

## INSTRUCTION MANUAL

### SMALL SIZE FLOW SENSOR RAPIFLOW®

#### FSM2 Series

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.



## Safety precautions

Always read before starting use.

When designing and manufacturing a device using CKD products, the manufacturer is obligated to check that device safety mechanical 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.**

Contact CKD when using the product outside the unique specifications range, when using it outdoors, and when using it under the conditions and environment below.

Do not attempt to modify or additionally machine the product.

(1) Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, or applications coming into contact with beverage or food, amusement equipment, emergency shutoff circuits, press machine, brake circuits, or for safeguard.

(2) 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.**

ISO 4414, JIS B 8370 (pneumatic system rules)

JPAS 005 (policy for pneumatic cylinder use and selection)

High Pressure Gas Maintenance Laws Occupational Safety and Sanitation Laws, and other safety rules, association standards and regulations.

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

(1) Inspect and service the machine and devices after confirming safety of the entire system related to this product.

(2) Note that there may be hot or charged sections even after operation is stopped.

(3) 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.

(4) 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.

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.

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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.

## DESIGN AND SELECTION



### DANGER:

#### ■ WORKING FLUID

- A flammable fluid must not be used.

#### ■ WORKING ENVIRONMENT

- Flammable environment

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



### WARNING:

#### ■ WORKING FLUID

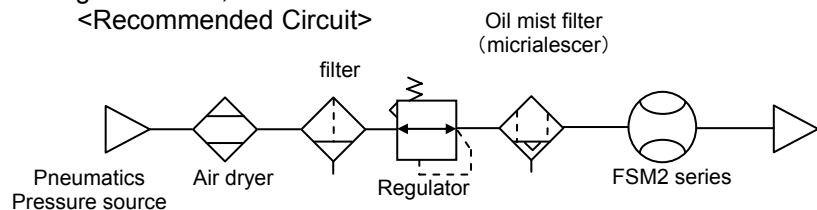
- This product cannot be used as a business meter.

Not conformed to the Measurement Law, do not use the product for the commercial purpose. Use the product as an industrial sensor.

- Do not use the product with other than applicable working fluids, or the accuracy can not be guaranteed.

- Install a filter, an air dryer and an oil mist filter (micro-alescer) onto the primary side (upstream) of the sensor since the compressed air from the compressor contains drain (water, oil oxide and foreign material, etc.) Mesh (wire net) in a sensor is used to rectify the flow in the pipe. Always install a filter since this mesh is not a filter to remove foreign materials, etc.

<Recommended Circuit>



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

- Please let it evaporate when you use the liquefied gas such as carbon dioxide. When the liquefying gas flows into this product, it causes the breakdown.

#### ■ WORKING ENVIRONMENT

- Corrosive environment

Do not use the product in an environment containing corrosive gas such as sulphur dioxide, etc.

- Ambient temperature, fluid temperature

Use the product within the ambient and fluid temperature ranges 0 to 50 °C. Even in the specified temperature range, do not use the product where ambient and fluid temperatures will change suddenly, and form dew condensations.

- Maximum working pressure/usage flow range

Use the product in accordance with specifications. If used out of the maximum working pressure and working flow range, the product may result in failures.

- Drip-proof environment

The protective structure of this product is equivalent to IP40. Do not install the product where moisture, salt, dust or swarf is contained, or where pressurized, or depressurized, neither. The product can not be used where the temperature changes suddenly or has high humidity since a failure by dew condensation may be produced in the body.



## CAUTION:

### ■ FLOW UNIT

- This controller's flow rate is measured with mass flow not affected by pressure.  
The unit is l/min, that is the mass flow converted to volumetric flow at 20 °C 1 barometric pressure (101 kPa).

### ■ WITHSTANDING PRESSURE

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

### ■ OVREFLOW

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

### ■ ADSORPTION VERIFICATION, etc.

- When using this product with adsorption verification, etc., select the flow rate range according to vacuum range and adsorption nozzle diameter. Refer to Page 54 on the attached sheet for [flow rate theory calculation method]
- When using this product with adsorption verification, etc., always install an air filter onto the upstream of suction side to prevent suction of foreign materials.
- When using this product with adsorption verification, etc., considering atmospheric dew point and ambient temperature of this product, use the product under the conditions that dew condensations will not be formed in the inside of pipe.
- When using this product with adsorption verification, etc., response time may delay per pipe volume between this product from adsorption nozzle. In that case, take countermeasures such as, reducing piping volume, etc.
- When using the product with vacuum applications such as air absorption, etc., do not bend the tube near the push-in joint section. If stress is applied to the tube near the push in joint, insert the tube into the push-in joint after inserting the insert ring.
- When the sensor for adsorption verification is replaced from the pressure sensor (switch) to the flow sensor (switch), in the image (refer to right Fig.), the theory of sensor output (switch output) is reversed.

	Pressure sensor (switch)	Flow sensor (switch)
	Setpoint and over ON	Setpoint or less ON
Adsorption verification	<p>ON</p> <p>OFF</p> <p>Atmospheric pressure side      High vacuum side</p>	<p>ON</p> <p>OFF</p> <p>Flow rate 0 side      Flow rate large side</p>

Care must be taken since change and modification of sequence program of PLC are required. If source pressure/vacuum is not supplied especially when equipment power turned on, problems must not be created in sequence program, etc., of PLC since flow sensor (switch) maintains [flow rate 0]=[sensor output (switch output) ON].

## INSTALLATION & ADJUSTMENT



### CAUTION:

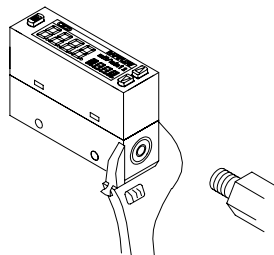
#### ■ PIPING

- Pipe based on the fluid direction and the direction indicated on the device.
- When piping a sensor, refer to the torques below not to apply excessive screw-in and load torques to the port.

[Reference value]

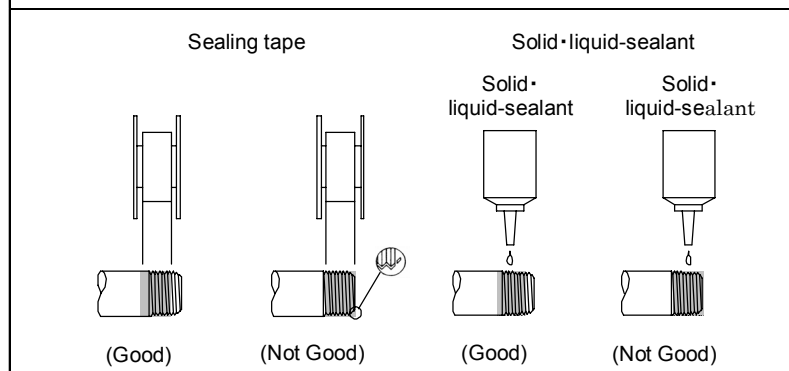
Set screw	Tightening torque N·m
M5	0.5~1.0
Rc1/8	3~5
Rc1/4	6~8
Rc1/2	16~18

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



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

• When winding fluorine resin sealing tape around threads, wind the sealing tape one to two times, leaving two to three threads open at the end of the screw. Press down on the tape to stick it onto threads. When using liquid sealing agent, leave one to two threads open from the end, and avoid applying too much.



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

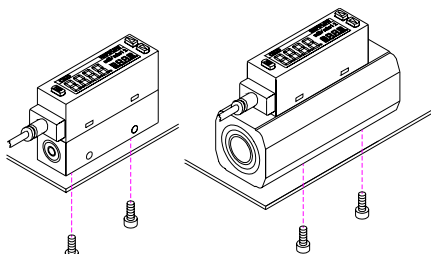


## CAUTION:

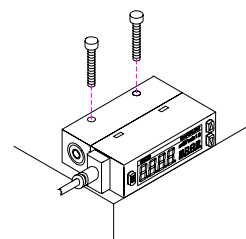
### ■ INSTALLATION

- The display part uses the LCD. The display becomes difficult to see for the view angle.
- This product can be installed with any attitude; vertical, horizontal, right or left.

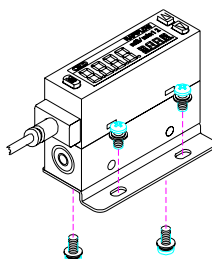
Vertical mount  
(with bottom thread)



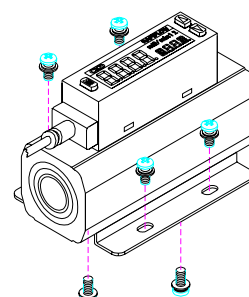
Horizontal mount  
(with through hole)



Bracket mount (with bracket)



Bracket (separate sales)  
Model no. : FSM2-LB1  
Port size: Push-in joint  $\phi 4$ 、6、8、10  
Rc1/8、Rc1/4、M5



Bracket (separate sales)  
Model no. : FSM2-LB2  
Port size: Rc1/2



## DANGER:

### ■ WIRING

- Power supply voltage and outputs must be used with the specified voltage. Applying the voltage more than specified voltage may cause malfunction, damage of sensor, electric shock or fire. Do not apply load more than the rated output. Damage or fire of the output may be caused.



## WARNING:

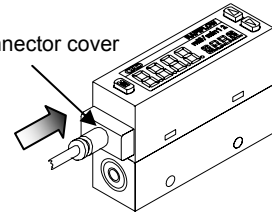
### ■ WIRING

- Line color must be checked when wiring. Check the wiring color with handling precaution, since improper wire connection may result in damage, failure or malfunction of the sensor.
- Insulation of wiring must be checked. Eliminate contact, ground fault and terminal insulation defective with other circuits, or over-current will be admitted into the sensor to damage.
- For the power supply to be used, use DC safety power supply insulated from alternating current power supply and in rated range. If power supply is not insulated, electric shock may be created. If power supply is not stabilized, the peak magnitude in summer may exceed the rated value, causing damage of this product, or reducing the accuracy.



## **WARNING: ■ WIRING**

- After the connectors are inserted, lay the connector covers over the connectors.
- Make sure that stress by forcible bend or pulling is not applied directly to the sensor cable joint.
- For wiring, stop control unit/machinery and equipment, and turn off the power supply. Sudden operation may create not anticipated motions, causing a danger. First, attempt energizing test, then set the desired switch data while control unit, machinery and equipment are stopped. Discharge static electricity built in body, tool and equipment before and during work. Use a wire with elasticity as wire for robot connection in the movable part.
- Do not use the product out of power supply voltage range. If voltage more than usage range is applied, or if alternating current power (AC100V) applied, causing damage or burn.
- This product and wiring must be installed as far away as possible from noise source such as strong electric line, etc. Take other countermeasures for a surge on the power supply line.
- Do not short-circuit a load, or causing damage or burn.
- Use DC safety power supply thoroughly insulated from the AC primary side for a power supply for the metal body (stainless steel and aluminum bodies) type, while connecting either + or - side on the power supply to F.G. Variable resistor (clamping voltage approximate 40V) is connected between the inside power circuit of metal body type and the metal body to prevent breakdown of the sensor. High potential and insulation resistance tests between the inside power circuit of metal body type and the metal body must not be done. If required, attempt these tests after wiring is disconnected. The excessive electric potential difference between power supply and metal body makes inside parts burn. When electric welding equipment or frame and when creating a short-circuit accident after metal body type installed, connected or wired, transient high and surge voltages may run in ground line or fluid path connected to the components above when welding current runs or when welding, causing a damage. Remove all F.G. connections of the product and electric wiring before work such as electric welding, etc.



## **■ ADJUSTMENT**

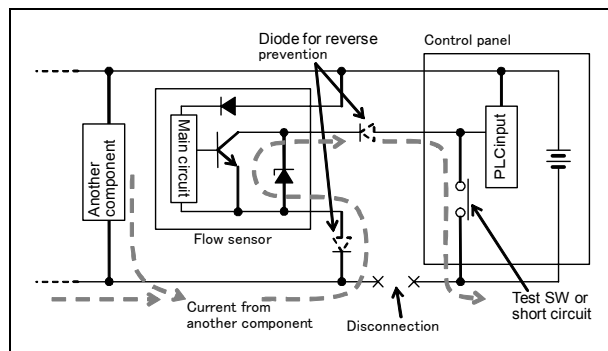
- If a switch is activated in unstable flow rate state such as a fluid pulsation, etc., unstable operation may be provided. In this case, maintain a sufficient difference between two set-points, or avoid switch setting in the unstable area, then use the product after checking that switching operation be stabilized.
- Output accuracy is affected by self exoergics caused by energizing other than temperature characteristics. When using, stand-by time (5 minutes and over after energizing) must be provided.
- For self-diagnosis, this product does not conduct flow rate detecting switch operation for proximate 2 seconds immediately after energized. Make a control circuit and programs to ignore signals for approximate 2 seconds after energized.

## DURING USE & MAINTENANCE



### CAUTION:

- When an error occurs during operation, turn off power supply immediately, and terminate the operation, and contact to the sales office.
- Use the product within range of rated flow.
- Use the product within range of working pressure.
- When changing set-points of the output, stop the equipment, then change the set-points, or an accident may occur.
- A periodic inspection should be done at least once a year, then make sure that the product be operated properly.
- Disassembly and modification must not be done or causing a failure.
- The material of case is resin. Solvent/alcohol/cleaner, etc., must not be used to remove contamination, etc., or causing a resin to be corroded. Wipe weakened neutral detergent with tightly squeezed waste cloth, etc.
- Be careful of reverse current by disconnection/wiring resistance. If other components including another flow sensor are connected to the same power source of the sensor, when switch output line and - side of power line are short-circuited to check operation of input device in the control panel, or if - side of power line is disconnected, reverse flow in switch circuit may cause damage.



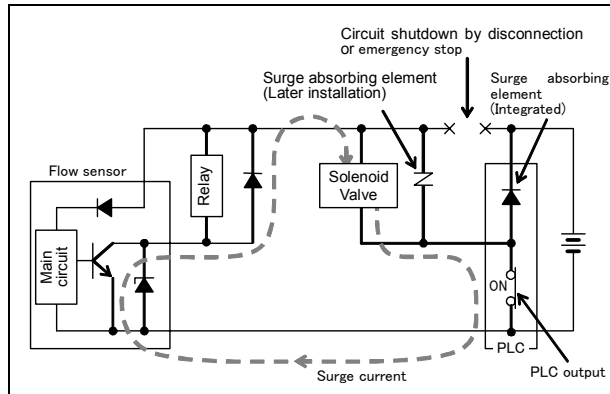
Preventing damage by reverse current, take the following countermeasures.

- (1) Avoid concentration to - side power line, and use the wire as fat as possible.
  - (2) Narrow the number of components to connect to the same power source of the sensor.
  - (3) Provide a diode on the flow sensor output line in serial to prevent reverse current.
  - (4) Provide a diode on - side of flow sensor power line to prevent reverse current.
- Be careful of leading of surge current. If the flow sensor shares the power source with inductive load forming surge of a solenoid valve or a relay, etc., when a circuit is disconnected with the inductive load activated, depended with surge absorbing element, surge current may lead to the switch output circuit, causing a damage.



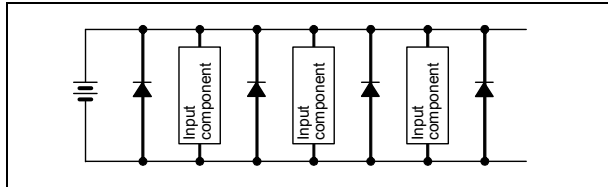


## CAUTION:



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

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



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

- When out of flow rate range, analog output will be provided. [Hi] or [Lo] will be displayed, and The bar display blinks for separated indicator type. However, accuracy is not guaranteed.
- Do not push the display part., or causing damage.

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SMALL SIZE FLOW SENSOR RAPIFLOW FSM2 Series  
Manual No. SM-385853-A

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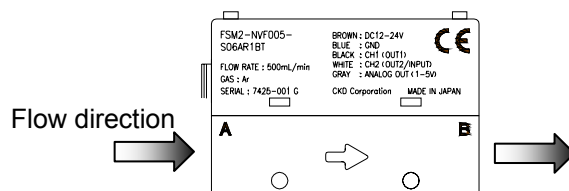
# 1 INSTALLATION

## 1. INSTALLATION

### 1. 1 Piping

<Caution>

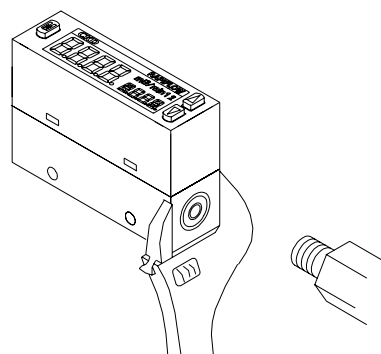
Arrange piping so that the flow direction agrees with the direction of the arrow indicated on the sensor body.



- Flash the pipe to remove foreign substances and swarf, etc., in inside of pipe before piping.
- When piping a sensor, do not apply excessive screw-in and load torques to the port.  
When piping, apply a spanner on the metal section not to apply forces onto the resin section.

[Reference value]

Set screw	Tightening torque N·m
M5	0.5~1.0
Rc1/8	3~5
Rc1/4	6~8
Rc1/2	16~18

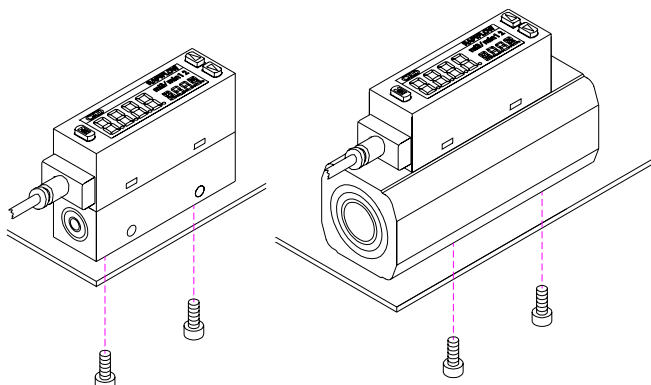


- When piping, care must be taken that sealing tape and adhesive must not enter into the inside.
- If a push-in joint is used, the tube must be inserted certainly. Pulls the tube to check that the tube not be come out

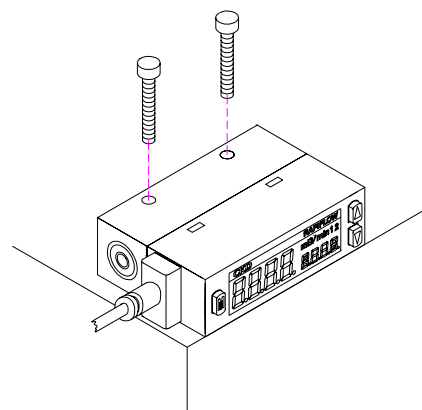
## 1. 2 Installation

- The display part uses the LCD. The display becomes difficult to see for the view angle.
- This product can be installed with any attitude; vertical, horizontal, right or left. The tightening torque for screws should be 0.5N·m.

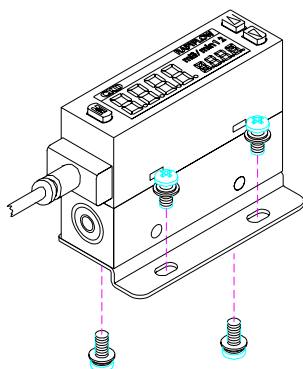
Vertical mount(with bottom thread)



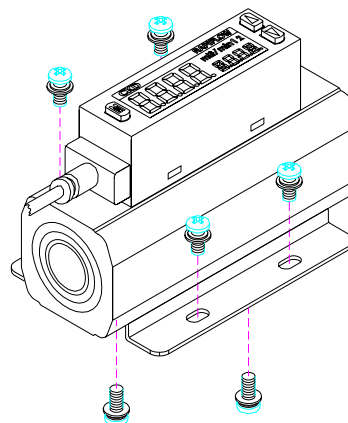
Horizontal mount  
(with through hole)



Bracket mount (with bracket)



Bracket (separate sales)  
Model no. : FSM2-LB1  
Port size: Push-in joint  $\phi 4$ 、6、8、10  
Rc1/8、Rc1/4、M5

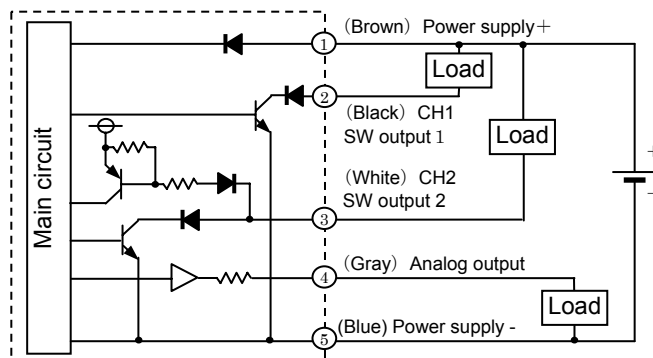


Bracket (separate sales)  
Model no. : FSM2-LB2  
Port size: Rc1/2

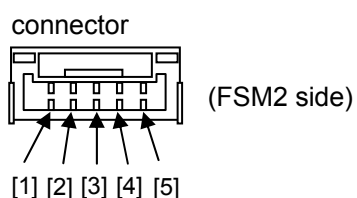
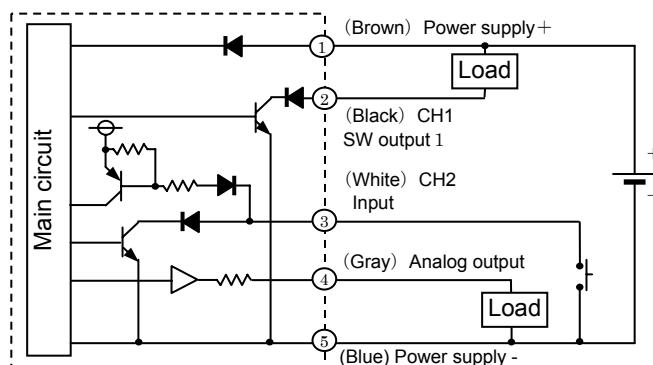
## 1. 3 Wiring

### 1. 3. 1 FSM2-N series(Integrated indicator type, NPN output type)

CH2 function selected  
switch output



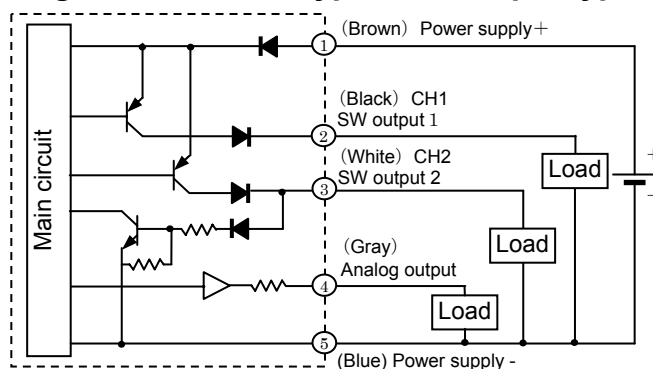
CH2 function selected  
external input



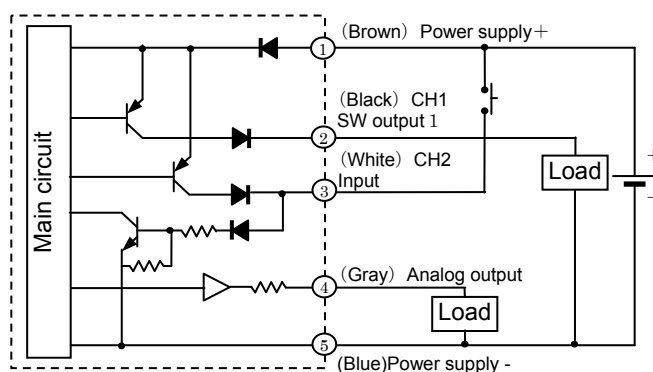
Pin No.	Line color	Content
[1]	Brown	Power supply (DC 12 to 24V, DC 24V)
[2]	Black	CH1(Switch output 1: max50mA)
[3]	White	CH2(Switch output 2: max50mA or External input)
[4]	Gray	Analog voltage output : DC 1 to 5V Connected load impedance 50kΩ and over) Analog current output : DC 4 to 20mA Connected load impedance 300Ω or less)
[5]	Blue	0V (GND)

### 1. 3. 2 FSM2-P series(Integrated indicator type, PNP output type)

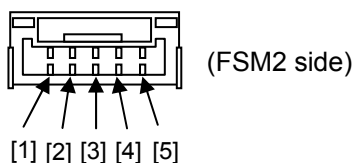
CH2 function selected  
switch output



CH2 function selected  
external input



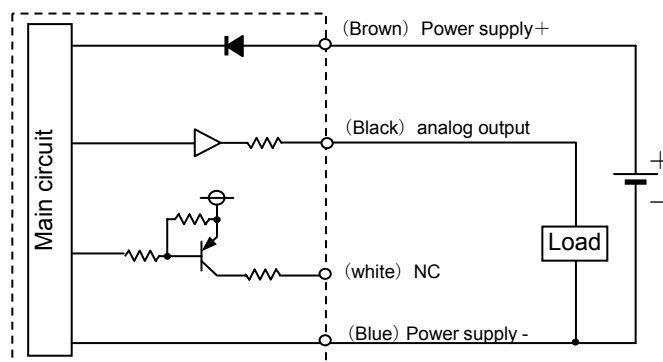
connector



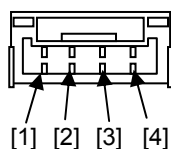
Pin No.	Line color	Content
[1]	Brown	Power supply (DC 12 to 24V, DC 24V)
[2]	Black	CH1(Switch output 1: max50mA)
[3]	White	CH2(Switch output 2: max50mA or External input)
[4]	Gray	Analog voltage output : DC 1 to 5V Connected load impedance 50kΩ and over) Analog current output : DC 4 to 20mA Connected load impedance 300Ω or less)
[5]	Blue	0V (GND)

# 1 INSTALLATION

## 1. 3. 3 FSM2-A series (Separated indicator type)



connector



(FSM2 side)

Pin No.	Line color	Content
[1]	Brown	Power supply (DC 12 to 24V, DC 24V)
[2]	Black	Analog voltage output : DC 1 to 5V Connected load impedance 50kΩ and over) Analog current output : DC 4 to 20mA Connected load impedance 300Ω or less)
[3]	White	Non connection
[4]	Blue	0V (GND)





## 2. 2 Function (FSM2-N/P series)

●Normal mode (Refer to Page 18 for the operation.)

Item	Description	Setting at shipping out of factory
Flow rate display	Instantaneous flow rate is displayed.	—
Integrating function	Integrated flow rate is displayed.	Instantaneous flow rate
Peak hold function	Maximum and minimum flow rate values during the specified period can be read.	Peak hold : OFF
Key lock	Setting changes are disabled to prevent incorrect operations.	Key unlock
Error display function	The error state is displayed.	—

●Standard setting mode (Refer to Page 20 for the operation.)

Item	Description	Setting at shipping out of factory
Switch output	Having 2 pieces of switch output, 7 operation patterns and stop of operation can be set.	OFF
Forcible output	Switch output is turned on forcibly to check wiring connection and initial operation of input unit.	—
0 point adjustment	Deviation of the display from 0 is corrected	Zero

●Detailed setting mode (Refer to Page 24 for the operation.)

Item	Description	Setting at shipping out of factory
Flow direction selection	Only bi-directional type, flow direction can be switched.	Bi-direction
CH2 function selection	Sets the CH2 function. Selects "Switch output", "External input of auto reference", or "External input of integrated reset".	Switch output
Auto reference function	When CH2 function selected external input of auto reference, setting value of switch output can be taken by external input or key operation.	Auto reference function : OFF
Response time setting	Sets the response time. The response time can be selected from 20ms to 1280ms.	Response time : 50msec
Display speed selection	Change the speed of the displayed.	Display speed : 250msec
Sub-display selection	Change the indication of the sub-display. Selects "Flow direction", "Flow rate unit", or "Working fluid".	Sub-display
Displayed color selection	Displayed color can be changed.	Red when ON Green when OFF
Hysteresis fixed value selection	Sets hysteresis of the window operation mode and the auto reference mode. (8 steps)	Hysteresis : 1%FS
Unit selection	Flow rate unit can be changed. Standard condition (ANR): Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa). Reference condition (NOR): Converted to volumetric flow at 0°C and 1 atmospheric pressure (101kPa).(calculation value)	Flow rate unit : ANR
Eco mode setting	Current consumption can be lowered. When the product is left for 1 min. without any operation, it's shift to eco mode.	Eco mode : OFF
Reset setting	Return to default settings (factory settings)	—

## 2. 3 Normal mode (Integrated indicator type)

### 2. 3. 1 Displaying the integrated flow

<Instantaneous flow rate display.>

456 mL/min -->

Press once

Display unit selection

Instantaneous flow rate display.  
(unit : mL/min, L/min)



456 mL/min

Integrated display (unit : mL, L)

000 mL 0368

Press once (setting)

Press simultaneously for 2 sec.

Integration reset  
Integration is reset when the  and  keys are held down for 2 sec.

<Integrated display>

000 mL 0368

000 0000

Note: Integration is reset with the external input. See auto reference function.

Note: Integration is also reset when power is turned OFF.

### 2. 3. 2 Peak hold function

<Instantaneous flow rate display.>

456 mL/min -->

Press simultaneously

Peak hold display

456 mL/min PER

Being held down

Being held down

<Peak value displayed>

481 mL/min

<Bottom value displayed>

432 mL/min

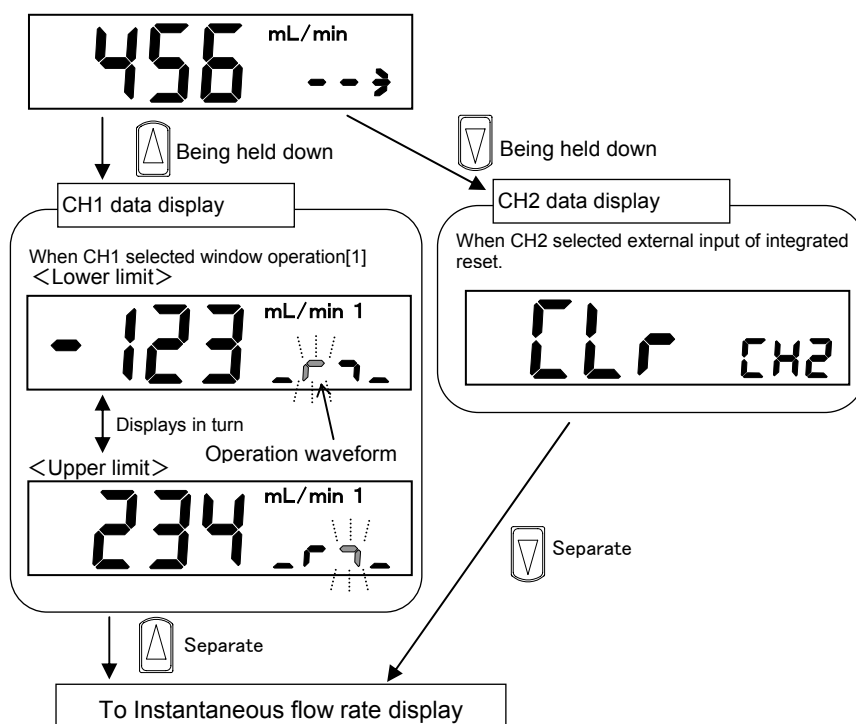
Press once

Reset peak hold function. To instantaneous flow rate display

Note: The screen color at switch ON doesn't change while holding the peak.

### 2. 3. 3 Set-point verification method

<Instantaneous flow rate display.>

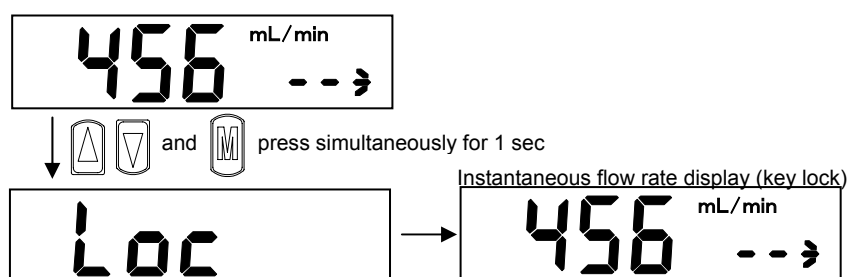


Note: When an external input uses the auto reference function, it doesn't operate.

### 2. 3. 4 Key lock / Key unlock function

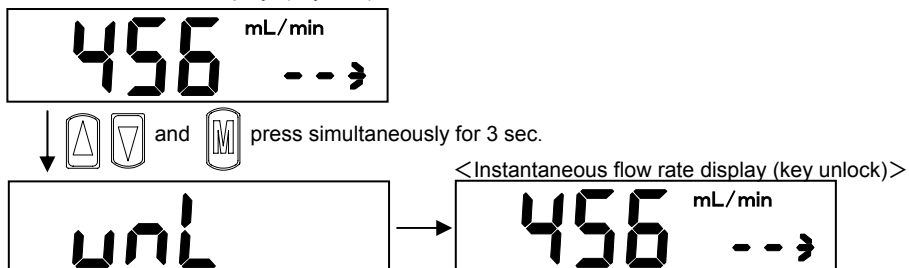
#### ● Key lock

<Instantaneous flow rate display.(key unlock)>



#### ● Key unlock

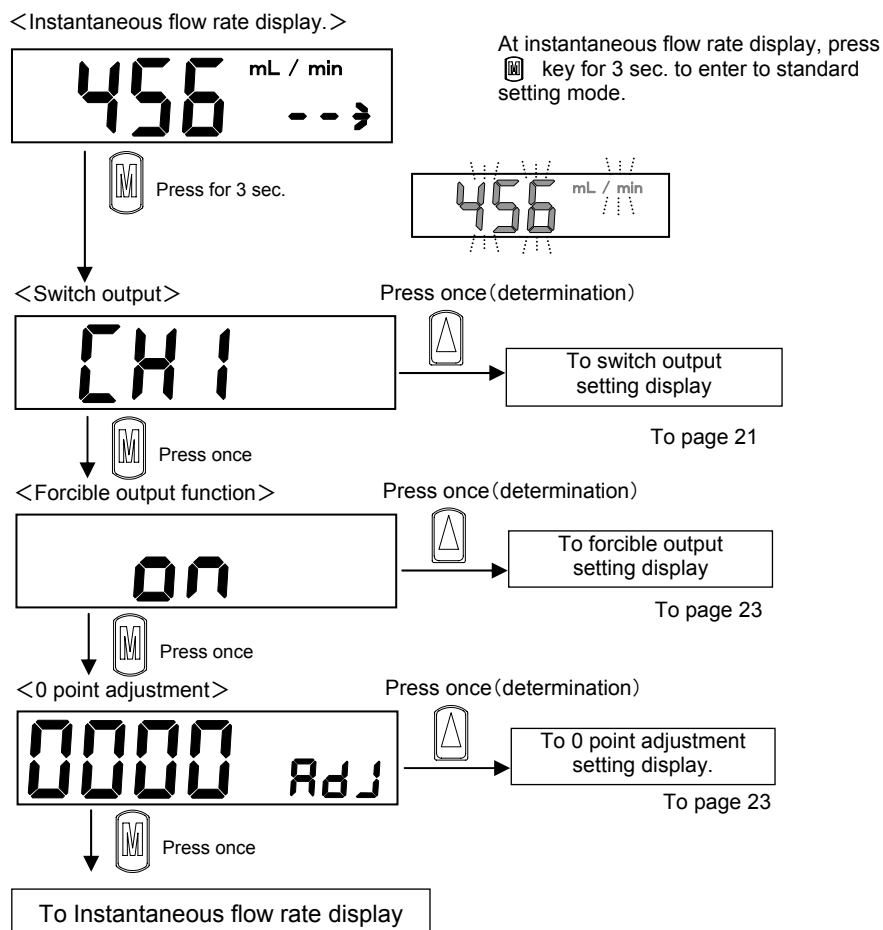
<Instantaneous flow rate display. (key lock)>



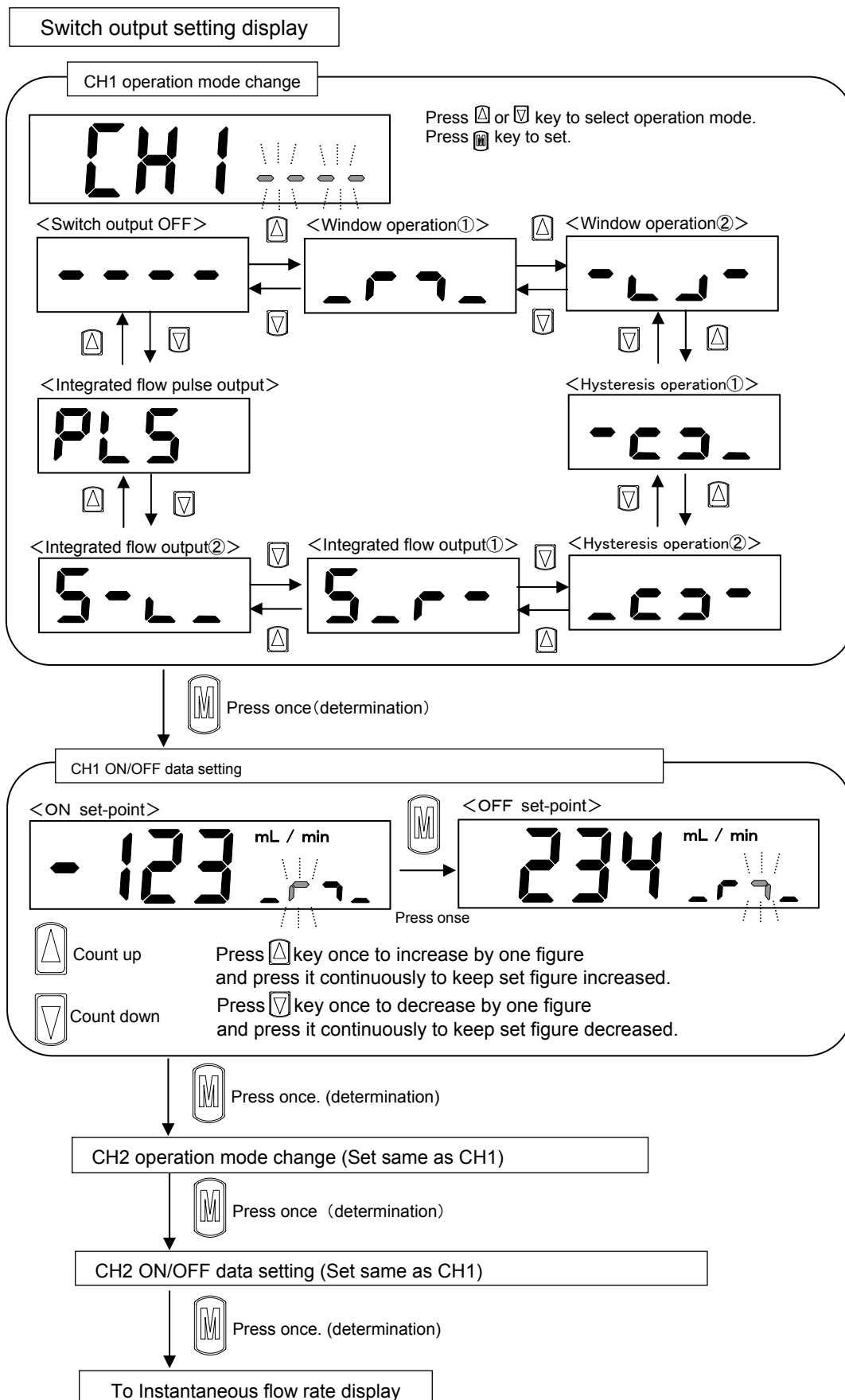
Note: Keys are unlocked when the controller is shipped. Lock keys if necessary.  
The key lock/unlock state is held even if power is turned OFF.

## 2. 4 Standard setting mode

### 2. 4. 1 How to enter to standard setting mode

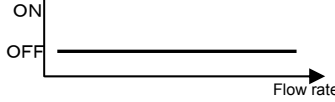
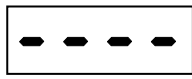
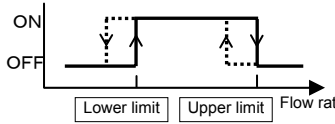
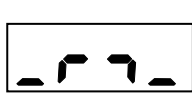
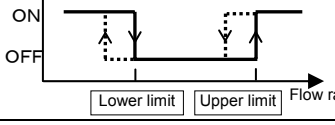
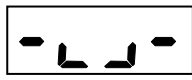
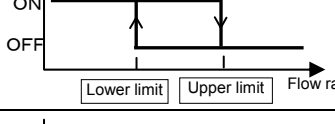

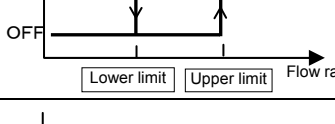

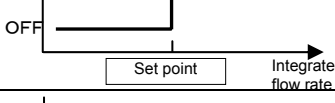

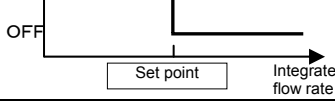

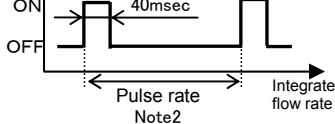



## 2. 4. 2 Setting of switch output function



## ● Switch output

Having 2 pieces of switch output, 7 operation patterns and stop of operation can be set.

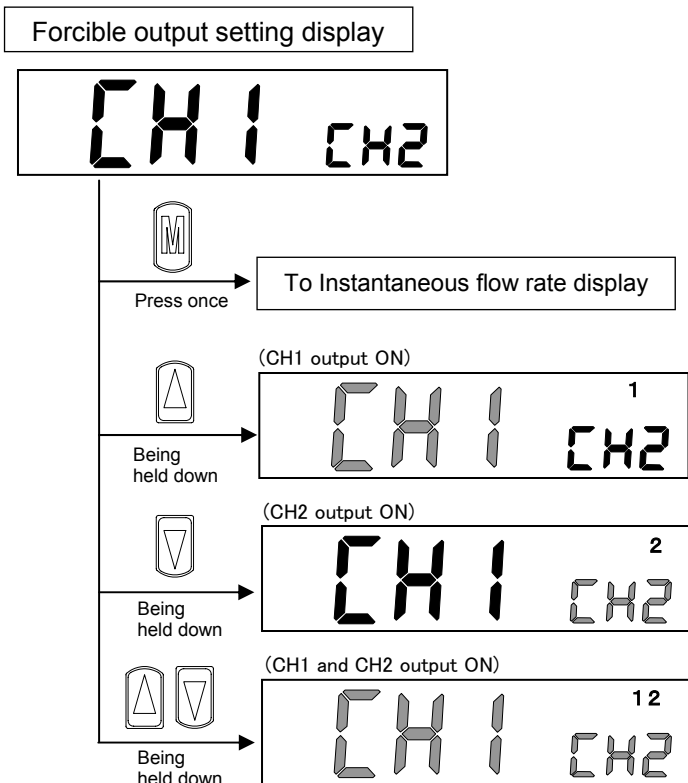
No.	Operation pattern	Description	Operation waveform	LCD display
1	Switch output OFF	Switch output OFF		
2	Window operation[1] (Range inside ON) Note1	The switch turns ON when the level is within the designated flow rate range.		
3	Window operation[2] (Range out ON) Note1	The switch turns ON when the level is not within the designated flow rate range.		
4	Hysteresis operation[1] (Flow rate small side ON)	ON when lower than set point. Hysteresis can be arbitrarily set.		
5	Hysteresis operation[2] (Flow rate large side ON)	ON when higher than set point. Hysteresis can be arbitrarily set.		
6	Integrated output[1] (On when higher than set integration)	The switch turns ON at the set integrated flow.		
7	Integrated output[2] (Off when higher than set integration)	The switch turns OFF at the set integrated flow.		
8	Integrated pulse	The integrated pulse is output during integration. See specifications for details on the pulse output rate.		

Note1: Hysteresis is provided on upper and lower limit of window operation automatically.

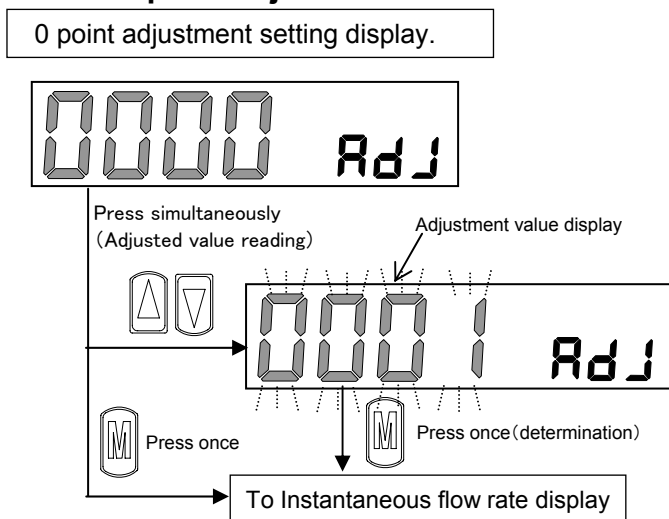
The hysteresis can be fixed in 8 steps. Refer to <2.5.8.Hysteresis fixed value selection> in <Detailed setting mode>.

Note2: Refer to <Pulse output rate> in <4.1. Specifications>.

### 2. 4. 3 Switch output forcible ON mode



### 2. 4. 4 Zero point adjustment



Note: Always adjust 0 point without flow.

Note: If fluid flows during zero adjustment setting, "E 02" is indicated.

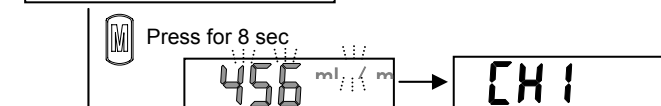
Note: The offset value is different to display it by the operation processing value from an actual flowing quantity value.



## 2. 5 Detailed setting mode

### 2. 5. 1 How to enter to detailed setting mode

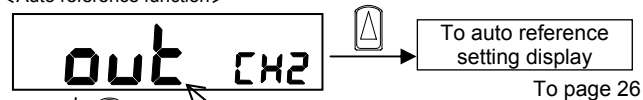
<Instantaneous flow rate display>



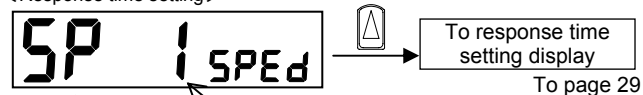
<Flow direction selection>  
(only bi-directional type)



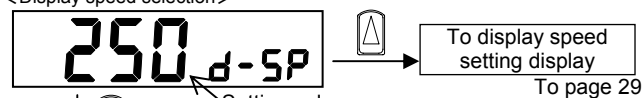
<Auto reference function>



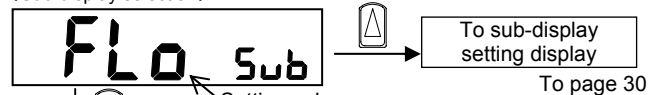
<Response time setting>



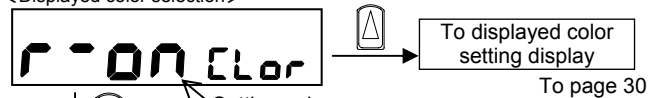
<Display speed selection>



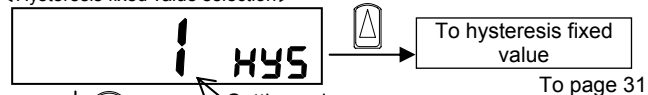
<Sub-display selection>



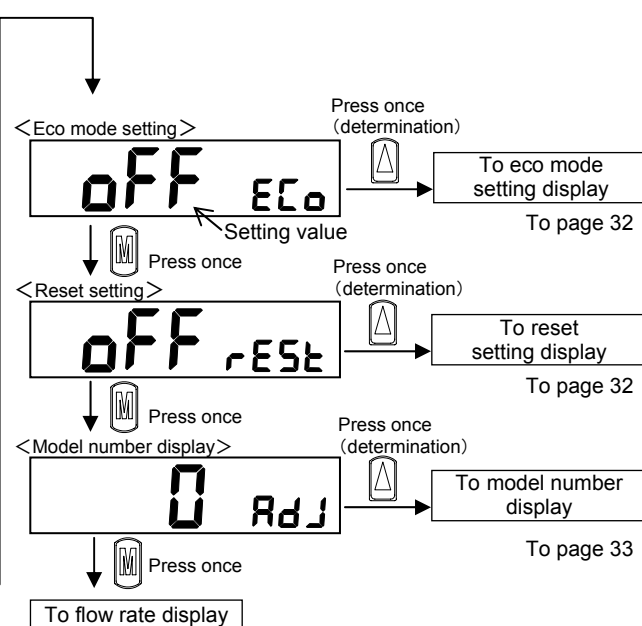
<Displayed color selection>



<Hysteresis fixed value selection>






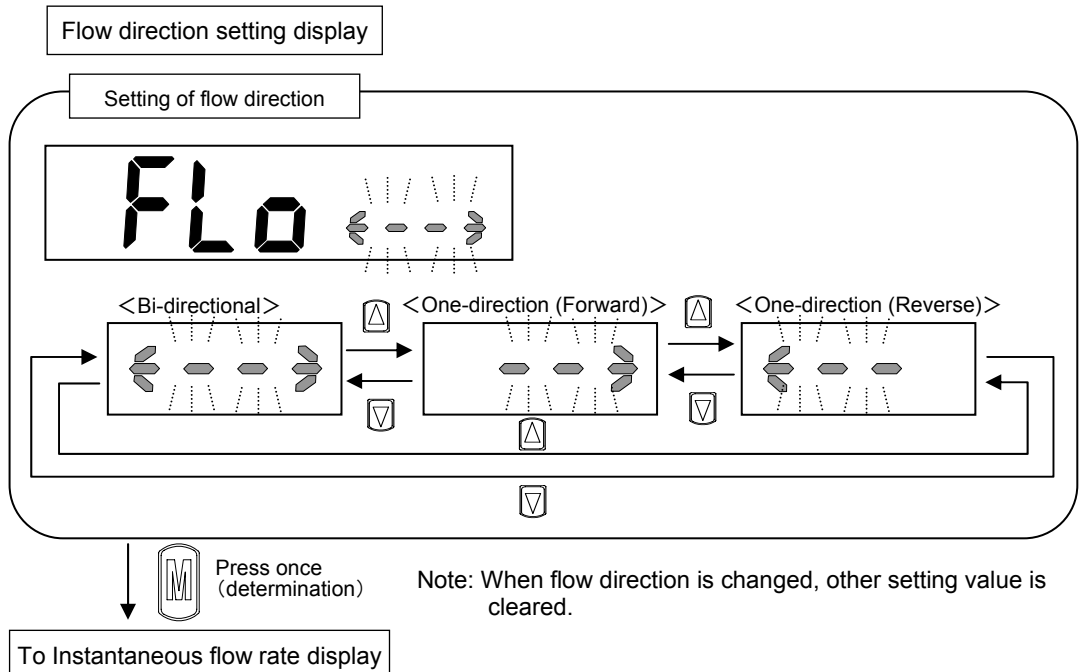
<Unit selection>



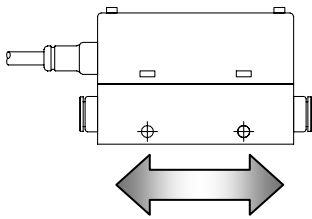
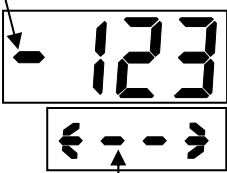
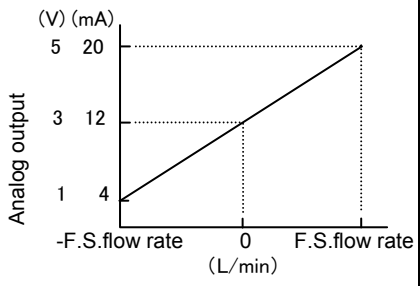
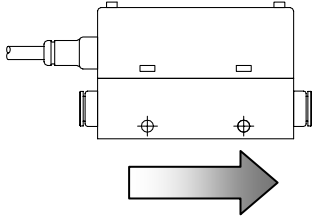
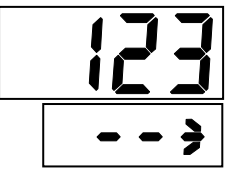
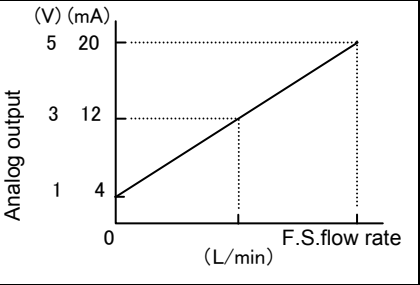
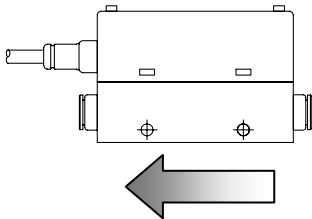
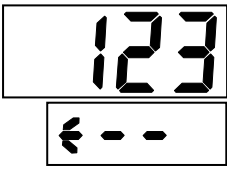
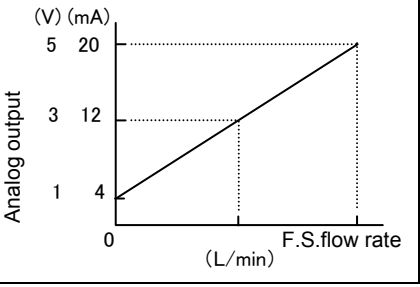
2. 5. 2 Setting of flow direction (Integrated indicator type, Bi-directional type only)

Flow direction can be switched.

Press  or  key to select flow direction. Press  key to set.



●Flow direction

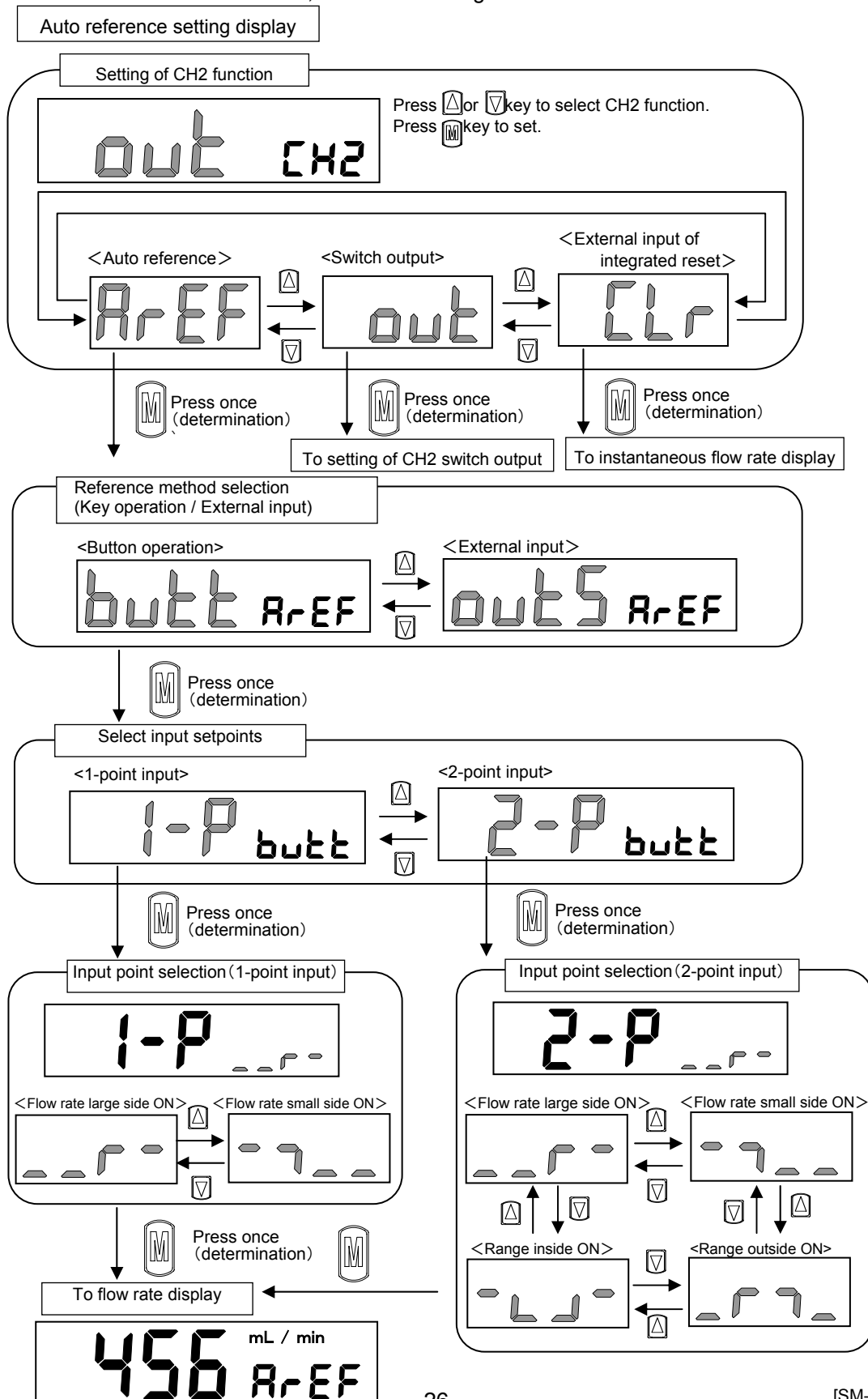
Flow direction	LCD display	Analog output characteristics
<p>&lt;Bi-directional&gt;</p> 	<p>When reverse flow, “-” is indicated</p>  <p>The arrow changes according to flow direction</p>	
<p>&lt;One-direction (Forward)&gt;</p> 		
<p>&lt;One-direction (Reverse)&gt;</p> 		

### 2. 5. 3 Setting of auto reference

When CH2 function selected external input of auto reference, setting value of switch output can be taken by external input or key operation.




The set point takes the flow rate when external input is turned on (or key operation).

When auto reference is executed, the switch setting of CH2 becomes invalid.



## 2 OPERATION

### ● How to take set point by key operation

- 1-point input : The set point takes the flow rate when press  key for 2 sec.
- 2-point input : The upper limit takes the flow rate when press  key for 2 sec.  
The lower limit takes the flow rate when press  key for 2 sec.
- After taking, the set point is displayed.

### ● How to take set point by external input

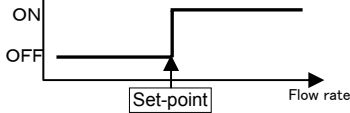
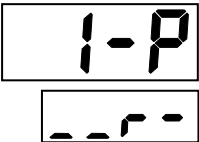
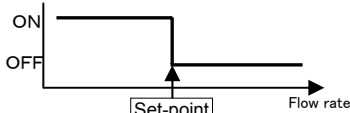
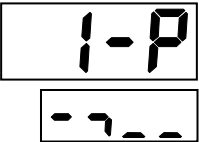
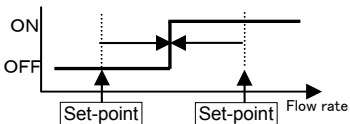
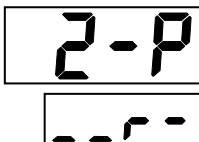
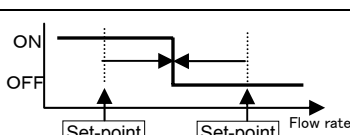

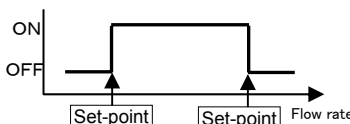
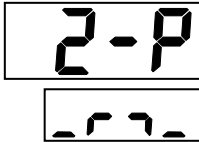
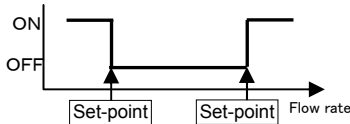

- 1 point input : The set point takes the flow rate when external input is turned on (keep approx. 40msec.).
- 2 points input : The set point takes the flow rate when external input is turned on (keep approx. 40msec.).  
The big and small relations between latest two points are compared, upper limit and lower limit are distinguished automatically.

(Example)

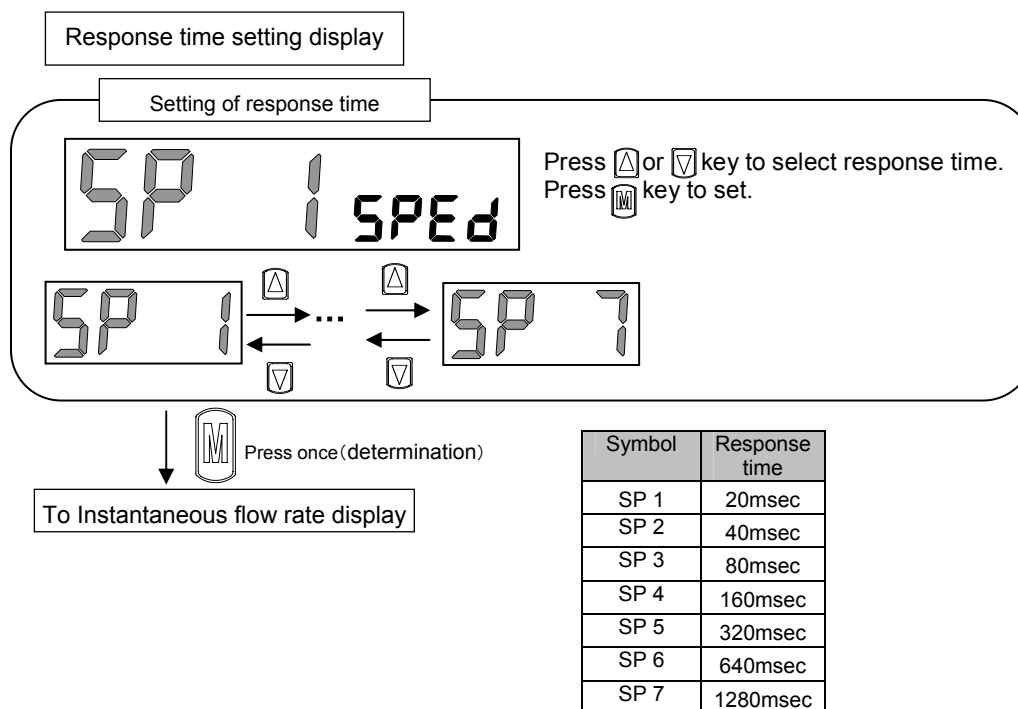
Input point (mL/min)		Upper limit (mL/min)	Lower limit (mL/min)
Initial value		0	0
1 <sup>st</sup>	123	0	123
2 <sup>nd</sup>	234	123	234
3 <sup>rd</sup>	45	45	234
4 <sup>th</sup>	345	45	345
5 <sup>th</sup>	456	345	456

- After taking, the set point is displayed. Also the pulse is output from CH1 for the taking confirmation.
- The set point value is cleared if power is turned OFF.

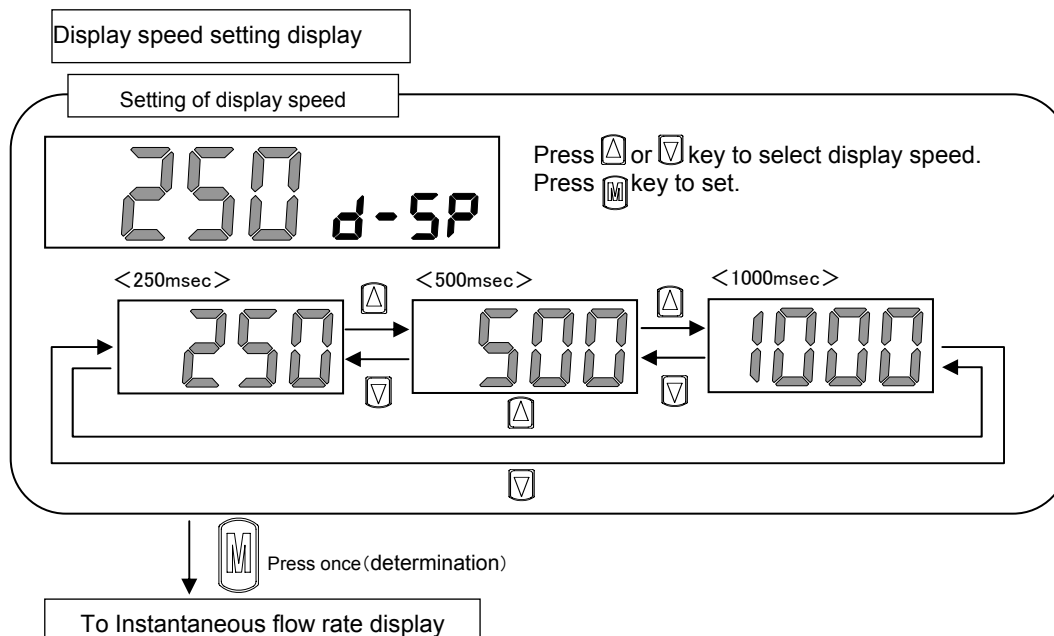
●Auto reference

Points of input	Operation pattern name	Description	Operation waveform	LCD display
1 point (1-P)	1-point input[1] (Flow rate large side ON)	ON when higher than input point. Set-point=input point		
	1-point input[2] (Flow rate small side ON)	OFF when higher than input point. Set-point=input point		
2 points (2-P)	2-point input[1] (Flow rate large side ON)	ON when higher than centre value of two input points (Set-point: $\frac{\text{Input1} + \text{Input2}}{2}$ )		
	2-point input[2] (Flow rate small side ON)	OFF when higher than centre value of two input points (Set-point: $\frac{\text{Input1} + \text{Input2}}{2}$ )		
	2-point inside (Range inside ON)	ON when flow rate level is within two input points. (Set-point1 : input point1) (Set-point2 : input point2)		
	2-point outside (Range outside ON)	OFF when flow rate level is (Set-point1 : input point1) (Set-point2 : input point2)		

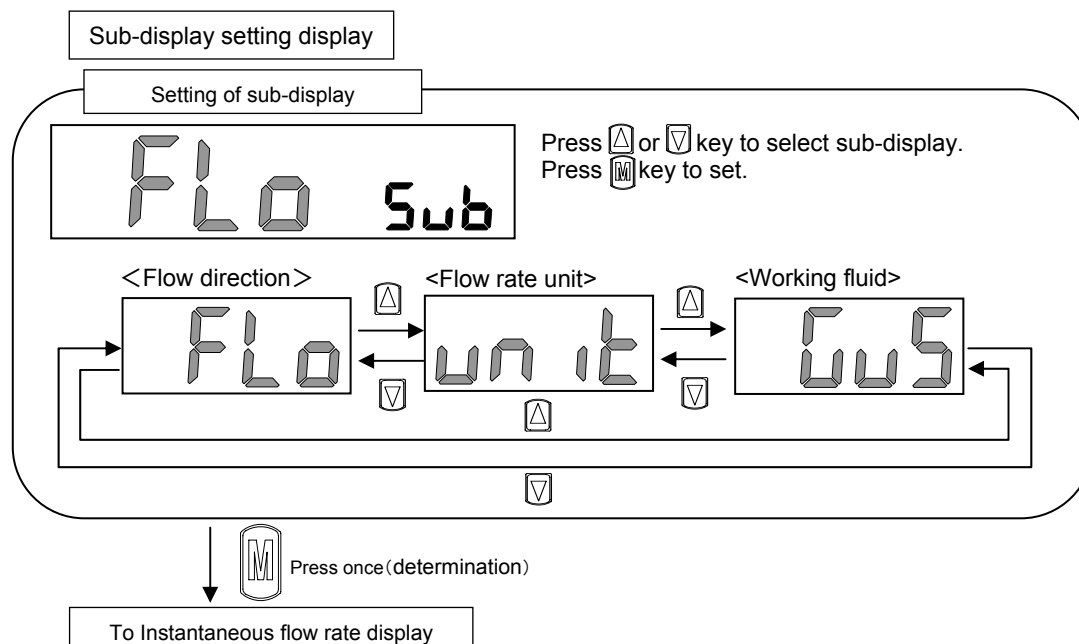
## 2. 5. 4 Setting of response time



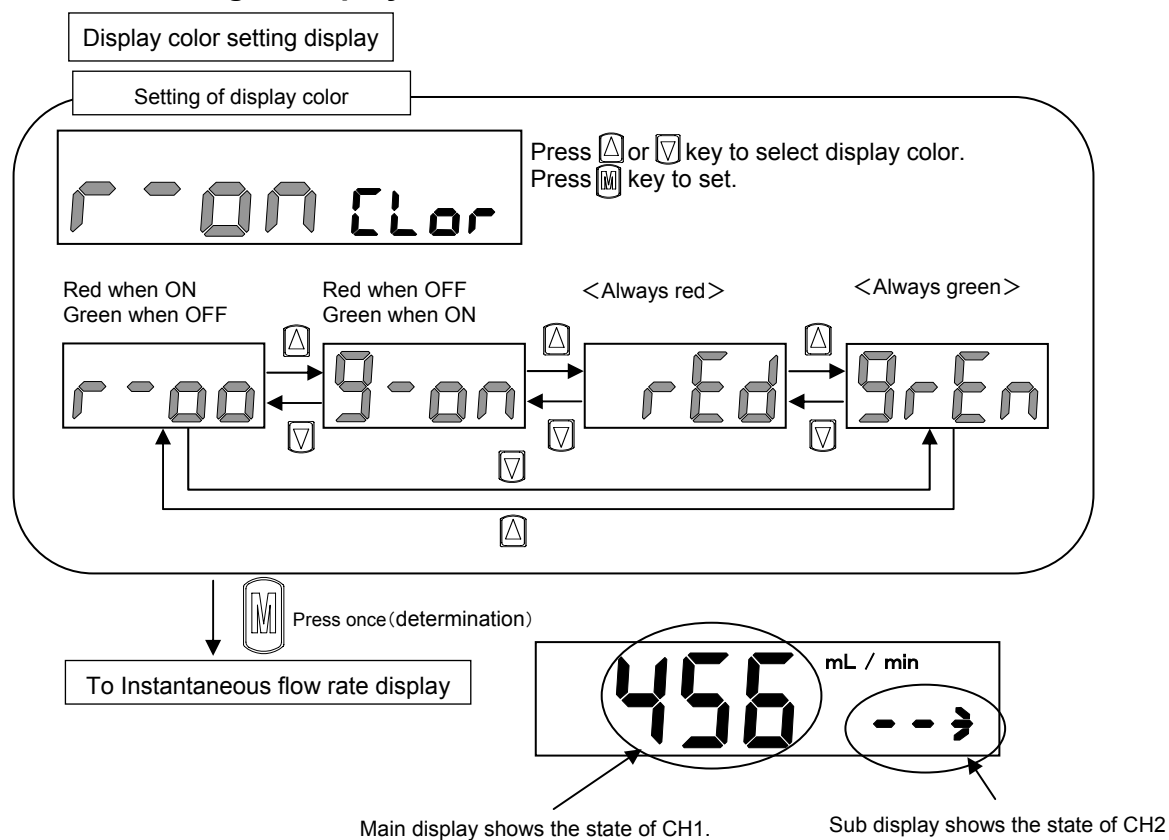
## 2. 5. 5 Setting of display speed



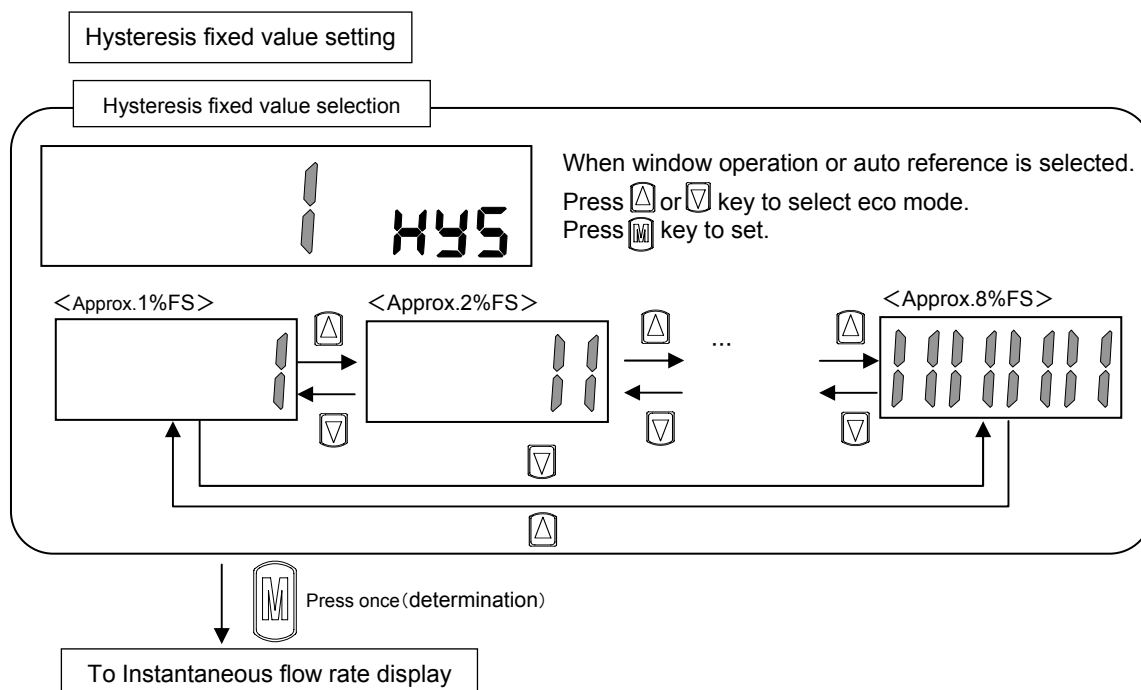
## 2. 5. 6 Setting of sub-display



## 2. 5. 7 Setting of display color

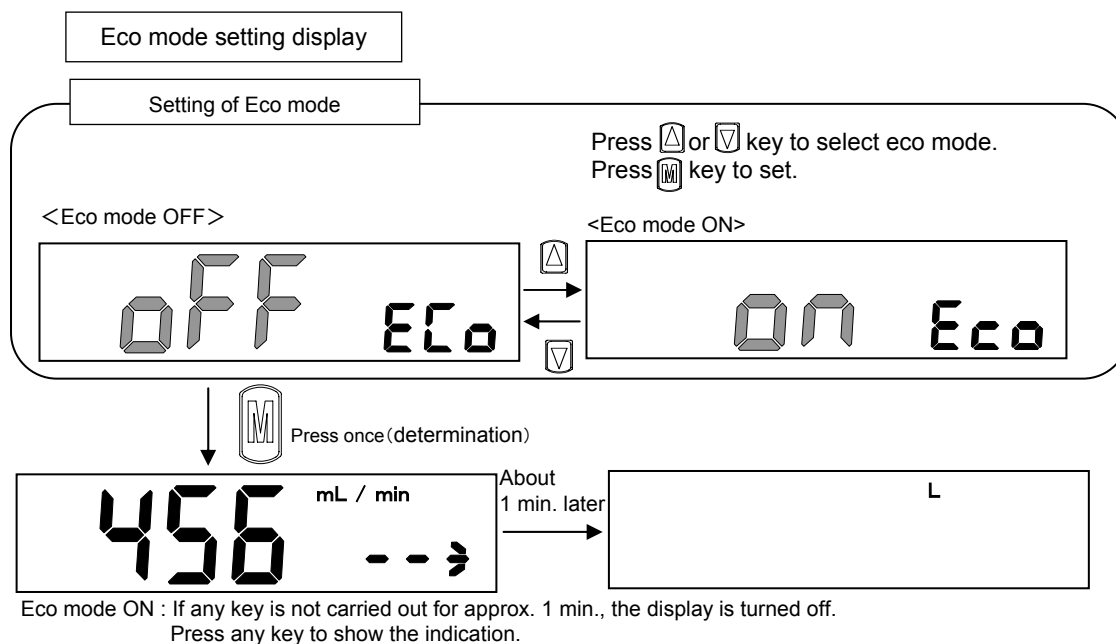


## 2. 5. 8 Hysteresis fixed value selection

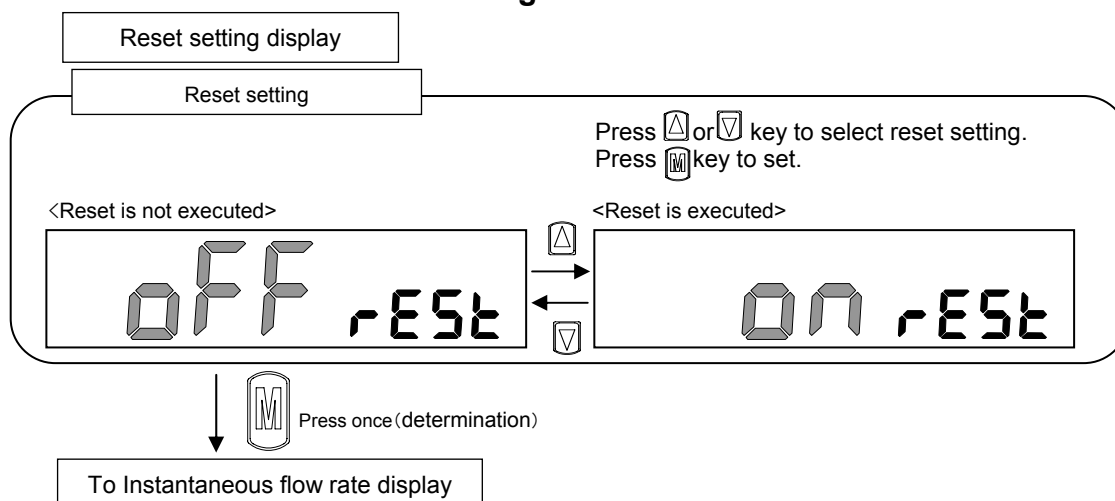




## 2. 5. 10 Setting of Eco mode



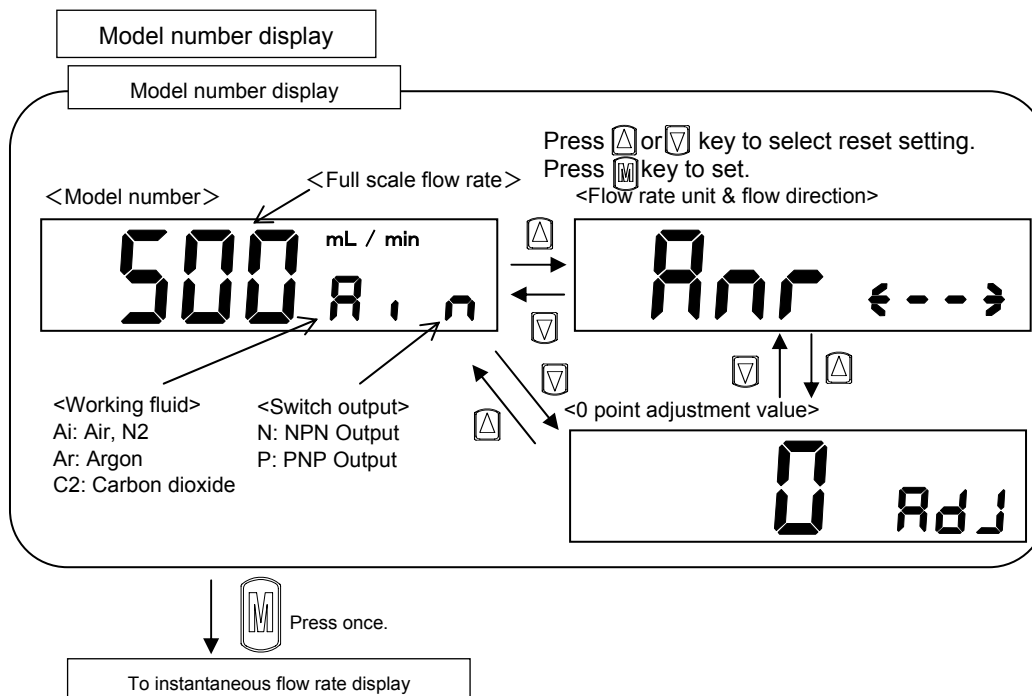
## 2. 5. 11 Reset to the initial setting



### ●Setting at shipping out of factory

Item	Setting at shipping out of factory
Switch out put	OFF
Zero adjustment value	Zero
Integrating flow rate value	Zero
Flow direction (bi-directional type only)	Bi-direction
Auto reference (CH2 setting)	Switch output
Response time	20msec
Display speed	250msec
Sub-display	Flow direction display
Displayed color	ON: Red (OFF: Green)
Hysteresis	1%FS
Flow rate unit	ANR
Eco mode	OFF




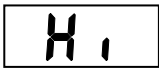

## 2. 5. 12 Model number display



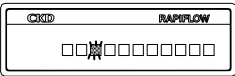
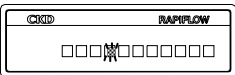
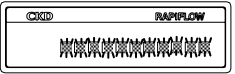
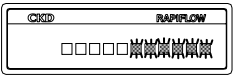
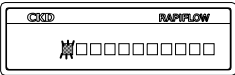
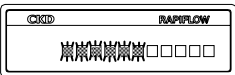
### 3. MAINTENANCE

#### 3. 1 Error displays and corrective action

##### ● Integrated indicator type

Error indication	Cause	Corrective action
	If fluid flows during zero adjustment setting, "E 02" is indicated.	Please check that fluid doesn't flow at the time of zero adjustment setting.
	An error occurred during EEPROM reading or writing.	Contact your nearest CKD Sales Office or dealer.
	An error occurred during memory reading or writing.	Contact your nearest CKD Sales Office or dealer.
	Reading exceeds the upper limit of detection range.	Reduce the flow.
	Sensor chip is broken.	Replace FSM2.
	Reading exceeds the lower limit of detection range.	Reduce the flow.
	Sensor chip is broken.	Replace FSM2.
Switch output indicator is blinking	Switch output over current protection circuit is activated.	Check whether load current exceeds the rating, correctly connect the controller, and turn power ON again.

##### ● Separated indicator type

Error indication	Cause	Corrective action
The third from the left blinks. 	An error occurred during EEPROM reading or writing.	Contact your nearest CKD Sales Office or dealer.
The fourth from the left blinks. 	An error occurred during memory reading or writing.	Contact your nearest CKD Sales Office or dealer.
<One-direction> Blinking of all  <Bi-directional> Half the left blinking 	Reading exceeds the upper limit of detection range.	Reduce the flow.
	Sensor chip is broken.	Replace FSM2.
<One-direction> The leftmost blinking  <Bi-directional> Half the left blinking 	Reading exceeds the lower limit of detection range.	Reduce the flow.
	Sensor chip is broken.	Replace FSM2.

### 3. 2 Troubleshooting

Trouble	Cause	Corrective action
No flow display (No analog output)	Breakage of wire.	Replace FSM2. Recheck/repair external wiring.
	Wrong connection of power source.	Connect the rated power source correctly.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from noise source.
	Output circuit is broken.	Replace FSM2.
	FSM2 is broken.	Replace FSM2.
Flow display remains 0. (Analog output remains 1V or 3V)	Flow path clogged by foreign matter.	Remove foreign matter and install filter at primary side of FSM2.
Flow display does not reach 0. (Analog output does not make 1V or 3V)	Leakage	Check and correct piping.
	Foreign matter sticking to sensor chip.	Replace FSM2.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from the noise source.
Poor precision	Sensor chip is broken.	Replace FSM2.
	Foreign matter sticking to sensor chip.	Replace FSM2.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from the noise source.
Flow display is not stable. (Analog output is not stable. Output is chattering.)	Pulsation of air.	Reduce pulsation by installing tank, etc.
	Fault in power source (not enough voltage/capacity)	Change the response time.
	Pulsation of air.	Change the display speed.
		Change the hysteresis.
	Fault in power source (not enough voltage/capacity)	Supply rated voltage. Provide power source with enough capacity.
	Malfunction caused by noise.	Keep FSM2 main body and cable away from noise source.

## 4. PRODUCTS

### 4. 1 Specifications

#### 4. 1. 1 Integrated indicator type(FSM2-N/P series)

##### ● Integrated indicator type(Resin / Aluminum body)

Model no.			Integrated indicator type ( Resin / Aluminum body) FSM2-[*1][*2][*3][*4]-[*5]												
Descriptions			005	010	020	050	100	200	500	101	201	501	102		
Full scale flow rate Note 1	*4	005	500mL/min	●											
		010	1L/min		●										
		020	2L/min			●									
		050	5L/min				●								
		100	10L/min					●							
		200	20 L/min						●						
		500	50 L/min							●					
		101	100 L/min								●				
		201	200 L/min									●			
		501	500 L/min										●		
Poet size/ Body material	*5	102	1000 L/min										●		
		H04	φ 4 push-in / resin	●	●	●	●	●	●						
		H06	φ 6 push-in / resin	●	●	●	●	●	●						
		H08	φ 8 push-in / resin							●	●	●			
		H10	φ 10 push-in/ resin								●	●			
A15	Rc1/2 / aluminum										●	●			
Flow rate display	Dual (2×4-digit 7-segment) Two-color LCD														
	Type of display	Flow rate 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
	Display resolution		1mL/min		0.01L/min		0.1L/min		1L/min						
	Flow rate range		9999999mL		99999.99L		999999.9L		9999999L						
Integrating function	Display resolution		1mL		0.01L		0.1L		1L						
	Pulse output rate		5mL	10mL	0.02L	0.05L	0.1L	0.2L	0.5L	1L	2L	5L	10L		
	Clean air (JIS B 8392-1.1.1 to 5.6.2), Compressed air (JIS B 8392-1.1.1~1.6.2), and Nitrogen gas														
Working conditions	Working fluid Note 2		0 to 50°C and 90%RH or less												
	Maximum working pressure		0.7MPa												
	Minimum working pressure		-0.09MPa												
	Withstanding pressure		1MPa												
	Ambient temperature / humidity		0 to 50°C and 90%RH or less												
Accuracy	Working fluid temperature		0 to 50°C (to be no dew condensation.)												
	Flow rate range		3 to 100%F.S.												
	Linearity (display / analog output)		±3%F.S. or less (25°C, 1 atmospheric pressure)												
	Pressure characteristics		±5%F.S. or less (-0.09 to 0.7MPa, 25°C, 1 atmospheric criteria)												
	Temperature characteristics		±0.2%F.S./°C or less (15 to 35°C, 25°C criteria)												
Response time Note3			±1%F.S. or less												
Output	Switch output	*1	N	50ms or less											
			P	2 points (NPN open collector output, 50mA or less, voltage drop 2.4V or less)											
	Analog output	*2	V	2 points (PNP open collector output, 50mA or less, voltage drop 2.4V or less)											
			A	1 point (1 to 5V voltage output and connected load impedance 50kΩ and over)											
Power supply voltage note4		*2	V	1 point (4 to 20mA current output and connected load impedance 300Ω or less)											
			A	DC12 / 24V (10.8 to 26.4V)											
Current consumption Note5			DC24V (21.6 to 26.4V)												
Lead wire			50mA or less												
Functions			φ 3.7 AWG26×5												
Installation attitude			Flow rate display, flow rate display-peak hold, switch output and analog output												
Strait piping section			Both vertical and horizontal												
Protective structure			Not required												
Protective circuit Note6			IEC standards IP40												
Mass			Power supply and switch output reverse connection protections, and switch output load short-circuit protection												
Mass	*4	H04	Approx. 50g												
		H06	Approx. 50g												
		H08	Approx. 70g												
		H10	Approx. 75g												
		A15	Approx. 155g												

Note1: Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa)

Note2: When using compressed air, use clean air complying with JIS B 8392-1:2003 class over 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration rating : 5μm) , air dryer (minimum pressure dew point 10°C or less) and oil mist filter(maximum oil concentration 0.1mg/m<sup>3</sup>) on the primary side of the product to maintain product function.

When using for purposes 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.

Note3: The response time can be selected from 50ms to 1.5s.

Note4: Current consumption is different according to the state of the load.

Note5: This product's protective circuit is effective only for specific incorrect connections and load short-circuits. It does not necessarily provide protection for all incorrect connections.

No.te6: Integrated flow value is reset by turning power off.

● Integrated indicator type (Stainless body)

Model no.				Integrated indicator type (Stainless body) FSM2-[*1][*2][*3][*4]-[*5][*6]								
Descriptions				005	010	020	050	100	200	500	101	201
Full scale flow rate Note 1	*4	005	Full scale flow rate 500mL/min	●								
		010	1L/min		●							
		020	2L/min			●						
		050	5L/min				●					
		100	10L/min					●				
		200	20 L/min						●			
		500	50 L/min							●		
		101	100 L/min								●	
201	200 L/min									●		
Poet size/ Body material	*5	S06	Rc1/8 / Stainless	●	●	●	●	●	●	● (only Air, Ar)		
		S08	Rc1/4 / Stainless							●	●	● (only Air, Ar)
		SM5	M5 / Stainless (order made)	●	●	●	●	●	● (only Air, Ar)			
Flow rate display	Type of display			Dual (2×4-digit 7-segment) Two-color LCD								
	Flow rate 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
			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			1mL/min		0.01L/min		0.1L/min		1mL/min		
Integrating function Note 6	Flow rate range			9999999mL		99999.99L		999999.9L		999999.9mL		
	Display resolution			1mL		0.01L		0.1L		1mL		
	Pulse output rate			5mL	10mL	0.02L	5mL	10mL	0.02L	5mL	10mL	2L
Working conditions	Working fluid Note 2	*6	Blank	Clean air (JIS B 8392-1.1.1 to 5.6.2), Compressed air (JIS B 8392-1.1.1~1.6.2), and Nitrogen gas								
			AR	Argon								
			C2	Carbon dioxide								
	Maximum working pressure			1.0MPa								
	Minimum working pressure			-0.09MPa								
	Withstanding pressure			1.5MPa								
	Ambient temperature / humidity			0 to 50°C and 90%RH or less								
Working fluid temperature			0 to 50°C (to be no dew condensation.)									
Accuracy	Flow rate range			3 to 100%F.S.								
	Linearity (display / analog output)			±3%F.S. or less (25°C, 1 atmospheric pressure)								
	Pressure characteristics			±5%F.S. or less (-0.09 to 0.7MPa, 25°C, 1 atmospheric criteria)								
	Temperature characteristics			±0.2%F.S./°C or less (15 to 35°C, 25°C criteria)								
	Repeatability			±1%F.S. or less								
Response time Note3				50ms or less								
Output	Switch output	*1	N	2 points (NPN open collector output, 50mA or less, voltage drop 2.4V or less)								
			P	2 points (PNP open collector output, 50mA or less, voltage drop 2.4V or less)								
	Analog output	*2	V	1 point (1 to 5V voltage output and connected load impedance 50kΩ and over)								
			A	1 point (4 to 20mA current output and connected load impedance 300Ω or less)								
Power supply voltage note4		*2	V	DC12／24V (10.8 to 26.4V)								
			A	DC24V (21.6 to 26.4V)								
Current consumption Note5				50mA or less								
Lead wire				φ 3.7 AWG26×5								
Functions				Flow rate display, flow rate display-peak hold, switch output and analog output								
Installation attitude				Both vertical and horizontal								
Strait piping section				Not required								
Protective structure				IEC standards IP40								
Protective circuit Note6				Power supply and switch output reverse connection protections, and switch output load short-circuit protection								
Mass	*5	S06	Approx. 95g									
		S08	Approx. 115g									
		SM5	Approx. 140g									

Note1: Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa)

Note2: When using compressed air, use clean air complying with JIS B 8392-1:2003 class over 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration rating: 5μm), air dryer (minimum pressure dew point 10°C or less) and oil mist filter (maximum oil concentration 0.1mg/m<sup>3</sup>) on the primary side of the product to maintain product function.

When using for purposes 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.

Note3: The response time can be selected from 50ms to 1.5s.

Note4: Current consumption is different according to the state of the load.

Note5: This product's protective circuit is effective only for specific incorrect connections and load short-circuits. It does not necessarily provide protection for all incorrect connections.

Note6: Integrated flow value is reset by turning power off.

#### 4. 1. 2 Separated indicator type(FSM2-A series)

##### ●Separated indicator type (Resin / Aluminum body)

Model no.				Separated indicator type ( Resin / Aluminum body) FSM2-A[*1][*2][*3]-*4]										
Descriptions				005	010	020	050	100	200	500	101	201	501	102
Full scale flow rate Note 1	*3	005	500mL/min	●										
		010	1L/min		●									
		020	2L/min			●								
		050	5L/min				●							
		100	10L/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											●
		Poet size/ Body material	*4	H04	φ 4 push-in / resin	●	●	●	●	●	●			
H06	φ 6 push-in / resin			●	●	●	●	●	●					
H08	φ 8 push-in / resin									●	●	●		
H10	φ 10 push-in/ resin									●	●	●		
A15	Rc1/2 / aluminum												●	●
Flow direction		*2	F	One-direction										
			R	Bi-directional										
Working conditions	Working fluid Note 2			Clean air (JIS B 8392-1.1.1 to 5.6.2), Compressed air (JIS B 8392-1.1.1~1.6.2), and Nitrogen gas										
	Maximum working pressure			0.7MPa										
	Minimum working pressure			-0.09MPa										
	Withstanding pressure			1MPa										
	Ambient temperature / humidity			0 to 50°C and 90%RH or less										
Accuracy	Working fluid temperature			0 to 50°C (to be no dew condensation.)										
	Linearity (display / analog output)			±3%F.S. or less (25°C, 1 atmospheric pressure)										
	Pressure characteristics			±5%F.S. or less (-0.09 to 0.7MPa, 25°C, 1 atmospheric criteria)										
	Temperature characteristics			±0.2%F.S./°C or less (15 to 35°C, 25°C criteria)										
	Repeatability			±1%F.S. or less										
Response time			50mA or less											
Type of display			The flowing quantity bar display											
Output	Analog output	*1	V	1 point (1 to 5V voltage output and connected load impedance 50kΩ and over)										
			A	1 point (4 to 20mA current output and connected load impedance 300Ω or less)										
Power supply voltage note4		*1	V	DC12／24V (10.8 to 26.4V)										
			A	DC24V (21.6 to 26.4V)										
Current consumption Note3			50mA or less											
Lead wire			φ 3.7 AWG26×5											
Functions			Analog-output, The flowing quantity bar display											
Installation attitude			Both vertical and horizontal											
Strait piping section			Not required											
Protective structure			IEC standards IP40											
Protective circuit Note4			Power supply and switch output reverse connection protections, and switch output load short-circuit protection											
Mass	*4	H04	Approx. 40g											
		H06	Approx. 40g											
		H08	Approx. 60g											
		H10	Approx. 65g											
		A15	Approx. 145g											

Note1: Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa)

Note2: When using compressed air, use clean air complying with JIS B 8392-1:2003 class over 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration rating : 5μm) , air dryer (minimum pressure dew point 10°C or less) and oil mist filter(maximum oil concentration 0.1mg/m<sup>3</sup>) on the primary side of the product to maintain product function.

When using for purposes 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.

Note3: Current consumption is different according to the state of the load.

Note4: This product's protective circuit is effective only for specific incorrect connections and load short-circuits. It does not necessarily provide protection for all incorrect connections.

● Separated indicator type (Stainless body)

Model no.				Separated indicator type (Stainless body) FSM2-A[*1][*2][*3]-[*4][*5]								
Descriptions				005	010	020	050	100	200	500	101	201
Full scale flow rate Note 1	*3	005	500mL/min	●								
		010	1L/min		●							
		020	2L/min			●						
		050	5L/min				●					
		100	10L/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	●	●	●	●	●	●	(only Air, Ar)		
		S08	Rc1/4 / Stainless							●	●	● (only Air, Ar)
		SM5	M5 / Stainless (order made)	●	●	●	●	●	● only Air, Ar			
Flow direction		*2	F	One-direction								
			R	Bi-direction								
Working conditions	Working fluid Note 2	*5	Blank	Clean air (JIS B 8392-1.1.1 to 5.6.2), Compressed air (JIS B 8392-1.1.1~1.6.2), and Nitrogen gas								
			AR	Argon								
			C2	Carbon dioxide								
			Maximum working pressure	1.0MPa								
	Minimum working pressure		-0.09MPa									
	Withstanding pressure		1.5MPa									
	Ambient temperature / humidity		0 to 50°C and 90%RH or less									
Working fluid temperature		0 to 50°C (to be no dew condensation.)										
Accuracy	Linearity (display / analog output)		±3%F.S. or less (25°C, 1 atmospheric pressure)									
	Pressure characteristics		±5%F.S. or less (-0.09 to 0.7MPa, 25°C, 1 atmospheric criteria)									
	Temperature characteristics		±0.2%F.S./°C or less (15 to 35°C, 25°C criteria)									
	Repeatability		±1%F.S. or less									
Response time			50ms or less									
Type of display			The flowing quantity bar display									
Output	Analog output	*1	V	1 point (1 to 5V voltage output and connected load impedance 50kΩ and over)								
			A	1 point (4 to 20mA current output and connected load impedance 300Ω or less)								
Power supply voltage note4		*1	V	DC12／24V (10.8~26.4V)								
			A	DC24V (21.6~26.4V)								
Current consumption Note3			50mA or less									
Lead wire			φ 3.7 AWG26×5									
Functions			Analog output, The flowing quantity bar display									
Installation attitude			Both vertical and horizontal									
Strait piping section			Not required									
Protective structure			IEC standards IP40									
Protective circuit Note4			Power supply and switch output reverse connection protections, and switch output load short-circuit protection									
Mass		*4	S06	Approx. 85g								
			S08	Approx. 105g								
			SM5	Approx. 130g								

Note1: Converted to volumetric flow at 20°C and 1 atmospheric pressure (101kPa)

Note2: When using compressed air, use clean air complying with JIS B 8392-1:2003 class over 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter (filtration rating : 5μm) , air dryer (minimum pressure dew point 10°C or less) and oil mist filter(maximum oil concentration 0.1mg/m<sup>3</sup>) on the primary side of the product to maintain product function.

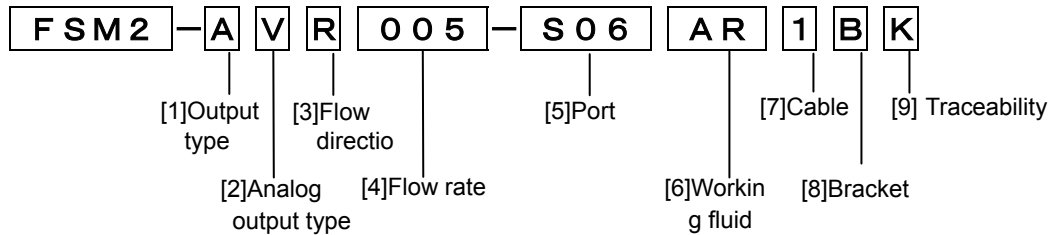
When using for purposes other than compressed air, use dry gas that does not contain corrosive elements such as chlorine, sulfur or acids, and clean gas that does not contain dust or oil mist.

Note3: Current consumption is different according to the state of the load.

Note4: This product's protective circuit is effective only for specific incorrect connections and load short-circuits. It does not necessarily provide protection for all incorrect connections.



## 4. 2 How to order



[1] Output type		[2] Analog output type		[3] Flow direction		[4] Flow rate range (full scale flow rate)	
A	Separated indicator type Analog output: 1point	V	1 to 5V	F	Bi-directional	005	500 mL/min
		A	4 to 20mA	R	One-directional	010	1 L/min
N	Integrated indicator type Switch output(NPN): 2points Analog output: 1point					020	2 L/min
						050	5 L/min
						100	10 L/min
						200	20 L/min
						500	50 L/min
P	Integrated indicator type Switch output(PNP): 2points Analog output: 1point					101	100 L/min
						201	200 L/min
						501	500 L/min
						102	1000 L/min

[5] Port size(body material)		[6] Working fluid		[7] Cable		[8] Bracket		[9] Traceability	
H04	φ 4 push-in (resin)	Blank	Air, Nitrogen gas	Blank	None	Blank	None	Blank	None
H06	φ 4 push-in (resin)	AR	Argon	1	1m	B	With bracket	T	Traceability certificate, system diagram, inspection results included
H08	φ 4 push-in (resin)	C2	Carbon dioxide	3	3m				
H10	φ 4 push-in (resin)							K	Inspection results included
S06	Rc1/8 (stainless)								
S08	Rc1/4 (stainless)								
A15	Rc1/2 (aluminum)								
SM5	M5 (stainless)								

### ●Combination of flow rate range, port size, and working fluid

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

[6] Working fluid  
 ●: Air, Nitrogen gas  
 ○: Argon  
 △: Carbon dioxide

### Discrete option model

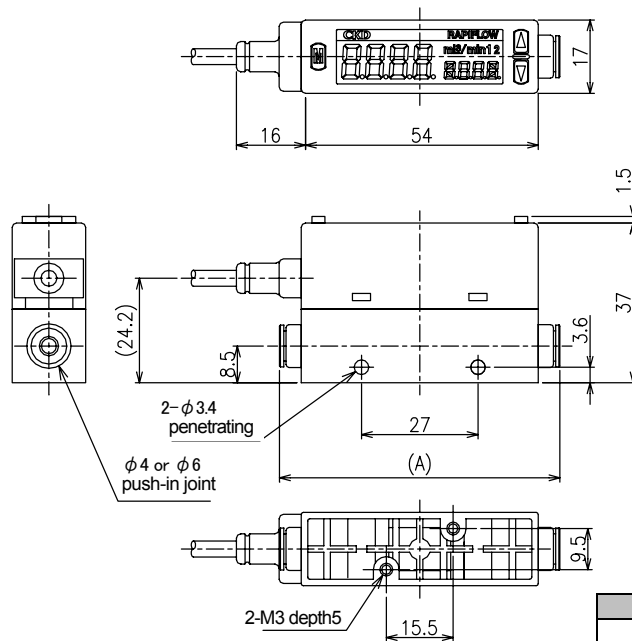
F S M 2 — L B 1

Symbol	Content
LB1	Bracket (for port sizeφ4,6,8,10, Rc1/8, Rc1/4, M5)
LB2	Bracket (for port size Rc1/2)
C51	1m (for Integrated indicator type)
C53	3m (for Integrated indicator type)
C41	1m (for Separated indicator type)
C43	3m (for Separated indicator type)

## 4. 3 Dimensions

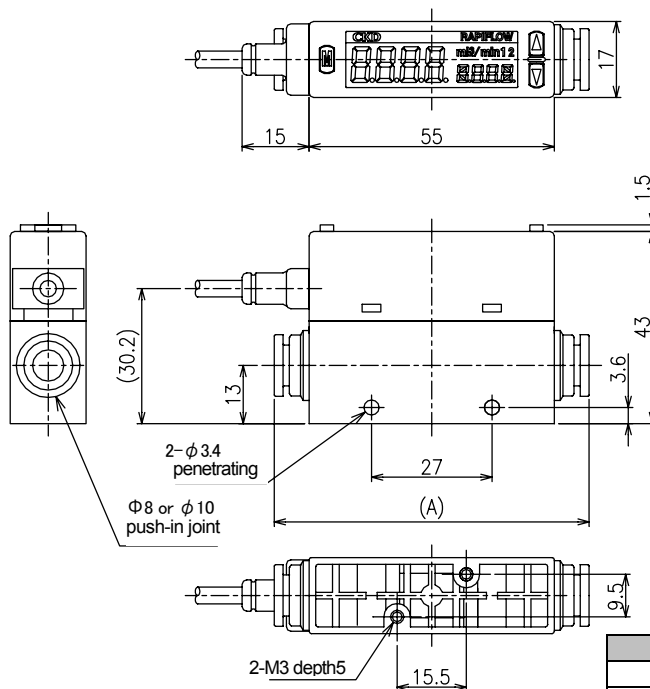
### 4. 3. 1 Integrated indicator type (FSM2-N/P series)

●FSM2-N/P□-H04/H06□ (Flow range : 005 / 010 / 020 / 050 / 100 / 200 / 500)



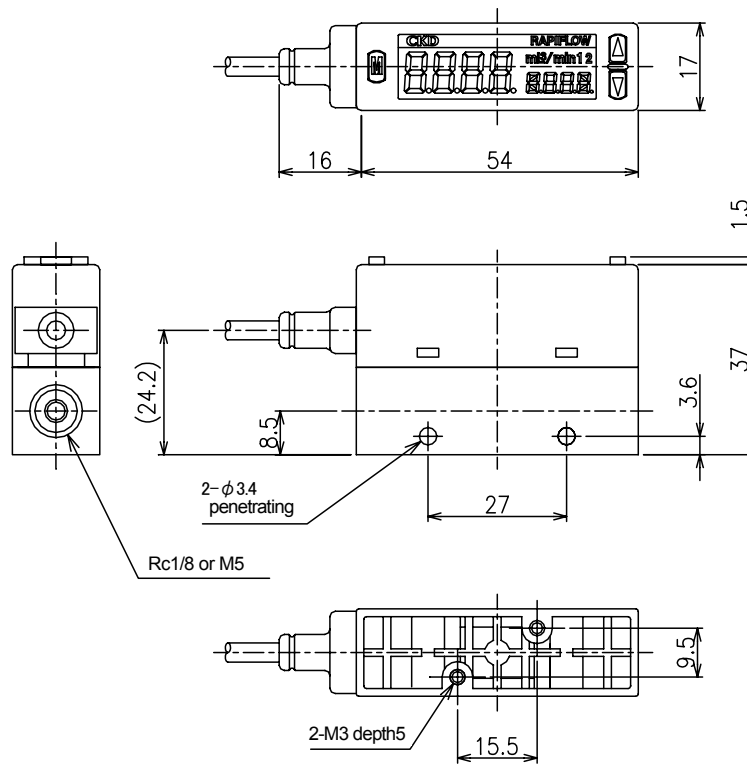
Model No.	Port size	Dimension (A)
FSM2-[ ]-H04[ ]	Φ4 push-in	64
FSM2-[ ]-H06[ ]	Φ6 push-in	65

●FSM2-N/P□-H08/H10□ (Flow range : 500 / 101 / 201)

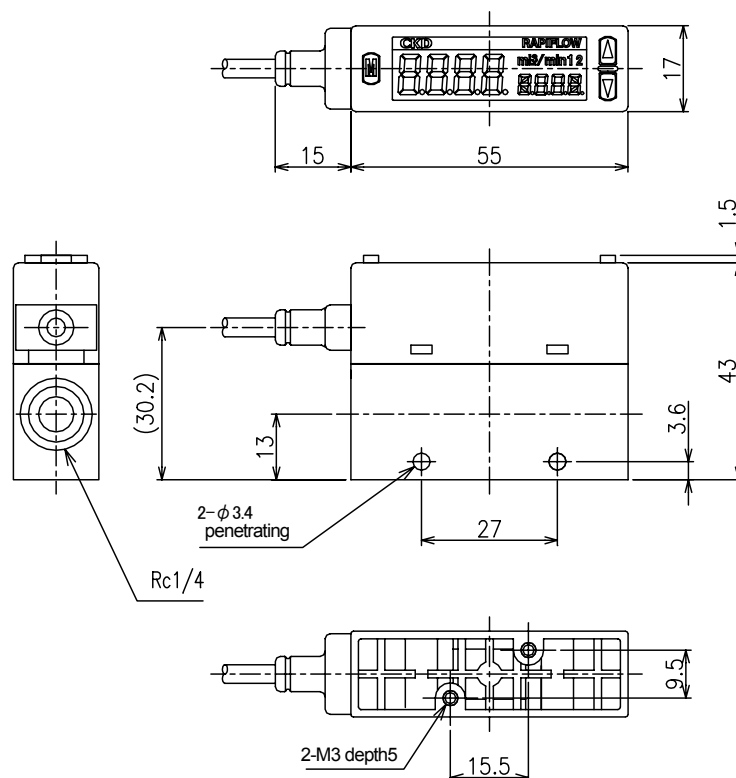


Model No.	Port size	Dimension (A)
FSM2-[ ]-H08[ ]	Φ8 push-in	70.6
FSM2-[ ]-H10[ ]	Φ10 push-in	82.1

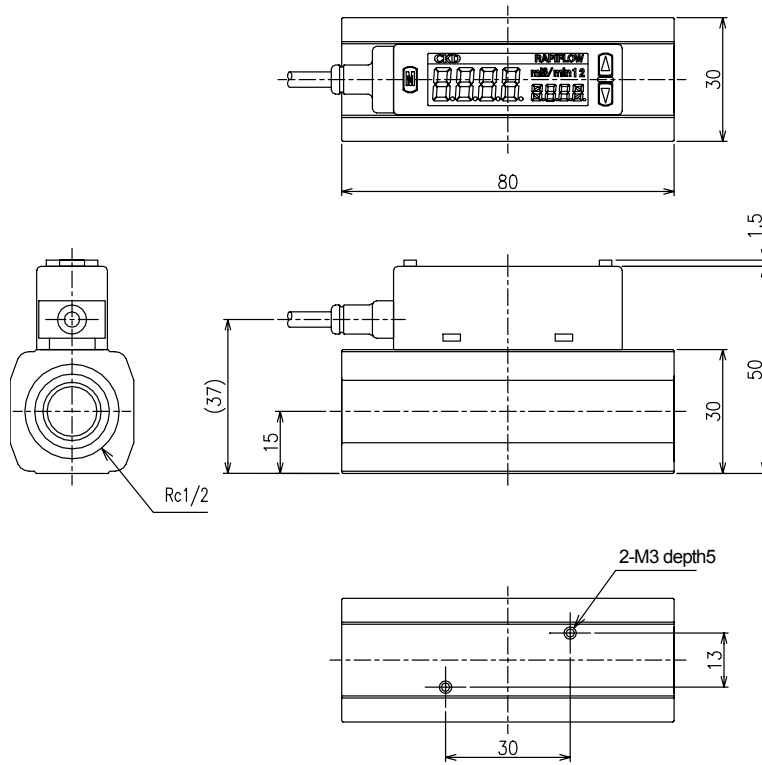
●FSM2-N/P□-S06/SM5□ (Flow range: 005/010/020/050/100/200)



●FSM2-N/P□-S08□ (Flow range: 101/201)

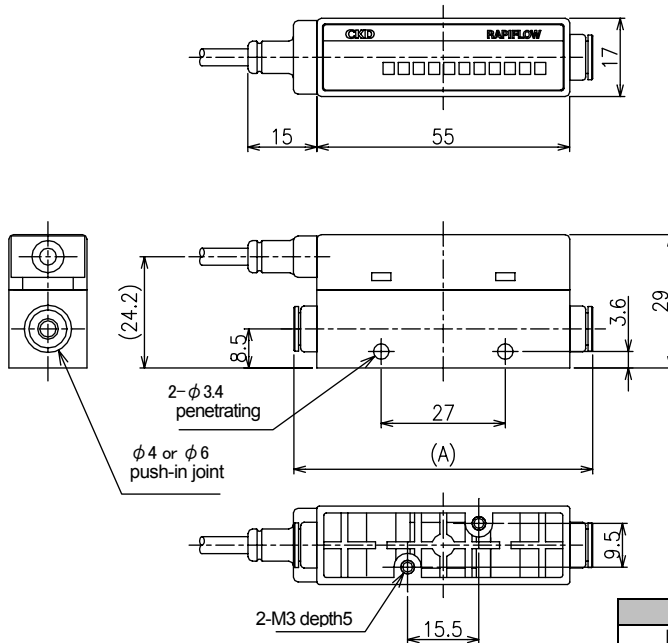


●FSM2-N/P□-A15(Flow range:501／102)



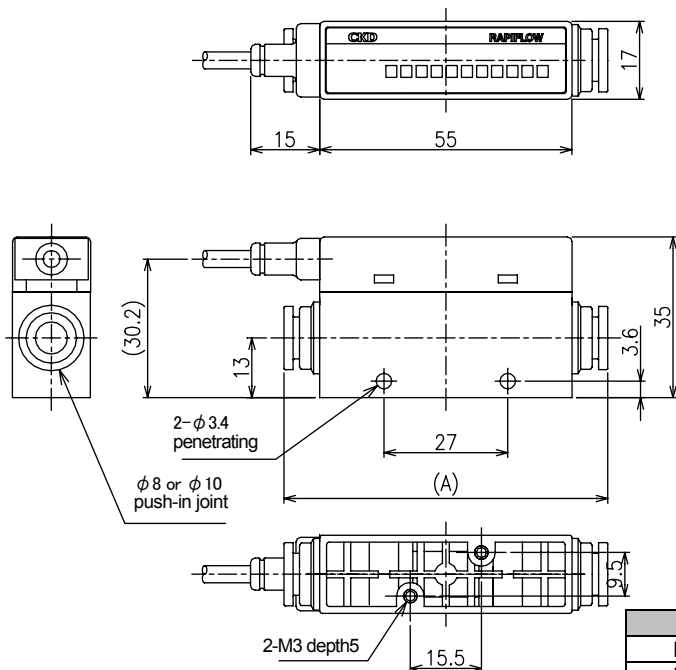
#### 4. 3. 2 Separated indicator type (FSM2-A series)

●FSM2-A□-H04/H06□ (Flow range: 005/010/020/050/100/200)



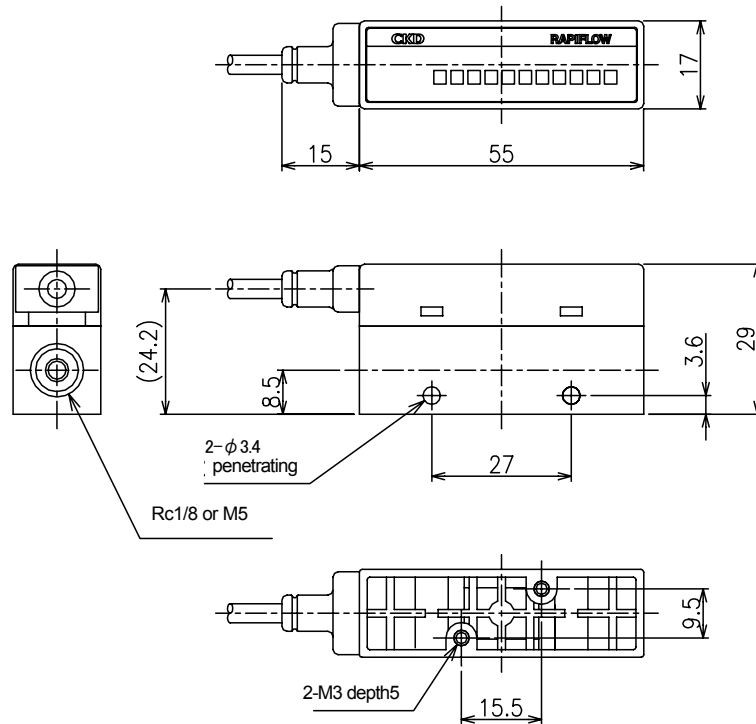
Model No.	Port size	Dimension (A)
FSM2-[ ]-H04[ ]	Φ4 push-in	64
FSM2-[ ]-H06[ ]	Φ6 push-in	65

●FSM2-A□-H08/H10□ (Flow range: 101/201)

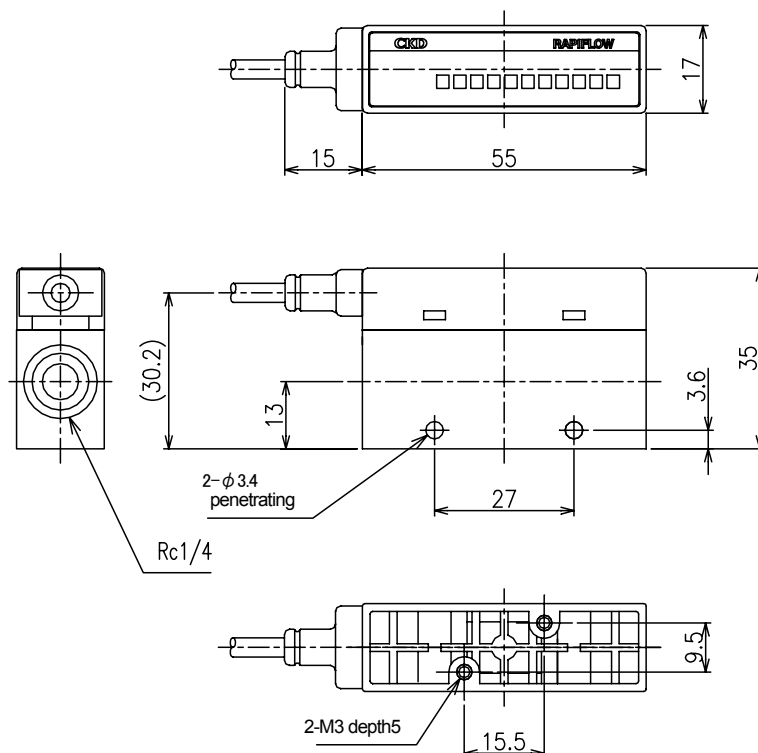


Model No.	Port size	Dimension (A)
FSM2-[ ]-H08[ ]	Φ8 push-in	70.6
FSM2-[ ]-H10[ ]	Φ10 push-in	82.1

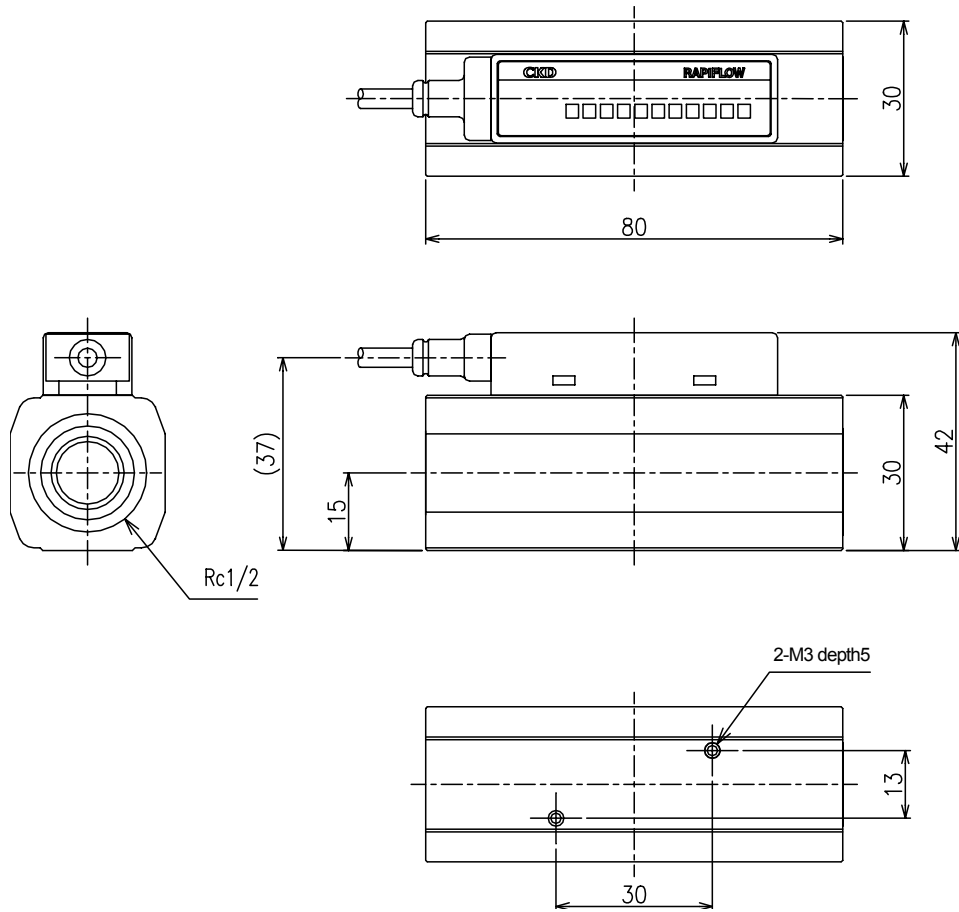
●FSM2-A□-S06/SM5□ (Flow range: 005/010/020/050/100/200)



●FSM2-A□-S08□ (Flow range: 101/201)

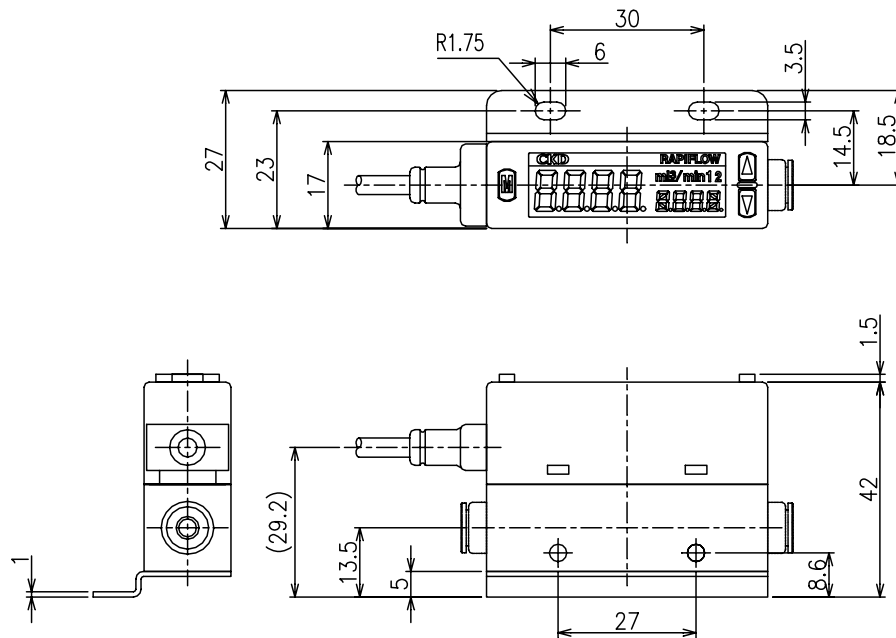


●FSM2-A□-A15(Flow range:501／102)

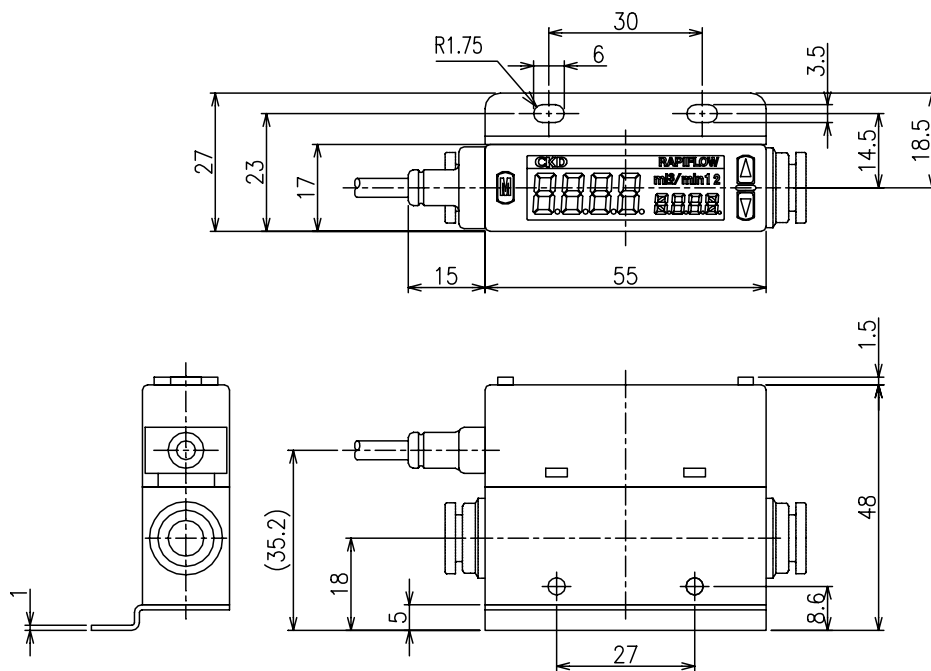


### 4. 3. 3 Integrated indicator type (with bracket)

●FSM2-N/P□-H04/H06/S06/SM5□B

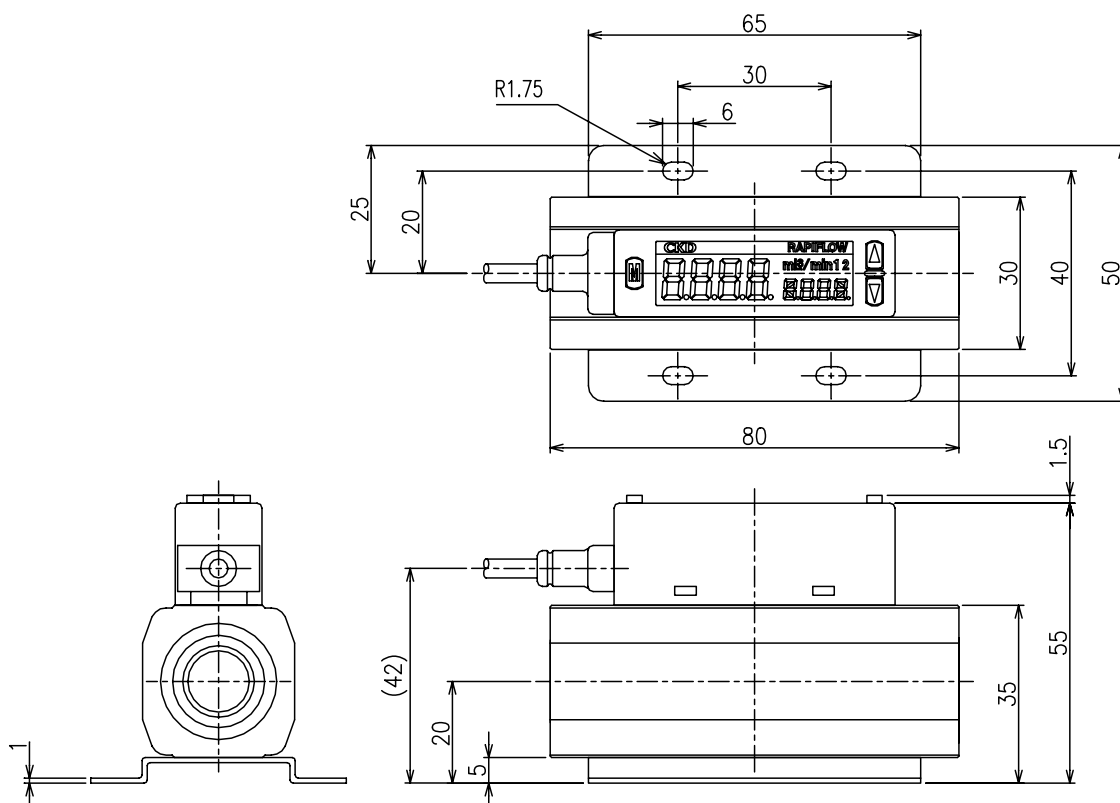


●FSM2-N/P□-H08/H10/S08□B



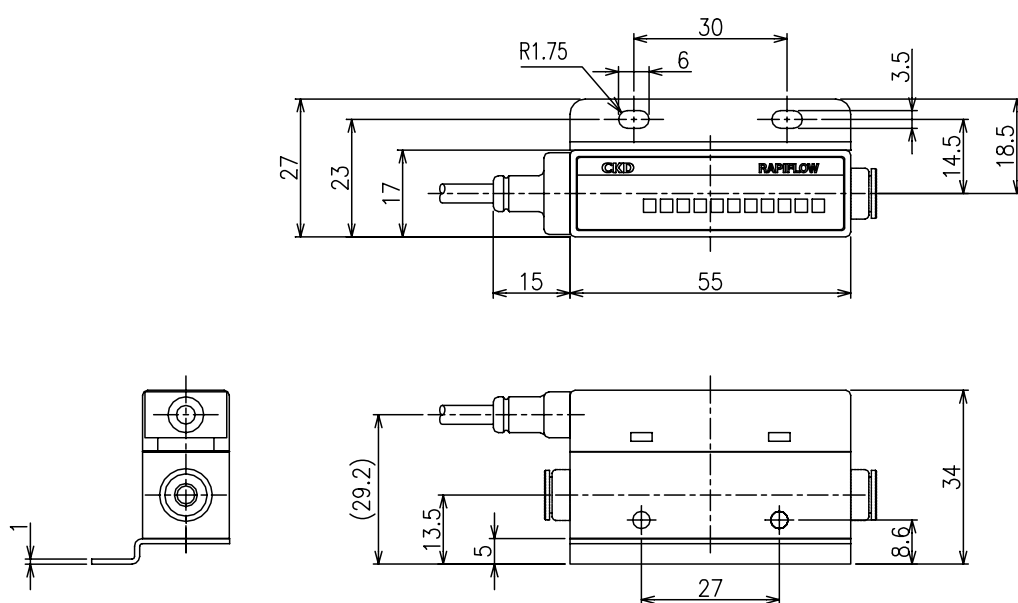


●FSM2-N/P□-A15□B

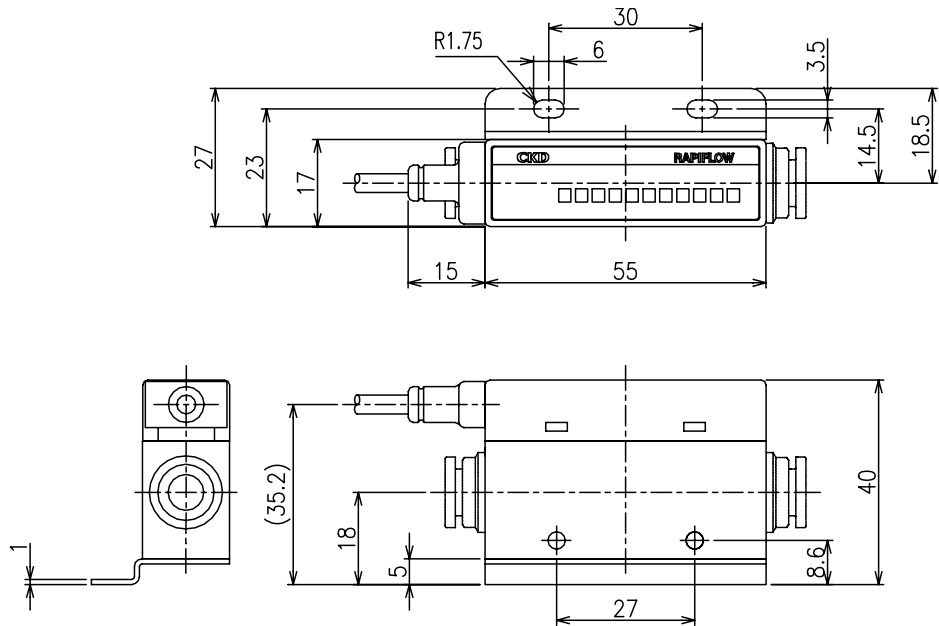


4. 3. 4 Separated indicator type (with bracket)

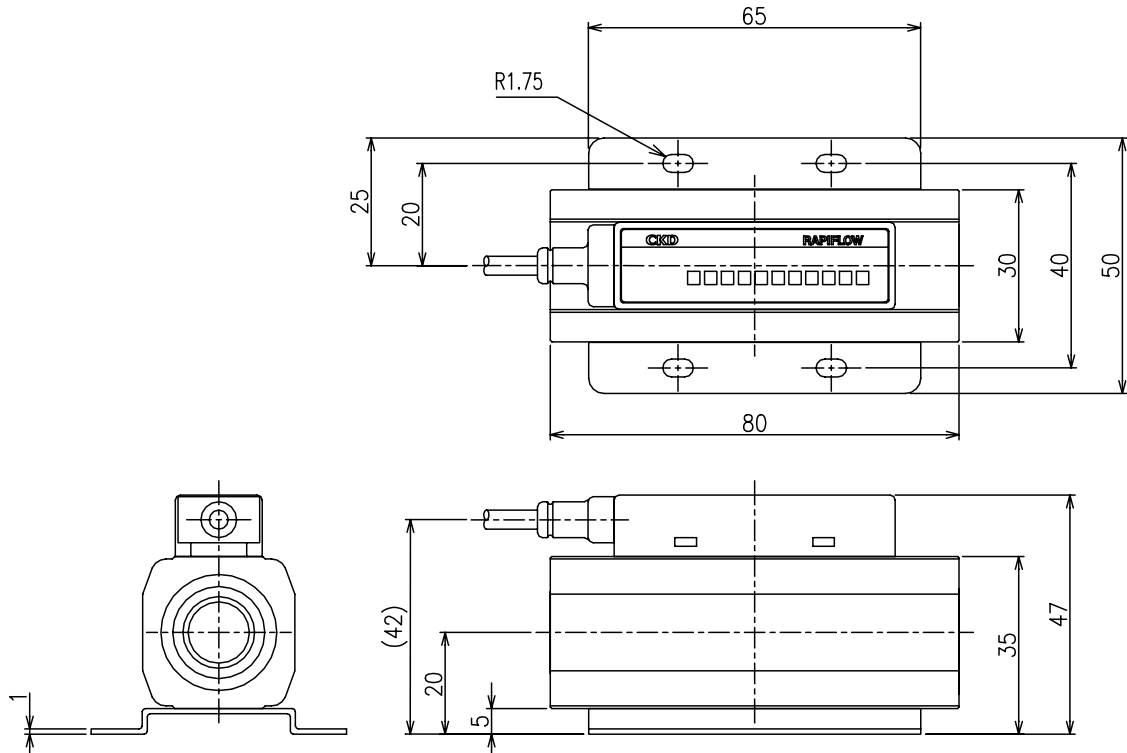
●FSM2-A□-H04/H06/S06/SM5□B



●FSM2-A□-H08/H10/S08□B

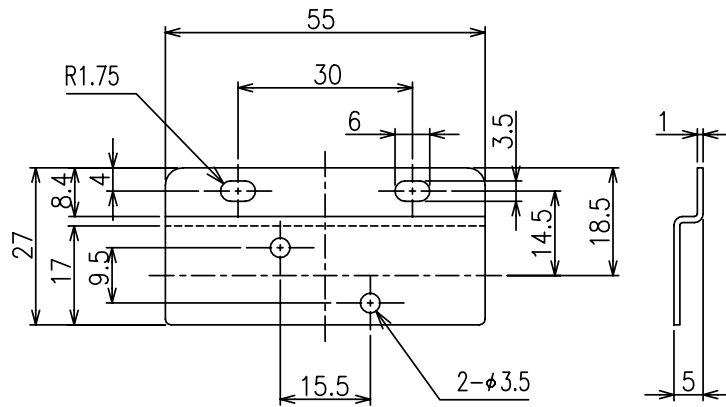


●FSM2-A□-A15□B

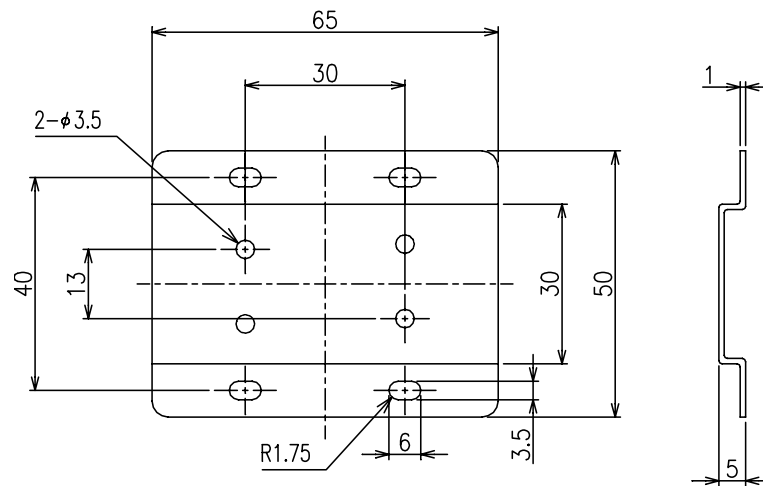


#### 4. 3. 5 Bracket

●FSM2-LB1 (FSM2-□005/010/020/050/100/200/500/101/201)

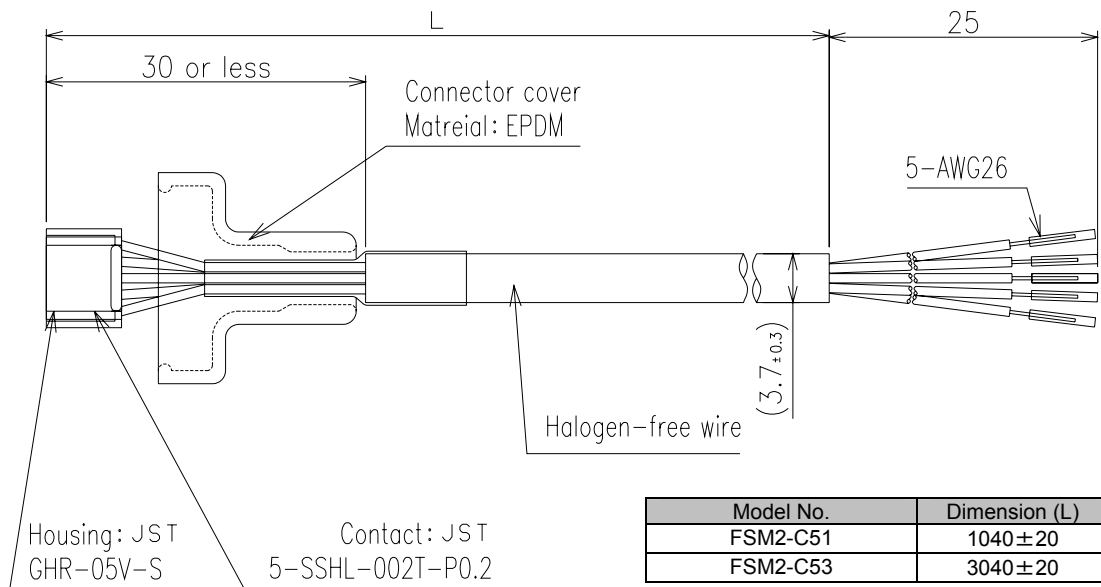


●FSM2-LB2 (FSM2-□501/102)

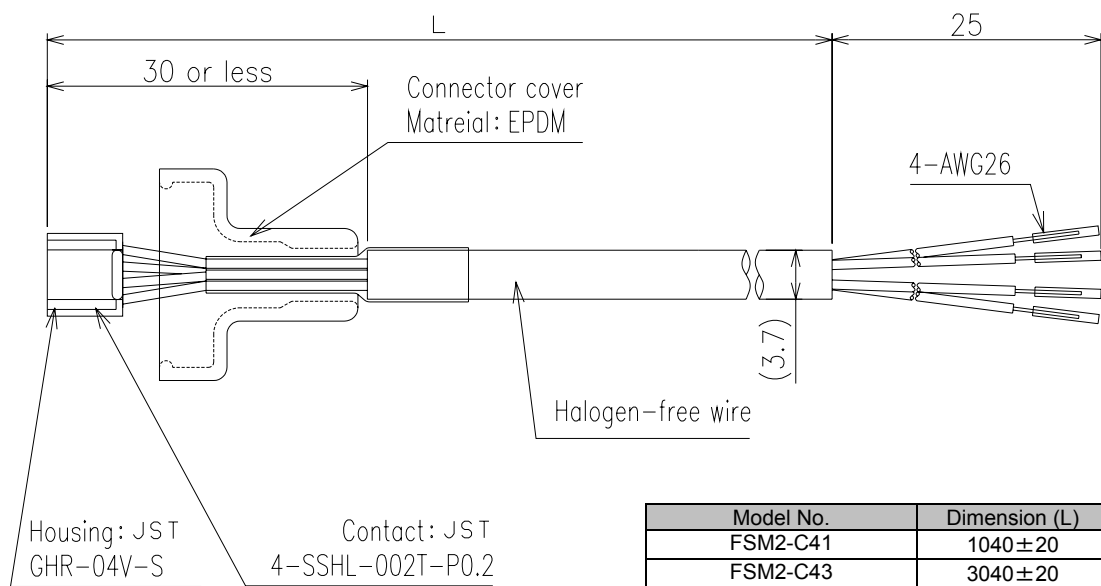


#### 4. 3. 6 Cable option

##### ●FSM2-C51/C53 (Integrated indicator type)

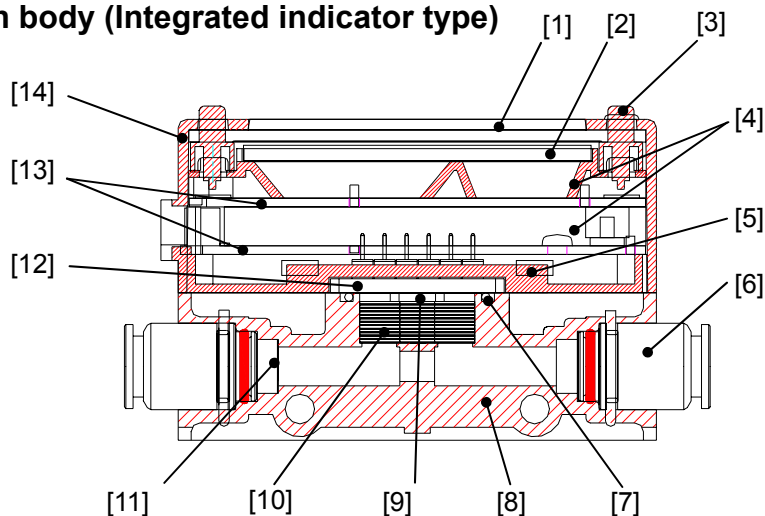


##### ●FSM2-C41/C43 (Separated indicator type)



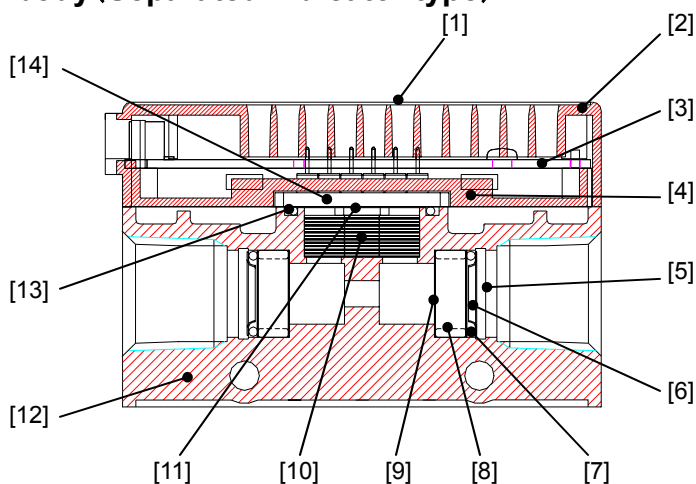
## 4. 4 Internal structure

### 4. 4. 1 Resin body (Integrated indicator type)



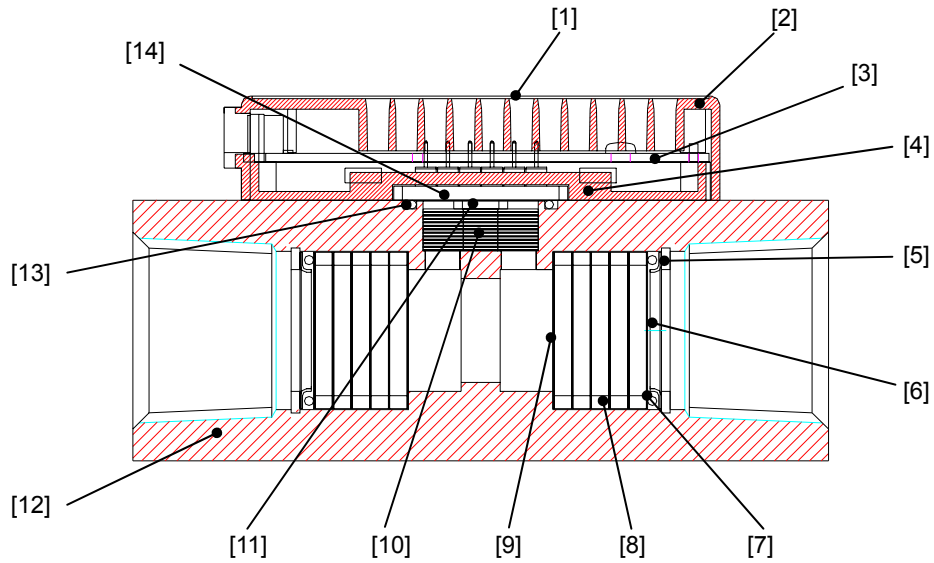
No.	Parts name	Material	No.	Parts name	Material
[1]	LCD cover	Acrylic resin	[8]	Resin body	Polyamide resin
[2]	LCD		[9]	Sensor tip	Semiconductor tip
[3]	Switch	EPDM	[10]	Rectifier	Stainless steel(SUS304)
[4]	Substrate spacer	Polycarbonate resin	[11]	Port filter	Stainless steel(SUS304)
[5]	Module holder	Polyamide resin	[12]	Sensor circuit board	Alumina
[6]	Push in cartridge joint		[13]	Electron circuit board	
[7]	Sensor gasket	Fluoro rubber	[14]	Case	ABS resin

### 4. 4. 2 Stainless body (Separated indicator type)



No.	Parts name	Material	No.	Parts name	Material
[1]	Front sheet	Polyester film	[8]	Spacer	Stainless steel(SUS304)
[2]	Case	ABS resin	[9]	Port filter	Stainless steel(SUS304)
[3]	Electron circuit board		[10]	Port filter	Stainless steel(SUS304)
[4]	Module holder	Polyamide resin	[11]	Sensor tip	Semiconductor tip
[5]	C-ring	Stainless steel(SUS304)	[12]	Stainless body	Stainless steel(SUS316)
[6]	O-ring holder	Stainless steel(SUS304)	[13]	Sensor gasket	Fluoro rubber
[7]	O-ring	Fluoro rubber	[14]	Sensor circuit board	Alumina

#### 4. 4. 3 Aluminum body(Separated indicator type)



No.	Parts name	Material	No.	Parts name	Material
[1]	Front sheet	Polyester film	[8]	Spacer	Aluminum
[2]	Case	ABS resin	[9]	Port filter	Stainless steel(SUS304)
[3]	Electron circuit board		[10]	Port filter	Stainless steel(SUS304)
[4]	Module holder	Polyamide resin	[11]	Sensor tip	Semiconductor tip
[5]	C-ring	Stainless steel(SUS304)	[12]	Aluminum body	Aluminum
[6]	O-ring holder	Stainless steel(SUS304)	[13]	Sensor gasket	Fluoro rubber
[7]	O-ring	Fluoro rubber	[14]	Sensor circuit board	Alumina

## 5. Technical data

### 5. 1 How to select flow sensor

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

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

- For  $P_1 < 1.89P_2$  (subsonic)

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

- Q : Flow rate L/min
- $P_1$  : Primary side absolute pressure MPa
- $P_2$  : Secondary side absolute pressure MPa
- S : Ef.sec. area mm<sup>2</sup> of Nozzle(pinhole)

- Example of calculation

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

	P <sub>1</sub> (MPa) Absolute pressure	P <sub>1</sub> (MPa) Gauge pressure	P <sub>2</sub> (MPa) Absolute pressure	P <sub>2</sub> (MPa) Gauge pressure	Acoustic/ subsonic velocity	Calculated flow rete value (L/min)									
						φ 0.1	φ 0.2	φ 0.3	φ 0.4	φ 0.5	φ 0.7	φ 1	φ 1.5	φ 2	
Suction	0.1013	0	0.0313	-0.07	Acoustic	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0413	-0.06	Acoustic	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007	
	0.1013	0	0.0513	-0.05	Acoustic	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	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	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	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	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	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	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	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	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	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	Acoustic	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	Acoustic	0.268	1.071	2.410	4.284	6.694	13.119	26.774	60.242	107.096	
	0.4013	0.3	0.1013	0	Acoustic	0.357	1.426	3.209	5.706	8.915	17.474	35.660	80.236	142.641	
	0.5013	0.4	0.1013	0	Acoustic	0.445	1.782	4.009	7.127	11.137	21.828	44.547	100.230	178.186	
0.6013	0.5	0.1013	0	Acoustic	0.534	2.137	4.809	8.549	13.358	26.182	53.433	120.224	213.731		

(Caution)

·If piping has a leakage, the actual flow will be larger than the calculated value. Please consider the leakage then selecting flow rate.

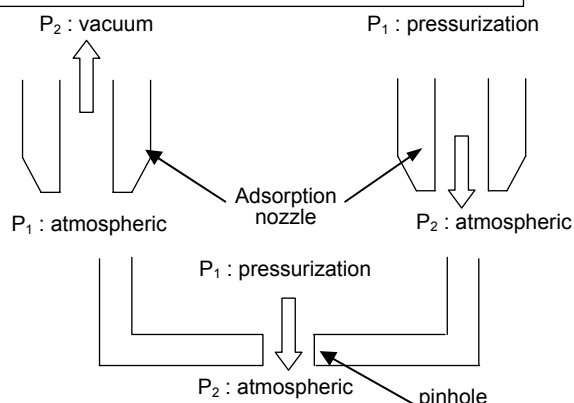
·If there is a narrower section than adsorption nozzle diameter in the midway of piping, flow rate will be restricted, so the value will be smaller than the calculated value.

Also, adsorption, etc., could not be done.

·The effective sectional area is just reference. If the nozzle is elongated, the effective sectional area will be smaller than opening area of the nozzle.

·Response time is decided by capacity of pipe from adsorption nozzle(pinhole) to flow sensor. When detecting with high speed, reduce capacity in pipe as placing a flow sensor near the adsorption nozzle.

This is a guide of flow range when using a flow sensor as the adsorption/separation verification with adsorption nozzle and leakage inspection, etc. The flow rate can be calculated according to effective sectional area of a nozzle(pinhole) and differential pressure between inside and outside of nozzle.



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