

# FLOW METERS

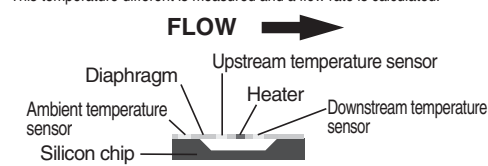
## FA Series

### ■ Sensor

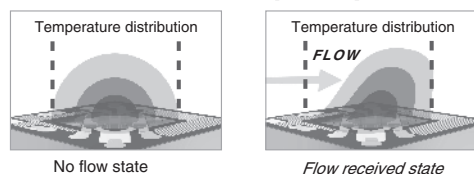
A thermal mass flow meter sensor enables accurate measurement even in the case of gas temperature and pressure fluctuations.

#### Sensor structure

The FA Series flow meter measures flow rates using heat from the heater and a temperature sensor. In a no flow state, the air temperature distribution around the heater is uniform, so there is no difference in the temperature between the upstream and downstream temperature sensor positions. When flow is received in this state, the downstream temperature rises while the upstream temperature falls, so a temperature difference between the upstream and downstream sensor positions is generated. This temperature difference is measured and a flow rate is calculated.

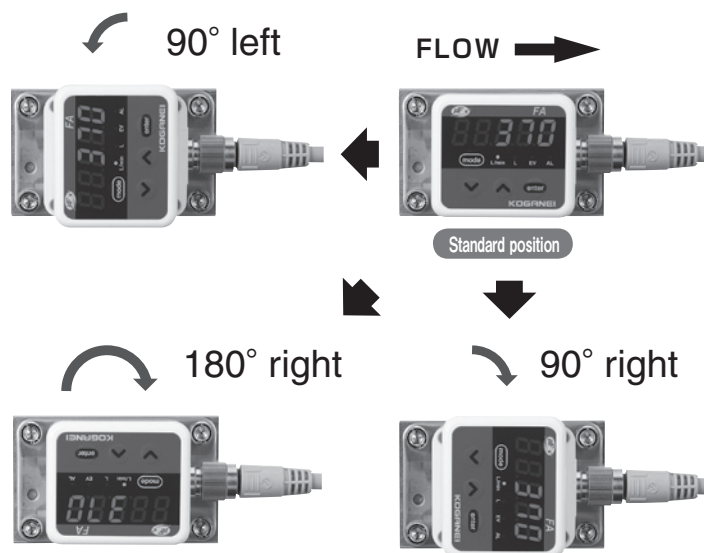


#### Measurement principles



### ■ Rotary display

The display of the flow meter can be rotated 90° to the left or 180° to the right, making it easy to read regardless of whether piping is horizontal or vertical.



Note: Do not try to rotate the display more than 90° to the left or 180° to the right.



### ■ Models

Practical measuring range of 50:1 (excluding some mounting directions) helps to provide an idea of air leaks.

Model	Port size	Flow measurement range ( $\pm 3\%$ FS accuracy guaranteed range) $\ell / \text{min}$ (normal)
FAS-002	Rc1/4	4(10) <sup>Note</sup> 200
FAS-005	Rc1/2	10(25) <sup>Note</sup> 500
FAS-030	Rc1	60(150) <sup>Note</sup> 3000
FAS-060	Rc1 1/2	120(300) <sup>Note</sup> 6000
FAS-120	Rc2	240(600) <sup>Note</sup> 12000

Note: Values in parentheses are flow measurement ranges for mounting directions 2 and 3. Refer to page 1675 for information about mounting directions.

## ■ Features

- Separation measurement using an orifice for large-volume flow measurement at each piping port and small pressure load.
- A self-diagnostic function simplifies troubleshooting in the case of product trouble.
- In the case of the **FAS-030**, **FAS-060**, and **FAS-120** models, replacement required in the case of malfunction can be achieved by replacing the bypass unit only, without detaching piping. However, the  $\pm 3\%$ FS guaranteed accuracy of the replacement product becomes  $\pm 5\%$ FS.

### ● Range extension function

The FA Series flow meter displays up to double the maximum flow measurement range, and support analog output and switch output.

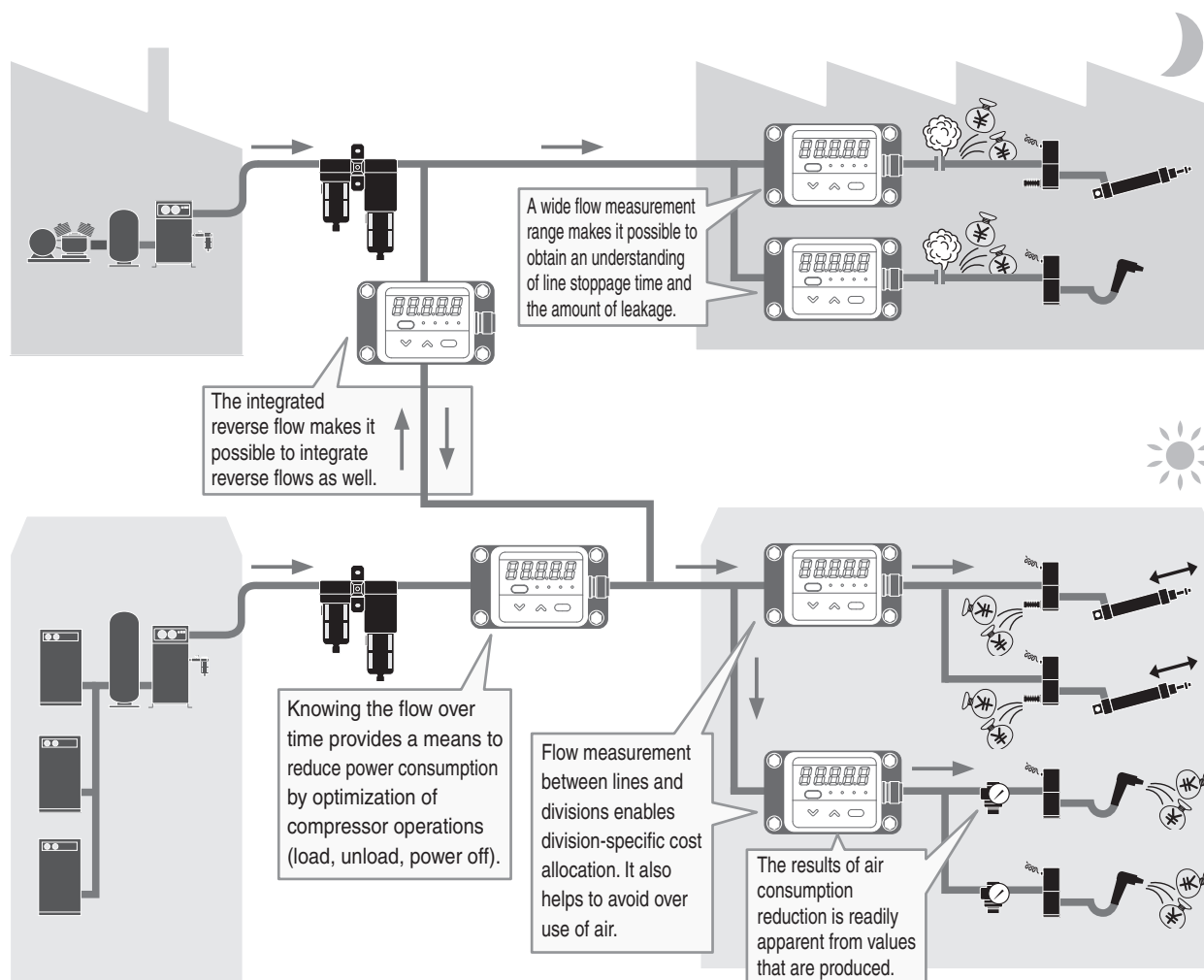
However, the measurement accuracy of the additional part is approximately  $\pm 10\%$ RD.

\* Remark: RD stands for "reading" (read value). With the **FAS-002**, error is  $\pm 30$   $\ell/\text{min}$  (ANR) [ $\pm 1.06$   $\text{ft}^3/\text{min}$ ] (normal) for an instantaneous flow display of 300  $\ell/\text{min}$  (ANR) [ $10.6$   $\text{ft}^3/\text{min}$ ] (normal) and error is  $\pm 40$   $\ell/\text{min}$  (ANR) [ $\pm 1.413$   $\text{ft}^3/\text{min}$ ] (normal) for an instantaneous flow display of 400  $\ell/\text{min}$  (ANR) [ $14.1$   $\text{ft}^3/\text{min}$ ] (normal).

### ● Reverse flow detection function

FA Series flow meters can display a reverse flow (flow in the opposite direction from unit's flow arrow) up to 30% of the maximum flow measurement range, and flow integration. However, reverse flow measurement accuracy is approximately  $\pm 6\%$ FS, and analog output and switch output (except for some integrating functions) is not possible.

## Example of use



## Safety Precautions (Flow Meters FA Series)

The safety precautions below are specific to FA Series flow meters. For other safety precautions in addition to the information below, also be sure to read the safety precautions at the front of the general personal catalog.

### DANGER

- Do not attempt any adjustment (connecting or disconnecting wire connectors, piping work, etc.) to mechanisms attached to the product while the product is operating. Abnormal operation creates the risk of personal injury.

### WARNING

- Do not apply external magnetic field to the flow meter while it is operating. Unintended operations could damage equipment or cause injury.
- When wiring, take care to ensure that wiring polarity is correct. Incorrect polarity could result in damage to the flow meter.

### CAUTION

- Do not subject flow meter cables that have connectors to excessive loads by pulling on them, lifting the product by them, or by placing heavy objects on them. Doing so may cause current leakage or defective continuity leading to fire, electric shock, or abnormal operation.
- While handling the flow meter, do not subject them to excessive shock ( $490 \text{ m/s}^2$  [50 G] or greater) by hitting, dropping or bumping it. Even if the product appears undamaged, damage to internal components can cause abnormal operation.
- Avoid short circuiting loads.  
Turning on switch output while a load short-circuit condition exists can cause damage to the flow meter due to over current.  
Load short-circuit example: output lead of switch output connected to DC power supply.

## Handling Instructions and Precautions



### General precautions

#### Mounting location

Avoid installing the FA Series Flow Meter in the following types of locations.

1. Locations where the ambient temperature or product temperature is  $-10^{\circ}\text{C}$  [ $14^{\circ}\text{F}$ ] or lower, or exceeds  $60^{\circ}\text{C}$  [ $140^{\circ}\text{F}$ ].
2. Locations where the ambient humidity exceeds 90%RH.
3. Locations subjected to sudden temperature changes that can cause condensation.
4. Locations subjected to concentrations of corrosive and/or flammable gasses.
5. Locations subjected to high amounts of dust, salt, iron powder, or other conductive matter, moisture, oil mist, or organic solvents.
6. Locations where the product is directly subjected to vibration and/or impact.
7. Locations exposed to direct sunlight.
8. Locations where water, rain, or other moisture can get on the product.
9. Locations where oil or chemicals can get on the product.
10. Locations that are always wet or dusty, or subject to water or dust.
11. Locations where strong magnetism or strong electric fields are being generated.

#### Operation outside the maximum flow range

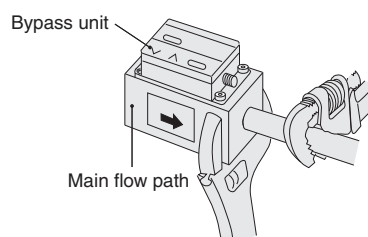
When the flow rate exceeds the maximum flow rate range of the FA Series Flow Meter, the alarm message "AL40" will alternate on the display with the flow rate reading. Always use this flow meter within the specified maximum flow rate range.



### Mounting and piping

#### Piping

1. The FA Series Flow Meter is a precision instrument. Take care when handling it. It can be damaged by dropping it or otherwise subjecting it to strong impact.
2. Whenever connecting piping to the FA Series Flow Meter, make sure that the direction of the arrow marked on it matches the flow direction of the fluid.
3. When connecting piping, do not apply force to the bypass unit section.
4. When connecting piping, secure the main flow channel and rotate the pipe to the suitable tightening torque range.

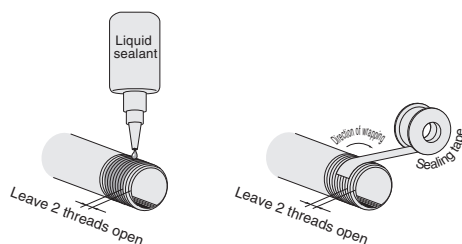


Model	Port size Rc	Suitable tightening torque N·m [in·lbf]
FAS-002	1/4	12 to 14 [106.212 to 123.914]
FAS-005	1/2	31 to 33 [274.381 to 292.083]
FAS-030	1	36 to 38 [318.636 to 336.338]
FAS-060	1 1/2	59 to 61 [522.209 to 539.911]
FAS-120	2	74 to 76 [654.974 to 672.676]

5. Take care to keep foreign matter from flowing into the FA Series Flow Meter. Any rust, water droplets, oil mist, dust, or other foreign matter inside piping that gets into the FA Series Flow Meter creates the risk of measurement error and damage to the flow meter. Before installation, be sure to thoroughly flush both the upstream and downstream piping (pipe cleaning) and check to make sure there is no foreign matter present.

## Handling Instructions and Precautions

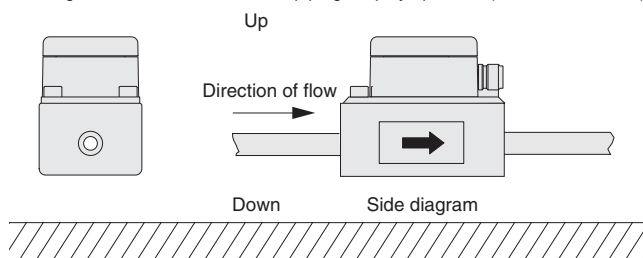
6. When connecting piping, apply an appropriate amount of sealant. Do not apply sealant to the first two threads of the end of the pipe. Over-application of sealant can cause it to get inside the piping, creating the risk of measurement error and damage to the FA Series Flow Meter.



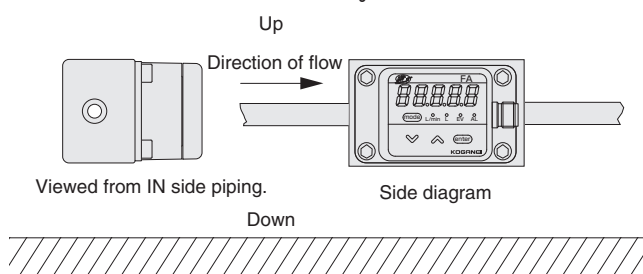
7. If different-diameter piping, a regulator, filter, valve, or other piping equipment is installed upstream from the FA Series Flow Meter, be sure to provide a straight pipe section as recommended. See "Specification accuracy and straight pipe section" for more information. Failure to provide a straight pipe section can cause flow rate errors.
8. Connecting expansion pipe or a tube coupler without providing a straight pipe section can produce a negative flow rate reading due to back flow in bypass unit, even though there is normal flow as far as the product is concerned.
9. Installing the display section on horizontal piping so it is in a downward orientation may cause rust, water droplets, oil mist, dust, or other foreign matter to adhere to the sensor, creating the risk of measurement errors and damage to the FA Series Flow Meter. Do not use the display section in a downward orientation. Installing the display section on horizontal piping in a sideways orientation will cause errors due to the effect of the attitude. For details, see "Installation Attitudes" below.
10. Do not install in locations where the effects of pulsating flow or flow maldistribution are present, such as in the vicinity of the compressor delivery port, on bellows piping, etc. Also, do not install in a location where a regulator or check valve is performing hunting. Doing so creates the risk of measurement error.

### Mounting direction

Mounting direction 1: With horizontal piping, display upwards. (Standard direction)



Mounting direction 2: Horizontal piping with the display on the right when viewed from the flow meter IN side pipe. When using this installation attitude, set the low flow cut parameter value to 5. Failure to do so will cause the flow rate to be displayed (output) even when there is no fluid flowing. The normal flow side and back flow side integral functions activate, causing the flow rate values to be integrated.

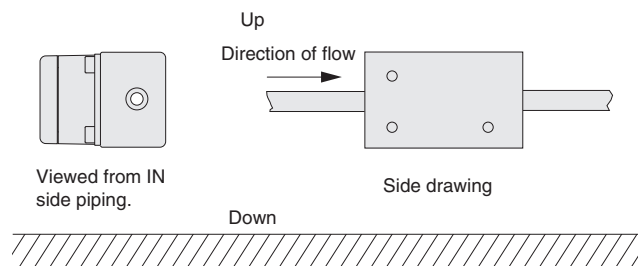


Operating pressure range	Flow range	Instantaneous flow display change volume
0 to 1 MPa [0 to 145 psi]	5 to 100% of FS flow <sup>Note</sup>	0.5% FS/0.1 MPa [1.5 psi] ± 1 digit or lower
-0.07 to 0 MPa [-10 to 0 psi]	5 to 100% of FS flow	0.5% FS/0.01 MPa [1 psi] ± 1 digit or lower

Note: "FS flow" is the full scale flow.

Example: At a pressure of 0.3 MPa when the flow meter is installed on horizontal piping with the display facing to the right, when viewed from the flow meter IN side pipe, causes a change in the flow rate that is no more than 1.5% FS ± 1 digit compared to the normal installation attitude.  
 $0.5[\% \text{ FS}/0.1 \text{ MPa}] \times 0.3[\text{MPa}] = 1.5[\% \text{ FS}]$

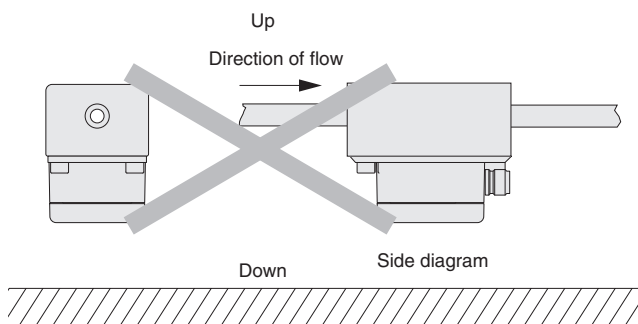
Mounting direction 3: Horizontal piping mounting with display leftwards relative to the flow level meter IN size pipe. When using this installation attitude, set the low flow cut parameter value to 5. Failure to do so will cause the flow rate to be displayed (output) even when there is no fluid flowing. The normal flow side and back flow side integral functions activate, causing the flow rate values to be integrated.



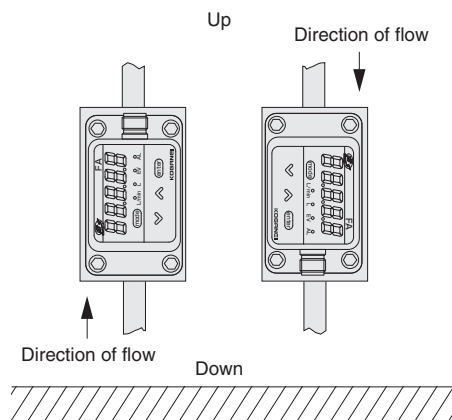
Operating pressure range	Flow range	Instantaneous flow display change volume
0 to 1 MPa [0 to 145 psi]	5 to 100% of FS flow	-0.5% FS/0.1 MPa [1.5 psi] ± 1 digit or lower
-0.07 to 0 MPa [-10 to 0 psi]	5 to 100% of FS flow	-0.5% FS/0.01 MPa [1 psi] ± 1 digit or lower

Example: At a pressure of 0.3 MPa when the flow meter is installed on horizontal piping with the display facing to the right when viewed from the flow meter IN side pipe, causes a change in the flow rate that is no more than -1.5% FS ± 1 digit compared to the normal installation attitude.  
 $-0.5[\% \text{ FS}/0.1 \text{ MPa}] \times 0.3[\text{MPa}] = -1.5[\% \text{ FS}]$

Mounting direction 4: With horizontal piping, display downwards. Do not use this mounting direction.



Mounting direction 5: With vertical piping



## Handling Instructions and Precautions

### Filter

- Whenever there is the risk of foreign matter (dust, sediment, oil mist, etc.) being mixed in with the measured fluid, be sure to install upstream from the FA Series Flow Meter a filter and mist filter that can remove foreign matter measuring  $1\ \mu\text{m}$  or larger.
- Periodically inspect and replace filters, and perform other periodic maintenance as required.

### Specification accuracy and pipe section

Install the FA Series Flow Meter so the arrow marked on its label is pointed in the same direction as the fluid flow direction. When connecting different diameter tubing, valves, filters, and other equipment, provides straight pipe in accordance with the information in the table below.

A "straight pipe" is straight piping that is the same bore diameter as the flow meter. The following types of pipes are suitable as straight pipe: carbon steel pipes for ordinary piping (JIS G3452), carbon steel pipes for pressure service (JIS G3454), Schedule 40 or less, and stainless steel pipes (JIS G3459), Schedule 40.<sup>Note1</sup>

For equipment not included in the table below, provide **15D** or larger straight piping when installing it upstream from the FA Series Flow Meter, and **5D** or larger straight piping when installing it downstream from the FA Series Flow Meter. The letter D represents the bore diameter.<sup>Note2</sup>

When measuring back flow in addition to normal flow, the same length as the upstream straight pipe is required downstream from the FA Series Flow Meter.

Piping, connection equipment	Connection location	Straight pipe section with FA Series flow meter	
		Specification ranges Within $\pm 3\%$ FS	Accuracy Within $\pm 5\%$ FS
Mist filter For <b>FAS-002</b> , <b>FAS-005</b> , <b>FAS-030</b> <sup>Note3, 5</sup>	Upstream from flow meter	10D	Not required
Mist filter For <b>FAS-060</b> , <b>FAS-120</b> <sup>Note4, 5</sup>	Upstream from flow meter	20D	Not required
1-size large port diameter piping (Reduction pipe connection) <b>FAS-002</b> 3/8B→1/4B <b>FAS-005</b> 3/4B→1/2B <b>FAS-030</b> 1 1/4B→1B <b>FAS-060</b> 2B→1 1/2B <sup>Note6</sup>	Upstream from flow meter	5D	Not required
	Downstream from flow meter	Not required	Not required
1-size larger port diameter piping (Reduction pipe connection) <b>FAS-120</b> 2 1/2B→2B <sup>Note6</sup>	Upstream from flow meter	10D	5D
	Downstream from flow meter	5D	5D
1-size small port diameter piping (Expansion pipe connection) <b>FAS-002</b> 1/8B→1/4B <b>FAS-005</b> 3/8B→1/2B <b>FAS-030</b> 3/4B→1B <b>FAS-060</b> 1 1/4B→1 1/2B <sup>Note7</sup>	Upstream from flow meter	15D	Not required
	Downstream from flow meter	Not required	Not required
More than 1-size smaller small port diameter piping (Expansion pipe connection) <b>FAS-120</b> 1 1/2B→2B <sup>Note7</sup>	Upstream from flow meter	25D	10D
	Downstream from flow meter	5D	5D
Single elbow <sup>Note8</sup>	Upstream from flow meter	10D	Not required
	Downstream from flow meter	Not required	Not required
Double elbow <sup>Note8</sup>	Upstream from flow meter	10D	10D
	Downstream from flow meter	Not required	Not required
Ball valve (Fully open elbow type) <sup>Note9</sup>	Upstream from flow meter	20D	10D
	Downstream from flow meter	10D	5D
Regulator <sup>Note10</sup> <b>FAS-002</b>	Upstream from flow meter	200D	Not required
	Downstream from flow meter	10D	Not required
Regulator <sup>Note10</sup> <b>FAS-005</b> , <b>FAS-030</b> , <b>FAS-060</b> , <b>FAS-120</b>	Upstream from flow meter	30D	Not required
	Downstream from flow meter	5D	Not required
Air filter	Upstream from flow meter	25D	Not required

Note 1: Note that accuracy deteriorates when piping carbon steel pipes for pressure service (JIS G3454) or stainless steel pipes (JIS G3459), larger than Schedule 40 is connected. A larger schedule results in a smaller pipe inside diameter which causes a pipe effect and deteriorated accuracy.

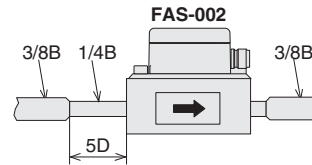
2: The approximate D (bore diameter) for **FAS-002** (1/4B) is 8 mm [0.315 in], for **FAS-005** (1/2B) is 15 mm [0.591 in], for **FAS-030** (1B) is 25 mm [0.984 in], for **FAS-060** (1 1/2B) is 40 mm [1.575 in], and for **FAS-120** (2B) is 50 mm [1.969 in].

3: Always provide a filter upstream from the mist filter.

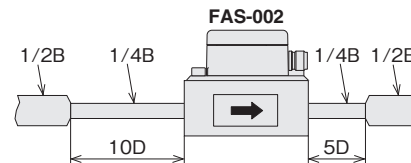
Note 4: Contact Koganei for information about 1 1/2B and 2B size filters and mist filters.

5: Required direct piping when connecting a filter with the same diameter as the flow meter.

6: A reduction pipe connection example (within the product specification range ( $\pm 3\%$ FS)) for the **FAS-002** is shown below.

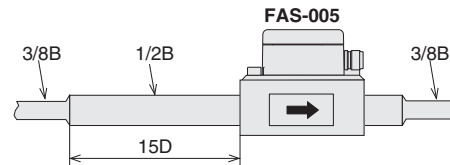


When connecting one size larger piping (for example, 1/2B for the **FAS-002**), take the specified value\*+5D for direct piping before the flow meter and the specified value\*+5D for the direct piping after the flow meter.



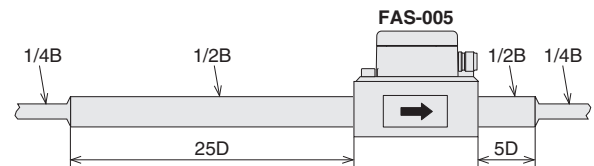
\* Piping length when connecting piping one size larger than the specified value.

7: A reduction pipe connection example (within the product specification range ( $\pm 3\%$ FS)) for the **FAS-005** is shown below.



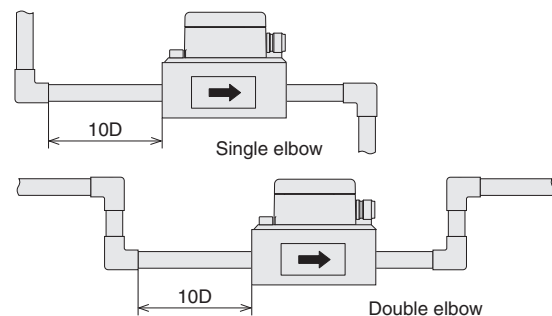
Do not connect piping that is thinner than the connection port without direct piping. Reverse flow by the bypass unit is possible even though the product is providing normal direction flow, and produce a negative reading on the flow display. Or an extremely low flow value may be displayed in place of the actual flow.

Or when connecting one size smaller piping (for example, 1/4B for the **FAS-005**), take the specified value\*+10D for direct piping before the flow meter and the specified value\*+5D for the direct piping after the flow meter.



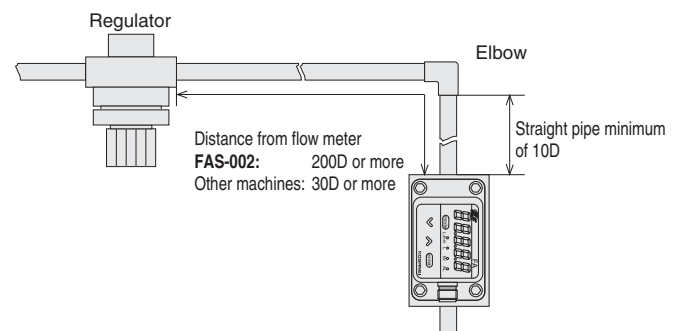
\* Piping length when connecting piping one size smaller than the specified value.

8: Reference diagrams for a single elbow and double elbow are shown below.



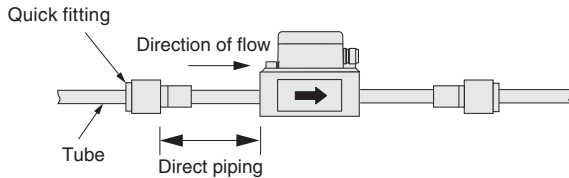
9: Install valves for flow adjustment downstream from the flow meter.

10: Install when the distance from the flow meter is greater than the specified distance. It makes no difference whether piping from the regulator to the flow meter is constructed of tubing or an elbow bend. However, install the required direct piping when connecting with the flow meter with an elbow bend. Allow for distance even if a filter or mist filter is inserted.





- For connection with a quick fitting  
Provide the straight pipe section noted in the table below when connecting the FA Series Flow Meter to a quick fitting. Connecting without a straight pipe section can produce a negative reading due to bypass unit back flow, even if flow in the main channel itself is normal direction flow. Also, the readout may show an extremely low flow rate instead of the actual flow rate.

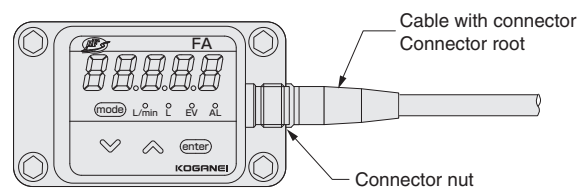


Piping, connection equipment	Fitting type	Connection location	Straight pipe section with FA Series flow meter	
			Specification ranges <sup>Note</sup> Within $\pm 3\%$ FS	Accuracy <sup>Note</sup> Within $\pm 5\%$ FS
Quick fitting Tube size $\phi 8$ [0.315 in] (With <b>FAS-002</b> )	Straight type	Upstream from flow meter	15D	5D
		Downstream from flow meter	Not required	Not required
	Elbow type	Upstream from flow meter	20D	10D
		Downstream from flow meter	5D	5D
Quick fitting Tube size $\phi 12$ [0.472 in] (With <b>FAS-002</b> )	Straight type	Upstream from flow meter	5D	Not required
		Downstream from flow meter	Not required	Not required
	Elbow type	Upstream from flow meter	10D	5D
		Downstream from flow meter	5D	5D
Quick fitting Tube size $\phi 12$ [0.472 in], $\phi 16$ [0.63 in] (With <b>FAS-005</b> )	Straight type	Upstream from flow meter	10D	5D
		Downstream from flow meter	Not required	Not required
	Elbow type	Upstream from flow meter	15D	10D
		Downstream from flow meter	5D	5D
Quick fitting Tube size $\phi 12$ [0.472 in], $\phi 16$ [0.63 in] (With <b>FAS-030</b> )	Straight type	Upstream from flow meter	10D	8D
		Downstream from flow meter	5D	5D
	Elbow type	Upstream from flow meter	15D	13D
		Downstream from flow meter	10D	10D

Note: Characteristics for connection when tubing from fitting is virtually straight for approximately 300 mm [11.8 in].

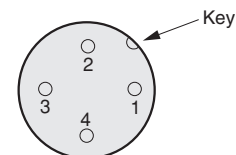
## Connections

- Use a power supply that is within the specification range.
- Wire a cable with connector separately from power lines and high voltage lines (use a separate conduit). Noise from these lines may cause the equipment to operate erratically.
- When connecting a cable with connector, align the core wire and push it in as far as it will go. Next, tighten the connector nut by hand. When tightening the nut, be sure to keep it within the prescribed torque (0.4 to 0.6 N·m [3.540 to 5.311 in·lbf] range). Failure to do so creates the risk of damage to the FA Series Flow Meter and inability to maintain the IP65 protective structure, and loosening of the nut due to vibration.
- Do not pull on the cable with strong force and do not lift the FA Series Flow Meter by the cable (pull out strength: 40 N [8.992 lbf] or less; bend strength: 20 N [4.496 lbf] or less). Also, do not subject the cable to repeated bending or pulling force.
- Do not rotate the center part of the connector (see figure below) while the connector is inserted fully into the FA Series Flow Meter. Doing so will cause the FA Series Flow Meter connector to rotate, which can cause internal wiring to twist and become damaged.



- Always turn off the power supply before doing any wiring.
- Keep load resistance connected to the instantaneous flow rate output below 300  $\Omega$ .
- Keep cable and connector ends away from moisture when doing wiring.
- Double-check to make sure that wiring is correct before turning on power. Wiring error creates the risk of damage and erratic operation.

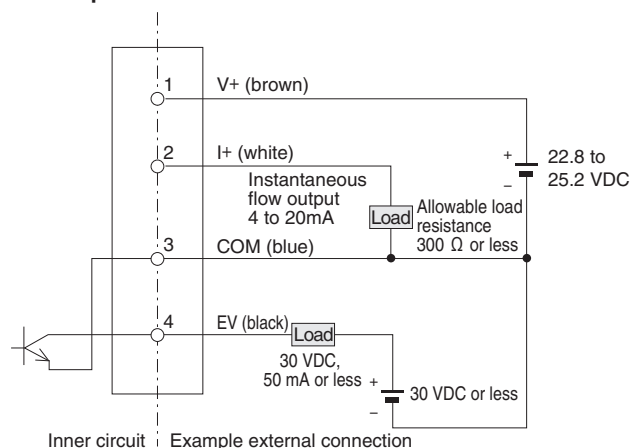
Pin number	Signal name	Description
1	V+	24 VDC
2	I+	Instantaneous flow output (4 to 20 mA)
3	COM	COM
4	EV	Switch output



Relationship between connector cable colors and pin numbers

Pin number	Signal name	Wire colors
1	V+	Brown
2	I+	White
3	COM	Blue
4	EV	Black

## Example connection



## Specifications

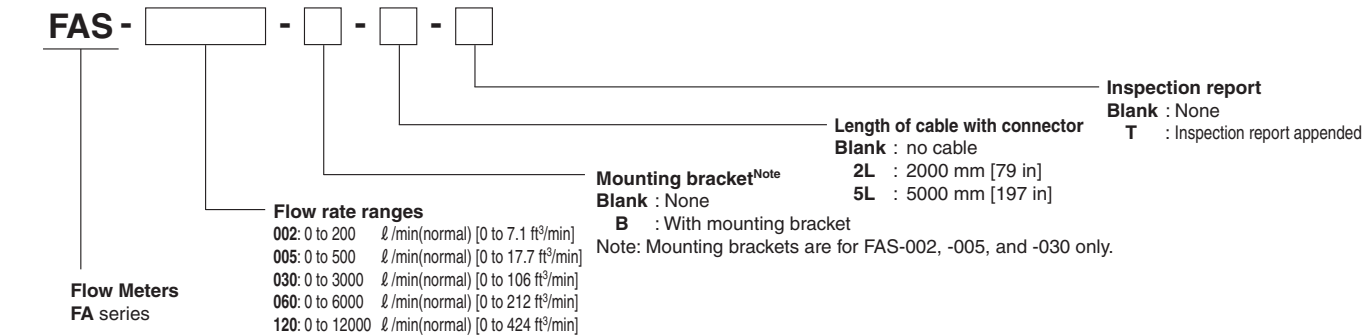
Item	Model	FAS-002	FAS-005	FAS-030	FAS-060	FAS-120
Media		Air, nitrogen ( However, dry air that does not include corrosive elements (salt, sulfur, acid, etc.) ) Clean gas that does not include dust and/or oil mist				
Port size		Rc1/4	Rc1/2	Rc1	Rc1 1/2	Rc2
Flow measurement range <sup>Note6</sup>	ℓ/min (normal) [ft <sup>3</sup> /min]	4 ~ 200 (10 ~ 200) [0.141 ~ 7.1 (0.353 ~ 7.1)]	10 ~ 500 (25 ~ 500) [0.353 ~ 17.7 (0.883 ~ 17.7)]	60 ~ 3000 (150 ~ 3000) [2.119 ~ 106 (5.3 ~ 106)]	120 ~ 6000 (300 ~ 6000) [4.2 ~ 212 (10.6 ~ 212)]	240 ~ 12000 (600 ~ 12000) [8.5 ~ 424 (21.2 ~ 42.4)]
Minimum sensitivity flow	ℓ/min (normal) [ft <sup>3</sup> /min]	2 [0.071]	5 [0.177]	30 [1.060]	60 [2.119]	120 [4.2]
Maximum flow range	ℓ/min (normal) [ft <sup>3</sup> /min]	-60 ~ 400 [-2.119 ~ 14.1]	-150 ~ 1000 [-5.3 ~ 35]	-900 ~ 6000 [-31.8 ~ 212]	-1800 ~ 12000 [-64 ~ 424]	-3600 ~ 24000 [-127 ~ 848]
Display resolution <sup>Note5</sup>	Instantaneous flow	1 [0.035]	1 [0.035]	5 [0.177]	10 [0.353]	10 [0.353]
	Integrated flow	10 [0.353]	10 [0.353]	10 [0.353]	100 [3.5]	100 [3.5]
Maximum display range	ℓ/min(normal) [ft <sup>3</sup> /min]	-60 ~ 400 [-2.119 ~ 14.1]	-150 ~ 1000 [-5.3 ~ 35]	-900 ~ 6000 [-31.8 ~ 212]	-1800 ~ 12000 [-64 ~ 424]	-3600 ~ 24000 [-127 ~ 848]
	m <sup>3</sup> /h (normal)	-3.6 ~ 24.0	-9.0 ~ 60.0	-54.0 ~ 360	-108.0 ~ 720.0	-220.0 ~ 1440.0
	m <sup>3</sup> /min(normal)	-0.060 ~ 0.400	-0.150 ~ 1.000	-0.900 ~ 6.000	-1.800 ~ 12.000	-3.600 ~ 24.000
	kg/h	-4.7 ~ 31.0	-11.6 ~ 77.6	-70 ~ 465.5	-140.0 ~ 931.0	-279.0 ~ 1862.0
Instantaneous flow display accuracy		±3% FS ±1digit (2 ~ 100% of FS flow, 5 ~ 100% in the case of mounting directions 2 and 3) <sup>Note9</sup> ±6% FS (-30 ~ 0% of FS flow) ±10% RD (100 ~ 200% of FS flow) <sup>Note7</sup>				
Instantaneous flow display repeatability		±1.0% FS ±1digit (2 ~ 100% of FS flow) ±2% FS (-30 ~ 0% of FS flow) ±10% RD (100 ~ 200% of FS flow) <sup>Note7</sup>				
Temperature characteristics		±0.15% FS/°C ±1digit or lower				
Pressure characteristics	Operating pressure 0 to 1 MPa [0 to 145 psi]	-0.25% FS/0.1 MPa [1.5 psi]±1digit or lower (2 ~ 40% of FS flow) -0.55% FS/0.1 MPa [1.5 psi]±1digit or lower (40 ~ 100% of FS flow)				
	Operating pressure -0.07 to 0 MPa [-10 to 0 psi]	±0.25% FS/0.01 MPa [1 psi]±1digit or lower (2 ~ 40% of FS flow) ±0.55% FS/0.01 MPa [1 psi]±1digit or lower (40 ~ 100% of FS flow)				
Instantaneous flow display change volume by mounting direction 2 <sup>Note 8</sup>	Operating pressure 0 to 1 MPa [0 to 145 psi]	0.5% FS/0.1 MPa [1.5 psi]±1digit or lower (5 ~ 100% of FS flow)				
	Operating pressure -0.07 to 0 MPa [-10 to 0 psi]	0.5% FS/0.01 MPa [1 psi]±1digit or lower (5 ~ 100% of FS flow)				
Instantaneous flow display change volume by mounting direction 3 <sup>Note 8</sup>	Operating pressure 0 to 1 MPa [0 to 145 psi]	-0.5% FS/0.1 MPa [1.5 psi]±1digit or lower (5 ~ 100% of FS flow)				
	Operating pressure -0.07 to 0 MPa [-10 to 0 psi]	-0.5% FS/0.01 MPa [1 psi]±1digit or lower (5 ~ 100% of FS flow)				
Operating pressure range		-0.07 ~ 1.0 MPa [-10 ~ 145 psi] (gauge pressure)				
Operating temperature range		-10 ~ +60° C [14 ~ 140° F] (non-freezing)				
Operating humidity range		0 ~ 90% RH (Non-condensation)				
Storage temperature range		-20 ~ +70° C [-4 ~ 158° F] (non-freezing)				
Storage humidity range		0 ~ 90% RH (Non-condensation)				
Proof pressure		1.5 MPa [218 psi] (gauge pressure)				
Amount of external leakage		100 ml/h (normal) (When internal flow meter pressure is 1.5 MPa [218 psi])				
Rated voltage		24 VDC				
Power supply voltage range		22.8 ~ 25.2 VDC				
Consumption current		120mA Max.				
Calculation cycle		50±5ms (when shipped)				
Instantaneous flow output <sup>Note10</sup>		Current output, 1 point: 4-20mA (Output range: 3.2 ~ 20.8 mA) Alarm time fixed output (up): 21.6±0.4 mA (Default, can be changed by setting) Alarm time fixed output (down): 0.0±0.4mA fixed Allowable load resistance: 300Ω or less Maximum output current: 24 mA				
Response time		Within 1.5s (Time ~ reach 95% of final value upon step input of 0 ~ 100%FS; Calculation cycle: 50 ms)				
Switch output <sup>Note11</sup>		Open collector output, 1 point: 30 VDC, 50 mA or less One of the functions below can be selected. • Instantaneous flow upper limit, lower limit, range • Integrated flow count up, count down • Alarm generation • Integration pulse output (3-level selectable pulse weight)				

# Specifications

Item	Model	FAS-002	FAS-005	FAS-030	FAS-060	FAS-120
Data recording		Semiconductor non-volatile memory EEPROM Recorded data: Function settings, parameters, integrated values, etc.				
Insulation resistance		50 MΩ or more 500 VDC megger applied for one second between the connector pin and main flow path or mounting bolt				
Cable		Option (with connector, oil resistant, flame retardant cable; UL2464EN standard)				
Mounting direction		Refer to "Mounting direction" on page 1675.				
Protective structure		IP65 (JISC0920 and IEC529); splash resistant and dust resistant, assuming indoor installation)				
Gas contact part material	Main flow path	Aluminum alloy (anodized)				
	Bypass unit	SUS304, PBT, H-NBR (hydrogenated nitrile rubber)				
	Gasket	H-NBR (hydrogenated nitrile rubber)				
Bypass unit case material		Denatured PPO				
Load mass	kg [lb]	0.4 [0.882]	0.4 [0.882]	0.5 [1.102]	0.7 [1.543]	1.1 [2.425]

- Note 1: (normal) is a value converted to a 0° C [32° F], 101.325 kPa [29.9 inHg] (abs) flow.
- 2: "FS flow" is the maximum flow of the flow measurement range.
- 3: "RD" stands for "reading" (read value).
- 4: A minus (–) flow rate value indicates a back flow rate (flow in the direction opposite that indicated by the flow meter arrow).
- 5: Regardless of the unit of display and the decimal point position, this indicates resolution from the lowest display digit.
- 6: A flow rate inside of parentheses ( ) is for installation attitudes 2 and 3.
- 7: This accuracy is a value representing instantaneous flow rate display accuracy along with instantaneous display repeatability.
- 8: See the installation attitudes on page 1675.
- 9: Replacing the bypass unit with a new unit causes instantaneous flow rate display accuracy to become ±5% FS ±1 digit. (FAS-030, FAS-060, FAS-120)
- 10: The back flow side cannot output.
- 11: Back flow side settings cannot be configured.

# Order Codes

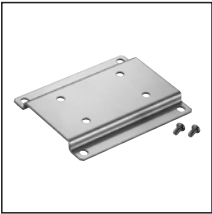


# Additional Parts

● Bypass unit  
(For FAS-030, -060, -120 only.)  
**FAB**



● Mounting bracket  
(For FAS-002, -005, -030 only.)  
**B-FAS**



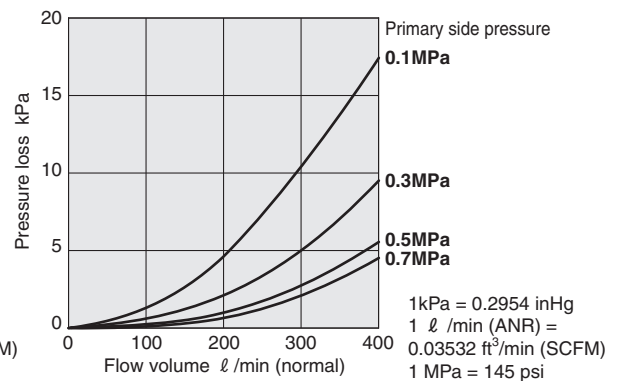
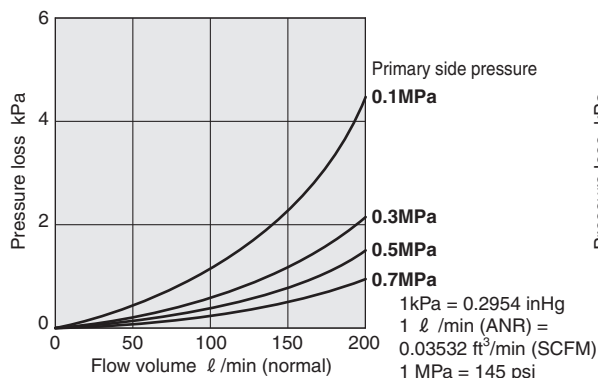
■ Cable with connector  
**FAK-2L** (Cable length: 2000 mm [79 in])  
**FAK-5L** (Cable length: 5000 mm [197 in])



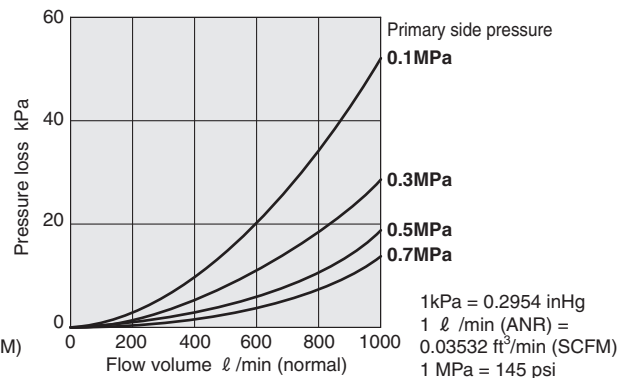
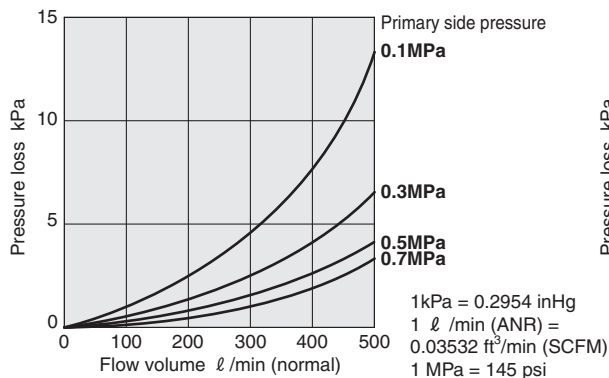


\_\_\_\_\_

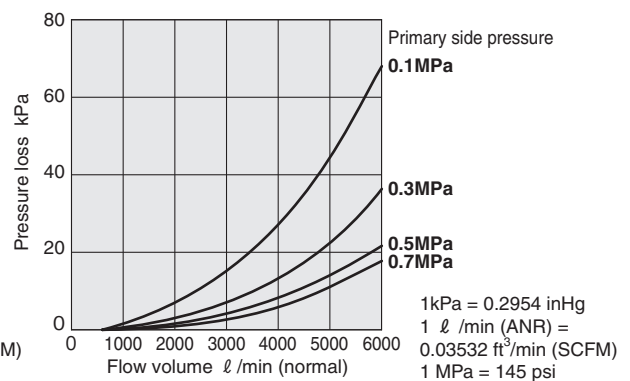
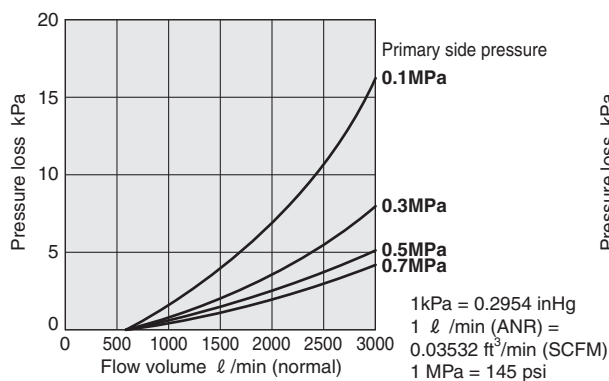
● **FAS-002**



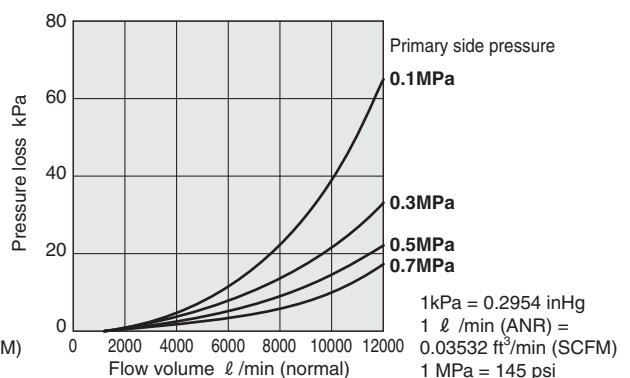
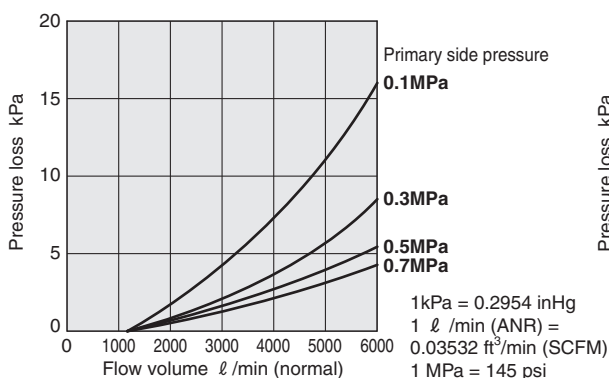
● **FAS-005**



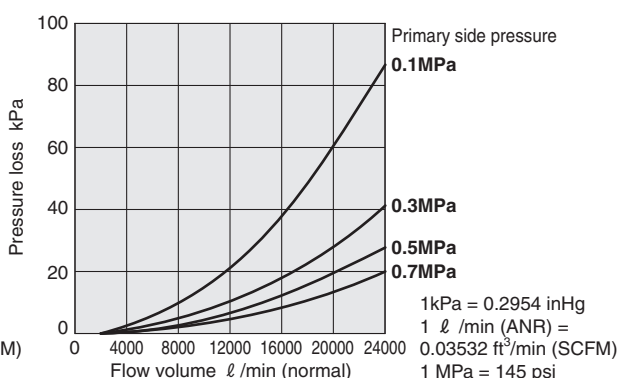
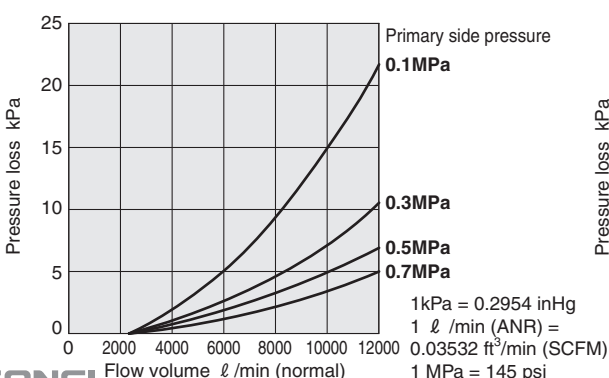
● **FAS-030**



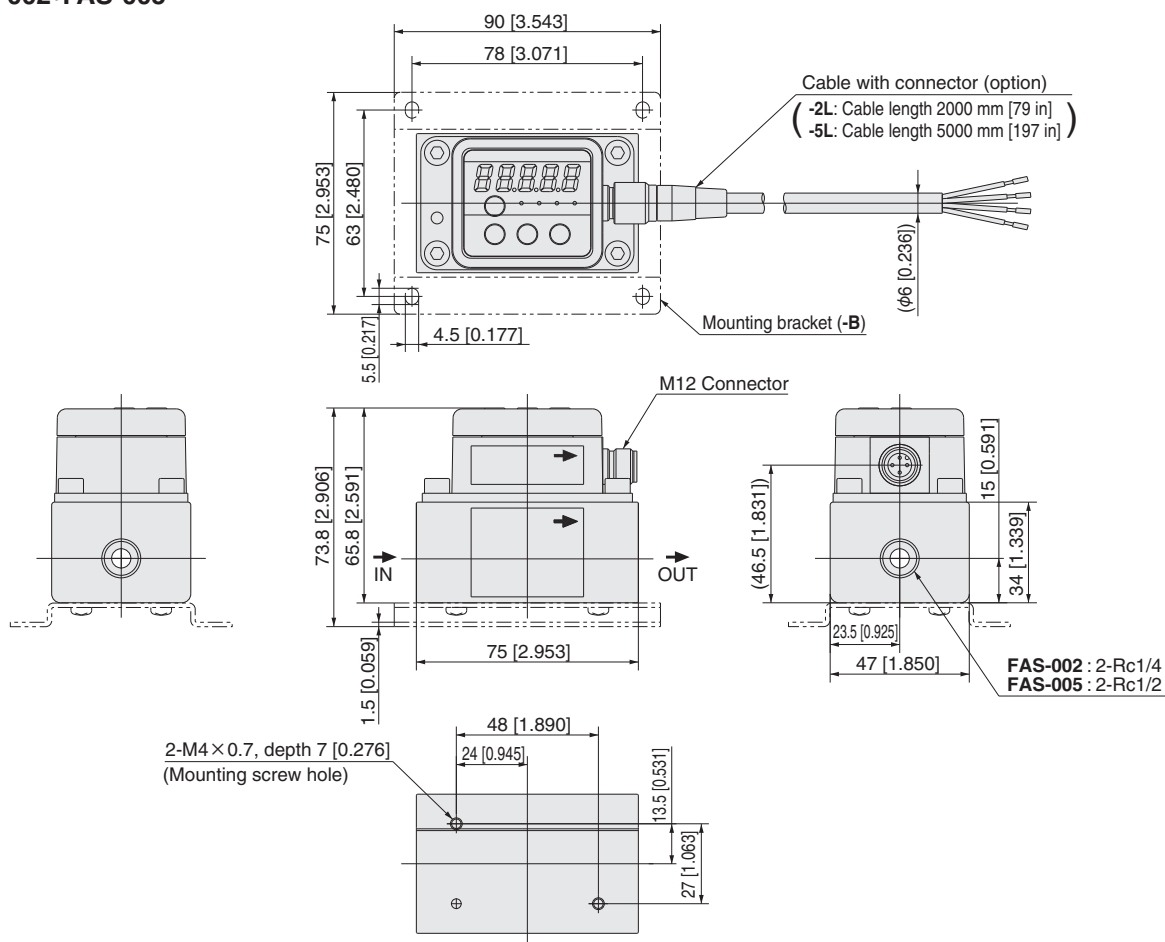
● **FAS-060**



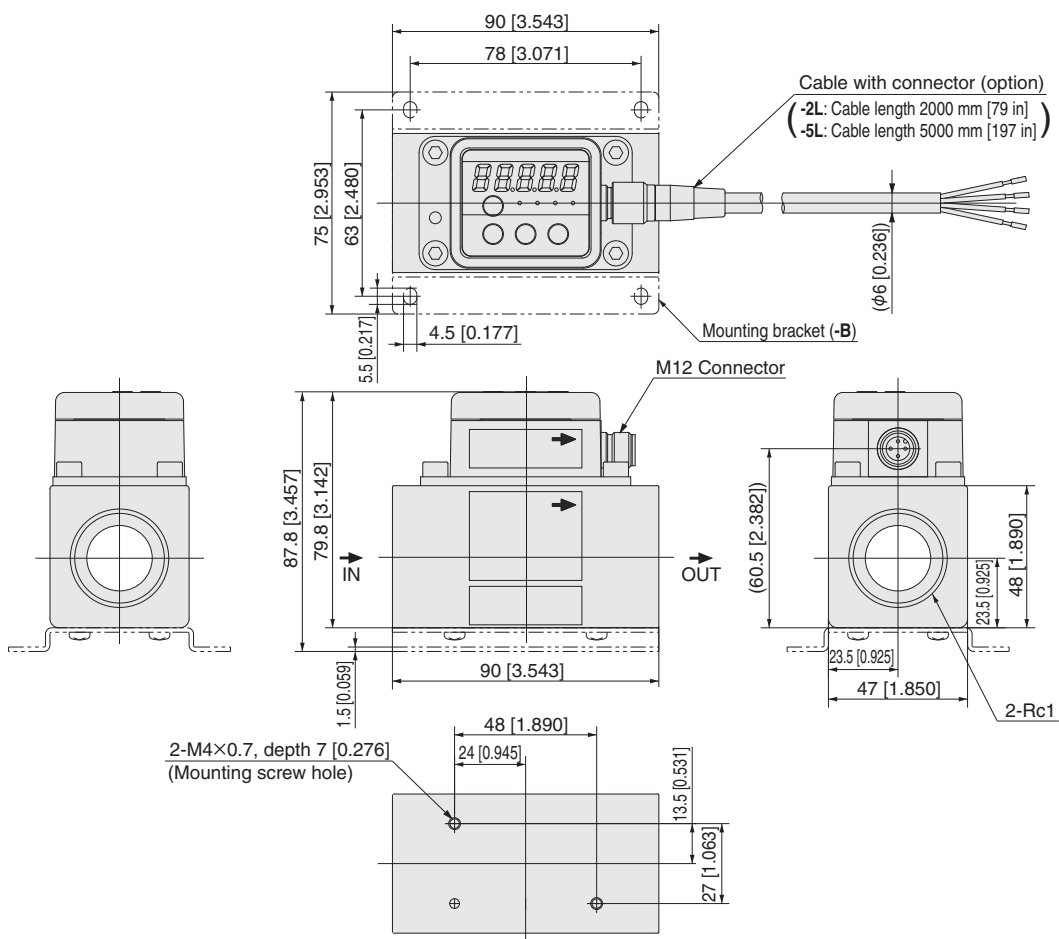
● **FAS-120**



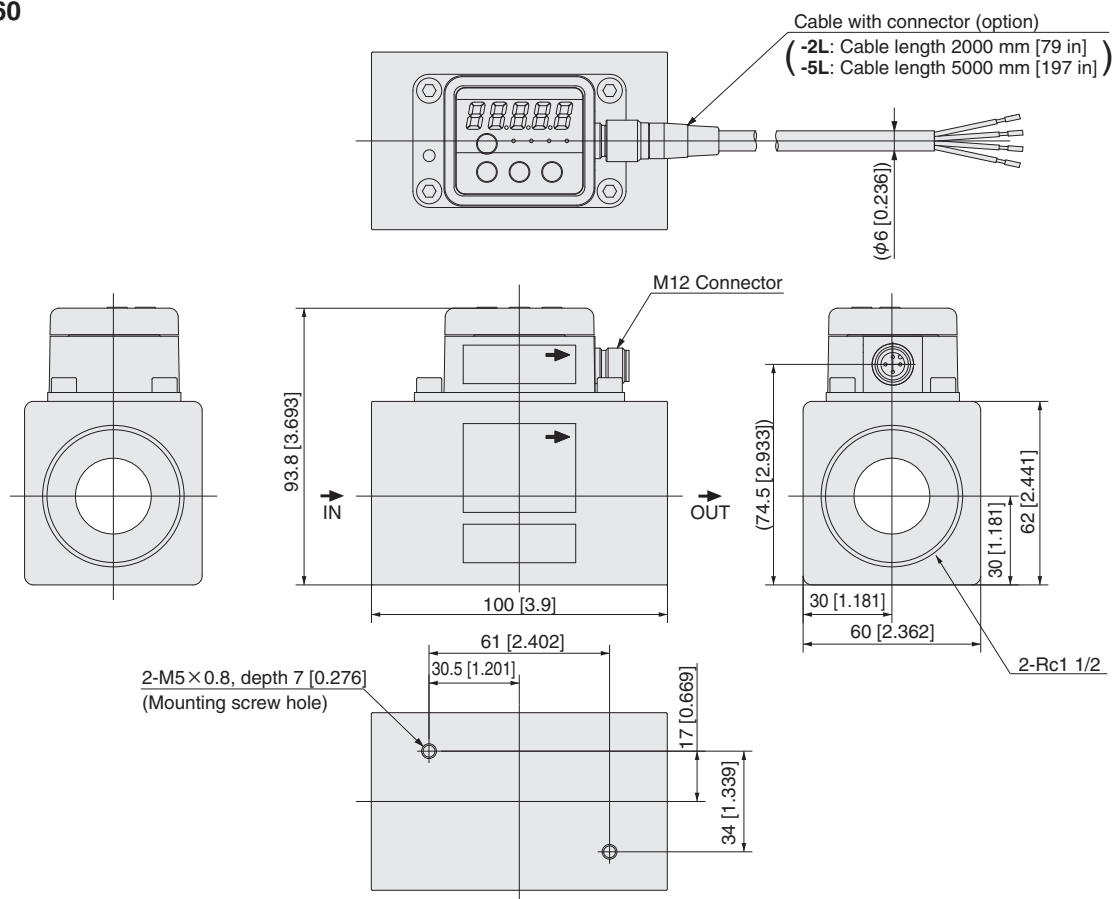
● FAS-002・FAS-005



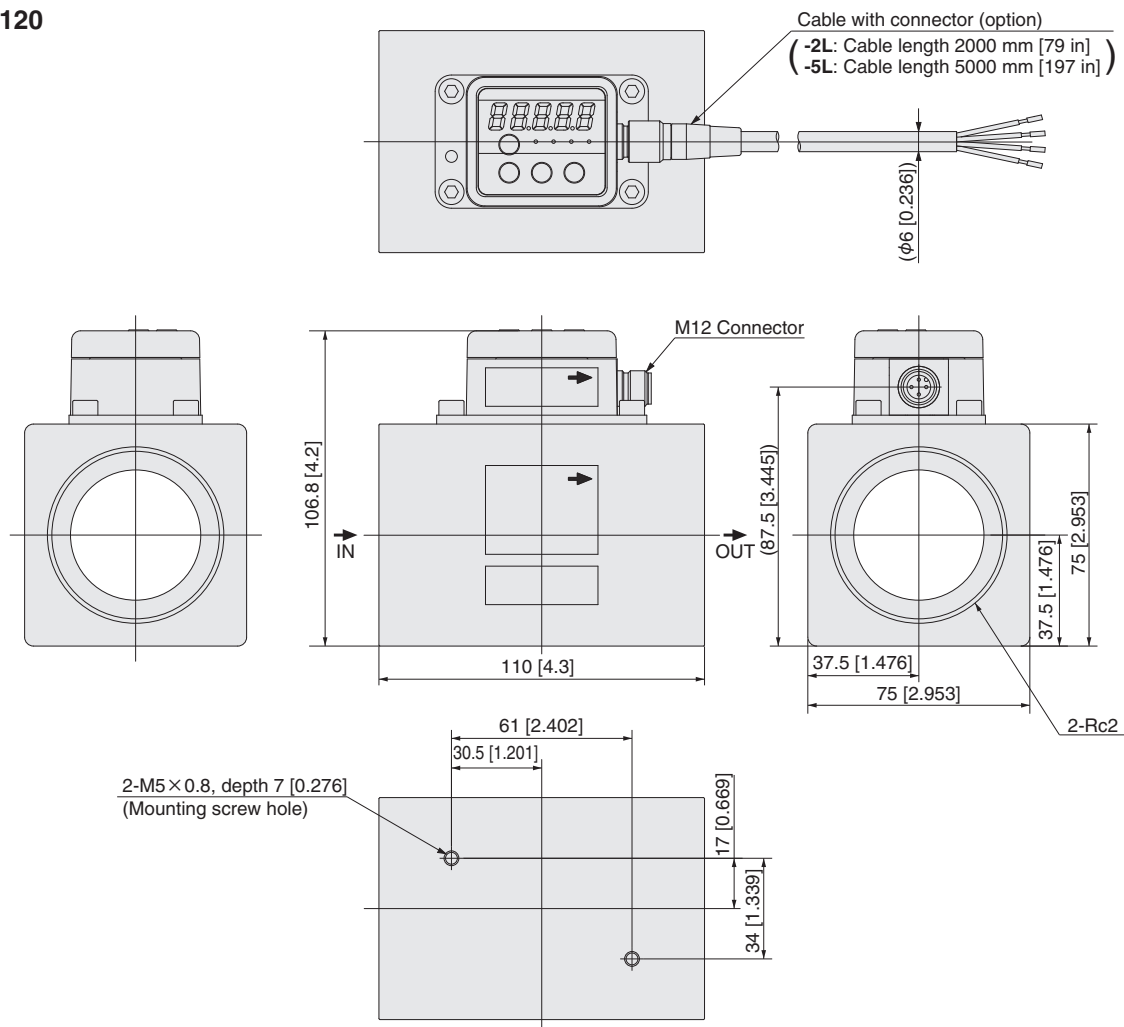
● FAS-030



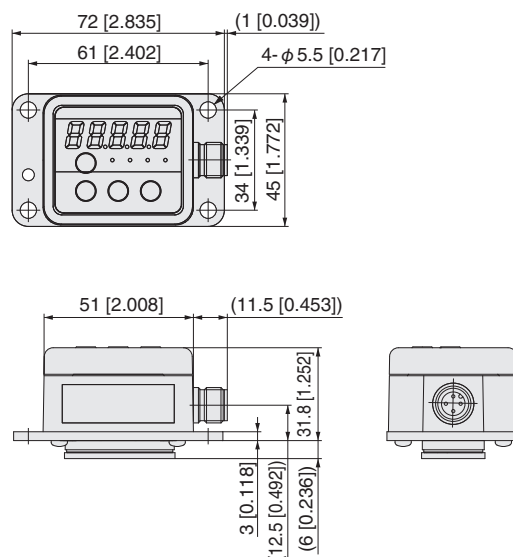
● FAS-060



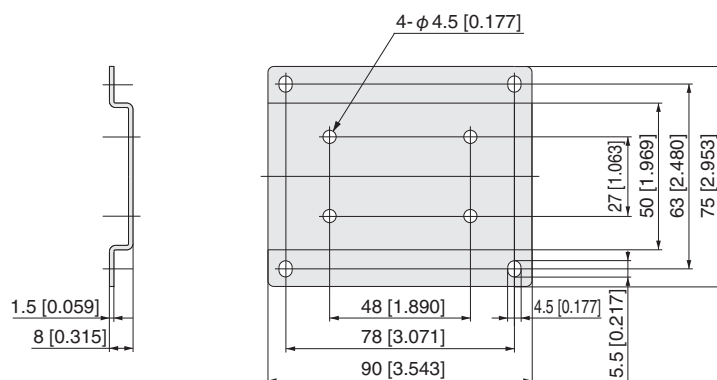
● FAS-120



## ● Bypass unit FAB



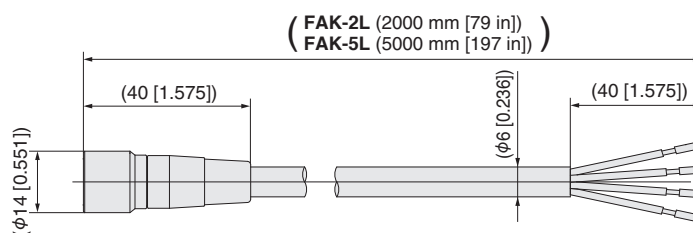
## ● Mounting bracket B-FAS



Cross head pan screw  
M4×0.7 Length6 [0.236] Two attached

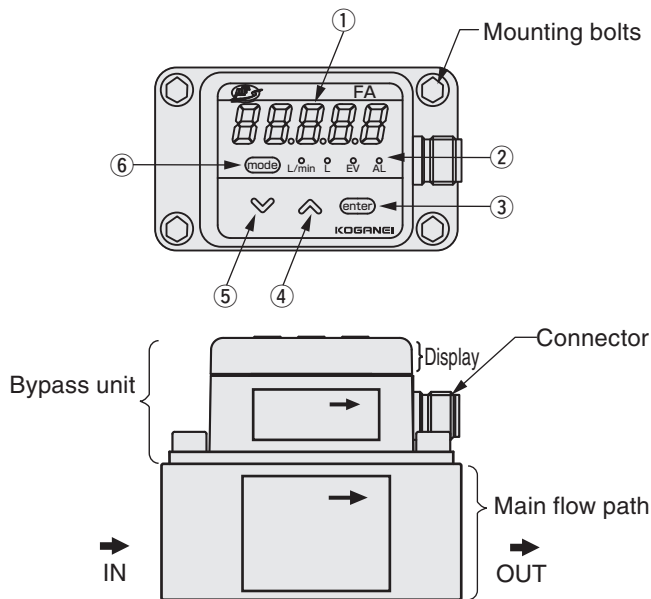
## ■ Cable with connector

**FAK-2L** (Cable length: 2000 mm [79 in])  
**FAK-5L** (Cable length: 5000 mm [197 in])

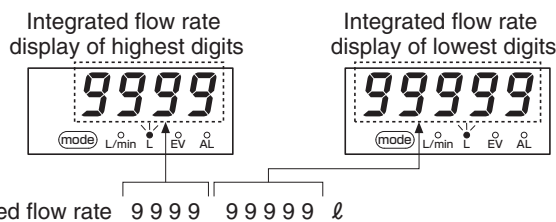


## Setting Guidelines

### Nomenclature and functions



- ① Flow rate display : 5-digit, 7-segment LED that normally shows the instantaneous flow rate and integrated flow rate. For integrated flow rate, the displayed value is divided between the four highest digits and five lowest digits. In setting mode, the display shows setting items and values. When an alarm occurs, it shows an alarm code.



#### ② LED lamps :

L/min	Lights during instantaneous flow rate display.
L/min	Lights during integrated flow rate display.
EV	Remains lit while switch output is on.
AL	Lights when an alarm occurs.

#### Key switches :

- ⑥ **mode** Used to switch the display screen, enter setting mode, etc.
- ⑤ **V** ④ **^** Used to configure function settings and parameter settings, to switch between the instantaneous flow rate peak value, lower value, and information display, and to reset the integrated value.
- ③ **enter** Used to check configuring function and parameter setting contents, and to go to the information display.

Main flow path : Connects to piping. There is an IN side and an OUT side.

Bypass unit : **FAS-030**, **FAS-060**, and **FAS-120** support replacement with new bypass unit.

Display: The display on top of the bypass unit can be rotated so it is parallel with the flow path. From the basic position shown in the illustration above, the display can be tilted 180° right or 90° left, a range of 270°.

Connector: Used for power input and signal connection.

Mounting bolts : Secures the bypass unit to the main channel.

### Integration functions

The function setting can be configured for integrated count up or integrated count down.

- When the integrated count up reaches 999999999, it reverts to 0 and continues from there.
- Integrated count down continues from the specified starting value until it reaches 0. Count down stops when the integrated value becomes 0.
- The integrated count up values are recorded in non-volatile memory every 10 counts. This means that, depending on when power is cut, the exact current integrated count up value may not be stored in memory.

Also, note that the integrated count down value is not recorded.

- To reset the integrated value to 0, check to make sure that the count screen upper order digits or lower digits are displayed, and then hold down both the **V** key and **^** key for at least five seconds.

In the case of a integrated countdown, the above operation resets the integrated value to the integration event set value. An integrated value reset records the current integrated value to non-volatile memory.

### ● Integrated process and operations during back flow

The integrated process when back flow occurs is performed in accordance with the selected integrated option as shown in the table below.

C12 Setting	Process details
00: Normal flow and back flow integrated separately	<p>Normal flow and back flow are integrated separately.</p> <p>Instantaneous flow rate</p> <p>Normal flow rate integration</p> <p>Integration counter</p> <p>Back flow counter</p>
01: Integration with back flow compensation	<p>When an instantaneous back flow is generated, the normal flow integrated counter counts up after the back flow integration amount reaches zero.</p> <p>Instantaneous flow rate</p> <p>Normal flow rate integration</p> <p>Integration counter</p> <p>Back flow counter</p> <p>Back flow rate integration</p> <p>Count up is suspended during back flow</p> <p>The back flow counter integration remains during this period, so suspension continues</p> <p>The stock of the back flow counter reaches 0, so the integration counter starts count up again after this point</p> <p>The integration counter stops counting up during back flow and the back flow is stocked to the back flow counter. After that, if the flow becomes normal, the portion stocked on the back flow counter is consumed and then the integration counter starts count up again.</p>

Note: In either case, the back flow integrated volume can be viewed on the information display.



## Switch output

### ●Switches

One of the switches shown in the table below can be selected. Except for integrated pulse output, you can also select inverted output.

Switch	Operation
Instantaneous flow rate upper limit switch	Outputs when the value set with the instantaneous flow rate switch 1 parameter is exceeded.
Instantaneous flow rate lower limit switch	Outputs when the value set with the instantaneous flow rate switch 1 parameter is subceeded.
Instantaneous flow rate range switch	Outputs when instantaneous flow rate is within the range set by instantaneous flow rate switch 1 and instantaneous flow rate switch 2.
Integrated flow rate count up switch	Outputs when the value set with the integrated switch setting parameter is exceeded.
Integrated flow rate countdown switch	Outputs when a value of zero results after the value set with the integrated switch setting parameter is decremented.
Integrated pulse output	Performs pulse output of the integrated flow rate with the pulse weight set by switch output of the function setting. Function settings can be used to select a pulse width of 50 ms, 250 ms, or 500 ms. For information about the pulse weights see the table below.
Alarm output	Outputs when an alarm is generated.

## Model-specific pulse weight

Model	Setting [ ℓ /pulse]			Setting [m³/pulse, kg/pulse]		
	Minimum unit	Minimum unit x 10	Minimum unit x 100	Minimum unit	Minimum unit x 10	Minimum unit x 100
FAS-002	10	100	1000	0.01	0.1	1
FAS-005	10	100	1000	0.01	0.1	1
FAS-030	10	100	1000	0.01	0.1	1
FAS-060	100	1000	10000	0.1	1.0	10.0
FAS-120	100	1000	10000	0.1	1.0	10.0

### ●Switch hysteresis

When the instantaneous flow rate switch is selected, sets the hysteresis (operation interval).

### ●Switch on delay

When the instantaneous flow rate switch is selected, sets the delay until switch operation.

### ●Switch wait

When the instantaneous flow rate lower limit switch of the instantaneous flow rate switch is selected, specifies switch operation wait unit a lower limit setting value is exceeded once before power is turned on.

## Displays

### ●Instantaneous flow rate screen and integrated flow rate screen

The seven segments of the display can be switched between instantaneous flow rate and integrated flow rate. Up to five digits are used for instantaneous flow rate display. A total of nine digits are shown for integrated flow rate value, with the displayed value is divided between the four highest digits five lowest digits.

When the four highest digits are displayed, the leftmost 7-segment LED shows “H” for countup or “d” for countdown. If there is no countdown/up indication, it means that the lowest digits are displayed.

### ●Instantaneous flow rate peak value and lower value

These values show the instantaneous flow rate peak value and low value during the measurement period. The measurement period can be reset (started) using a key operation.

### ●Information display

The information display function can be used to view the model ID, firmware version, cumulative integrated values, and integrated value before integration reset.

## Flow rate display unit

The display unit for instantaneous flow rate and integrated flow rate can be changed as required.

## Flow rate display example

Display unit setting	C02 : 00	C02 : 01	C02 : 02	C02 : 03
Unit	ℓ/min (ANR) [ft³/min (SCFM)], ℓ	m³/h, m³ [ft³]	m³/min, m³ [ft³]	kg/h, kg [lb]
Instantaneous flow rate	200 [7.1]	12.0 [423.72]	0.200 [7.062]	15.5 [34.172]
Integrated flow rate	100000000 [3532000]	100000.000 [3531000]	100000.000 [3531000]	100000.000 [220462]

Conversion from ℓ /min to each unit are shown below.

$$\text{m}^3/\text{h} = \ell / \text{min} \times 60 \div 1000$$

$$\text{kg}/\text{h} = \ell / \text{min} \times 60 \div 1000 \times 1.293$$

Density at 0°C [32°F], 101.325 kPa [29.9 inHg] (abs) is assumed to be 1.293.

Note: After changing the unit of flow rate display, select the applicable sticker from among those provided and affix it to the flow meter.

## Analog output

The instantaneous flow rate is output as an analog current (4 to 20 mA). Parameter settings can be used to change the flow rate value (display value) at 20 mA output. Setting resolution can be set in display value 1-digit intervals. Initial default settings are 4 mA at flow rate 0, and 20 mA at 100% FS flow rate.

## Operating pressure selection

Selecting a value that is in the vicinity of operating pressure will perform output compensation of the selected pressure and reduce the effects of pressure characteristics.

## Reference temperature selection

The flow rate display reference temperature can be set in 1°C [34°F] steps within the range of 0 to 35°C [32 to 95°F]. (Factory default temperature is 0°C.)

## Low flow cut

Low flow cut can be set in 1% steps within the range of 1 to 50% of FS flow rate (factory default: 1%).

At a setting of 1%, for example, 0 is always displayed as the flow rate when the FS flow rate is within the range of -1 to 1%.

The low flow cut setting is applied to instantaneous flow rate and integrated display values, and to the analog output value.

## Self-diagnostic function

The self-diagnostic function automatically causes the FA Series Flow Meter to display an alarm whenever there is an abnormality in the output signal of the sensor that measures the flow rate or a memory abnormality.

## Back flow measurement

Enables measurement of back flow up to -30% of the FS flow rate. Note: For information about accuracy, see the specifications on page 1678 and 1679.

## Flow rate range expansion function

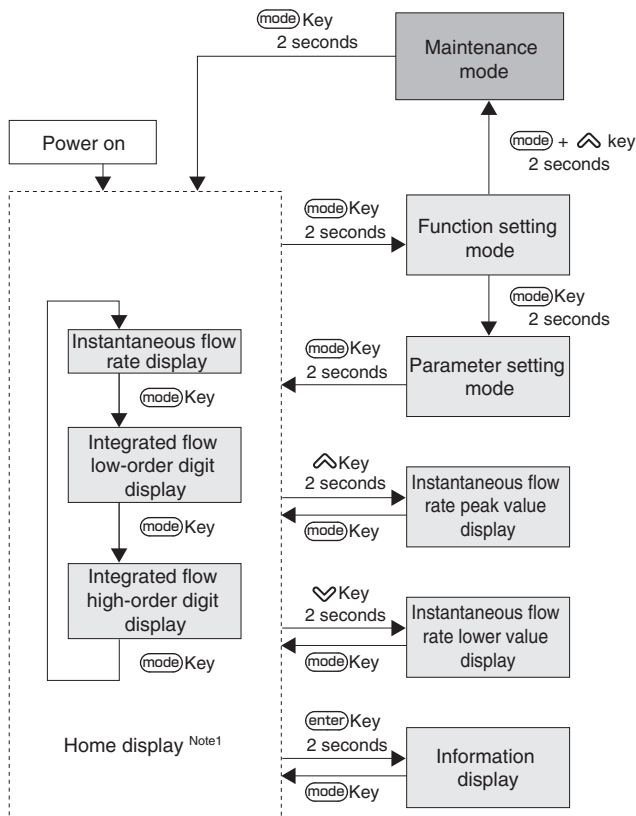
Enables measurement up to 200% of the FS flow rate.

Note: For information about accuracy, see the specifications on page 1678 and 1679.

## Setting Guidelines

### Settings

#### ● State transition



Note 1: The basic screen shows instantaneous flow rate, integrated flow rate lowest digits, or integrated flow rate highest digits, in accordance with the **C04** function number setting.

When an alarm is generated, the alarm code and basic screen alternate at an interval of two seconds.

Each press of the **(mode)** key cycles through the screens in the following sequence: Instantaneous flow rate → Integrated flow rate lowest digits → Integrated flow rate highest digits → Alarm code → Instantaneous flow rate.

#### 2: Integrated value reset

While the integrated flow rate highest digits or lowest digits are displayed, hold down the **(V)** and **(A)** keys at the same time for about five seconds.

Normally this will reset the integrated value to "0". However, when the switch output select **C03** is configured for integration countdown (**09** or **10**), the integration switch setting values (**E 14 1** and **E 14 0**) will be set.



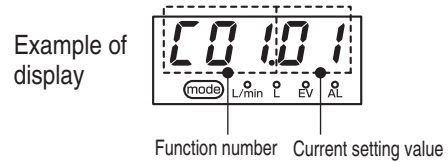
#### CAUTION

Do not operate keys by pressing with a mechanical pencil, a screw driver, or any other pointed object. Doing so can lead to malfunction.

#### ● Function settings

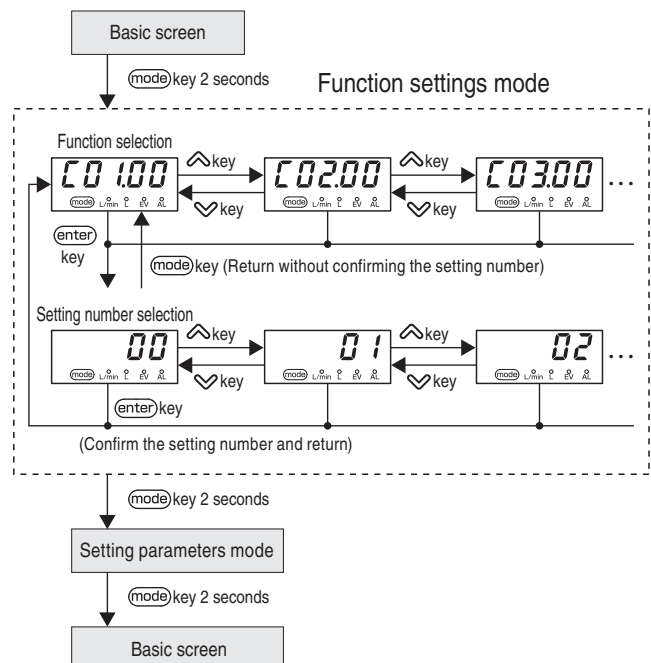
- ① While the basic screen is displayed, hold down the **(mode)** key for about two seconds.

The three digits on the left will show the function number, while the two digits on the right will show the current setting of the function.



- ② Use the **(V)** and **(A)** keys to scroll through the function numbers and display the one you want to change. Next, press the **(enter)** key. This will cause the function number to disappear, leaving the two-digit setting value on the display.
- ③ Use the **(V)** and **(A)** keys to scroll through the settings and display the one you want. Next, press the **(enter)** key. This will apply the setting and display the corresponding function number and setting value. Instead of pressing the **(enter)** key in the above procedure, pressing the **(mode)** key will return to the function number/setting value display without changing the setting.
- ④ To configure other settings, repeat steps ② and ③ as many times as required.

To exit function selection, hold down the **(mode)** key for about two seconds to change to the parameter setting screen. Next, hold down the **(mode)** key again for about two seconds to return to the basic screen.



## Function setting list

Function number	Description	Setting number and description	Default	Remarks
C01	Setting key lock	00: No key lock 01: Key lock	00	You can also use this setting to cancel key lock. Performing a change operation while key lock is engaged will cause "LoL" to be displayed.
C02	Display unit setting	Instantaneous flow rate, integrated flow rate <sup>Note</sup> 00: l/min, l 01: m³/h, m³ 02: m³/min, m³ 03: kg/h, kg	00	Caution: After changing the unit, existing integrated values continue to be integrated in the previous unit. They are not converted automatically. After changing the unit, reset integration before using it again. • The peak value and lower value are reset when the unit is changed.
C03	Switch output	00: Not used 01: Instantaneous flow rate upper limit 02: Instantaneous flow rate lower limit 03: Instantaneous flow rate range 04: Instantaneous flow rate upper limit (inverted) 05: Instantaneous flow rate lower limit (inverted) 06: Instantaneous flow rate range (inverted) 07: Integrated count up 08: Integrated count up (inverted) 09: Integrated countdown 10: Integrated count down (inverted) 11: Integrated pulse (minimum unit) 12: Integrated pulse (Minimum unit x 10) 13: Integrated pulse (Minimum unit x 100) 14: Alarm generation switch 15: Alarm generation switch (inverted)	00	Inversion causes output ON and OFF to be inverted.
C04	Basic screen	00: Instantaneous flow rate screen 01: Integrated lowest digit screen 02: Integrated highest digit screen	00	Determines the content of the flow rate display when power is turned on. The function setting mode is entered from the basic screen.
C07	Switch wait	00: Not used 01: Use	00	
C08	Gas type	00: Air, nitrogen (fixed)	00	Cannot be changed.
C10	Operating pressure	00: 0.3 MPa standard 01: 0.1 MPa standard 02: 0.5 MPa standard 03: 0.7 MPa standard	00	When the installation attitude is "Installation attitude 2" or "Installation attitude 3", error due to installation attitude can be reduced by maintenance mode pressure compensation adjustment value and operating pressure. For details, see "Maintenance Mode" on page 1690.
C11	Reference value conversion	00 to 35°C (1°C steps)	00	Changing setting resets peak value and lower value.
C12	Integration options	00: Integration with only normal flow rate 01: Integration with back flow compensation	00	
C14	Integrated pulse width	00: 50 ms 01: 250 ms 02: 500 ms	00	
C15	Fixed output during alarm	00: Not used 01: Up 02: Down (fixed)	00	Outputs a fixed value from instantaneous flow rate output when a sensor abnormality or memory abnormality occurs. Flow rate indication is zero when an alarm occurs.

Note: After changing the display unit setting, select the provided sticker that corresponds to the new unit and affix it to the flow meter.

## Setting parameters

- While the basic screen is displayed, hold down the (mode) key for about two seconds to enter the function select mode. Next, hold down the (mode) key again for about two seconds to enter parameter setting mode.

Example of display when setting parameter items

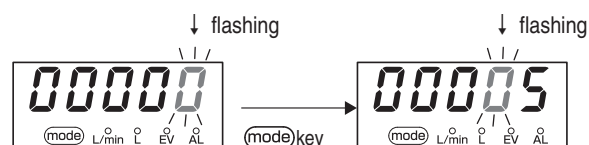


Example of display during setting



- Use the (V) and (A) keys to scroll through the setting items and display the one you want. Next, press the (enter) key. This will display a value with the rightmost digit flashing.

- Press the (mode) key to move the flashing to the left.

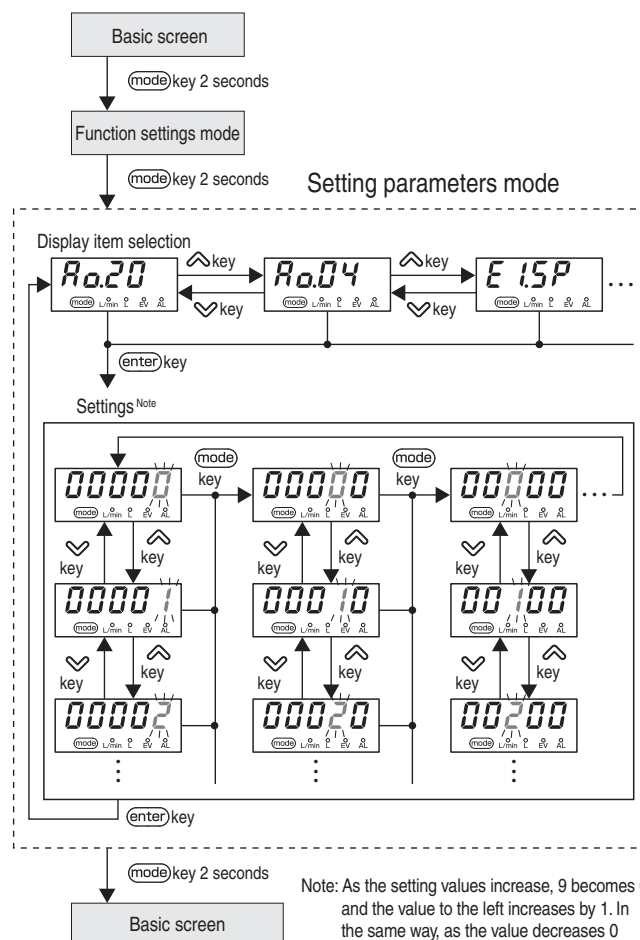


- Use the (V) and (A) keys to change the value of the currently flashing digit. Use the (V) and (A) keys to change each of the digits until the value is the one you want.

- After the value is the one you want, press the (enter) key. This will display the setting item and its set value.

- To configure other settings, repeat steps ② through ⑤ as many times as required.

- To exit the setting procedure, while a setting item is displayed hold down the (mode) key for about two seconds to return to the basic screen.



Note: As the setting values increase, 9 becomes 0 and the value to the left increases by 1. In the same way, as the value decreases 0 becomes 9 and the value to the left decreases by 1.

## Setting Guidelines

### Parameter setting list

Display item	Item content	Setting range	Default	Remarks
<b>Ra20</b>	Analog output 20 mA flow rate specification <small>Note 1</small>	Flow rate value equivalent to 0 to 400% FS can be set. <small>Note 5</small>	Depends on model number.	<ul style="list-style-type: none"> <li>Initial default depends on model. FAS-002 → 200 FAS-005 → 500 FAS-030 → 3000 FAS-060 → 6000 FAS-120 → 12000</li> <li>Setting ranges are values with decimal points removed. Decimal points will be added with model settings.</li> <li>Expected output cannot be obtained when the setting values is less than 10% of FS. Setting zero outputs fixed output during an alarm.</li> <li>Reconfigure this setting after changing the display unit setting with function selection <b>002</b>.</li> </ul>
<b>Ra04</b>	Analog output 4mA flow rate specification <small>Note 1</small>	Flow rate value equivalent to 0 to 400% FS can be set. <small>Note 5</small>	0	<ul style="list-style-type: none"> <li>Settings are values with decimal points removed. Decimal points will be added with model settings.</li> </ul>
<b>E1SP</b>	Instantaneous flow rate switch Output 1 <small>Note 2</small>	Flow rate value equivalent to 0 to 400% FS can be set. <small>Note 5</small>	0	<ul style="list-style-type: none"> <li>This setting can be configured when function selection <b>003</b> is set to <b>01</b> through <b>06</b>.</li> </ul>
<b>E1HY5</b>	Switch output hysteresis 1 <small>Note 2</small>	0 to 10% FS flow rate	1	<ul style="list-style-type: none"> <li>Settings are values with decimal points removed. Decimal points will be added with model settings.</li> </ul>
<b>E1dLY</b>	Switch output on delay 1 <small>Note 3</small>	0 to 60 s	0	<ul style="list-style-type: none"> <li>Reconfigure this setting after changing the display unit setting with function selection <b>002</b>.</li> </ul>
<b>E2SP</b>	Instantaneous flow rate switch output 2 <small>Note 2</small>	Flow rate value equivalent to 0 to 400% FS can be set. <small>Note 5</small>	0	<ul style="list-style-type: none"> <li>This setting can be configured when function selection <b>003</b> is set to <b>03</b> or <b>06</b>.</li> </ul>
<b>E2HY5</b>	Switch output hysteresis 2 <small>Note 2</small>	0 to 10% FS flow rate	1	<ul style="list-style-type: none"> <li>Settings are values with decimal points removed. Decimal points will be added with model settings.</li> </ul>
<b>E2dLY</b>	Switch output on delay 2 <small>Note 3</small>	0 to 60 s	0	<ul style="list-style-type: none"> <li>Reconfigure this setting after changing the display unit setting with function selection <b>002</b>.</li> </ul>
<b>CF</b>	Output compensation factor	0.100 ~ 2.000	1.000	Can be set in 0.001 steps. Display value is reflected in output. Changing setting resets peak value and lower value.
<b>LFcut</b>	Low flow cut	1 ~ 50%	1	Applied to both normal and back flow.
<b>H1L</b>	Maximum display value	100 ~ 200%	200	Changes display range maximum value from standard 200% of FS. When flow rate exceeds setting value, set maximum display value alternates with error display <b>RL40</b> (flow rate over).
<b>E1Lo</b>	Integration switch setting value lowest digits	00000 ~ 99990	0	Can be configured when function selection <b>003</b> is set to <b>07</b> through <b>10</b> .
<b>E1Hi</b>	Integration switch setting value highest digits	0000 ~ 9999	0	
<b>Cost</b>	Cost rate <small>Note 4</small>	1.0 ~ 100.0	100.0	Specifies the cost rate when cost is displayed on information display.

#### Note 1: Analog output scaling

Output for an instantaneous flow rate value is calculated using the formula below.

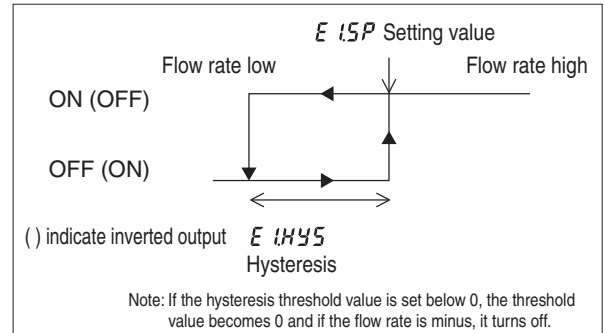
$$\frac{([\text{Indicated Flow Rate}] - [4 \text{ mA Setting Value}])}{([20 \text{ mA Setting Value}] - [4 \text{ mA Setting Value}])} \times 16 + 4 \text{ [mA]}$$

- 4 mA setting value : Instantaneous flow rate when 4 mA is output
- 20 mA setting value : Instantaneous flow rate when 20 mA is output
- Minus flow output limit is 3.2 mA, plus side output upper limit is 20.8 mA.
- When  $[4 \text{ mA Setting Value } R_{a04}] \geq [20 \text{ mA Setting Value } R_{a20}]$ , a fixed output value will be output during an alarm.
- When  $[20 \text{ mA Setting Value}] - [4 \text{ mA Setting Value}] < 10\%$  of FS flow rate, resolution is insufficient so desired output may not be possible.

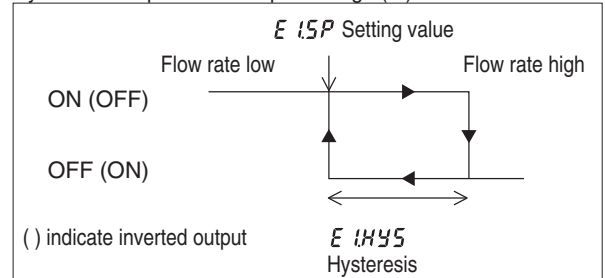
#### Note 2: Instantaneous flow rate switch operation

Operation depends on the setting of function selection **003**.

- (1) When function selection **003** is set to **01** or **04** (instantaneous flow rate upper limit switch)  
After exceeding the instantaneous flow rate upper limit value and the switch turning on, the settings for conditions to turn the switch off are set to hysteresis.  
[Switch OFF Conditions] = [Instantaneous Flow Rate Upper Limit Value] - [Hysteresis]  
Hysteresis is specified as a percentage (%) of the FS flow rate.



- (2) When function selection **003** is set to **02** or **05** (instantaneous flow rate lower limit switch)  
After falling below the instantaneous flow rate lower limit value and the switch turns on, the settings for conditions to turn the switch off are set to hysteresis.  
[Switch OFF Conditions] = [Instantaneous Flow Rate Lower Limit Value] + [Hysteresis]  
Hysteresis is specified as a percentage (%) of the FS flow rate.



- (3) When function selection **003** is **03** or **06** (instantaneous flow rate range switch)

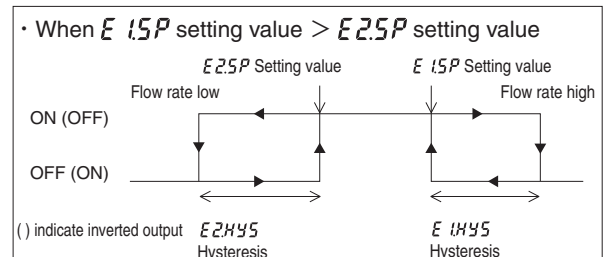
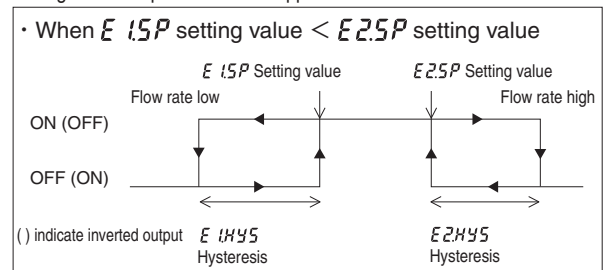
When  $E1SP > E2SP$ , the  $E1SP$  setting value is the upper limit and the  $E2SP$  setting value is the lower limit.

When  $E1SP < E2SP$ , the  $E1SP$  setting value is the lower limit and the  $E2SP$  setting value is the upper limit.

Operation does not work when  $E1SP = E2SP$ .

Hysteresis operation can be taken outside of the lower and upper limit setting values as shown below.

Hysteresis is specified as a percentage (%) of the FS flow rate. Different settings can be specified for the upper limit value and lower limit value.



### Note 3: Switch on delay operation

Switch on delay specifies the delay time until a switch turns ON.

Switch on delay is enabled when the **E 15P** setting is set to **E 1dLY**, and the **E 25P** setting is set to **E 2dLY**.

### Note 4: Cost rate

Cost rate is the rate specified in accordance with function selection "**C02**: display unit selection" setting.

<b>C02</b> selection value	Cost rate setting unit
00: ℓ/min, ℓ	Per 1m <sup>3</sup>
01: m <sup>3</sup> /h, m <sup>3</sup>	
02: m <sup>3</sup> /min, m <sup>3</sup>	
03: kg/h, kg	Per 1 kg

### Note 5: Setting ranges

Setting ranges depend on the model number and display unit. The table below shows the available ranges.

<b>C02</b> Setting value	FAS-002	FAS-005	FAS-030	FAS-060	FAS-120	Remarks
00: [ℓ/min]	0 to 800	0 to 2000	0 to 12000	0 to 24000	0 to 48000	Setting range upper limit is equivalent to a 400% FS flow rate value.
01: [m <sup>3</sup> /h]	0 to 48.0	0 to 120.0	0 to 720.0	0 to 1440.0	0 to 2880.0	
02: [m <sup>3</sup> /min]	0 to 0.800	0 to 2.000	0 to 12.000	0 to 24.000	0 to 48.000	
03: [kg/h]	0 to 62.1	0 to 155.2	0 to 931.0	0 to 1862.0	0 to 3724.0	

If a value that is greater than the maximum display value is set, instantaneous flow rate output will be up to equivalent to the maximum display value.

Do not set values that exceed the maximum display value for instantaneous flow rate switch output 1 and instantaneous flow rate switch output 2. The instantaneous flow rate may not reach the set value during operation and may not work in the case.

### ● Instantaneous flow rate peak value display

① While the instantaneous flow rate screen or integrated flow rate screen is displayed, hold down the **↵** key for about two seconds. This will change to the instantaneous flow rate peak value screen, which alternate between **FLoH I** and the peak value.

② To exit the peak value screen, press the **(mode)** key. This will return to the instantaneous flow rate screen or integrated flow rate screen.

- To clear the current instantaneous flow rate peak value, display the peak value and then hold down the **↵** key for about five seconds.

### ● Instantaneous flow rate lower value display

① While the instantaneous flow rate screen or integrated flow rate screen is displayed, hold down the **✓** key for about two seconds. This will change to the instantaneous flow rate lower value screen, which alternate between **FLoLo** and the lower value.

② To exit the lower value screen, press the **(mode)** key. This will return to the instantaneous flow rate screen or integrated flow rate screen.

- To clear the current instantaneous flow rate lower value, display the lower value and then hold down the **✓** key for about five seconds.

### ● Information display

① While the instantaneous flow rate screen or integrated flow rate screen is displayed, hold down the **(enter)** key for about two seconds.

This will change to the information screen, which alternate between the display item and value.

② To go to the next item, press the **↵** key. To go to the previous item, press the **✓** key.

③ To exit the information screen, press the **(mode)** key. This will go to the instantaneous flow rate screen or integrated flow rate screen.

### Display content list

Display item	Item content	Description
<b>Id_01</b>	Model ID	ID that identifies the model. <b>FAS-002</b> → 0000 <b>FAS-005</b> → 0001 <b>FAS-030</b> → 0002 <b>FAS-060</b> → 0003 <b>FAS-120</b> → 0004
<b>Id_02</b>	Range ID	ID that identifies the reference range <b>FAS-002</b> → 02000 (200.0 l/min(ANR) [7.1 ft <sup>3</sup> /min(SCFM)]) <b>FAS-005</b> → 05000 (500.0 l/min(ANR) [17.7 ft <sup>3</sup> /min(SCFM)]) <b>FAS-030</b> → 03000 (3000 l/min(ANR) [106 ft <sup>3</sup> /min(SCFM)]) <b>FAS-060</b> → 06000 (6000 l/min(ANR) [212 ft <sup>3</sup> /min(SCFM)]) <b>FAS-120</b> → 12000 (12000 l/min(ANR) [424 ft <sup>3</sup> /min(SCFM)])
<b>Id_03</b>	F/W version	
<b>C05tL</b>	Cost display (lowest digits)	Shows the cost. <sup>Note 1</sup>
<b>C05tH</b>	Cost display (highest digits)	
<b>IrE_L</b>	Back flow rate integrated value (lowest digits)	Shows the back flow integrated flow rate. <sup>Note 2</sup>
<b>IrE_H</b>	Back flow rate integrated value (highest digits)	
<b>It0tL</b>	Cumulative integrated value (lowest digits)	Shows cumulative integrated value since shipment. This value is not returned to 0 by integrated value reset.
<b>It0tH</b>	Cumulative integrated value (highest digits)	
<b>IPrEL</b>	Integrated value before integrated value reset (lowest digits)	Shows the integrated value immediately before an integrated value reset was performed.
<b>IPrEH</b>	Integrated value before integrated value reset (highest digits)	

Note 1: The conversion rate can be changed by setting the cost rate setting of parameter setting "**C05t**".

This item is not displayed when integrated countdown is selected.

2: When the function selection "**C12**" integration option is set to **01**, the remaining back flow amount will be displayed and decremented when there is normal flow.

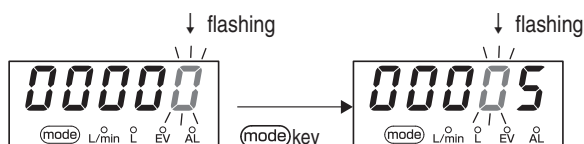


## Setting Guidelines

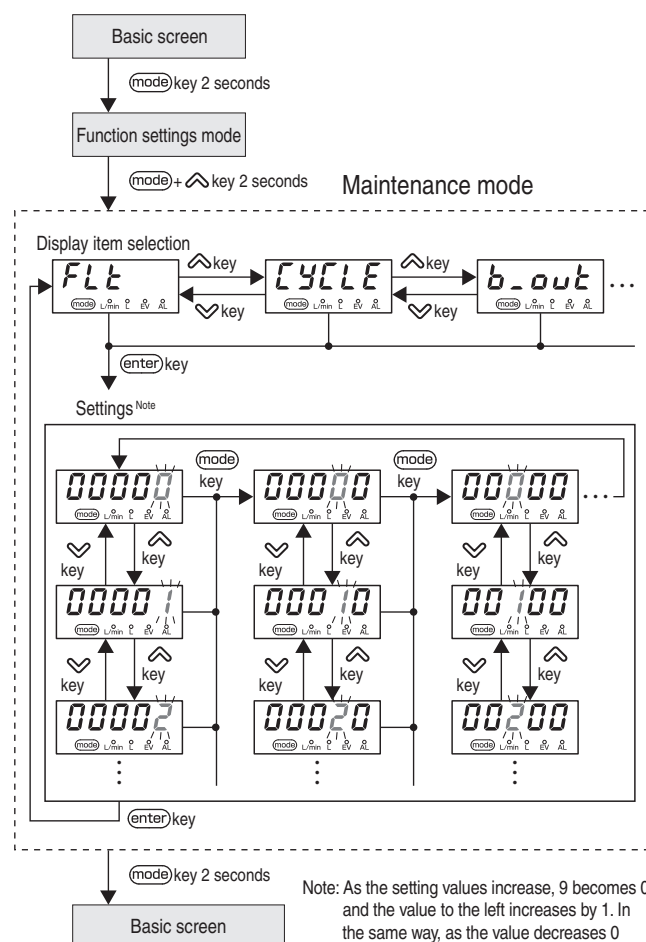
### ● Maintenance mode

The maintenance mode of this product makes it possible to embed adjustment values, to adjust the output circuit, and to configure other special option settings, when replacing the bypass unit.

- While the basic screen is displayed, hold down the (mode) key for about two seconds to enter function selection mode. Next, hold down the (mode) and  $\wedge$  keys at the same time for about two seconds.
- Use the  $\vee$  and  $\wedge$  keys to scroll through the setting items and display the one you want. Next, press the (enter) key. This will display a setting value with the rightmost digit flashing.
- Press the (mode) key to move the flashing to the left.



- Use the  $\vee$  and  $\wedge$  keys to change the value of the currently flashing digit. Use the  $\vee$  and  $\wedge$  keys to change each of the digits until the value is the one you want.
- After the setting value is the one you want, press the (enter) key. This will specify the setting value and display the setting item.
- To configure other settings, repeat steps ② through ⑤.
- To exit the setting procedure, while a setting item is displayed, hold down the (mode) key for about two seconds to return to the basic screen.



Note: As the setting values increase, 9 becomes 0 and the value to the left increases by 1. In the same way, as the value decreases 0 becomes 9 and the value to the left decreases by 1.

### Setting list

Display item	Item content	Setting range	Default	Remarks
<i>FLE</i>	Calculation filter	1 to 16	8	
<i>CYCLE</i>	Measurement cycle	5 to 100	5	[×10ms]
<i>b_out</i>	Fixed output during alarm (Up)	0 to 120%	110	Step of 1
<i>PSCF1</i>	Pressure compensation adjustment value <sup>Note</sup>	Adjustment value	0.998	Compensation factor when 01 selected for <i>CLD</i> pressure compensation.
<i>PSCF2</i>	Pressure compensation adjustment value <sup>Note</sup>	Adjustment value	1.002	Compensation factor when 02 selected for <i>CLD</i> pressure compensation.
<i>PSCF3</i>	Pressure compensation adjustment value <sup>Note</sup>	Adjustment value	1.004	Compensation factor when 03 selected for <i>CLD</i> pressure compensation.
<i>oP0</i>	Channel ID number 0	Adjustment value	***	Configured when using the replacement bypass unit. Settings register main channel characteristic values. Not displayed for <b>FAS-002</b> , <b>FAS-005</b> . Do not change except when replacing bypass unit. Cannot be changed without inputting a password for the <i>PCode</i> reservation code.
<i>oP1</i>	Channel ID number 1	Adjustment value	***	
<i>oP2</i>	Channel ID number 2	Adjustment value	***	
<i>SYSD1</i>	Model	<b>FAS-030=2</b> <b>FAS-060=3</b> <b>FAS-120=4</b>	***	Configured when using the replacement bypass unit. Note that proper flow rate measurement will not be possible if a different model number from the actual channel is selected. Not displayed for <b>FAS-002</b> , <b>FAS-005</b> . Do not change except when replacing bypass unit. Cannot be changed without inputting a password for the <i>PCode</i> reservation code.
<i>PCode</i>	Reservation code	***	0	For information about the reservation code, see "Bypass Unit Replacement Guidelines" on page 1692.

Note: Certain operating pressures may cause errors in the displayed flow rate when the installation attitude is "Installation attitude 2" (Installation on horizontal piping, display on the right when viewed from the flow meter IN side pipe) or "Installation attitude 3" (Installation on horizontal piping, display on the left when viewed from the flow meter IN side pipe). However, error due to installation attitude can be reduced by setting the pressure compensation adjustment values to the values in the table below. For information about flow rate display change caused by installation attitude, see "Installation attitude" on page 1675.

Setting conditions		Setting values	
Display direction	Operating pressure	<i>CLD</i> setting	Maintenance mode setting change
Installation on horizontal piping, display on the right when viewed from the flow meter IN side pipe, Installation attitude 2	0.3 MPa [44 psi]	Set to 01.	Change " <i>PSCF1</i> " to 0.997.
	0.1 MPa [15 psi]	01	Change " <i>PSCF1</i> " to 0.997.
	0.5 MPa [73 psi]	02	Change " <i>PSCF2</i> " to 0.997.
	0.7 MPa [102 psi]	03	Change " <i>PSCF3</i> " to 0.997.
Installation on horizontal piping, display on the left when viewed from the flow meter IN side pipe, Installation attitude 3	0.3 MPa [44 psi]	Set to 01.	Change " <i>PSCF1</i> " to 1.003.
	0.1 MPa [15 psi]	01	Change " <i>PSCF1</i> " to 0.999.
	0.5 MPa [73 psi]	02	Change " <i>PSCF2</i> " to 1.007.
	0.7 MPa [102 psi]	03	Change " <i>PSCF3</i> " to 1.011.

Note: Changing the pressure compensation adjustment value is not required when using an installation attitude other than "Installation Attitude 2" and "Installation Attitude 3".

## Maintenance and troubleshooting

### Maintenance

To ensure proper operation, conduct periodic inspection at least once a year.

If the self-diagnostic function displays an alarm that does not clear even though the cause of the alarm is eliminated, request servicing from Koganei. Contact the Overseas Department for more information.

The addresses and telephone numbers are shown at the back of this manual.

### Troubleshooting

#### ● Abnormalities and remedies

Symptom	Remedy
Nothing appears on the display.	<ul style="list-style-type: none"> <li>•Make sure the supply power voltage and polarity are being applied correctly.</li> <li>•Make sure that connectors are connected correctly.</li> </ul>
The flow rate display does not become zero even when valves upstream or downstream from the flow meter is closed and there is no flow. (Output signal is not 4 mA.)	<ul style="list-style-type: none"> <li>•Make sure there are no air leaks in the piping.</li> <li>•Make sure that wiring is correct.</li> <li>•When the flow meter is installed on horizontal piping with the display sideways, influence of the installation attitude may cause zero point drift. (Since installation on horizontal piping with the display sideways causes the accuracy guarantee flow rate range to become 5 to 100% FS, set the low flow cut in this case to 5%.)</li> <li>•In a location subject to large ambient temperature fluctuation and large flow fluid temperature fluctuation, convection within the piping may be detected as flow. Perform measurement after temperature has stabilized sufficiently.</li> </ul>
Large instrument error compared against the standard instrument. The instrument is outside the accuracy range.	<ul style="list-style-type: none"> <li>•Make sure there are no air leaks in the piping.</li> <li>•Check for foreign matter trapped in the main channel orifice. If foreign matter is present, remove it.</li> <li>•Check for dirt, oil, or other foreign matter in piping and the flow meter connection port. If foreign matter is present, Koganei servicing and replacement are required. Contact your nearest Koganei sales office or the Overseas Department.</li> <li>•Check to make sure that wiring is correct.</li> <li>•Check to make sure that there is no large fluctuation in flow rate within a few seconds and that the measurement range is not exceeded by a large amount.</li> </ul>

#### ● Alarm displays and required actions

Alarm Code	Item	Description	Cause	Remedy
RL 40	Flow rate over	A flow rate that exceeds the value set by the maximum display value parameter setting is flowing. Or a back flow that exceeds the back flow rate range is flowing.	There may be a high flow rate outside of the maximum display range or back flow. Note 1	Check if a high flow rate exists and eliminate its cause. If the instantaneous flow rate display when the alarm occurs shows a minus (–) sign, back flow occurs. Eliminate the cause of the back flow. The alarm will cease displaying when the actual flow rate becomes within the display range flow rate.
RL 51	Registration data abnormality 1	Abnormal channel ID numbers registered. Correct flow rate calculation cannot be performed.	The registered channel ID numbers may be wrong.	Use maintenance mode to register the correct channel ID numbers. Note 2 If changing the setting does not clear the alarm, turn the instrument off and then back on again. If this does not clear the alarm, request servicing.
RL 52	Registration data abnormality 2	Correct calculation cannot be performed because of abnormal data registered for the flow sensor characteristic values.	Registered characteristic data may be corrupted, resulting in abnormal values.	Turn the instrument off and then back on again. If this does not clear the alarm, request servicing.
RL 81	Sensor abnormality 1	Flow rate signal is outside the proper range.	The signal level may be exceedingly low due to a short circuit caused by adherence of foreign matter or excessive back flow that exceeds the measurement range.	If excessive back flow is the cause, this error will clear automatically when the flow rate returns within the measurement range. If it is not due to excessive back flow and the alarm does not clear after a number of hours, request servicing.
RL 82	Sensor abnormality 2	Flow rate signal level may not match the actual flow rate.	Sensor may be malfunctioning or output may be dropping. Foreign matter may be adhering to sensor, or there may be condensation on the sensor, etc.	Pass dry air through the system. If the error does not clear after a number of hours, request servicing.
RL 83	Sensor abnormality 3			
RL 84	Sensor abnormality 4	Heater voltage is outside the proper range.	The sensor may be damaged, or there may be a short circuit due to the adherence of foreign matter, etc.	If the error does not clear after a number of hours, request servicing.
RL 91	Memory abnormality	Instrument information data abnormality	Data may have been corrupted by noise, etc.	Turn the instrument off and then back on again. If this does not clear the alarm, request servicing.
RL 92		Characteristic value information data abnormality		
RL 93		Setting information data abnormality	Power was cut off during data writing, which created the risk of abnormal completion.	Reconfigure the data, and then turn the instrument off and then back on again. If this does not eliminate the alarm, request servicing.
RL 94		Integrated information data abnormality		

Note 1: If parameter setting were used to change the maximum display value, this alarm occurs in accordance with the changed setting.

2: For information about channel ID numbers, see "Bypass Unit Replacement Guidelines" on page 1692.

## Bypass Unit Replacement Guidelines



### CAUTION

●The following modes support bypass unit replacement: **FAS-030**, **-060**, and **-120**.

- Do not lift or carry the flow meter by holding the bypass unit. Doing so can damage the flow meter or cause it to fall, creating the risk of personal injury.
- When replacing the bypass unit, be sure to release flow meter internal pressure before removing the current bypass unit.
- Replacing the bypass unit causes the  $\pm 3\%$  FS  $\pm 1$  digit instantaneous flow rate display accuracy to become  $\pm 5\%$  FS  $\pm 1$  digit.

### Removing the bypass unit

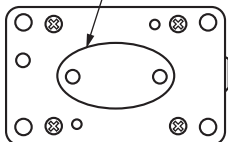
1. Prepare the following items: Safety glasses, helmet, gloves, hex key (for M5, between flats 4 mm [0.157 in])<sup>Note 1</sup>
2. Release the pressure from inside the flow meter and piping, use a pressure gauge to confirm that pressure is zero.
3. Gradually loosen the four bolts that secure the bypass unit in place and then remove them.<sup>Note 2</sup>

Note 1: For safety, wear safety glasses when removing the bypass unit.

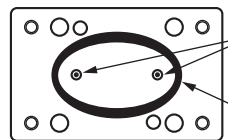
2: Be sure to leave the gasket in place on the main channel.



Rubber sheet



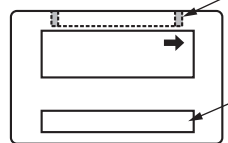
Bypass unit bottom view



Main flow path top view  
(Bypass unit removed)

Bypass unit orifice

Gasket<sup>Note 2</sup>

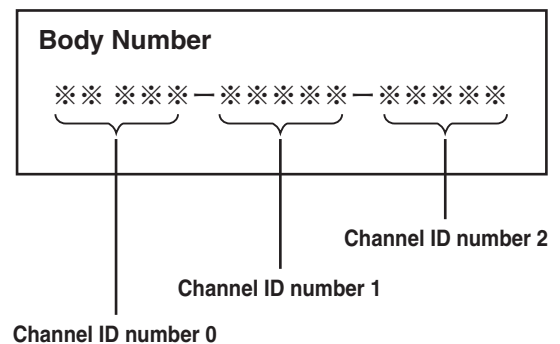


Main flow path front view

Body Number label

### Mounting the bypass unit

1. Check to make sure that the rubber sheet of the new bypass unit is securely affixed and that the gasket that was in place when you purchased the unit is affixed to the main channel. With the arrow on the label of the bypass unit aligned with the arrow on the label of the main channel, mount the bypass unit on the main channel with four bolts. Be sure to tighten the bolts evenly to a tightening torque of 2.6 to 3.3 N·m [23.013 to 29.208 in·lbf].
  2. Connect the cables and turn on power. Keep the tightening torque of the cable nut to 0.4 to 0.6 N·m [3.54 to 5.311 in·lbf] range.
  3. From the basic screen, enter maintenance mode. Input channel ID numbers for 0, 1, and 2, and input the model number.  
For details, see "●Maintenance Mode" on page 1690.  
If the new replacement bypass unit remains locked, normally the setting lock of the channel ID numbers and model number are disengaged, input 1111 for the P\_Code reservation code in the case.
- The channel ID numbers are marked on the **Body Number** label of the main channel.



- Model numbers are 2 for the **FAS-030**, 3 for the **FAS-060**, and 4 for the **FAS-120**.
- Be sure to double check the channel ID numbers and the model number after you input them.

4. Check to make sure that the instantaneous flow rate display shows zero.
5. Apply pressure to the flow meter and inside the piping, and check to make sure that the instantaneous flow rate shows zero when there is no flow.
6. Be sure to check and make sure there are no external leaks.

Reference: Channel ID numbers

"Channel ID numbers" are main channel's characteristic information that represent main channel's split flow ratio adjustment values. Channel ID numbers 0, 1, and 2 correspond to bypass flow ratio adjustment values 0, 1, and 2. Using maintenance mode to write these values into the bypass unit adjusts output to match the characteristics of each main channel, which makes it possible to maintain accuracy even if the bypass unit is replaced.