4

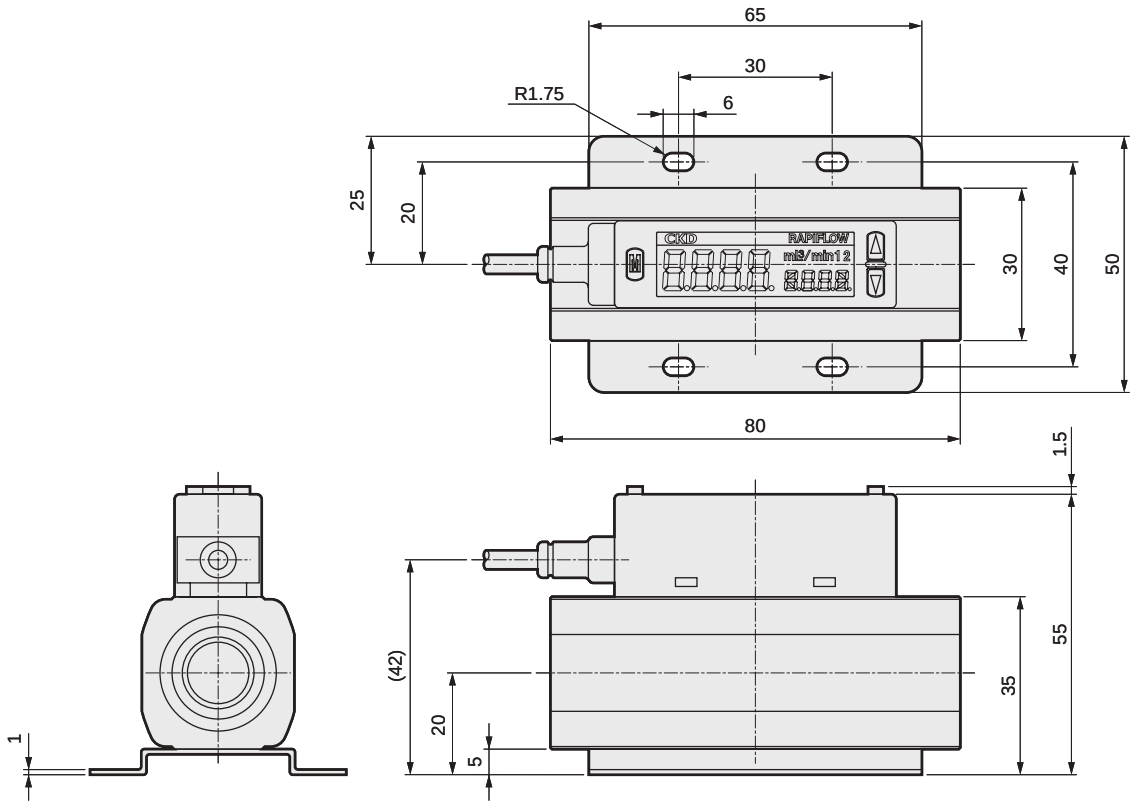
● **FSM2-N/P*-H08/H10/S08*B (full scale flow: 50, 100, 200 ℓ/min.)**



Dimensions with options (B: with bracket)

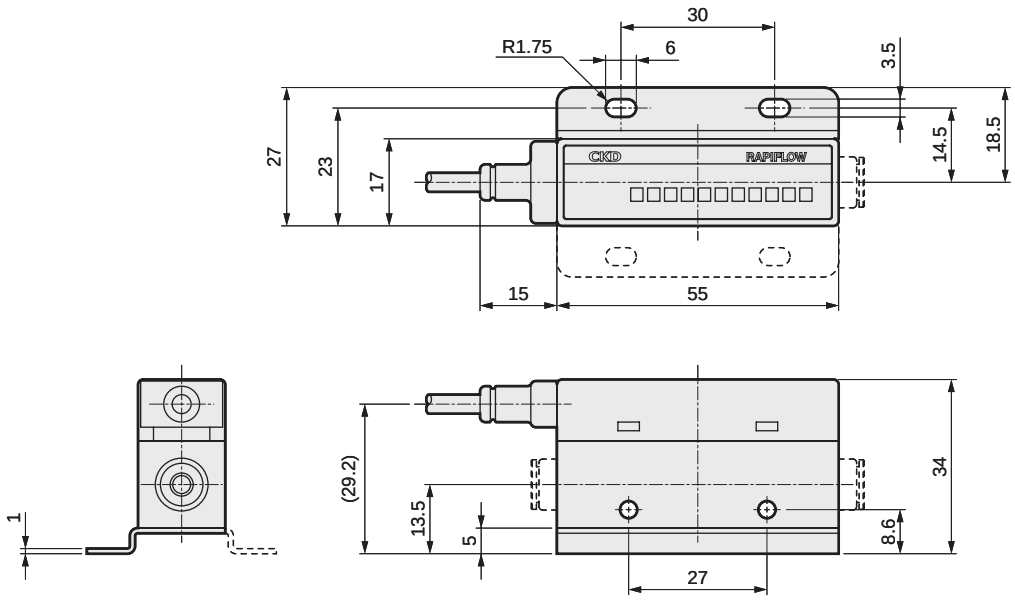
Display integrated type, port size: Rc1/2

● **FSM2-N/P*-A15*B (full scale flow: 500, 1000 ℓ/min.)**



Display separate type, port size: Push-in Φ4, Φ6, Rc1/8, M5

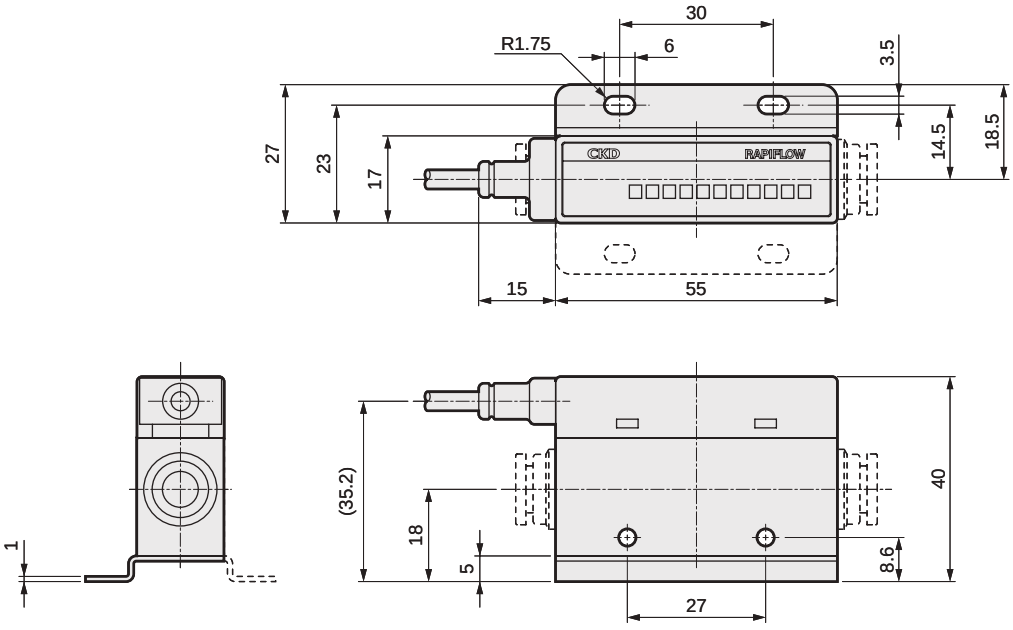
● **FSM2-A*-H04/H06/S06/SM5*B (full scale flow: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min.)**



Dimensions with options (B: with bracket)

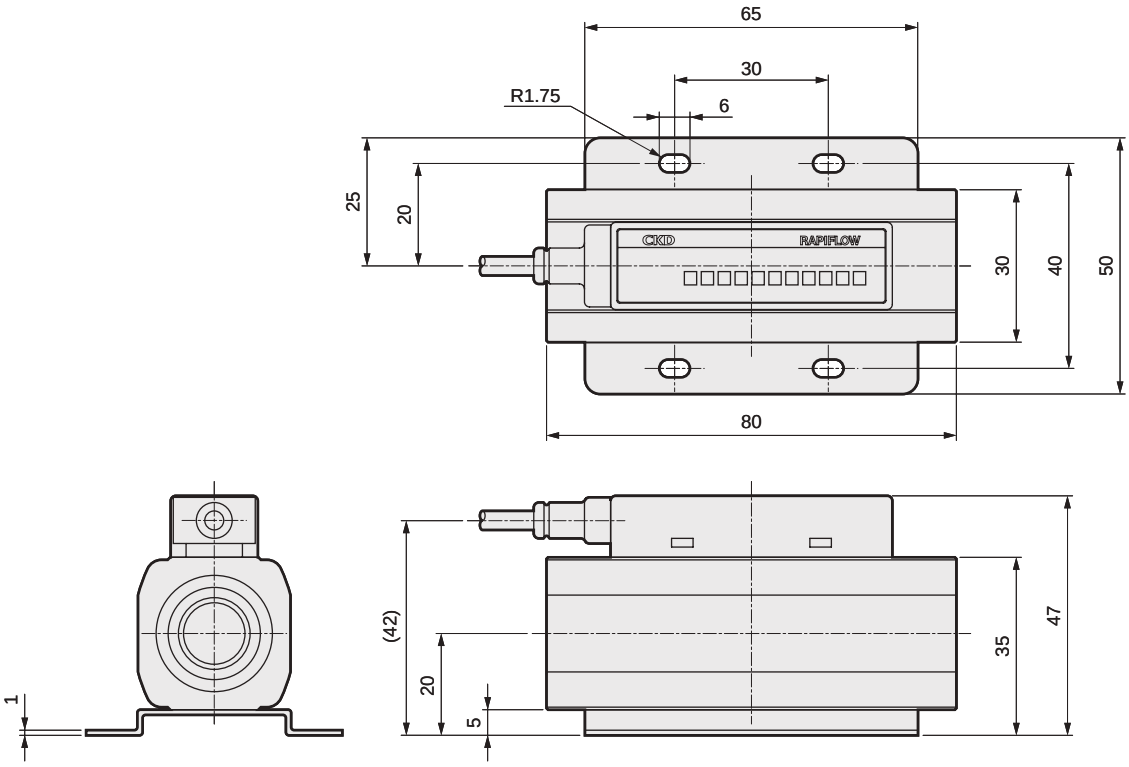
Display separate type, port size: Push-in Φ8, Φ10, Rc1/4

●FSM2-A*-H08/H10/S08*B (full scale flow: 50, 100, 200 ℓ/min.)



Display separate type, port size: Rc1/2

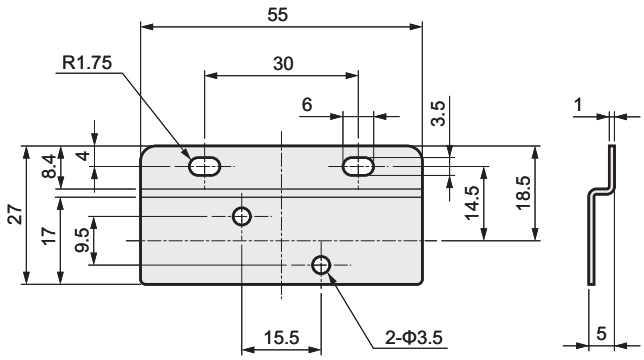
●FSM2-A*-A15*B (full scale flow: 500, 1000 ℓ/min.)



Optional dimensions

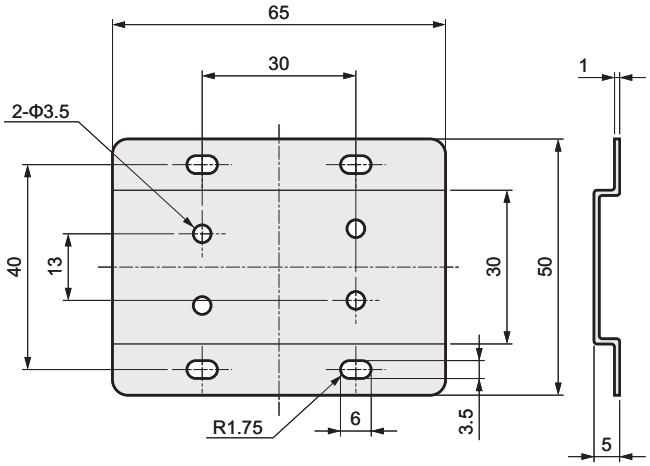
●Bracket

Model No.: FSM2-LB1
(Full scale flow: 0.5, 1, 2, 5, 10, 20, 50, 100, 200 ℓ/min.)



*** 2 M3 (length 6mm) screws for fixing enclosed**

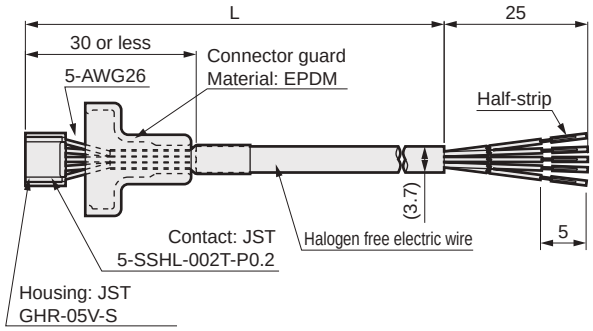
Model No.: FSM2-LB2
(Full scale flow: 500, 1000 ℓ/min.)



*** 2 M3 (length 6mm) screws for fixing enclosed**

●Cable option

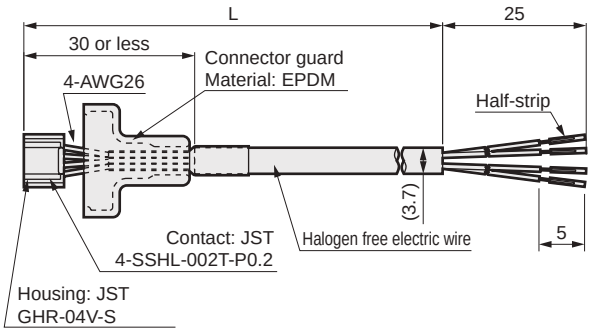
Model No.: FSM2-C51, C53
(For display integrated type FSM2-N/P*-*)



Terminal No.	Cable color
1	Brown
2	Black
3	White
4	Gray
5	Blue

Model No.	L dimensions
FSM2-C51	1040±20
FSM2-C53	3040±20

Model No.: FSM2-C41, C43
(For display separate type FSM2-A*-*)



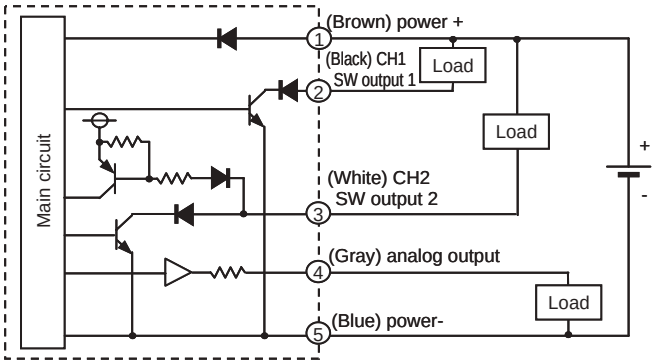
Terminal No.	Cable color
1	Brown
2	Black
3	White
4	Blue

Model No.	L dimensions
FSM2-C41	1040±20
FSM2-C43	3040±20

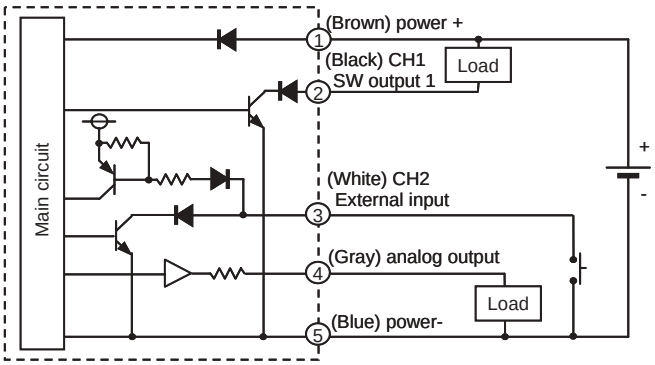
Examples of internal circuit and load connection

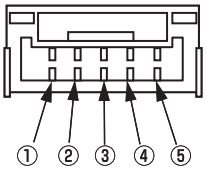
●FSM2-N *-* (display integrated type NPN output)

(Using CH2 as SW output)



(Using CH2 as external input)



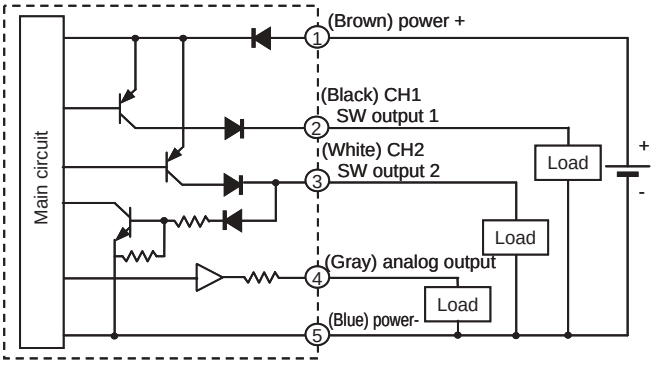


(FSM2 side)

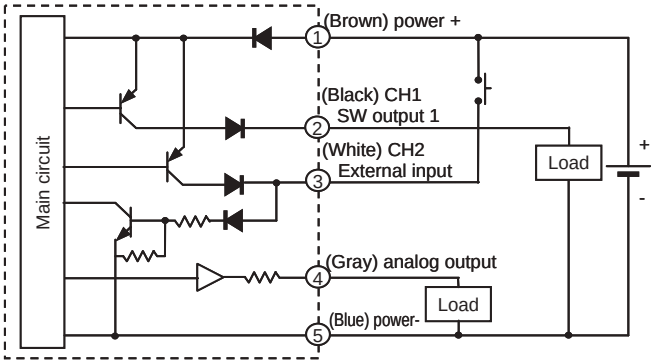
Terminal No.	Option cable color	Name	
①	Brown	Power + (voltage output: 12 to 24V, current output: 24V)	
②	Black	CH1 (switch output 1: max. 50mA)	
③	White	CH2 (switch output 2: max. 50mA, or external input)	
④	Gray	Analog output	Voltage output: 1 to 5V, load impedance 50kΩ and over Current output: 4 to 20mA, load impedance 300Ω or less
⑤	Blue	Power- (GND)	

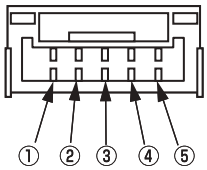
●FSM2-P*-* (display integrated type PNP output)

(Using CH2 as SW output)



(Using CH2 as external input)



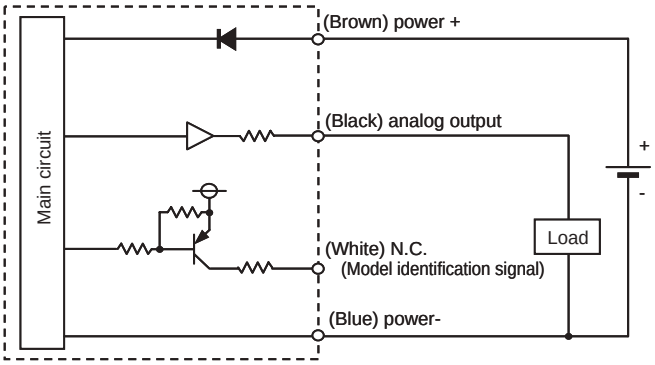


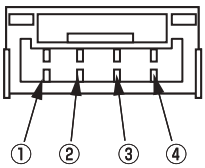
(FSM2 side)

Terminal No.	Option cable color	Name	
①	Brown	Power + (voltage output: 12 to 24V, current output: 24V)	
②	Black	CH1 (switch output 1: max. 50mA)	
③	White	CH2 (switch output 2: max. 50mA, or external input)	
④	Gray	Analog output	Voltage output: 1 to 5V, load impedance 50kΩ and over Current output: 4 to 20mA, load impedance 300Ω or less
⑤	Blue	Power- (GND)	

Examples of internal circuit and load connection

●FSM2-A*-* (display separate type)



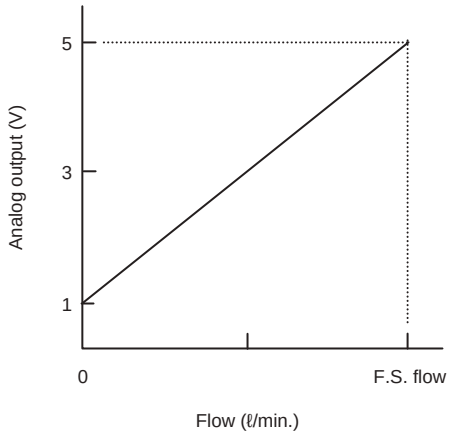


(FSM2 side)

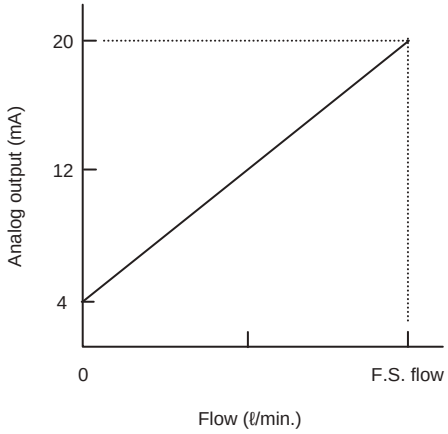
Terminal No.	Option cable color	Name
①	Brown	Power + (voltage output: 12 to 24V, current output: 24V)
②	Black	Analog output — Voltage output: 1 to 5V, load impedance 50kΩ and over; Current output: 4 to 20mA, load impedance 300Ω or less
③	White	N.C. (Model identification signal; Not connected when used as discrete unit.)
④	Blue	Power- (GND)

Analog output characteristics

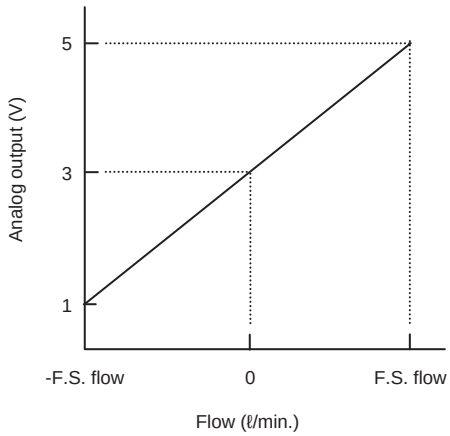
Voltage output type Flow direction: unidirectional



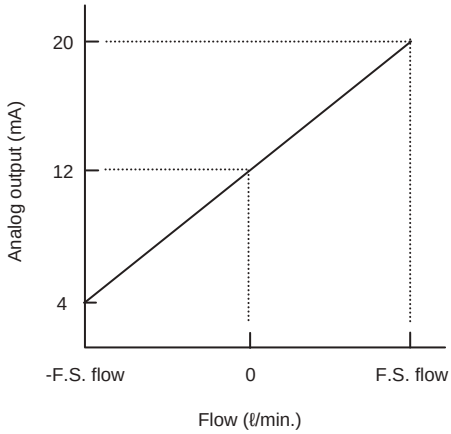
Current output type Flow direction: unidirectional



Voltage output type Flow direction: bidirectional



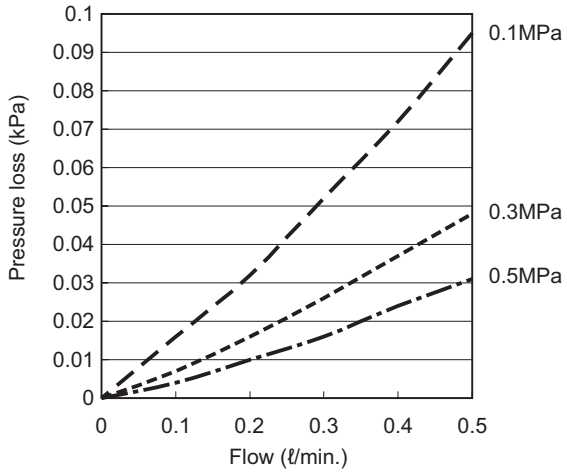
Current output type Flow direction; bidirectional



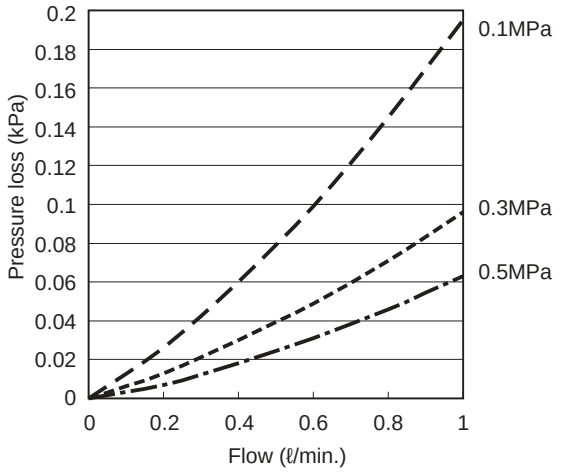
The integrated bidirectional display can be switched to unidirectional output by setting the button. Refer to page 29 for details.

Pressure loss characteristics (air and nitrogen gas)

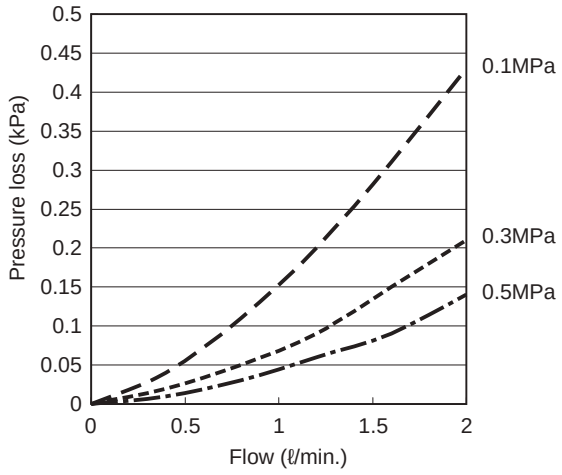
●FSM2-*005-*



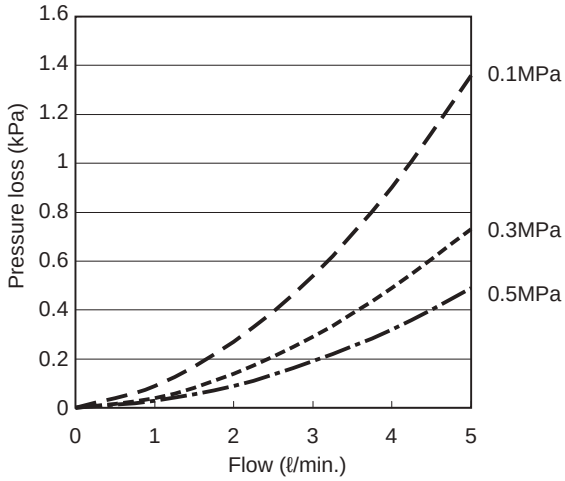
●FSM2-*010-*



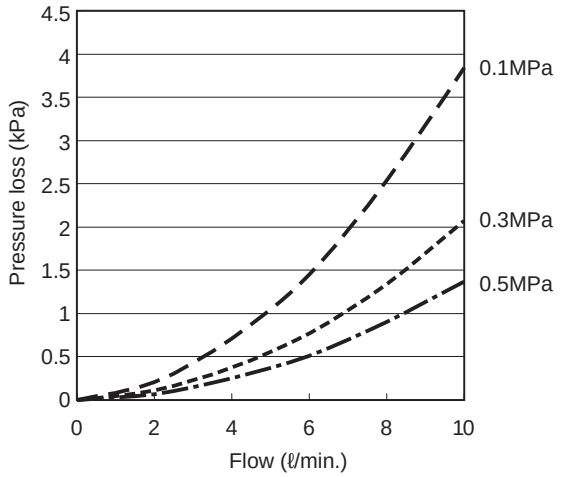
●FSM2-*020-*



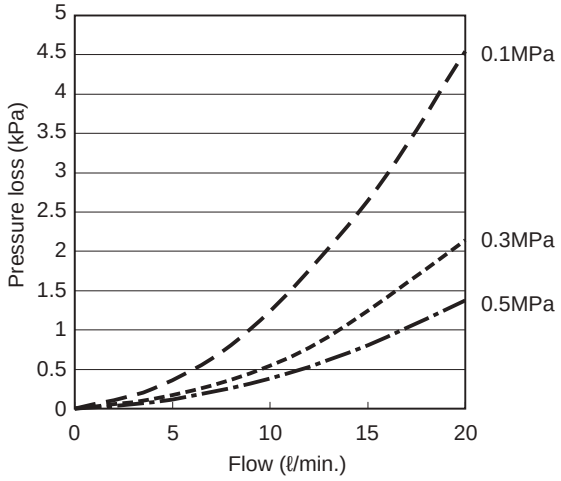
●FSM2-*050-*



●FSM2-*100-*

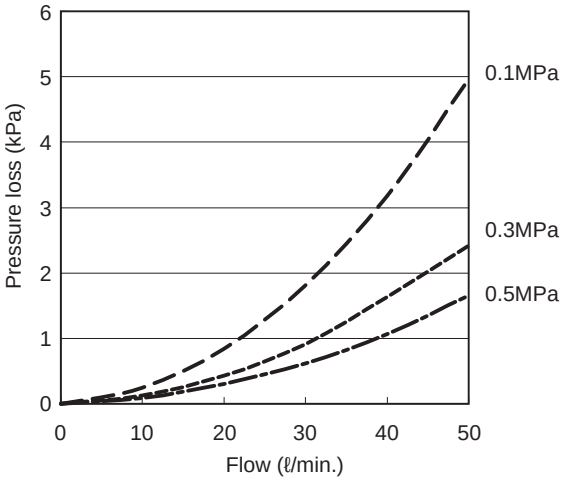


●FSM2-*200-*

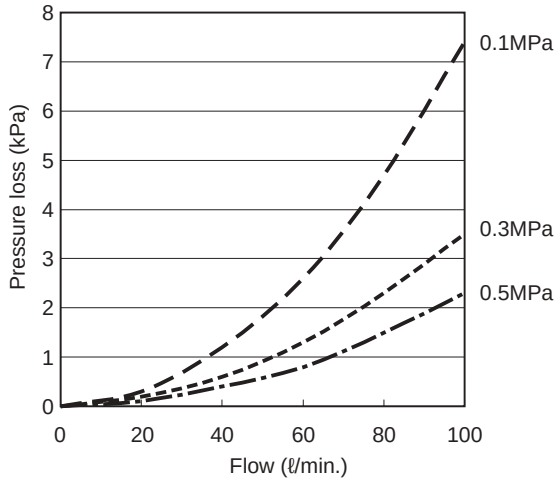


Pressure loss characteristics (air and nitrogen gas)

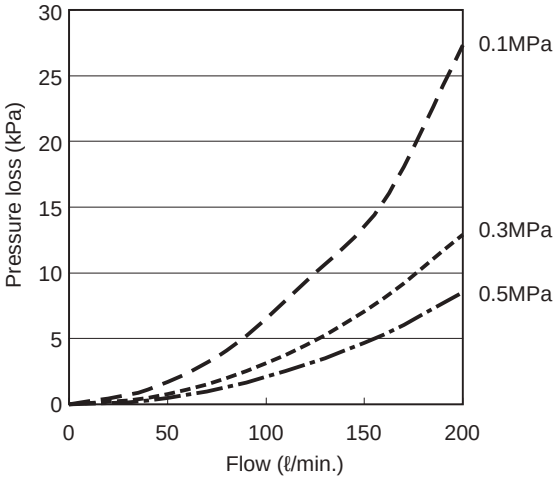
●FSM2-*500-*



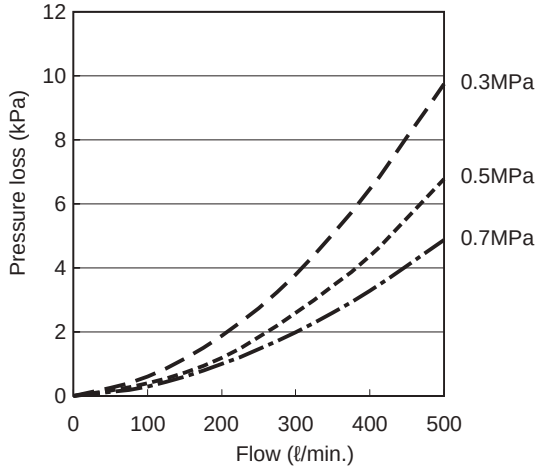
●FSM2-*101-*



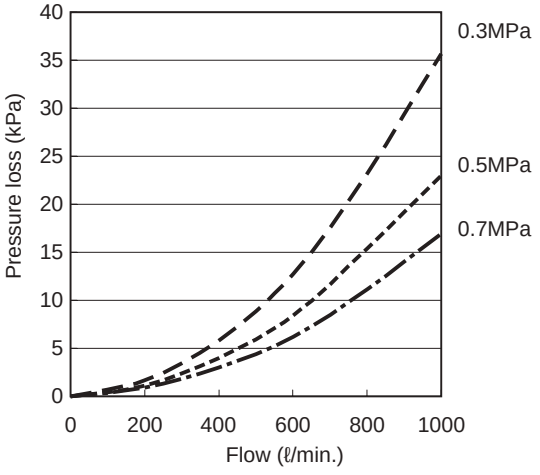
●FSM2-*201-*



●FSM2-*501-*

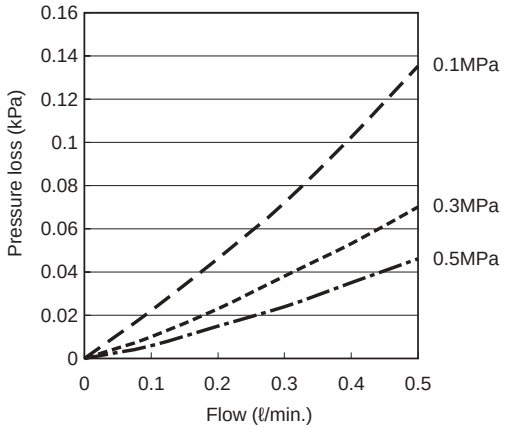


●FSM2-*102-*

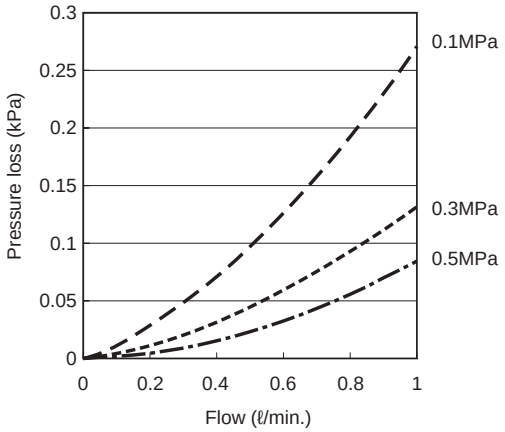


Pressure loss characteristics (argon)

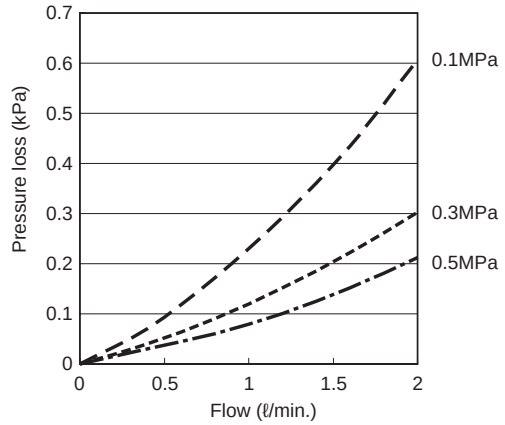
●FSM2-*005-*AR



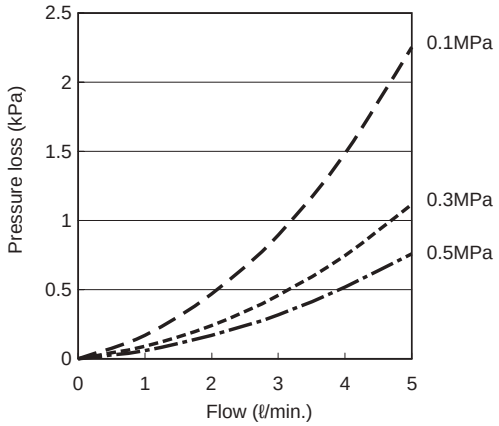
●FSM2-*010-*AR



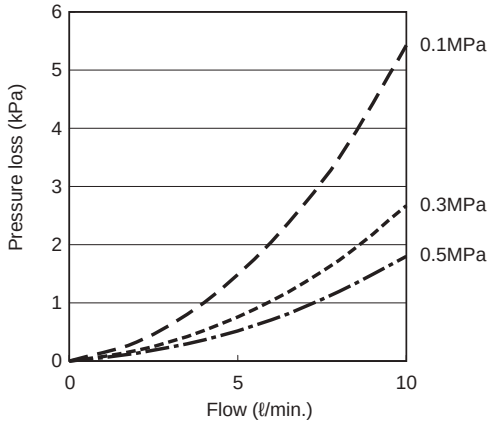
●FSM2-*020-*AR



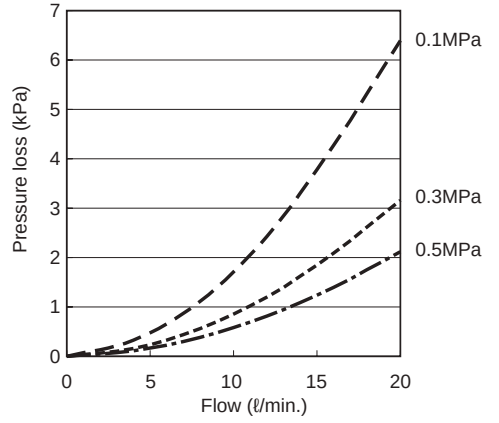
●FSM2-*050-*AR



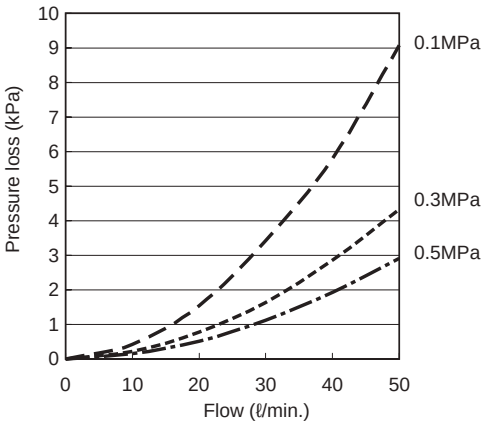
●FSM2-*100-*AR



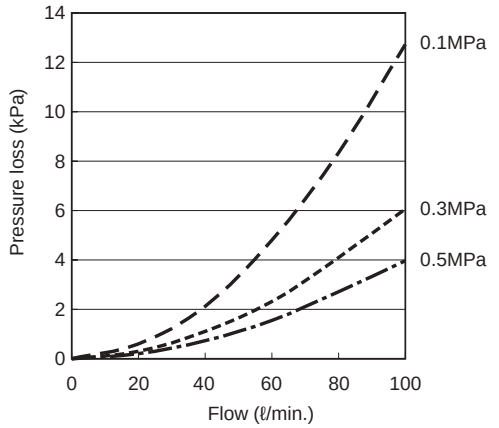
●FSM2-*200-*AR



●FSM2-*500-*AR

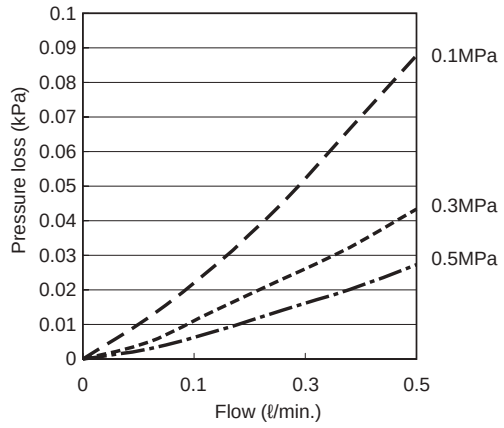


●FSM2-*101-*AR

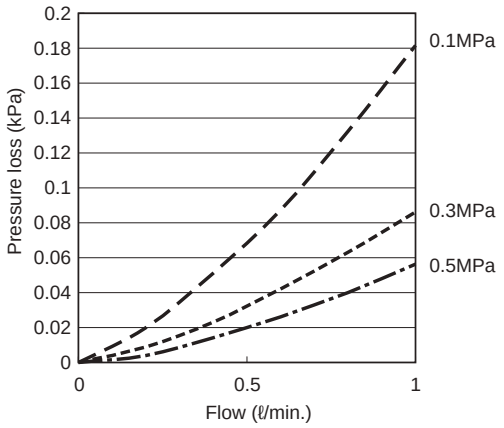


Pressure loss characteristics (carbon dioxide)

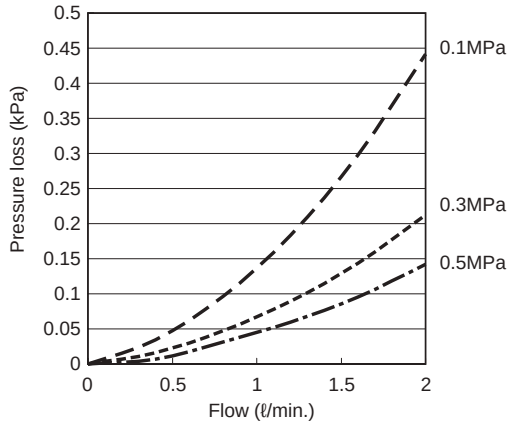
●FSM2-*005-*C2



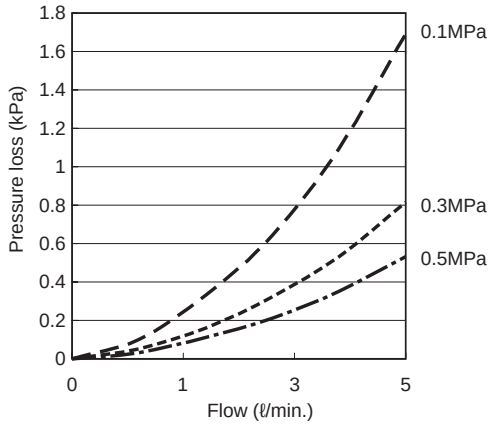
●FSM2-*010-*C2



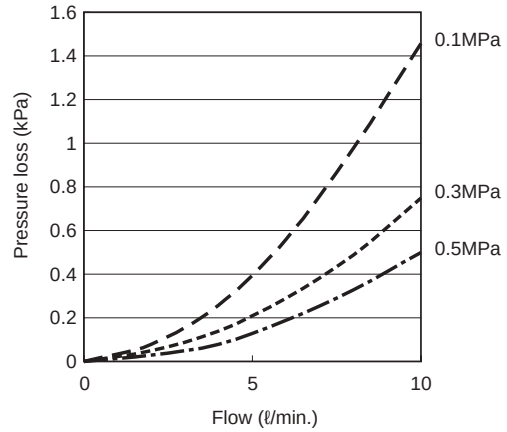
●FSM2-*020-*C2



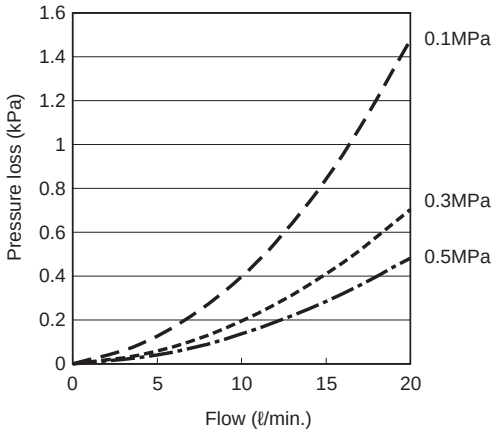
●FSM2-*050-*C2



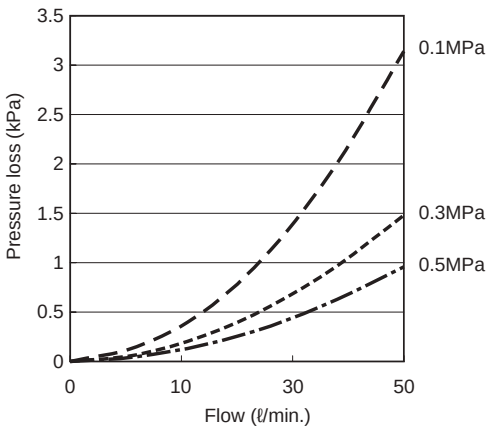
●FSM2-*100-*C2



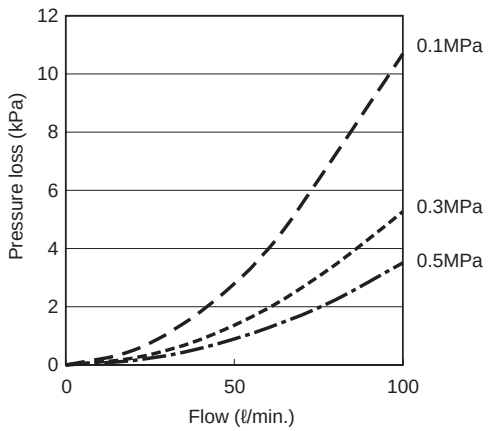
●FSM2-*200-*C2



●FSM2-*500-*C2

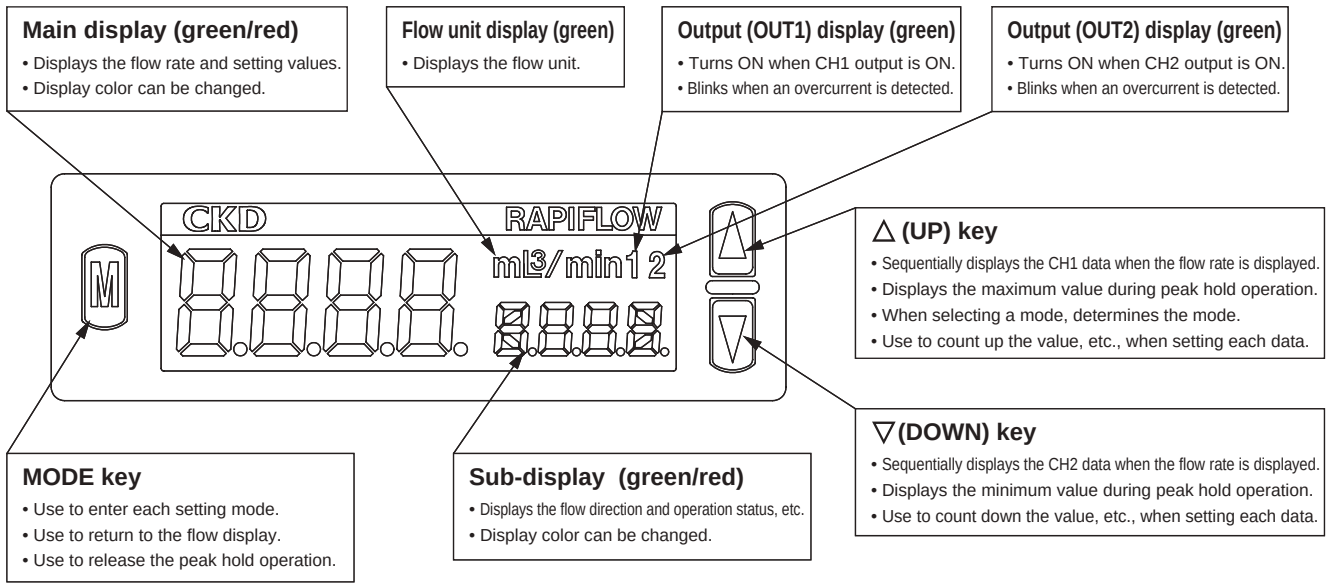


●FSM2-*101-*C2

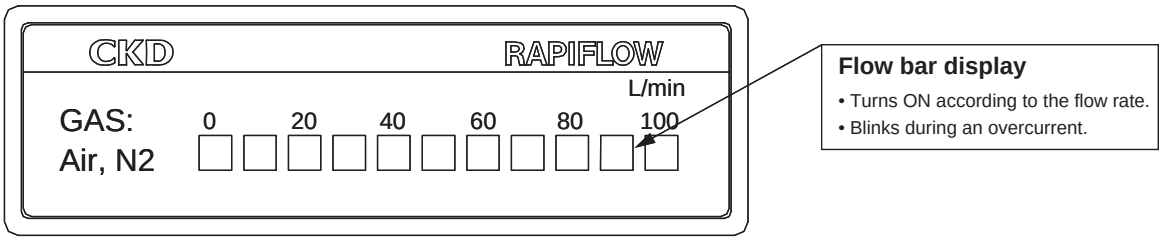


Names and functions of display and operating sections

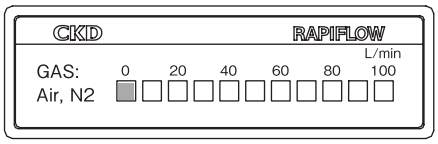
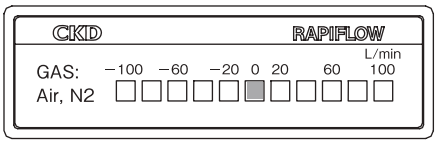
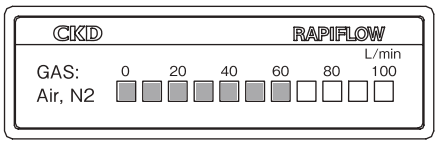
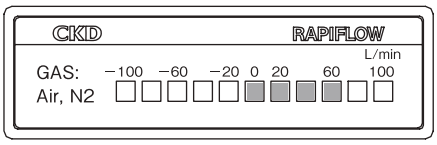
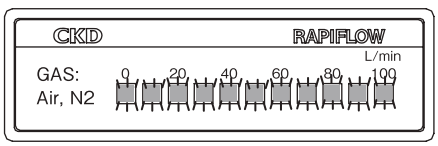
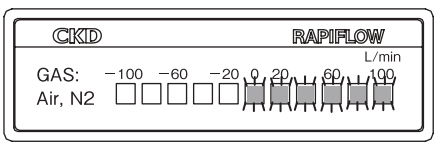
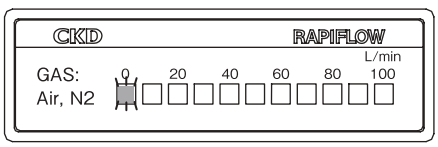
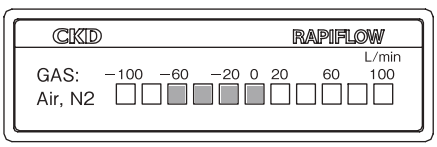
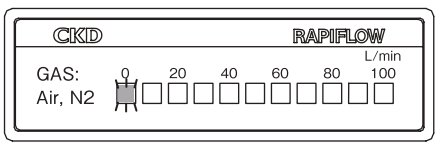
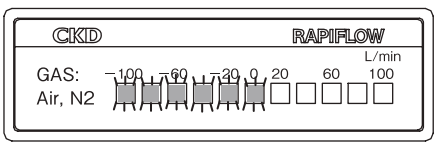
●Display integrated type



●Display separate type



The display above is for FSM2-A*F101-*.

Flow	Unidirectional type	Bidirectional type
0%F.S.		
+60%F.S. (Forward direction)		
+120%F.S. (Forward direction) Blinks at overflow		
-60%F.S. (Reverse direction)		
-120%F.S. (Reverse direction) Blinks at overflow		

Explanation of functions (display integrated type)

Some functions and settings are completed when the normal flow is displayed, and some after entering setting mode. The setting mode is divided into standard setting mode and detailed setting mode based on the frequency of use.

●Regular operation

Descriptions	Explanation	Default setting
Instantaneous flow display	Instantaneous flow is displayed.	—
Integrated flow display	An integrated flow is able to be displayed. The switch output function includes one to turn the switch ON and OFF when the specified count value is exceeded, and an integrated pulse function that outputs a pulse after a set count value.	Instantaneous flow display
Peak hold	Maximum and minimum values for the flow rate within a set interval is displayed.	Peak hold OFF
Key lock	Key operations are disabled to prevent incorrect operation.	Key lock invalid
Error display	The status of errors is displayed when trouble or error occurs.	—

●Standard setting mode

Descriptions	Explanation	Default setting
Switch output	Two-point switch output enables 7 operation patterns, and an operation stop can be set.	The switch is set off for both CH1 and CH2
Forced output	Switch output is forcibly turned on to check line connections and default operation of the input device.	—
Zero adjusting	Zero point deviation is corrected.	Adjusted value: 0

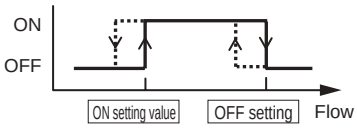
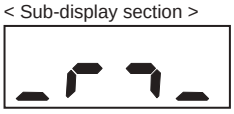
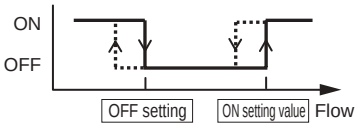
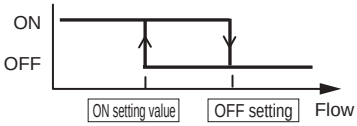
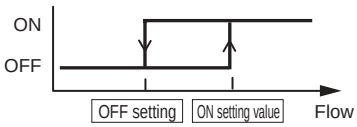
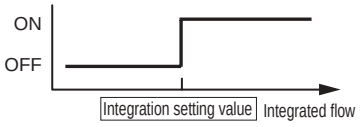
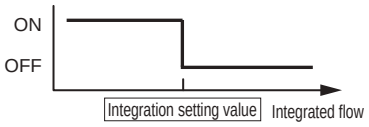
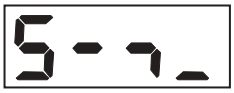
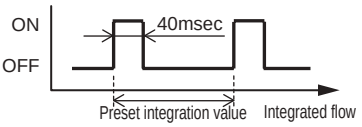
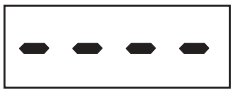
●Details setting mode

Descriptions	Explanation	Default setting
Selection with flow direction (Selectable only with bidirectional type)	Set the flow direction. The direction is set to bidirectional, single forward direction, or single reverse direction.	Bidirectional setting
CH2 operation selection	Select the CH2 function. Select whether to use CH2 as switch output or as external input (count value reset/auto reference).	Switch output
Auto-reference	When CH2 is set to auto reference, the switch output's threshold can be given by external input or button operations. The threshold is changed automatically when the switch's threshold changes, such as when work changes.	Auto-reference OFF
Response time setting	Set the response time. The response time is set in 7 stages from 50 ms to 1.5 s. Chattering or incorrect operations caused by sudden changes in the flow or noise are prevented.	Response time: 50ms
Display speed setting	The digital display's update cycle is set in 3 stages from 250 ms to 1 s. Display blinking is minimized by lengthening the display update cycle.	Display speed: 250ms
Sub-screen setting	Set the sub-display section's display. The method used can be switched to flow direction, flow unit, or gas type.	Flow direction display
Display color setting	Set the display color. The display color for the normal display and switch output ON is set.	For both main and sub, Normal display: green Switch ON: red
Hysteresis setting	Set switch setting value hysteresis. Use this if flow pulsates and the switch chatters near the threshold.	Hysteresis: 1% F.S.
Flow unit setting	Select the display unit from the standard state or reference state. Standard state (ANR): Flow converted to volumetric flow at 20°C 1 barometric pressure Reference state (NOR): Flow converted to volumetric flow at 0°C 1 barometric pressure	Flow unit: ANR
ECO MODE setting	ECO MODE is selectable. If no button is pressed for one minute, the mode changes to ECO and the backlight turns off, minimizing current consumption.	ECO MODE OFF
Setting reset	Settings are set to the default.	—

(Note) The reference status display is a calculated (reference) value.

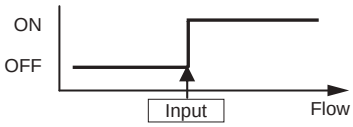
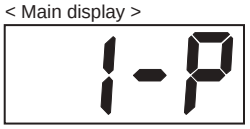
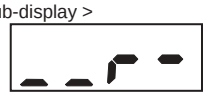
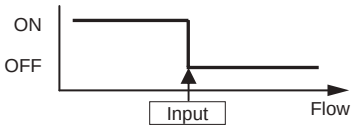
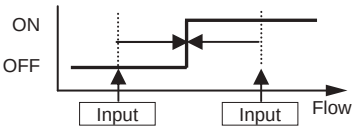
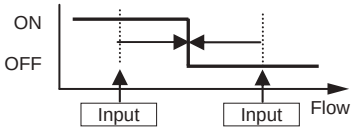
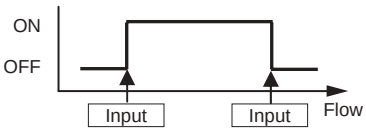
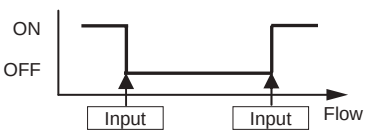
Switch output function

Switch output functions are selected from 7 switch operations based on the application. Functions can be used with both CH1 and CH2.

Operation pattern name	Explanation	Operation waveform	LCD display
Window operation (1) (ON within specified range)	**Switch output turns ON within the specified range.**		< Sub-display section > 
Window operation (2) (ON out of specified range)	**Switch output turns ON outside of the specified range.**		
Hysteresis operation (1) (Small flow side ON)	**Hysteresis is set randomly, and when the flow exceeds the designated level, switch output turns OFF.**		
Hysteresis operation (2) (Large flow side ON)	**Hysteresis is set randomly, and when the flow exceeds the designated level, switch output turns ON.**		
Integration output (1) (ON when higher than integrated flow)	**Switch output turns ON when higher than the set integration value.**		
Integration output (2) (OFF when higher than integrated flow)	**The switch turns off when higher than the set integration value.**		
Integrated pulse output	**An integrated pulse is output at each preset integration value. Refer to specifications for details on the preset integration value. (Pages 1, 2)**		
Switch operation OFF	**This is switch operation OFF status.**		

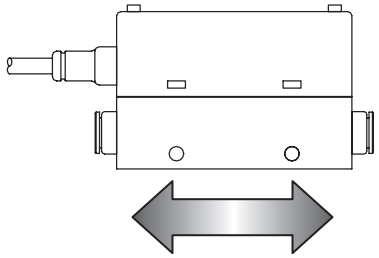
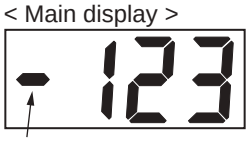
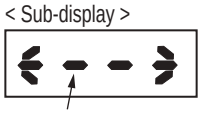
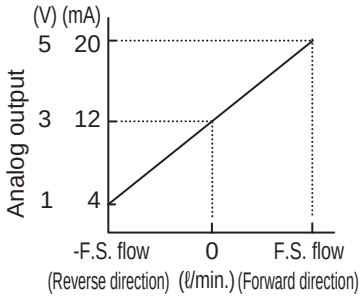
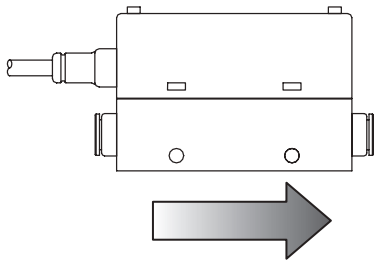
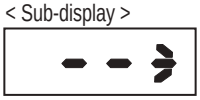
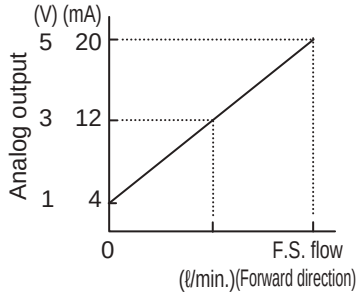
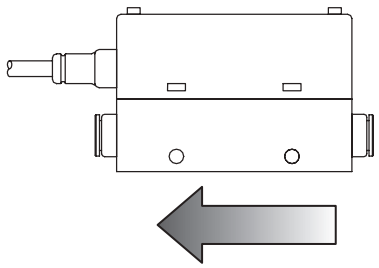
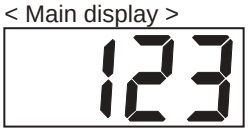
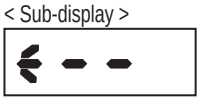
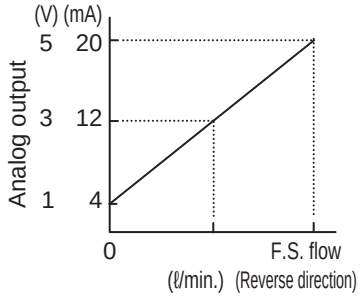
Auto-reference function

When CH2 is set to auto reference, the switch output's threshold can be given by external input or button operations. The threshold is changed automatically when the switch's threshold changes, such as when work changes. The input value is the flow rate when the external input is turned ON.
The CH2 switch setting is disabled during auto reference operation.

Input no.	Operation pattern name	Explanation	Operation waveform	LCD display
1 point	ON when higher than the input value	The switch turns ON when higher than the read value. (Threshold: Input value)		< Main display >  < Sub-display > 
	OFF when higher than the input value	The switch turns OFF when higher than the read value. (Threshold: Input value)		 
2 points	ON when higher than the value midway between two points	The switch turns ON when higher than the value midway between two points. (Threshold: (input 1 + input 2)/2)		 
	OFF when higher than the value midway between two points	The switch turns OFF when higher than the value midway between two points. (Threshold: (input 1 + input 2)/2)		 
	ON between two points	The switch turns ON between two read points. (Threshold 1: input value 1) (Threshold 2: input value 2)		 
	OFF between two points	The switch turns OFF between two read points. (Threshold 1: input value 1) (Threshold 2: input value 2)		 

Flow direction selection (integrated bidirectional display only)

With an integrated bidirectional display, the flow direction is set with button operations.

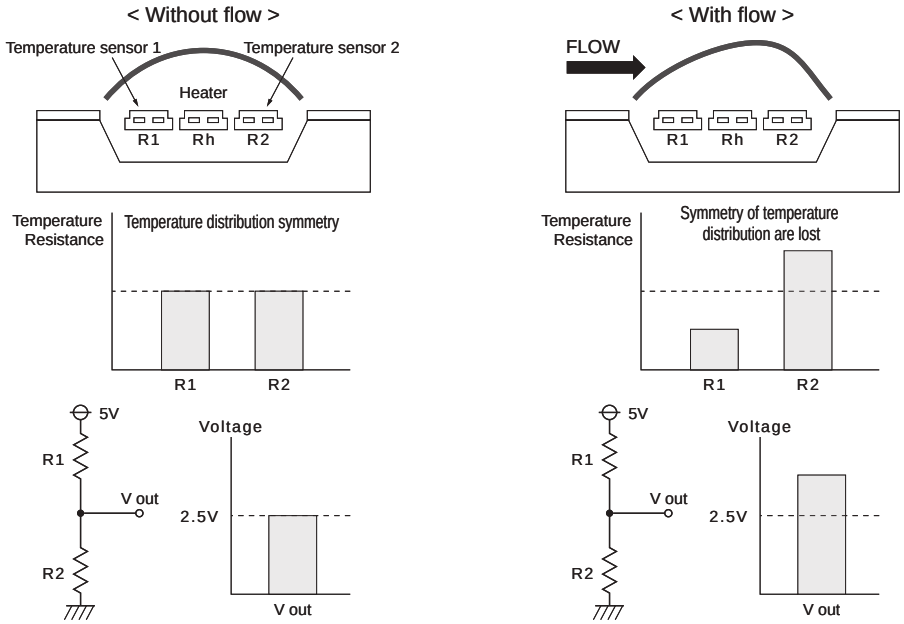
Flow direction	LCD display	Analog output characteristics
<Bidirectional> 	< Main display >  Minus display when direction is reversed. < Sub-display >  Arrow changes according to flow direction.	
<Unidirectional (forward direction)> 	< Main display >  < Sub-display > 	
<Unidirectional (reverse direction)> 	< Main display >  < Sub-display > 	

MEMO

FSM2 Series Measurement Principle

The FSM2 Series incorporates a platinum sensor chip (3 mm x 3.5 mm) machined with silicon micromachining. The sensor is thermally insulated from the silicon substrate. The heating capacity is extremely low, enabling high sensitivity with a high-speed response.

At the sensor, two temperature sensors are arranged with a heater in between. Platinum, which has a resistance that changes based on temperature, is used for the temperature sensor. When the heater is turned on and heated, the temperature distribution is symmetrical to the center of the heater if there is a flow. When flow is received, the symmetrical property of temperature distribution is lost, and temperature upstream from the heater drops, and that downstream rises. If flow is reversed, the temperature difference (resistance value difference) is reversed. A bidirectional flow is thus detected. This is suitable for detecting relatively small flows.



1 Flow sensor selection method

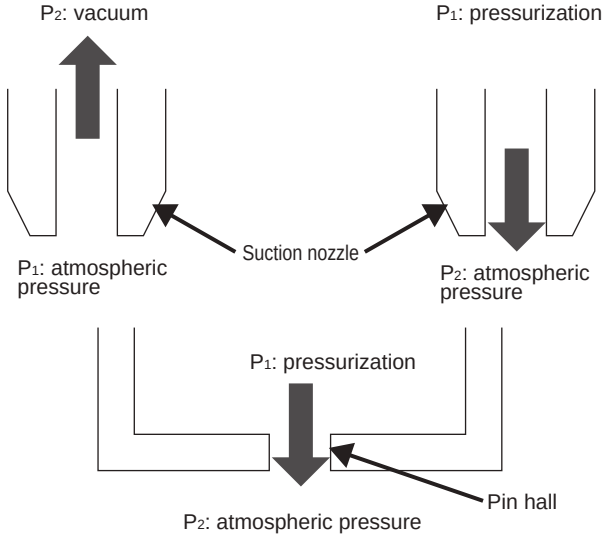
Use this as a guide to selecting the flow range when using a flow sensor to confirm suction and release with a suction nozzle or for leakage tests, etc.

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

●When P1 ≥ 1.89P_2 (sonic)
Q = 113.2 x S x P1

●When P1 < 1.89P_2 (subsonic)
$Q = 226.4 \times S \times \sqrt{P_2 (P_1 - P_2)}$

Q : Flow ℓ/min.
P_1 : Absolute primary pressure MPa
P_2 : Absolute secondary pressure MPa
S : Nozzle (pin hole) effective sectional area mm^2



●Example of calculation

The following table gives the flow calculation values when using Φ0.1 to 2 nozzle diameter and variable P2.

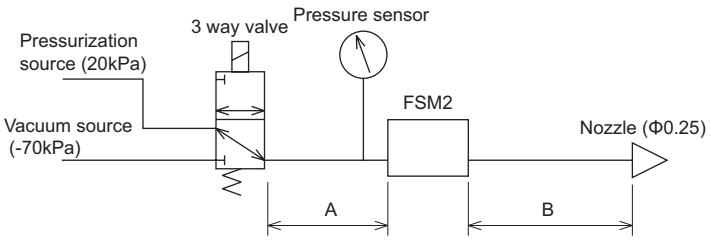
	P_1(MPa) Absolute pressure	P_1(MPa) Gauge pressure	P_2(MPa) Absolute pressure	P_2(MPa) Gauge pressure	Sonic /subsonic velocity	Flow calculation values (ℓ/min.)								
						Φ0.1	Φ0.2	Φ0.3	Φ0.4	Φ0.5	Φ0.7	Φ1	Φ1.5	Φ2
Suction	0.1013	0	0.0313	-0.07	Sonic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007
	0.1013	0	0.0413	-0.06	Sonic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007
	0.1013	0	0.0513	-0.05	Sonic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007
	0.1013	0	0.0613	-0.04	Subsonic velocity	0.088	0.352	0.792	1.408	2.200	4.312	8.800	17.249	35.202
	0.1013	0	0.0713	-0.03	Subsonic velocity	0.082	0.329	0.740	1.315	2.055	4.028	8.220	16.110	32.878
	0.1013	0	0.0813	-0.02	Subsonic velocity	0.072	0.287	0.645	1.147	1.792	3.512	7.166	14.046	28.666
	0.1013	0	0.0913	-0.01	Subsonic velocity	0.054	0.215	0.483	0.859	1.343	2.631	5.370	10.525	21.480
Blow (leakage inspection)	0.1113	0.01	0.1013	0	Subsonic velocity	0.057	0.226	0.509	0.905	1.414	2.772	5.657	11.087	22.626
	0.1213	0.02	0.1013	0	Subsonic velocity	0.080	0.320	0.720	1.280	2.000	3.920	8.000	15.679	31.998
	0.1413	0.04	0.1013	0	Subsonic velocity	0.113	0.453	1.018	1.810	2.828	5.543	11.313	22.174	45.252
	0.1613	0.06	0.1013	0	Subsonic velocity	0.139	0.554	1.247	2.217	3.464	6.789	13.856	27.157	55.423
	0.1813	0.08	0.1013	0	Subsonic velocity	0.160	0.640	1.440	2.560	4.000	7.840	15.999	31.358	63.996
	0.2013	0.1	0.1013	0	Sonic velocity	0.179	0.716	1.610	2.862	4.472	8.765	17.888	40.248	71.552
	0.3013	0.2	0.1013	0	Sonic velocity	0.268	1.071	2.410	4.284	6.694	13.119	26.774	60.242	107.096
	0.4013	0.3	0.1013	0	Sonic velocity	0.357	1.426	3.209	5.706	8.915	17.474	35.660	80.236	142.641
	0.5013	0.4	0.1013	0	Sonic velocity	0.445	1.782	4.009	7.127	11.137	21.828	44.547	100.230	178.186
	0.6013	0.5	0.1013	0	Sonic velocity	0.534	2.137	4.809	8.549	13.358	26.182	53.433	120.224	213.731

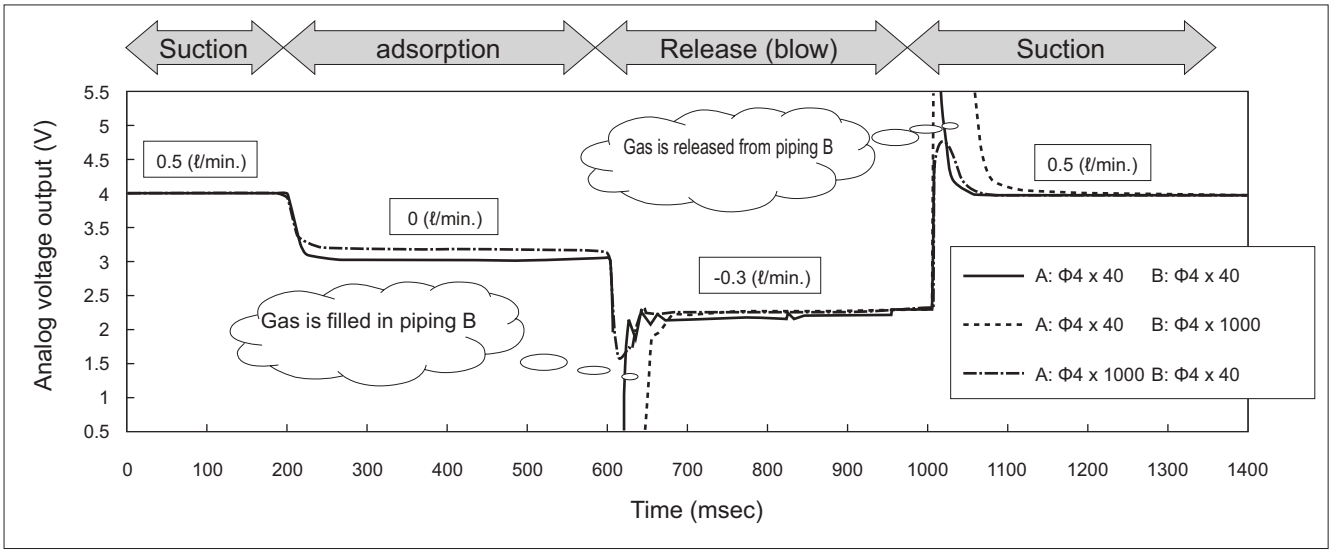
(CAUTION)
● If there is leakage in piping, etc., the actual flow will be larger than the calculated value. Take pipe leakage into account when selecting the flow.
● If there is a section thinner than the suction nozzle diameter in piping, the flow will be restricted, and may be less than the calculated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

Suction confirmation

1 Response time

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

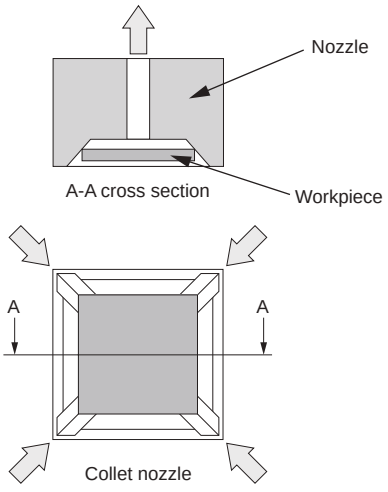




Dependency of response on piping

2 Using collet nozzle

A collet nozzle is often used when the workpiece to be picked up should not be directly seated against the nozzle. The collet nozzle is shaped like a pyramid so when the workpiece is picked up, a gap forms at the four corners. This causes leakage during pick up. If the effective sectional area of the piping, including valve and joints, etc., is smaller than the collet nozzle and workpiece gap (effective sectional area), flow is determined by the piping's effective sectional area, and the difference in flow during suction and when suction is disabled is low. In this case, suction is accurately confirmed by keeping the effective sectional area of piping larger than the effective sectional area of the gap between the collet nozzle and workpiece.



Small size flow sensor dedicated
Miniature inline filter

FSM-VFM Series

Features

This inline filter is dedicated to the compact flow sensor FSM2 Series. The content volume is small so high-speed response is not obstructed when confirming suction.

- Miniaturized space-saving components
- Easy-to-replace element
- Polyamide resin, with outstanding chemical resistance, used for the body
- The transparent case enables element contamination to be checked from outside

Specifications

Descriptions		FSM-VFM-H22	FSM-VFM-H44	FSM-VFM-M55
Working fluid		Clean air (JIS B 8392-1.1.1 to 5.6.2), compressed air (JIS B 8392-1.1.1 to 1.6.2) Note 1		
Applicable tube outer diameter		Φ1.8 (fiber tube)	Φ4 (push-in)	Port size M5
Withstanding pressure	MPa	0.75		
Working pressure range	MPa	-0.1 to 0.5		
Ambient temperature range	°C	0 to 50		
Material	Case	Polyamide		
	Element	Polypropylene, polyethylene		
Filtration rating	μm	10		
Product weight	g	5.2	9.5	4.2
Recommended flow rate	ℓ/min.	10 Note 2		

Note 1: Refer to the Compressed air quality classes according to JIS B 8392-1: 2003 on page 2.
Note 2: The pressure loss will increase when the flow exceeds 10ℓ/min., so use at 10ℓ/min. or less.

How to order

FSM - VFM - H44 - B

Model No.

A Tube outer diameter

Symbol	Descriptions
A Tube outer diameter	
H22	Φ1.8 (fiber tube)
H44	Φ4 (fiber tube)
M55	Port size M5

B Attachment

B Attachment	
Blank	Without bracket
B	Bracket attached

- Bracket part model No.

FSM - VFM - B

(Flat headed cross cut tapping screw M2.5 x 6: 1 pc.)

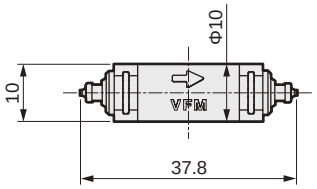
- Maintenance part model No.

FSM - VFM - E

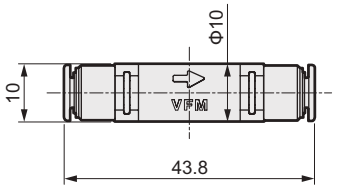
(Element: 5 pcs., joint fixing pin: 1 pc.)

Dimensions

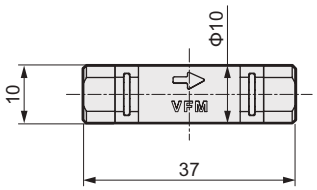
●FSM-VFM-H22



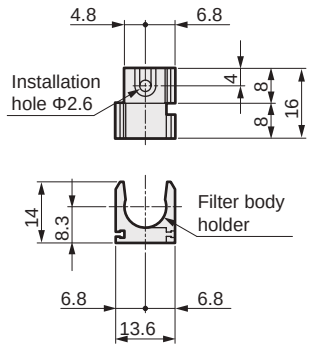
●FSM-VFM-H44



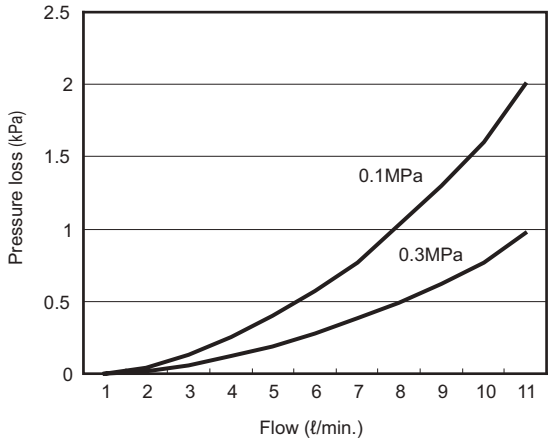
●FSM-VFM-H55



●FSM-VFM-B (bracket)



Flow characteristics (FSM-VFM-H44)



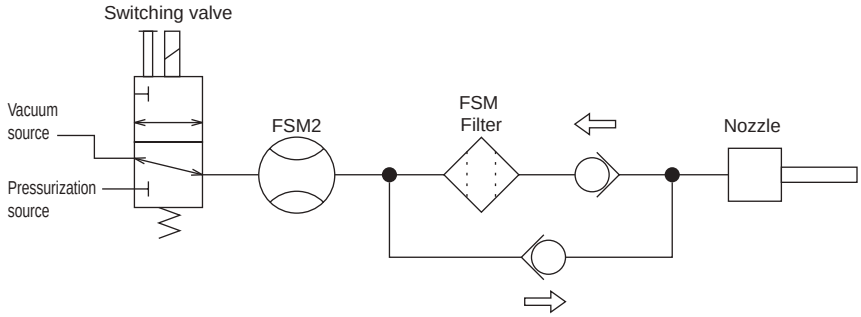
●When using the fiber tube, the pressure loss may increase depending on the piping conditions.

Cautions

●This filter has an orientation.

When using this filter to confirm suction, etc., use a check valve to prevent the flow of dirt.

(Example of circuit)



●Refer to Intro page 10 for the other precautions and element replacement methods.

Related products

Small size flow sensor FSM Series

Catalog No. CC-687

Compact flow sensor 2 series compatible with various applications

FSM-H Series

■ **Compact, high speed and extremely small flow rate**
Extremely small flow at 1 mℓ/min. or less is detected at high speed

■ **Positive and negative pressure combination**

FSM-V Series

■ **Miniature and ultra high speed response**
5ms quick response is possible

Inline clean filter FCS500/FCS1000 Series

Suitable as final filter for clean applications (Air and inert gas)

■ **High accuracy filtration 0.01μm and removal ratio 99.99%**
The hollow fiber membrane enables a filtration accuracy of 0.01 μm and efficient removal of 99.99%.

■ **Long service life**
Life has been increased to about five times that of the flat membrane.

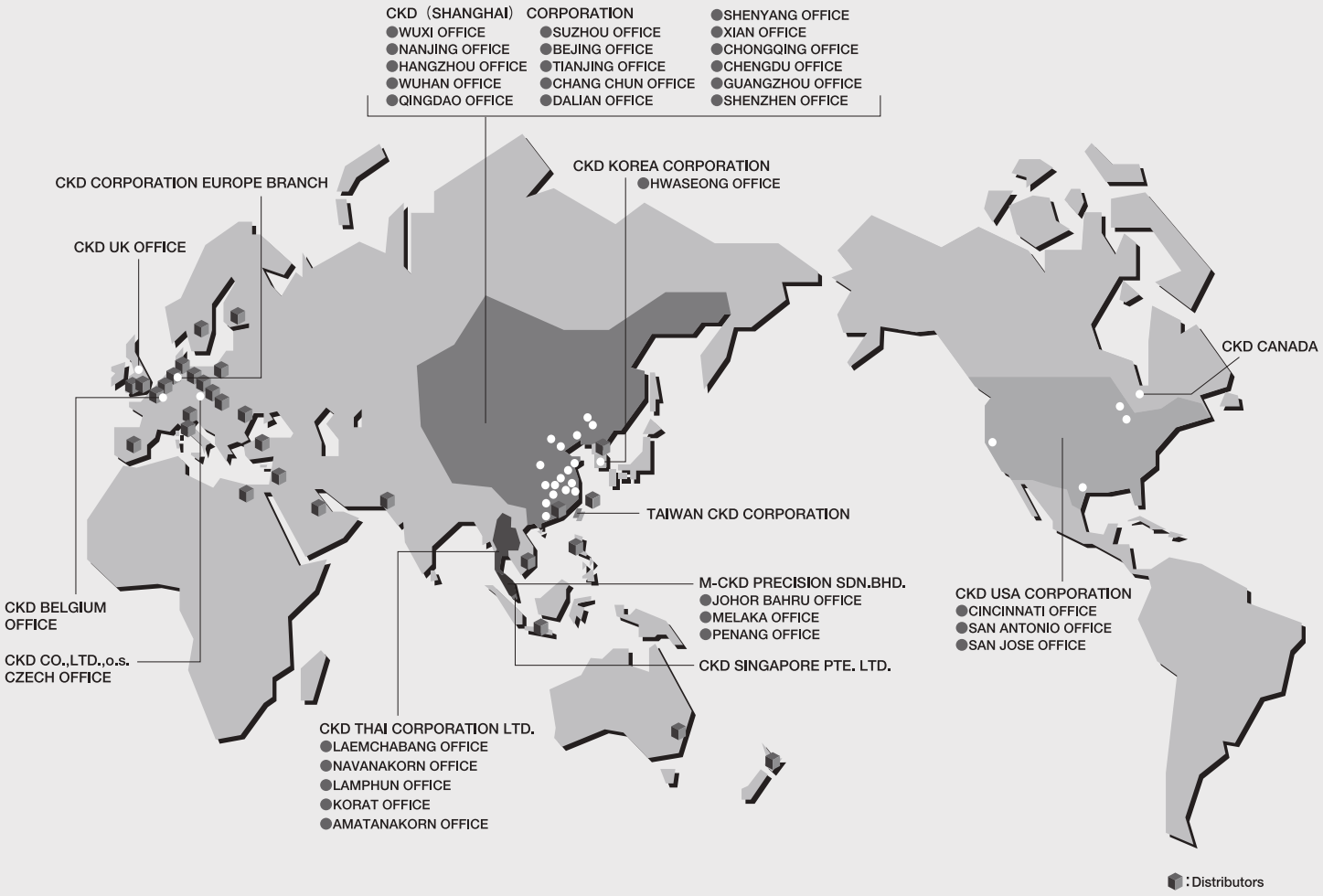
■ **Compact, lightweight and large flow rate**
The filtration area is 3 to 10 times larger than a flat membrane having the same capacity, so pressure loss is low even in high flows. The filter is compact and light-weight even for the same flow.

■ **Oil-prohibited specifications**
The entire part has been degreased and cleaned. All steps from assembly to packing are done in a cleanroom.

■ **Easy maintenance**
A transparent case is used for the resin type, enabling element contamination to be visually confirmed.

■ **Wide variation**
2 series, with flow 500 or 1000, are available. These are made of resin or stainless steel. Push-in joint, male or female thread piping are also available.

WORLD-NETWORK



CKD Corporation

Website http://www.ckd.co.jp/

☐ OVERSEAS DPT. SALES DIV. 2-250 Ouji Komaki, Aichi 485-8551, Japan
☐ PHONE +81-(0)568-74-1338 FAX +81-(0)568-77-3461

U.S.A
CKD USA CORPORATION
● HEADQUARTERS
4080 Winnetka Avenue, Rolling Meadows, IL 60008 USA
PHONE +1-847-368-0539 FAX +1-847-788-0575

EUROPE
CKD EUROPE BRANCH
De Fruittuinen 28 Hoofddorp 2132NZ The Netherlands
PHONE +31-(0)23-5541490 FAX +31-(0)23-5541491

Malaysia
M-CKD PRECISION SDN.BHD.
● HEADQUARTERS
Lot No.6,Jalan Modal 23/2, Seksyen 23, Kawasan, MIEL, Fasa 8, 40300 Shah Alam,Selangor Darul Ehsan, Malaysia
PHONE +60-(0)3-5541-1468 FAX +60-(0)3-5541-1533

Thailand
CKD THAI CORPORATION LTD.
● SALES HEADQUARTERS-BANGKOK OFFICE
Suwan Tower, 14/1 Soi Saladaeng 1, North Sathorn Rd., Bangrak, Bangkok 10500 Thailand
PHONE +66-(0)2-267-6300 FAX +66-(0)2-267-6305

Singapore
CKD SINGAPORE PTE LTD.
705 Sims Drive #03-01/02, Shun Li Industrial Complex, 387384 Singapore
PHONE +65-6744-2623 FAX +65-6744-2486

Taiwan
TAIWAN CKD CORPORATION
1F., No.16, Wucyuan 5th Rd., Wugu Township, Taipei Country 248, Taiwan (R.O.C)
PHONE +886-(0)2-2298-2866 FAX +886-(0)2-2298-0322

China
CKD (SHANGHAI) CORPORATION
● SALES HEADQUARTERS / SHANGHAI OFFICE
Room 1903, 333 Jiujiang Road, Shanghai, 200001, China
PHONE +86-(0)21-63602277 FAX +86-(0)21-63511661

Korea
CKD KOREA CORPORATION
Room No.1105, 11th FL, The Korea Teachers Pention B/L. 27-2, Yoido-Dong, Youngdeungpo-Gu, Seoul, 150-742, Korea
PHONE +82-(0)2-783-5201～5203 FAX +82-(0)2-783-5204

2007.10.DCC