CKD

New Products

Compact Flow Rate Sensor RAPIFLOW® FSM3 Series

CKD Corporation
CC-1235A

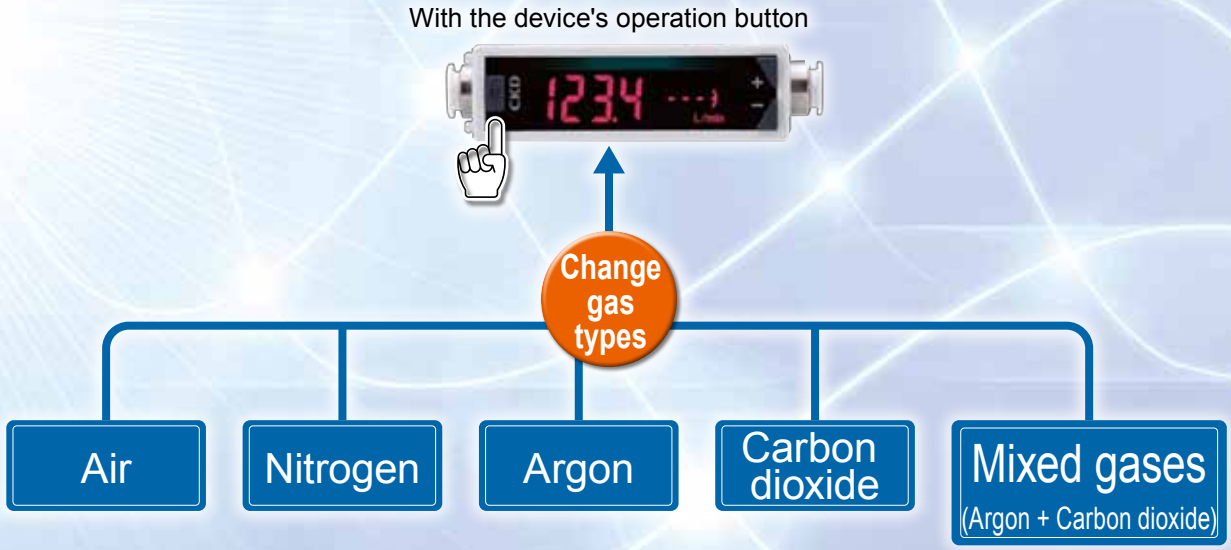
Diversified

Five types of gases can be measured with just one unit

Gas change function (Model with full scale flow rate of up to 200 L/min)

Air, nitrogen, argon, carbon dioxide, mixed gas (mixture of Ar:CO_2 (8:2)) supported with this single flow rate sensor.
Gas types can be changed with gases button operations.
In the IO-Link specifications, changing gases can be done remotely using the host controller.

* Contact a CKD representative if you have any requests for the mixed gases.



High performance

MEMS is short for Micro Electro Mechanical Systems, a compact device that applies the fine processing technology used in manufacturing semiconductor integrated circuits.

Clean-room specifications

Anti-dust generation (P70) and oil-prohibited specifications (P80) available in the standard lineup

Use according to the device grade is possible.

Reduction of pressure loss

Up to 50% reduction with flow path redesign

High precision/high-speed response

Repeatability: within ±1% F.S.
Display accuracy: within ±3% F.S.
Response time: 50 msec

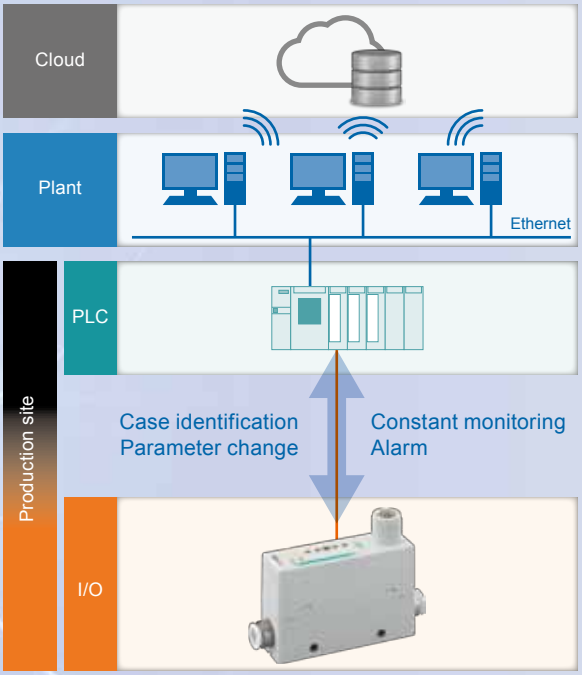
Bi-directional fluid measurement

Contributes to reducing tact time

Flow direction can be measured voluntarily.

Introducing IO-Link model

IO-Link complies with digital communication standards for factory sensors and actuators. (IEC61131-9)
Transmits parameters and event data that cannot be transmitted by analog communication.



IO-Link features

Constant monitoring with digital data is possible.

Parameters can be set and changed via the network, enabling remote operation of the device.

Model Nos. and serial Nos. can be checked via the network.

Settings can be copied from the master side, making troublesome parameter resetting during maintenance unnecessary.

Device damage and disconnection can be checked.

The network can also be changed to Ethernet connection, making the device a part of IoT.

User-friendly

Rotatable LCD display

Display can be vertically inverted

Wide variation of fittings

Push-in and screw-in lineup available

Push-in Elbow | Push-in Straight | Screw-in Elbow | Screw-in Straight

Easy mounting (option)

DIN rail mount

Panel mount

Mounting bracket

Space saving

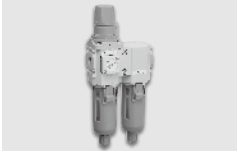
2-port valve connection possible

Solution examples

Leakage inspection

Fill a water container with gas and inspect whether it leaks.

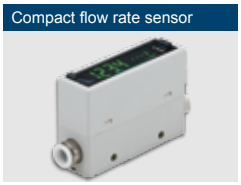
Filter unit

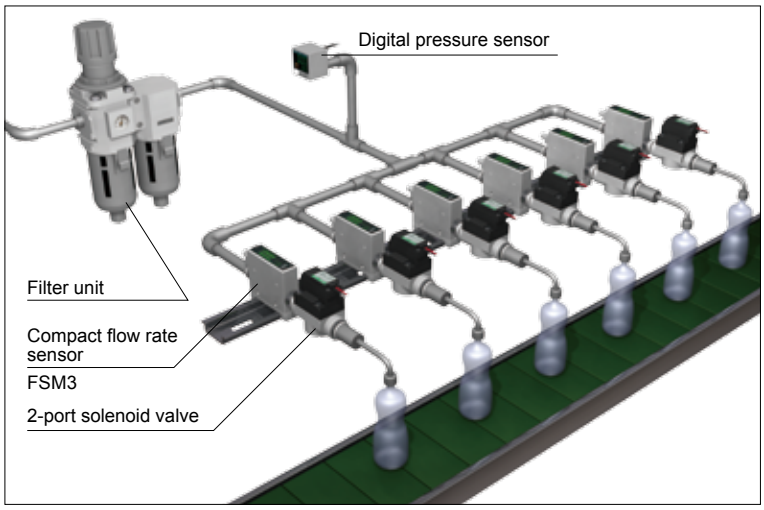


Digital pressure sensor

2-port solenoid valve

Compact flow rate sensor

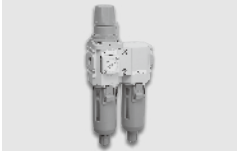




Maintenance of air consumption

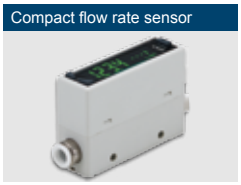
Monitor the air consumption of facilities using air devices.

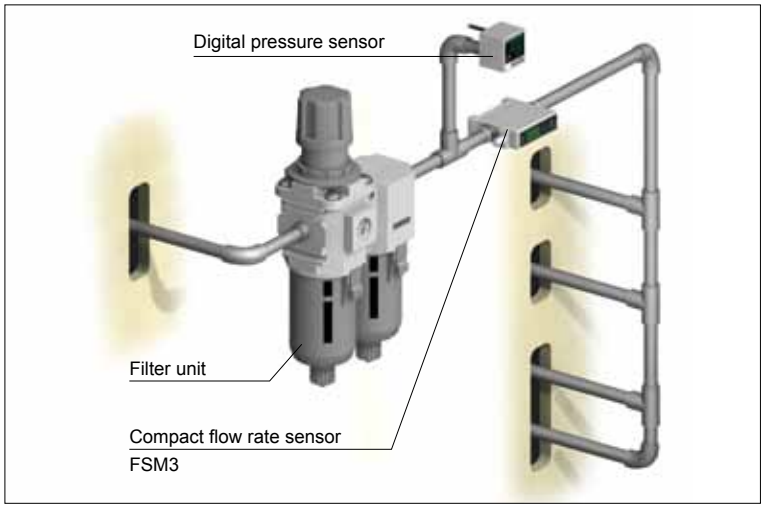
Filter unit



Digital pressure sensor

Compact flow rate sensor





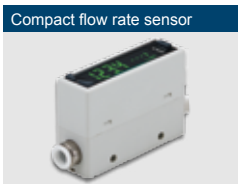
Painting air flow rate control

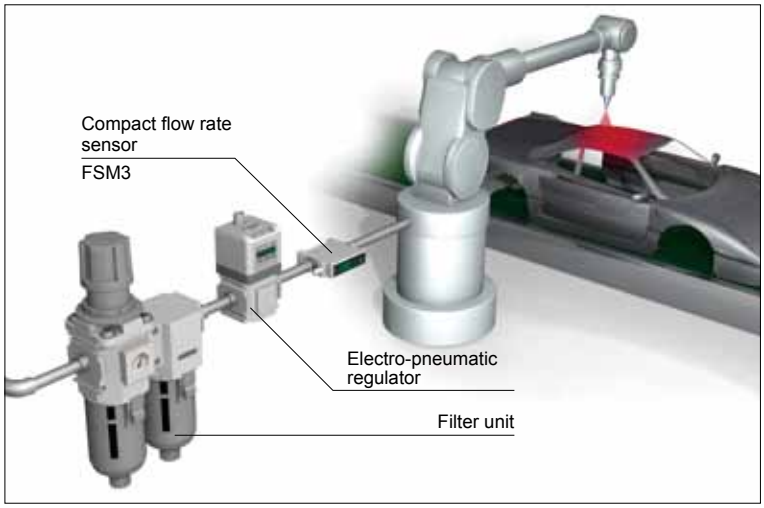
Change the air pressure and controls flow rate used during coating with the electro-pneumatic regulator.

Filter unit

Electro pneumatic regulator

Compact flow rate sensor

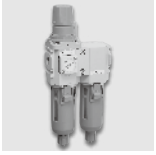




Confirm suction of electronic parts

Detect whether electronic parts have been suctioned or not using flow rate.

Filter unit

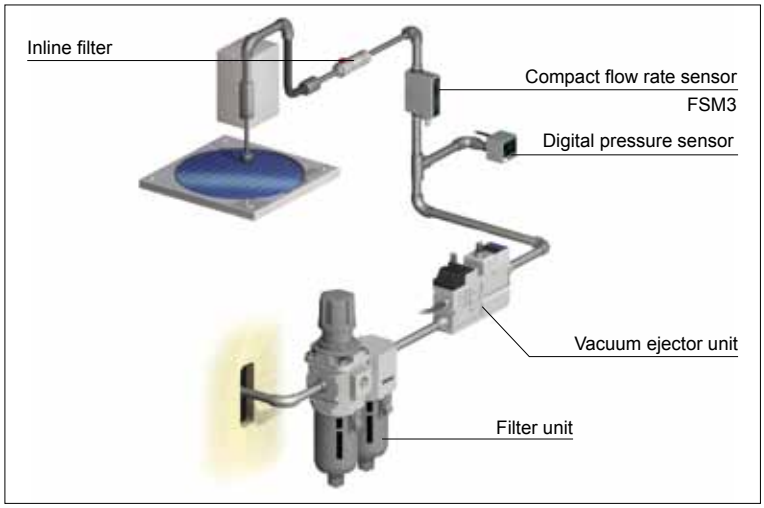


Vacuum ejector unit

Digital pressure sensor

Compact flow rate sensor

Inline filter



Arc welding

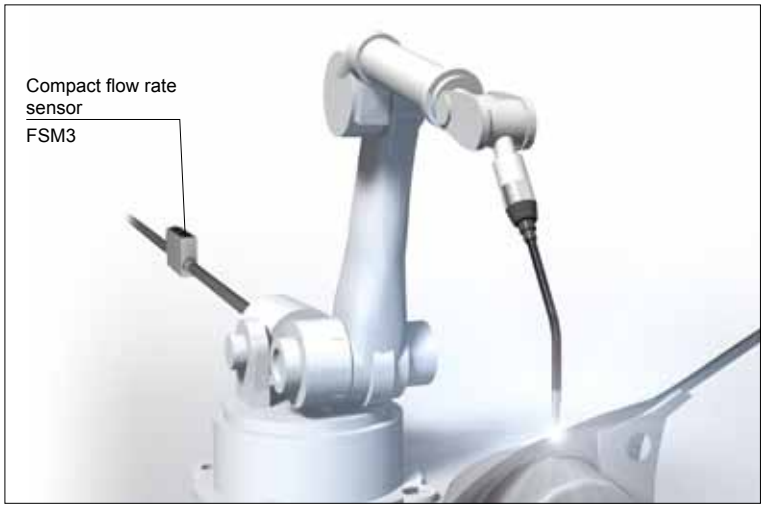
Maintain the flow rate of argon, mixed gas (argon + carbon dioxide), and other shielding gases.

Rotary clamp cylinder

Guided cylinder

Cylinder switch with connector

Compact flow rate sensor



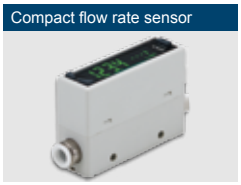
Electronic part installation

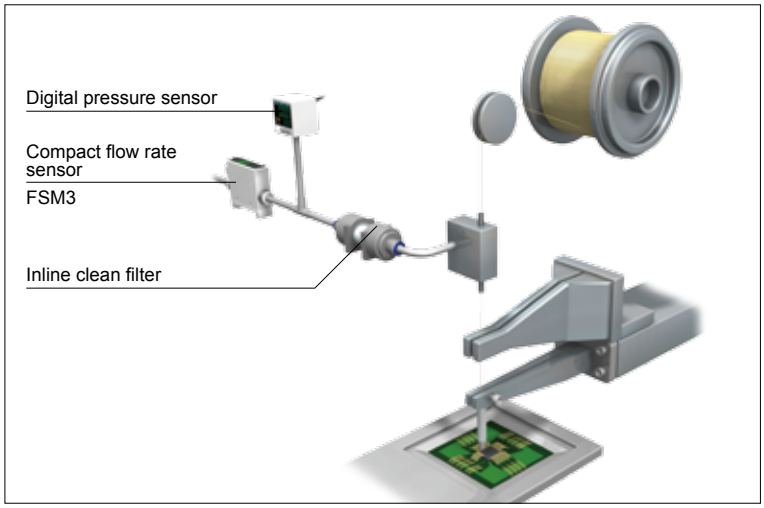
Control the tension of gold wire for installing electronic parts.

Inline clean filter

Digital pressure sensor

Compact flow rate sensor





Series variation

For compact flow rate sensor RAPIFLOW FSM3 Series

Appearance	Applicable fluids	Flow rate adjusting bar	EXA Connection fitting	Clean-room specifications	
				P70	P80
LCD display 	Air Nitrogen	●		●	●
		●		●	●
		●		●	
		●		●	
		●		●	
		●		●	
		●		●	●
		●	●	●	●
				●	●
		●		●	●
		●		●	●
				●	●
		●		●	●
		●		●	●
				●	●
Bar display 				●	●
				●	●
				●	
				●	
				●	
				●	
				●	●
			●	●	●
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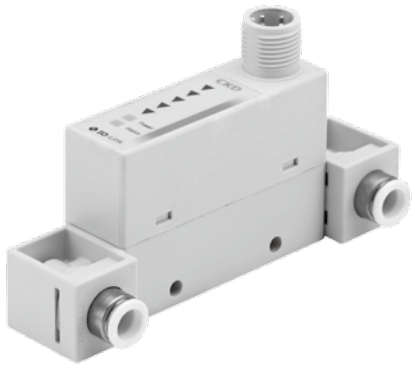
				●	●
IO-Link 				●	●
				●	●
				●	
				●	
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				●	●
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				●	●
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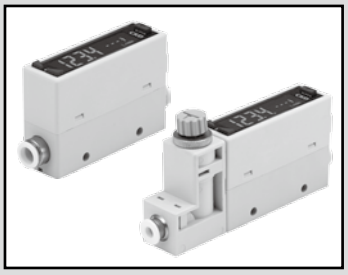
				●	●

	Port size	Max. flow rate (L/min)											Description page
		0.5	1	2	5	10	20	50	100	200	500	1000	
	φ4	●	●	●	●	●	●						
	φ6	●	●	●	●	●	●	●					
	φ8							●	●	●			
	φ10								●	●			
	φ1/4"	●	●	●	●	●	●	●					
	φ3/8"								●	●			
	Rc1/8	●	●	●	●	●	●	●					
	Rc1/4							●	●	●			1
	Rc1/2										●	●	
	NPT1/8	●	●	●	●	●	●	●					
	NPT1/4							●	●	●			
	NPT1/2										●	●	
	G1/8	●	●	●	●	●	●	●					
	G1/4							●	●	●			
	G1/2										●	●	
	φ4	●	●	●	●	●	●						
	φ6	●	●	●	●	●	●	●					
	φ8							●	●	●			
	φ10								●	●			
	φ1/4"	●	●	●	●	●	●	●					
	φ3/8"								●	●			
	Rc1/8	●	●	●	●	●	●	●					
	Rc1/4							●	●	●			7
	Rc1/2										●	●	
	NPT1/8	●	●	●	●	●	●	●					
	NPT1/4							●	●	●			
	NPT1/2										●	●	
	G1/8	●	●	●	●	●	●	●					
	G1/4							●	●	●			
	G1/2										●	●	
	φ4	●	●	●	●	●	●						
	φ6	●	●	●	●	●	●	●					
	φ8							●	●	●			
	φ10								●	●			
	φ1/4"	●	●	●	●	●	●	●					
	φ3/8"								●	●			
	Rc1/8	●	●	●	●	●	●	●					
	Rc1/4							●	●	●			13
	Rc1/2										●	●	
	NPT1/8	●	●	●	●	●	●	●					
	NPT1/4							●	●	●			
	NPT1/2										●	●	
	G1/8	●	●	●	●	●	●	●					
	G1/4							●	●	●			
	G1/2										●	●	



Compact flow rate sensor RAPIFLOW

FSM3 Series

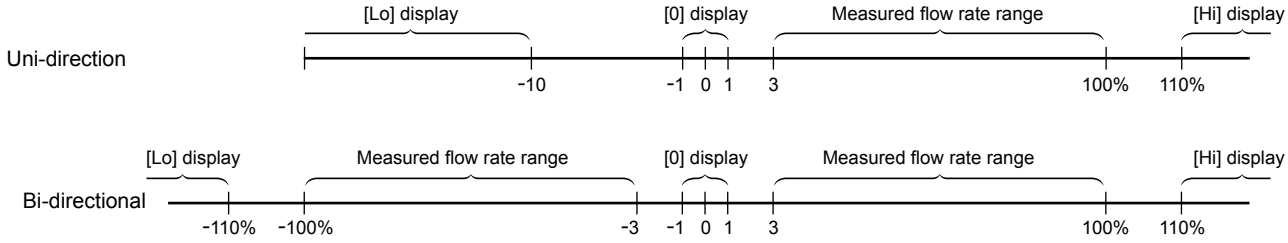
LCD display

● Resin body (flow rate range: 500 mL/min to 1000 L/min)

LCD display specifications

Descriptions			FSM3-[A][B][C][D][E][F][G][H][I]-[ ]										
			[B]										
			005	010	020	050	100	200	500	101	201	501	102
Flow direction	[C]	U	Uni-direction										
		B	Bi-direction										
Measured flow rate range (□/min) *1	[B]	U	15 to 500 mL	30 to 1000 mL	0.06 to 2.00 L	0.15 to 5.00 L	0.30 to 10.00 L	0.6 to 20.0 L	1.5 to 50.0 L	3.0 to 100.0 L	6 to 200 L	15 to 500 L	30 to 1000 L
		B	-500 to -15, 15 to 500 mL	-1000 to -30, 30 to 1000 mL	-2.00 to -0.06, 0.06 to 2.00 L	-5.00 to -0.15, 0.15 to 5.00 L	-10.00 to -0.30, 0.30 to 10.00 L	-20.0 to -0.6, 0.6 to 20.0 L	-50.0 to -1.5, 1.5 to 50.0 L	-100.0 to -3.0, 3.0 to 100.0 L	-200 to -6, 6 to 200 L	-500 to -15, 15 to 500 L	-1000 to -30, 30 to 1000 L
Display			4-digit + 4-digit 2-color LCD										
Flow rate display range (□/min) *2	[B]	U	0 to 549 mL	0 to 1099 mL	0.00 to 2.19 L	0.00 to 5.49 L	0.00 to 10.99 L	0.0 to 21.9 L	0.0 to 54.9 L	0.0 to 109.9 L	0 to 219 L	0 to 549 L	0 to 1099 L
		B	-549 to 549 mL	-1099 to 1099 mL	-2.19 to 2.19 L	-5.49 to 5.49 L	-10.99 to 10.99 L	-21.9 to 21.9 L	-54.9 to 54.9 L	-109.9 to 109.9 L	-219 to 219 L	-549 to 549 L	-1099 to 1099 L
Integration display *3		Display range	0 to 9999999 mL		0.00 to 99999.99 L			0.0 to 999999.9 L			0 to 9999999 L		
		Pulse output rate	5 mL	10 mL	0.02 L	0.05 L	0.1 L	0.2 L	0.5 L	1 L	2 L	5 L	10 L
Working conditions		Applicable fluids *4	Clean air (JIS B 8392-1:2012 1.1.1 to 5.6.2), compressed air (JIS B 8392-1:2012 1.1.1 to 1.6.2), nitrogen gas										
		Temperature range	0 to 50°C (no condensation)										
		Pressure range	−0.07 to 0.75 MPa								0 to 0.75 MPa		
		Proof pressure	1 MPa										
Operating ambient temperature/humidity			0 to 50°C, 90% RH or less										
Storage temperature			−10 to 60°C										
Accuracy (Fluid: in dry air)		Accuracy *5	Within ±3% F.S. (Secondary side released to atmosphere) (Scope of warranty depends on the "Measured flow rate range")										
		Repeatability *6	Within ±1% F.S. (Secondary side released to atmosphere)										
		Temperature characteristics	Within ±0.2% F.S./°C (15 to 35°C, base temperature 25°C)										
		Pressure characteristics	Within ±5% F.S. (−0.07 to 0.75 MPa, where secondary side is released to atmosphere)								Within ±5% F.S. (0 to 0.75 MPa, base pressure 0.35 MPa)		
Response time *7			50 msec or below (Response time set to OFF)										
Switch output	[G]	A, B, E, F	NPN open collector output (50 mA or less, voltage drop 2.4 V or less)										
		C, D, G, H	PNP open collector output (50 mA or less, voltage drop 2.4 V or less)										
Analog output *8		A, B, C, D	1 to 5 V voltage output (connecting load impedance 50 kΩ and over)										
		E, F, G, H	4 to 20 mA current output (connecting load impedance 0 to 300 Ω)										
Power supply voltage *9		A, B, C, D	12 to 24 VDC (10.8 to 26.4 V) ripple rate 1% or less										
		E, F, G, H	24 VDC (21.6 to 26.4 V) ripple rate 1% or less										
Current consumption *10			45 mA or less										
Lead wire			φ3.7, AWG26 or equivalent × 5-conductor (connector), insulator outer diameter φ1.0										
Functions *11			① Gas change, ② setting detail copy, ③ flow rate adjustment, ④ peak hold, etc.										
Degree of protection			IP40-equivalent (IEC standards)										
Protection circuit *12			Power reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection										
Vibration resistance			10 to 150 Hz, max. 100 m/s^2, X, Y, Z direction, every 2 hours										
EMC Directive			EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8										
Mounting		Mounting orientation *13	Unrestricted in vertical/horizontal direction										
		Straight piping installation section *14	Not required										

*1: The value converted to volumetric flow rate at standard condition (20°C 1 barometric pressure (101 kPa) relative humidity 65%)
*2: The displays of various flow rates are as shown below.



*3: The integrating flow is a calculated (reference) value. When using the integration maintaining function, be careful that the number of times maintained does not exceed the number of access times of the storage element (the limit is 1 million times). (Changes to the settings are counted in number of accesses.)

$$\text{Times maintained} = \frac{\text{Usage time}}{\text{Maintenance intervals}} < 1 \text{ million}$$

When instantaneous flow rate is below 1% it is not counted as integrating flow.
*4: Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist. When using compressed air, use clean air that complies with JIS B 8392-1:2012 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drain (water, oil oxide, foreign substances, etc.). To maintain the function of this product, install a filter, air dryer (min. pressure dew point 10°C or less), and oil mist filter (max. oil content 0.1 mg/m^3) on the primary side (upstream side) of this product. (Refer to the recommended values on page 38.)
*5: The accuracy is based on CKD's basic flow rate meter. It does not show absolute accuracy.
*6: Repeatability over a short period of time. Change over time is not included. (Refer to the product specifications sheet for details.)
*7: Actual response time may differ depending on piping conditions. Setting response time can be selected from between 50 msec to 1.5 sec.
*8: The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output and error increase. Check error with the impedance of the connecting load before using.
*9: The power supply voltage specifications differ for the voltage output and current output.
*10: Current for when 24 VDC is connected and no load is applied. The current consumption will vary depending on how the load is connected.
*11: Gas can be changed to argon, carbon dioxide, and argon 80% + carbon dioxide 20% with the gas change function. Full scale flow rate and analog output after changing gas is as follows. (Note that gas exchange function cannot be set with a full scale flow rate of 500 or 1000 L/min.)

Gas	Flow direction	Full scale flow rate	Analog output	
			Voltage	Current
Air/nitrogen	Uni-direction	0 to 100%	1 to 5 V	4 to 20 mA
	Bi-direction	−100 to 100%		
Argon	Uni-direction	0 to 100%	1 to 5 V	4 to 20 mA
	Bi-direction	−100 to 100%		
Carbon dioxide	Uni-direction	0 to 50%	1 to 3 V	4 to 12 mA
	Bi-direction	−50 to 50%	2 to 4 V	8 to 16 mA
Argon 80% Carbon dioxide 20%	Uni-direction	0 to 100%	1 to 5 V	4 to 20 mA
	Bi-direction	−100 to 100%		

*12: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.
*13: This product measures the change in heat distribution caused by flow.
When set to horizontal direction, the convection flow can influence a change in heat distribution, causing the zero point to shift.
*14: Piping conditions may affect accuracy. For more accurate measurements, use a straight pipe with an internal diameter ten times greater.
*15: Refer to page 32 for weight.

How to order

FSM3 - L 005 U 1 BH 1 A 1 N - B M R - P80

Model No. FSM3

Ⓐ Display — L

Ⓑ Flow rate range (full scale flow rate) — 005

Ⓒ Flow direction — U

Ⓓ Body material/compatible fluids — 1

Ⓔ Port size — BH

Ⓕ Piping direction — 1

Ⓖ Output specifications — A

Ⓗ Unit specifications — 1

Ⓘ Valve option — N

Ⓙ Cable — B

Ⓚ Mounting attachments — M

Ⓛ Attachments — R

Ⓜ Clean-room specifications — P80

Ⓐ Display

Code	Content
L	Liquid crystal display

Ⓑ Flow rate range (full scale flow rate)

005	500 mL/min	500	50 L/min
010	1 L/min	101	100 L/min
020	2 L/min	201	200 L/min
050	5 L/min	501	500 L/min
100	10 L/min	102	1000 L/min
200	20 L/min		

Ⓒ Flow direction

U	Uni-direction
B	Bi-direction

Ⓓ Body material/compatible fluids

	Body material	Compatible fluids
1	Resin	Air (Gas can be changed)

Ⓔ Port size

BH	Push-in (for φ4 mm tube)	AB	G1/8
CH	Push-in (for φ6 mm tube)	BB	G1/4
DH	Push-in (for φ8 mm tube)	CB	G1/2
EH	Push-in (for φ10 mm tube)	AC	NPT1/8
HH	Push-in (for φ1/4" tube)	BC	NPT1/4
JH	Push-in (for φ3/8" tube)	CC	NPT1/2
AA	Rc1/8		
BA	Rc1/4		
CA	Rc1/2		

Ⓕ Piping direction

1	Straight
2	Elbow *2

Ⓖ Output specifications

	Analog output	Switch output	Copy function
A	1-point (Voltage output) 1-5 V	1-point (NPN)	With
B		2-point (NPN)	-
C		1-point (PNP)	With
D		2-point (PNP)	-
E	1-point (Current output) 4-20 mA	1-point (NPN)	With
F		2-point (NPN)	-
G		1-point (PNP)	With
H		2-point (PNP)	-

Ⓗ Unit specifications

1	SI units only
2	With unit change function (only for overseas) *3

Ⓘ Valve option

N	None
T	With needle valve (only for models 200 L or less)
E	EXA connecting fitting (EXA sold separately) *6, *7

Ⓙ Cable

Blank	None
A	5 conductor 1 m
B	5 conductor 3 m

Ⓚ Mounting attachments *4, *5

Blank	None
H	Bracket 1 (for models 200 L or less)
J	Bracket 2 (for models 500 or 1000 L)
K	Panel mounting (for sensor products of models 200 L or less)
L	Panel mounting (for needle valves of models 200 L or less)
M	DIN rail mounting (for models 200 L or less)

Ⓛ Attachments

Blank	None
R	Company certification
S	Company certification + traceability certificate

Ⓜ Clean-room specifications

Blank	None
P70	Anti-dust generation *8
P80	Oil prohibited *9

[Example of model No.]

FSM3-L005U1BH1A1N-BMR-P80

Model: RAPIFLOW FSM3 Series

- Ⓐ Display L : Liquid crystal display
- Ⓑ Flow rate range 005 : 500 mL/min
- Ⓒ Flow direction U : Uni-direction
- Ⓓ Body material/compatible fluids 1 : Resin/air
- Ⓔ Port size BH : Push-in (φ4 mm for tube)
- Ⓕ Piping direction 1 : Straight
- Ⓖ Output specifications A : Analog voltage output ×1, NPN Switch output ×1, with copy function
- Ⓗ Unit specifications 1 : SI units only
- Ⓘ Valve option N : None
- Ⓙ Cable B : 5 conductor 3m
- Ⓚ Mounting attachments M : DIN rail mount
- Ⓛ Attachments R : Company certification
- Ⓜ Clean-room specifications P80 : Oil prohibited

Precautions for model No. selection

*1: During selection, always check the compatibility table on the next page.
*2: Note that if you mount the elbow fitting in a downward position, it will interfere with the DIN rail mounting.
*3: The model with unit change cannot be sold in Japan.
*4: Note that the bracket mounting position may interfere with the elbow fitting.
*5: Optional parts will come with the product. They are not pre-assembled.
*6: Connection to solenoid valves (EXA Series) is possible with the dedicated fitting. Refer to page 39.
*7: Be sure to set EXA to the OUT side of the product.
*8: Product surface is degreased before packaging and heat sealed into an antistatic bag on the clean bench (Class 1000 and over).
*9: The wetted section is degreased in addition to the specifications on P80.

Compatibility table of flow rate range and port size, needle valve option, and EXA connection fitting

Ⓑ Flow rate	Ⓔ Port size Ⓕ Piping direction													
	BH1	CH1	DH1	EH1	HH1	JH1	BH2	CH2	DH2	EH2	HH2	JH2	AA1	BA1
005	●○	●○			●○		●○	●○			●○		●○	
010	●○	●○			●○		●○	●○			●○		●○	
020	●○	●○			●○		●○	●○			●○		●○	
050	●○	●○			●○		●○	●○			●○		●○	
100	●○	●○			●○		●○	●○			●○		●○	
200	●○	●○			●○		●○	●○			●○		●○	
500		●○	●○		●○			●○	●○		●○		●○	●○★
101			●○	●○		●○			●○	●○		●○		●○★
201			●○	●○		●○			●○	●○		●○		●○★
501														
102														
	CA1	AA2	BA2	AB1	BB1	CB1	AB2	BB2	AC1	BC1	CC1	AC2	BC2	
005		●○		●○			●○		●○			●○		
010		●○		●○			●○		●○			●○		
020		●○		●○			●○		●○			●○		
050		●○		●○			●○		●○			●○		
100		●○		●○			●○		●○			●○		
200		●○		●○			●○		●○			●○		
500		●○	●○	●○	●○		●○	●○	●○	●○		●○	●○	
101			●○		●○			●○		●○			●○	
201			●○		●○			●○		●○			●○	
501	●					●					●			
102	●					●					●			

●: Port compatibility ○: Needle valve option compatibility ★: EXA connection fitting compatibility

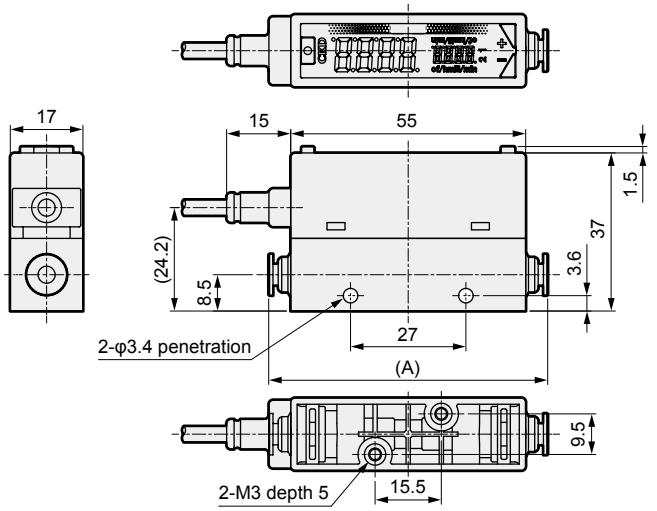
Compatibility table of port size and clean-room specifications

Ⓜ Clean-room specifications	Ⓔ Port size Ⓕ Piping direction													
	BH1	CH1	DH1	EH1	HH1	JH1	BH2	CH2	DH2	EH2	HH2	JH2	AA1	BA1
Blank	●	●	●	●	●	●	●	●	●	●	●	●	●	●
P70	●	●	●	●	●	●	●	●	●	●	●	●	●	●
P80	●	●					●	●					●	●
	CA1	AA2	BA2	AB1	BB1	CB1	AB2	BB2	AC1	BC1	CC1	AC2	BC2	
Blank	●	●	●	●	●	●	●	●	●	●	●	●	●	
P70	●	●	●	●	●	●	●	●	●	●	●	●	●	
P80	●	●	●	●	●	●	●	●	●	●	●	●	●	

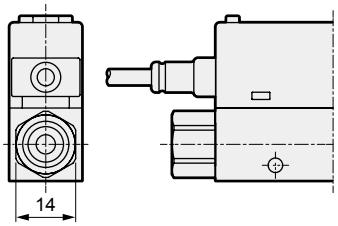
Dimensions (LCD display)

Port size: straight φ4 mm, φ6 mm, 1/4", Rc1/8, G1/8, NPT1/8

● FSM3-L[B][C]1/BH1/CH1/HH1/AA1/AB1/AC1 (Full scale flow rate: 500 mL/min,1, 2, 5, 10, 20, 50 L/min)



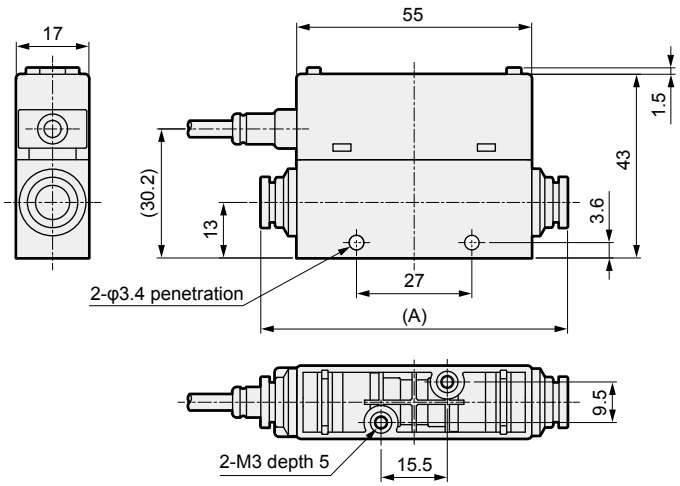
Rc1/8, NPT1/8, G1/8



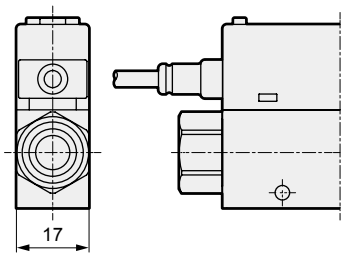
Model No.	Fitting	Dimension (A)
FSM3-L□□1BH1	Push-in φ4 mm	(64)
FSM3-L□□1CH1	Push-in φ6 mm	(65)
FSM3-L□□1HH1	Push-in 1/4"	(69.4)
FSM3-L□□1AA1	Rc1/8	(75)
FSM3-L□□1AB1	G1/8	(87)
FSM3-L□□1AC1	NPT1/8	(75)

Port size: straight φ8 mm, φ10 mm, 3/8", Rc1/4, G1/4, NPT1/4

● FSM3-L[B][C]1/DH1/EH1/JH1/BA1/BB1/BC1 (Full scale flow rate: 50, 100, 200 L/min)



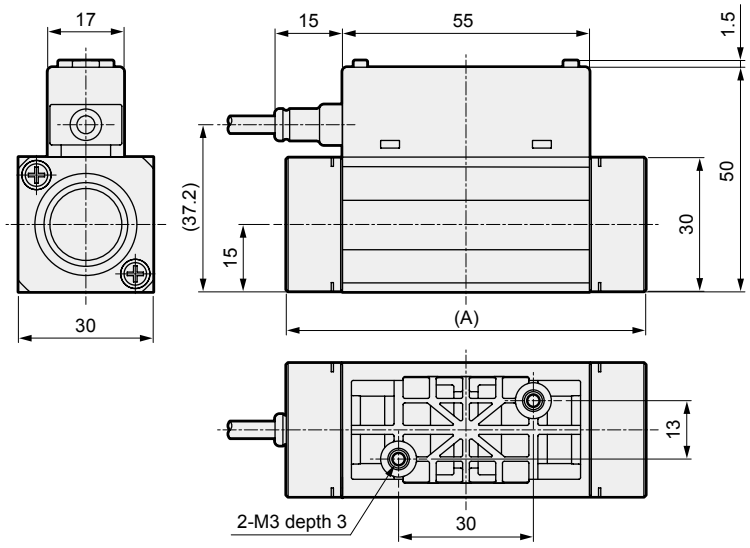
Rc1/4, NPT1/4, G1/4



Model No.	Fitting	Dimension (A)
FSM3-L□□1DH1	Push-in φ8 mm	(70.6)
FSM3-L□□1EH1	Push-in φ10 mm	(82.1)
FSM3-L□□1JH1	Push-in 3/8"	(83.2)
FSM3-L□□1BA1	Rc1/4	(75)
FSM3-L□□1BB1	G1/4	(88)
FSM3-L□□1BC1	NPT1/4	(75)

Port size: straight Rc1/2, G1/2, NPT1/2

● FSM3-L[B][C]1/CA1/CB1/CC1 (Full scale flow rate: 500, 1000 L/min)

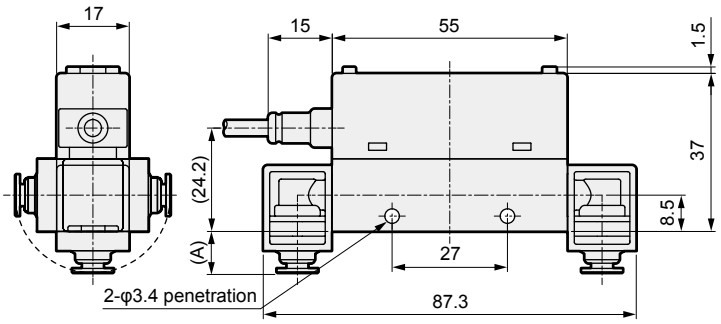


Model No.	Fitting	Dimension (A)
FSM3-L□□1CA1	Rc1/2	80
FSM3-L□□1CB1	G1/2	80
FSM3-L□□1CC1	NPTG1/2	95.4

Dimensions (LCD display)

Port size: elbow φ4 mm, φ6 mm, 1/4", Rc1/8, G1/8, NPT1/8

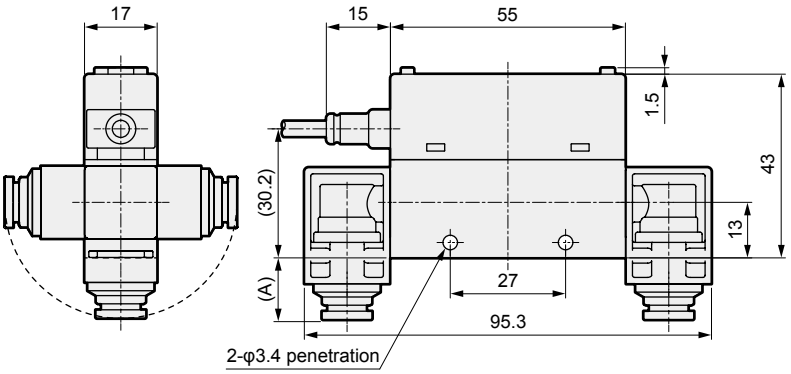
● FSM3-L[B][C]1/BH2/CH2/HH2/AA2/AB2/AC2 (Full scale flow rate: 500 mL/min, 1, 2, 5, 10, 20, 50 L/min)



Model No.	Fitting	Dimension (A)
FSM3-L□□1BH2	Push-in φ4 mm	(9.1)
FSM3-L□□1CH2	Push-in φ6 mm	(10.7)
FSM3-L□□1HH2	Push-in 1/4"	(14.7)
FSM3-L□□1AA2	Rc1/8	(14.5)
FSM3-L□□1AB2	G1/8	(20.5)
FSM3-L□□1AC2	NPT1/8	(14.5)

Port size: elbow φ8 mm, φ10 mm, 3/8", Rc1/4, G1/4, NPT1/4

● FSM3-L[B][C]1/DH2/EH2/JH2/BA2/BB2/BC2(Full scale flow rate: 50, 100, 200 L/min)

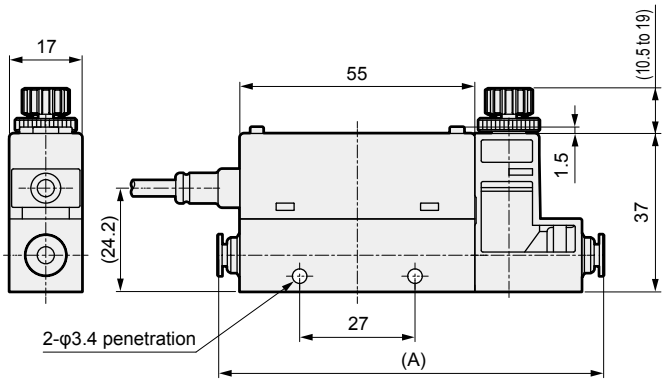


Model No.	Fitting	Dimension (A)
FSM3-L□□1DH2	Push-in φ8 mm	(13.4)
FSM3-L□□1EH2	Push-in φ10 mm	(19.2)
FSM3-L□□1JH2	Push-in 3/8"	(19.8)
FSM3-L□□1BA2	Rc1/4	(15.8)
FSM3-L□□1BB2	G1/4	(22.8)
FSM3-L□□1BC2	NPT1/4	(15.8)

With needle valve dimensions

Port size: φ4 mm, φ6 mm, 1/4", Rc1/8, G1/8, NPT1/8

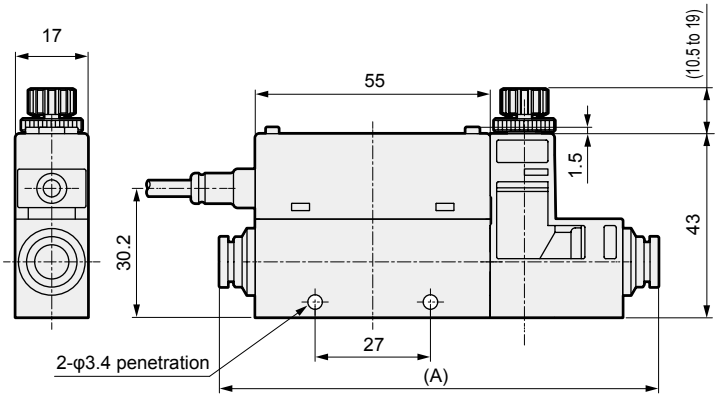
● FSM3-L[B][C]1/BH1/CH1/HH1/AA1/AB1/AC1/[G][H]T (Full scale flow rate: 500 mL/min, 1, 2, 5, 10, 20, 50 L/min)



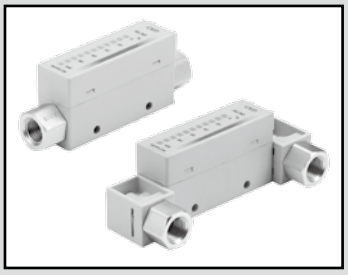
Model No.	Fitting	Dimension (A)
FSM3-L□□1BH1	Push-in φ4 mm	(89)
FSM3-L□□1CH1	Push-in φ6 mm	(90)
FSM3-L□□1HH1	Push-in 1/4"	(94.4)
FSM3-L□□1AA1	Rc1/8	(100)
FSM3-L□□1AB1	G1/8	(112)
FSM3-L□□1AC1	NPT1/8	(100)

Port size: φ8 mm, φ10 mm, 3/8", Rc1/4, G1/4, NPT1/4

● FSM3-L[B][C]1/DH1/EH1/JH1/BA1/BB1/BC1/[G][H]T (Full scale flow rate: 50, 100, 200 L/min)



Model No.	Fitting	Dimension (A)
FSM3-L□□1DH1	Push-in φ8 mm	(101.6)
FSM3-L□□1EH1	Push-in φ10 mm	(113.1)
FSM3-L□□1JH1	Push-in 3/8"	(114.2)
FSM3-L□□1BA1	Rc1/4	(106)
FSM3-L□□1BB1	G1/4	(119)
FSM3-L□□1BC1	NPT1/4	(106)



Compact flow rate sensor RAPIFLOW

FSM3 Series

Bar display

● Resin body (flow rate range: 500 mL/min to 1000 L/min)

CE RoHS

Bar display specifications

Descriptions			FSM3-[A][B][C][D][E][F][G][H][I]-[ ]										
			[B]										
			005	010	020	050	100	200	500	101	201	501	102
Flow direction	[C]	U	Uni-direction										
		B	Bi-direction										
Measured flow rate range (□/min) *1	[B]	U	15 to 500 mL	30 to 1000 mL	0.06 to 2.00 L	0.15 to 5.00 L	0.30 to 10.00 L	0.6 to 20.0 L	1.5 to 50.0 L	3.0 to 100.0 L	6 to 200 L	15 to 500 L	30 to 1000 L
		B	-500 to -15, 15 to 500 mL	-1000 to -30, 30 to 1000 mL	-2.00 to -0.06, 0.06 to 2.00 L	-5.00 to -0.15, 0.15 to 5.00 L	-10.00 to -0.30, 0.30 to 10.00 L	-20.0 to -0.6, 0.6 to 20.0 L	-50.0 to -1.5, 1.5 to 50.0 L	-100.0 to -3.0, 3.0 to 100.0 L	-200 to -6, 6 to 200 L	-500 to -15, 15 to 500 L	-1000 to -30, 30 to 1000 L
Display			LED bar display										
Working fluid		Applicable fluids *2	Clean air (JIS B 8392-1:2012 1.1.1 to 5.6.2), compressed air (JIS B 8392-1:2012 1.1.1 to 1.6.2), nitrogen gas										
		Temperature range	0 to 50°C (no condensation)										
		Pressure range	−0.07 to 0.75 MPa								0 to 0.75 MPa		
		Proof pressure	1 MPa										
Operating ambient temperature/humidity			0 to 50°C, 90% RH or less										
Storage temperature			−10 to 60°C										
Accuracy		Accuracy *3	Within ±3% F.S. (Secondary side released to atmosphere) (Scope of warranty depends on the "Measured flow rate range")										
		Repeatability *4	Within ±1% F.S. (Secondary side released to atmosphere)										
		Temperature characteristics	Within ±0.2% F.S./°C (15 to 35°C, base temperature 25°C)										
		Pressure characteristics	Within ±5% F.S. (−0.07 to 0.75 MPa, secondary side is released to atmosphere)								Within ±5% F.S. (0 to 0.75 MPa, base pressure 0.35 MPa)		
Response time *5			50 msec or less										
Analog output *6	[G]	J	1 to 5 V voltage output (connecting load impedance = 50 kΩ and over)										
		K	4 to 20 mA current output (connecting load impedance 0 to 300 Ω)										
Power supply voltage *7		J	12 to 24 VDC (10.8 to 26.4 V) ripple rate 1% or less										
		K	24 VDC (21.6 to 26.4 V) ripple rate 1% or less										
Current consumption *8			45 mA or less										
Lead wire			φ3.7, AWG26 or equivalent × 4-conductor (connector), insulator outer diameter φ1.0										
Degree of protection			IP40-equivalent (IEC standards)										
Protection circuit *9			Power supply reverse connection protection										
Vibration resistance			10 to 150 Hz, max. 100 m/s^2, X, Y, Z direction, every 2 hours										
EMC Directive			EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8										
Mounting		Mounting orientation *10	Unrestricted in vertical/horizontal direction										
		Straight piping installation section *11	Not required										

*1: The value converted to volumetric flow rate at standard condition (20°C 1 barometric pressure (101 kPa) relative humidity 65%)
*2: Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist. When using compressed air, use clean air that complies with JIS B 8392-1:2012 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drain (water, oil oxide, foreign substances, etc.) To maintain the function of this product, install a filter, air dryer (min. pressure dew point 10°C or less), and oil mist filter (max. oil content 0.1 mg/m^3) on the primary side (upstream side) of this product. (Refer to the recommended values on page 38.)
*3: The accuracy is based on CKD's basic flow rate meter. It does not show absolute accuracy.
*4: Repeatability over a short period of time. Change over time is not included. (Refer to the product specifications sheet for details.)
*5: Actual response time may differ depending on piping conditions.
*6: The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output and error increase. Check error with the impedance of the connecting load before using.
*7: The power supply voltage specifications differ for the voltage output and current output.
*8: Current for when 24 VDC is connected and no load is applied. The current consumption will vary depending on how the load is connected.
*9: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.
*10: This product measures the change in heat distribution caused by flow.
When set to horizontal direction, the convection flow can influence a change in heat distribution, causing the zero point to shift.
*11: Piping conditions may affect accuracy. For more accurate measurements, use a straight pipe with an internal diameter ten times greater.
*12: Refer to page 32 for weight.

How to order

FSM3 - B 005 U 1 BH 1 J 1 N - D H S - P70

Model No. FSM3
Ⓐ Display: B
Ⓑ Flow rate range (full scale flow rate): 005
Ⓒ Flow direction: U
Ⓓ Body material/compatible fluids: 1
Ⓔ Port size: BH
Ⓕ Piping direction: 1
Ⓖ Output specifications: J
Ⓗ Unit specifications: 1
Ⓘ Valve option: N
Ⓙ Cable: D
Ⓚ Mounting attachments: H
Ⓛ Attachments: S
Ⓜ Clean-room specifications: P70

Code	Content
Ⓐ Display	
B	Bar display

Ⓑ Flow rate range (full scale flow rate)			
005	500 mL/min	**500**	50 L/min
010	1 L/min	**101**	100 L/min
020	2 L/min	**201**	200 L/min
050	5 L/min	**501**	500 L/min
100	10 L/min	**102**	1000 L/min
200	20 L/min		

Ⓒ Flow direction	
U	Uni-direction
B	Bi-direction

Ⓓ Body material/compatible fluids		
	Body material	Compatible fluids
1	Resin	Air (Gas can be changed)

Ⓔ Port size			
BH	Push-in (for φ4 mm tube)	**AB**	G1/8
CH	Push-in (for φ6 mm tube)	**BB**	G1/4
DH	Push-in (for φ8 mm tube)	**CB**	G1/2
EH	Push-in (for φ10 mm tube)	**AC**	NPT1/8
HH	Push-in (for φ1/4" tube)	**BC**	NPT1/4
JH	Push-in (for φ3/8" tube)	**CC**	NPT1/2
AA	Rc1/8		
BA	Rc1/4		
CA	Rc1/2		

Ⓕ Piping direction	
1	Straight
2	Elbow

Ⓖ Output specifications	
J	Analog voltage output × 1-point
K	Analog current output × 1-point

Ⓗ Unit specifications	
1	SI units only

Ⓘ Valve option	
N	None
E	EXA connecting fitting (EXA sold separately) *6, *7

Ⓙ Cable	
Blank	None
C	4 conductor 1 m
D	4 conductor 3 m

Ⓚ Mounting attachments *4, *5	
Blank	None
H	Bracket 1 (for models 200 L or less)
J	Bracket 2 (for models 500 or 1000 L)
M	DIN rail mounting (for models 200 L or less)

Ⓛ Attachments	
Blank	None
R	Company certification
S	Company certification + traceability certificate

Ⓜ Clean-room specifications		
Blank	None	
P70	Anti-dust generation	*8
P80	Oil prohibited	*9

[Example of model No.]

FSM3-B005U1BH1J1N-DHS-P70

Model: RAPIFLOW FSM3 Series

Ⓐ Display	B	: Bar display
Ⓑ Flow rate range	005	: 500 mL/min
Ⓒ Flow direction	U	: Uni-direction
Ⓓ Body material/compatible fluids	1	: Resin/air
Ⓔ Port size	BH	: Push-in (φ4 mm for tube)
Ⓕ Piping direction	1	: Straight
Ⓖ Output specifications	J	: Analog voltage output × 1
Ⓗ Unit specifications	1	: SI units only
Ⓘ Valve option	N	: None
Ⓙ Cable	D	: 4 conductor 3 m
Ⓚ Mounting attachments	H	: Bracket
Ⓛ Attachments	S	: Company certification + traceability certificate
Ⓜ Clean-room specifications	P70	: Anti-dust generation

Precautions for model No. selection

*1: During selection, always check the compatibility table on the next page.
*2: When using in combination with the separate display (FSMD2-D), select ["V": 1 to 5 V].
*3: Note that if you mount the elbow fitting in a downward position, it will interfere with the DIN rail mounting.
*4: Note that the bracket mounting position may interfere with the elbow fitting.
*5: Optional parts will come with the product. They are not pre-assembled.
*6: Connection to solenoid valves (EXA series) is possible with the dedicated fitting. Refer to page 39.
*7: Be sure to set EXA to the OUT side of the product.
*8: Product surface is degreased before packaging and heat sealed into an antistatic bag on the clean bench (Class 1000 and over).
*9: The wetted section is degreased in addition to the specifications on P70.

Compatibility table of flow rate range and port size, and EXA connection fitting

Ⓑ Flow rate	Ⓔ Port size Ⓕ Piping direction													
	BH1	CH1	DH1	EH1	HH1	JH1	BH2	CH2	DH2	EH2	HH2	JH2	AA1	BA1
005	●	●			●		●	●			●		●	
010	●	●			●		●	●			●		●	
020	●	●			●		●	●			●		●	
050	●	●			●		●	●			●		●	
100	●	●			●		●	●			●		●	
200	●	●			●		●	●			●		●	
500		●	●		●			●	●		●		●	●★
101			●	●		●			●	●		●		●★
201			●	●		●			●	●		●		●★
501														
102														
	CA1	AA2	BA2	AB1	BB1	CB1	AB2	BB2	AC1	BC1	CC1	AC2	BC2	
005		●		●			●		●			●		
010		●		●			●		●			●		
020		●		●			●		●			●		
050		●		●			●		●			●		
100		●		●			●		●			●		
200		●		●			●		●			●		
500		●	●	●	●		●	●	●	●		●	●	
101			●		●			●		●			●	
201			●		●			●		●			●	
501	●					●					●			
102	●					●					●			

●: Port compatibility ★: EXA connection fitting compatibility

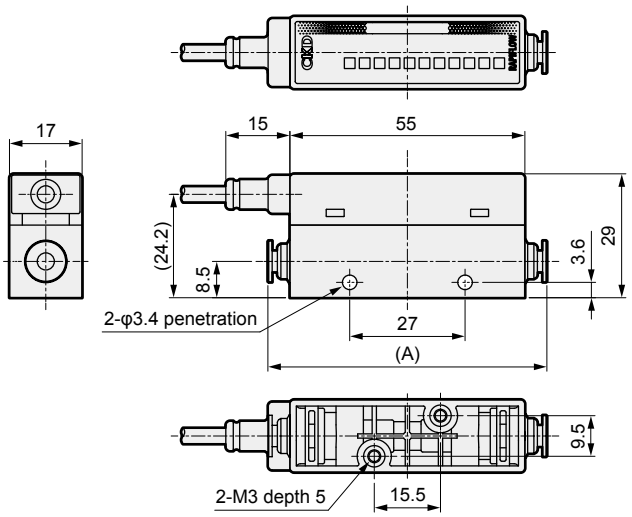
Compatibility table of port size and clean-room specifications

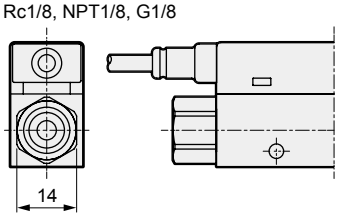
Ⓜ Clean-room specifications	Ⓔ Port size Ⓕ Piping direction													
	BH1	CH1	DH1	EH1	HH1	JH1	BH2	CH2	DH2	EH2	HH2	JH2	AA1	BA1
Blank	●	●	●	●	●	●	●	●	●	●	●	●	●	●
P70	●	●	●	●	●	●	●	●	●	●	●	●	●	●
P80	●	●					●	●					●	●
	CA1	AA2	BA2	AB1	BB1	CB1	AB2	BB2	AC1	BC1	CC1	AC2	BC2	
Blank	●	●	●	●	●	●	●	●	●	●	●	●	●	
P70	●	●	●	●	●	●	●	●	●	●	●	●	●	
P80	●	●	●	●	●	●	●	●	●	●	●	●	●	

Dimensions (bar display)

Port size: straight φ4 mm, φ6 mm, 1/4", Rc1/8, G1/8, NPT1/8

● FSM3-B□□1/BH1/CH1/HH1/AA1/AB1/AC1 (Full scale flow rate: 500 mL/min, 1, 2, 5, 10, 20, 50 L/min)

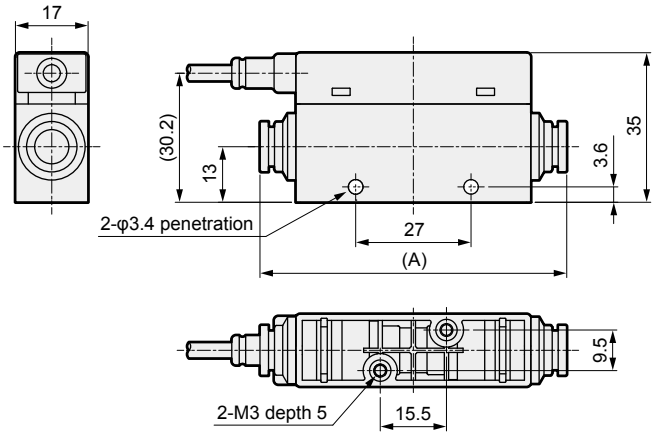


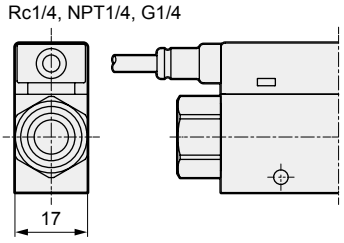


Model No.	Fitting	Dimension (A)
FSM3-B□□1BH1	Push-in φ4 mm	(64)
FSM3-B□□1CH1	Push-in φ6 mm	(65)
FSM3-B□□1HH1	Push-in 1/4"	(71)
FSM3-B□□1AA1	Rc1/8	(75)
FSM3-B□□1AB1	G1/8	(87)
FSM3-B□□1AC1	NPT1/8	(75)

Port size: straight φ8 mm, φ10 mm, 3/8", Rc1/4, G1/4, NPT1/4

● FSM3-B□□1/DH1/EH1/JH1/BA1/BB1/BC1 (Full scale flow rate: 50, 100, 200 L/min)

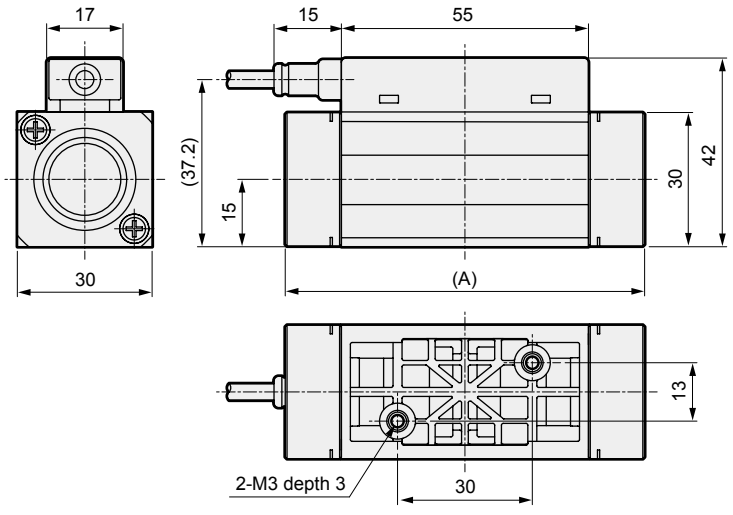




Model No.	Fitting	Dimension (A)
FSM3-B□□1DH1	Push-in φ8 mm	(70.6)
FSM3-B□□1EH1	Push-in φ10 mm	(82.1)
FSM3-B□□1JH1	Push-in 3/8"	(83.2)
FSM3-B□□1BA1	Rc1/4	(75)
FSM3-B□□1BB1	G1/4	(88)
FSM3-B□□1BC1	NPT1/4	(75)

Port size: straight Rc1/2, G1/2, NPT1/2

● FSM3-B□□1/CA1/CB1/CC1(Full scale flow rate: 500, 1000 L/min)

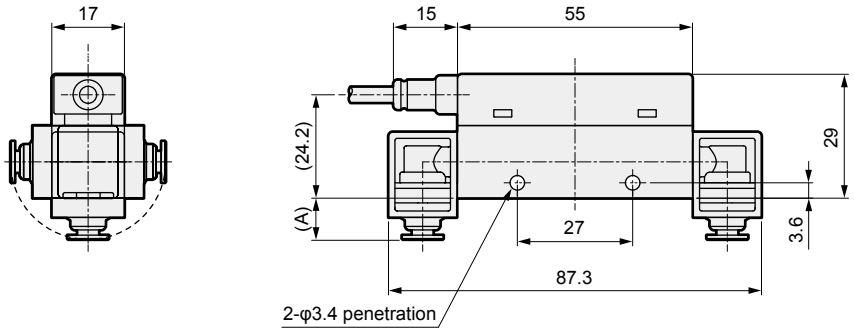


Model No.	Fitting	Dimension (A)
FSM3-B□□1CA1	Rc1/2	(80)
FSM3-B□□1CB1	G1/2	(95.4)
FSM3-B□□1CC1	NPT1/2	(80)

Dimensions (bar display)

Port size: elbow φ4 mm, φ6 mm, 1/4", Rc1/8, G1/8, NPT1/8

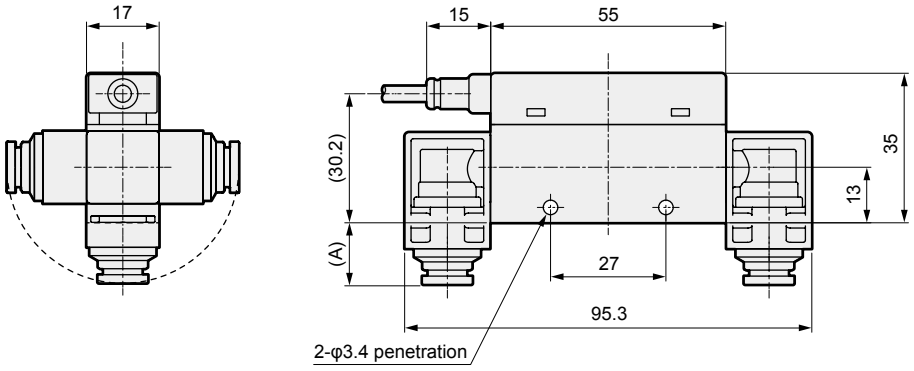
● FSM3-B[B][C]1/BH2/CH2/HH2/AA2/AB2/AC2 (Full scale flow rate: 500 mL/min, 1, 2, 5, 10, 20, 50 L/min)



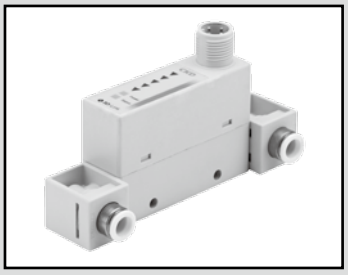
Model No.	Fitting	Dimension (A)
FSM3-B□□1BH2	Push-in φ4 mm	(9.1)
FSM3-B□□1CH2	Push-in φ6 mm	(10.7)
FSM3-B□□1HH2	Push-in 1/4"	(14.7)
FSM3-B□□1AA2	Rc1/8	(14.5)
FSM3-B□□1AB2	G1/8	(20.5)
FSM3-B□□1AC2	NPT1/8	(14.5)

Port size: elbow φ8 mm, φ10 mm, 3/8", Rc1/4, G1/4, NPT1/4

● FSM3-B[B][C]1/DH2/EH2/JH2/BA2/BB2/BC2 (Full scale flow rate: 50, 100, 200 L/min)



Model No.	Fitting	Dimension (A)
FSM3-L□□1DH2	Push-in φ8 mm	(13.4)
FSM3-L□□1EH2	Push-in φ10 mm	(19.2)
FSM3-L□□1JH2	Push-in 3/8"	(19.8)
FSM3-L□□1BA2	Rc1/4	(15.8)
FSM3-L□□1BB2	G1/4	(22.8)
FSM3-L□□1BC2	NPT1/4	(15.8)



Compact flow rate sensor RAPIFLOW

FSM3 Series

IO-Link

● Resin body (flow rate range: 500 mL/min to 1000 L/min)

IO-Link specifications

Descriptions			FSM3-[A][B][C][D][E][F][G][H][I]-[ ]										
			[B]										
			005	010	020	050	100	200	500	101	201	501	102
Flow direction	[C]	U	Uni-direction										
		B	Bi-direction										
Measured flow rate range (□/min) *1	[B]	U	15 to 500 mL	30 to 1000 mL	0.06 to 2.00 L	0.15 to 5.00 L	0.30 to 10.00 L	0.6 to 20.0 L	1.5 to 50.0 L	3.0 to 100.0 L	6 to 200 L	15 to 500 L	30 to 1000 L
		B	-500 to -15, 15 to 500 mL	-1000 to -30, 30 to 1000 mL	-2.00 to -0.06, 0.06 to 2.00 L	-5.00 to -0.15, 0.15 to 5.00 L	-10.00 to -0.30, 0.30 to 10.00 L	-20.0 to -0.6, 0.6 to 20.0 L	-50.0 to -1.5, 1.5 to 50.0 L	-100.0 to -3.0, 3.0 to 100.0 L	-200 to -6, 6 to 200 L	-500 to -15, 15 to 500 L	-1000 to -30, 30 to 1000 L
Display			LED display (power lamp, status lamp)										
Working fluid		Applicable fluids *2	Clean air (JIS B 8392-1:2012 1.1.1 to 5.6.2), compressed air (JIS B 8392-1:2012 1.1.1 to 1.6.2), nitrogen gas										
		Temperature range	0 to 50°C (no condensation)										
		Pressure range	−0.07 to 0.75 MPa								0 to 0.75 MPa		
		Proof pressure	1 MPa										
Operating ambient temperature/humidity			0 to 50 °C, 90% RH or less										
Storage temperature			−10 to 60°C										
Accuracy		Accuracy *3	Within ±3% F.S. (Secondary side released to atmosphere) (Scope of warranty depends on the "Measured flow rate range")										
		Repeatability *4	Within ±1%F.S. (Secondary side released to atmosphere)										
		Temperature characteristics	Within ±0.2% F.S./°C (15 to 35°C, base temperature 25°C)										
		Pressure characteristics	Within ±5% F.S. (−0.07 to 0.75 MPa, secondary side is released to atmosphere)								Within ±5% F.S. (0 to 0.75 MPa, base pressure 0.35 MPa)		
Response time *5			50 msec or less										
Power supply voltage			18 to 30 VDC ripple rate 1% or less										
Current consumption *6			45 mA or less										
Lead wire *7			M12 both ends connector cable (3 m) AWG #23 or equivalent 4 conductor										
Functions			① Various exchanges, ② flow rate adjustment, ③ peak hold, etc.										
Degree of protection			IP40-equivalent (IEC standards)										
Protection circuit *8			Power supply reverse connection protection										
Vibration resistance *9			10 to 150 Hz, max. 100 m/s^2, X, Y, Z direction, every 2 hours										
EMC Directive			EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8										
Mounting		Mounting orientation *10	Unrestricted in vertical/horizontal direction										
		Straight piping installation section *11	Not required										

* Refer to page 36 for communication specifications.

*1: The value converted to volumetric flow rate at standard condition (20°C 1 barometric pressure (101 kPa) relative humidity 65%)
*2: Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist. When using compressed air, use clean air that complies with JIS B 8392-1:2012 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drain (water, oil oxide, foreign substances, etc.) To maintain the function of this product, install a filter, air dryer (min. pressure dew point 10°C or less), and oil mist filter (max. oil content 0.1 mg/m^3) on the primary side (upstream side) of this product. (Refer to the recommended values on page 38.)
*3: The accuracy is based on CKD's basic flow rate meter. It does not show absolute accuracy.
*4: Repeatability over a short period of time. Change over time is not included. (Refer to the product specifications sheet for details.)
*5: Actual response time may differ depending on piping conditions.
*6: Current for when 24 VDC is connected, and no load is applied. The current consumption will vary depending on how the load is connected.
*7: The male side is straight and the female side is at an angle. (Refer to page 37.)
Tighten the M12 connector with a torque of 0.5 N·m or lower.
Tightening it using excessive force may lead to damages.
*8: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.
*9: Depending on the vibration conditions, a communication error may occur. Install this product in a place subject to as little vibration as possible.
*10: This product measures the change in heat distribution caused by flow.
When set to horizontal direction, the convection flow can influence a change in heat distribution, causing the zero point to shift.
*11: Piping conditions may affect accuracy. For more accurate measurements, use a straight pipe with an internal diameter ten times greater.
*12: Refer to page 32 for weight.

How to order

FSM3 - C 005 U 1 BH 1 L 1 N - G H R - P70

Model No. FSM3

Ⓐ Display — C

Ⓑ Flow rate range (full scale flow rate) — 005

Ⓒ Flow direction — U

Ⓓ Body material/compatible fluids — 1

Ⓔ Port size — BH

Ⓕ Piping direction — 1

Ⓖ Output specifications — L

Ⓗ Unit specifications — 1

Ⓘ Valve option — N

Ⓙ Cable — G

Ⓚ Mounting attachments — H

Ⓛ Attachments — R

Ⓜ Clean-room specifications — P70

[Example of model No.]

FSM3-C005U1BH1L1N-GHR-P70

Model: RAPIFLOW FSM3 Series

Ⓐ Display	C	: IO-Link
Ⓑ Flow rate range	005	: 500 mL/min
Ⓒ Flow direction	U	: Uni-direction
Ⓓ Body material/compatible fluids	1	: Resin/air
Ⓔ Port size	BH	: Push-in (φ4 mm for tube)
Ⓕ Piping direction	1	: Straight
Ⓖ Output specifications	L	: IO-Link
Ⓗ Unit specifications	1	: SI units only
Ⓘ Valve option	N	: None
Ⓙ Cable	G	: M12 both ends connector cable (3 m)
Ⓚ Mounting attachments	H	: Bracket
Ⓛ Attachments	R	: Company certification
Ⓜ Clean-room specifications	P70	: Anti-dust generation

Precautions for model No. selection

*1: During selection, always check the compatibility table on the next page.
*2: Note that if you mount the elbow fitting in a downward position, it will interfere with the DIN rail mounting.
*3: Note that the bracket mounting position may interfere with the elbow fitting.
*4: Optional parts will come with the product. They are not pre-assembled.
*5: Product surface is degreased before packaging and heat sealed into an antistatic bag on the clean bench (Class 1000 and over).
*6: The wetted section is degreased in addition to the specifications on P70.

Code	Content
Ⓐ Display	
C	IO-Link

Ⓑ Flow rate range (full scale flow rate)

005	500 mL/min	500	50 L/min
010	1 L/min	101	100 L/min
020	2 L/min	201	200 L/min
050	5 L/min	501	500 L/min
100	10 L/min	102	1000 L/min
200	20 L/min		

Ⓒ Flow direction

U	Uni-direction
B	Bi-direction

Ⓓ Body material/compatible fluids

	Body material	Compatible fluids
1	Resin	Air (Gas can be changed)

Ⓔ Port size

BH	Push-in (for φ4 mm tube)	AB	G1/8
CH	Push-in (for φ6 mm tube)	BB	G1/4
DH	Push-in (for φ8 mm tube)	CB	G1/2
EH	Push-in (for φ10 mm tube)	AC	NPT1/8
HH	Push-in (for φ1/4" tube)	BC	NPT1/4
JH	Push-in (for φ3/8" tube)	CC	NPT1/2
AA	Rc1/8		
BA	Rc1/4		
CA	Rc1/2		

Ⓕ Piping direction

1	Straight
2	Elbow

Ⓖ Output specifications

L	IO-Link communication

Ⓗ Unit specifications

1	SI units only	*1

Ⓘ Valve option

N	None

Ⓙ Cable

Blank	None
G	M12 both ends connector cable (3 m)

Ⓚ Mounting attachments *3, *4

Blank	None
H	Bracket 1 (for models 200 L or less)
J	Bracket 2 (for models 500 or 1000 L)
M	DIN rail mounting (for models 200 L or less)

Ⓛ Attachments

Blank	None
R	Company certification
S	Company certification + traceability certificate

Ⓜ Clean-room specifications

Blank	None	
P70	Anti-dust generation	*5
P80	Oil prohibited	*6

Flow rate range and port size

B Flow rate	E Port size F Piping direction													
	BH1	CH1	DH1	EH1	HH1	JH1	BH2	CH2	DH2	EH2	HH2	JH2	AA1	BA1
005	●	●			●		●	●			●		●	
010	●	●			●		●	●			●		●	
020	●	●			●		●	●			●		●	
050	●	●			●		●	●			●		●	
100	●	●			●		●	●			●		●	
200	●	●			●		●	●			●		●	
500		●	●		●			●	●		●		●	●
101			●	●		●			●	●		●		●
201			●	●		●			●	●		●		●
501														
102														
	CA1	AA2	BA2	AB1	BB1	CB1	AB2	BB2	AC1	BC1	CC1	AC2	BC2	
005		●		●			●		●			●		
010		●		●			●		●			●		
020		●		●			●		●			●		
050		●		●			●		●			●		
100		●		●			●		●			●		
200		●		●			●		●			●		
500		●	●	●	●		●	●	●	●		●	●	
101			●		●			●		●			●	
201			●		●			●		●			●	
501	●					●					●			
102	●					●					●			

●: Port size compatibility

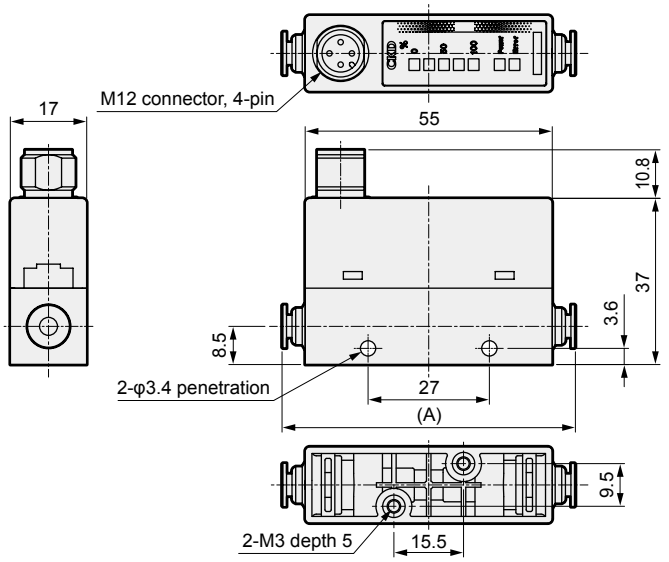
Compatibility table of port size and clean-room specifications

M Clean-room specifications	E Port size F Piping direction													
	BH1	CH1	DH1	EH1	HH1	JH1	BH2	CH2	DH2	EH2	HH2	JH2	AA1	BA1
Blank	●	●	●	●	●	●	●	●	●	●	●	●	●	●
P70	●	●	●	●	●	●	●	●	●	●	●	●	●	●
P80	●	●					●	●					●	●
	CA1	AA2	BA2	AB1	BB1	CB1	AB2	BB2	AC1	BC1	CC1	AC2	BC2	
Blank	●	●	●	●	●	●	●	●	●	●	●	●	●	
P70	●	●	●	●	●	●	●	●	●	●	●	●	●	
P80	●	●	●	●	●	●	●	●	●	●	●	●	●	

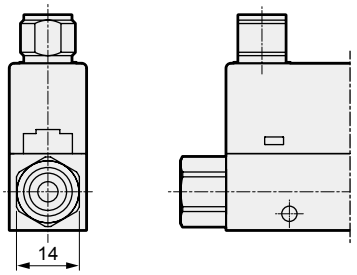
Dimensions (IO-Link)

Port size: straight φ4 mm, φ6 mm, 1/4", Rc1/8, G1/8, NPT1/8

●FSM3-C[B][C]1/BH1/CH1/HH1/AA1/AB1/AC1 (Full scale flow rate: 500 mL/min, 1, 2, 5, 10, 20, 50 L/min)



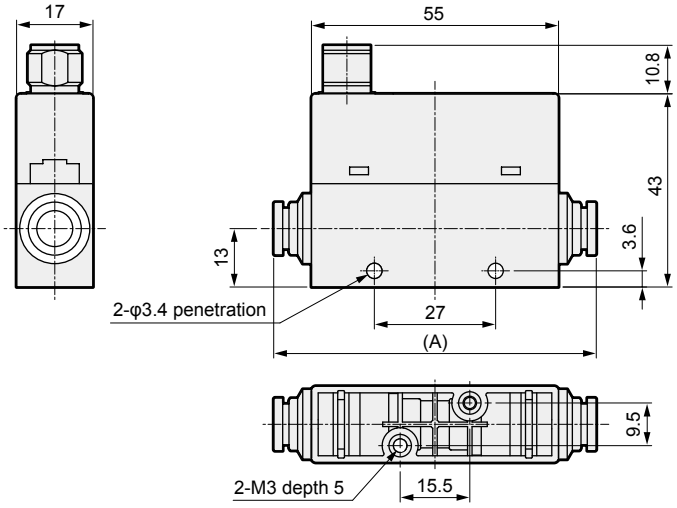
Rc1/8, NPT1/8, G1/8



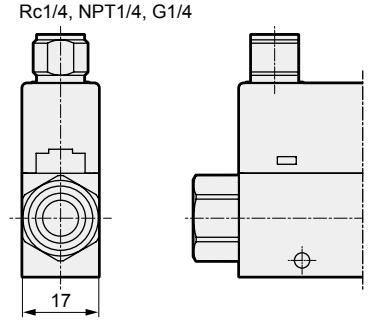
Model No.	Fitting	Dimension (A)
FSM3-C□□1BH1	Push-in φ4 mm	(64)
FSM3-C□□1CH1	Push-in φ6 mm	(65)
FSM3-C□□1HH1	Push-in 1/4"	(71)
FSM3-C□□1AA1	Rc1/8	(75)
FSM3-C□□1AB1	G1/8	(87)
FSM3-C□□1AC1	NPT1/8	(75)

Port size: straight φ8 mm, φ10 mm, 3/8", Rc1/4, G1/4, NPT1/4

●FSM3-C[B][C]1/DH1/EH1/JH1/BA1/BB1/BC1 (Full scale flow rate: 50, 100, 200 L/min)



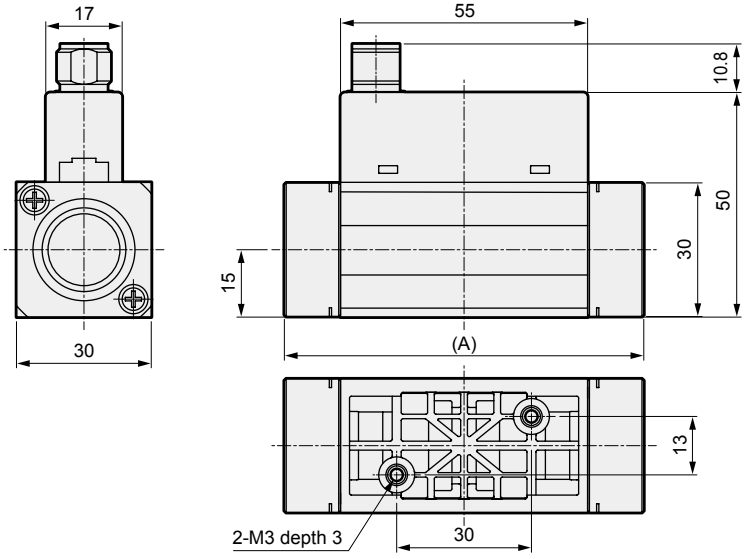
Rc1/4, NPT1/4, G1/4



Model No.	Fitting	Dimension (A)
FSM3-C□□1DH1	Push-in φ8 mm	(70.6)
FSM3-C□□1EH1	Push-in φ10 mm	(82.1)
FSM3-C□□1JH1	Push-in 3/8"	(83.2)
FSM3-C□□1BA1	Rc1/4	(75)
FSM3-C□□1BB1	G1/4	(88)
FSM3-C□□1BC1	NPT1/4	(75)

Port size: straight Rc1/2, G1/2, NPT1/2

●FSM3-C[B][C]1/CA1/CB1/CC1 (Full scale flow rate: 500, 1000 L/min)

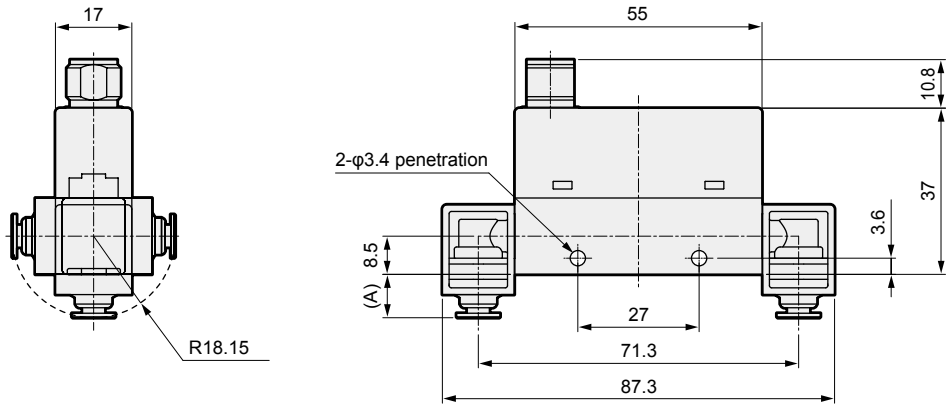


Model No.	Fitting	Dimension (A)
FSM3-C□□1CA1	Rc1/2	(80)
FSM3-C□□1CB1	G1/2	(80)
FSM3-C□□1CC1	NPT1/2	(95.4)

Dimensions (IO-Link)

Port size: elbow φ4 mm, φ6 mm, 1/4", Rc1/8, G1/8, NPT1/8

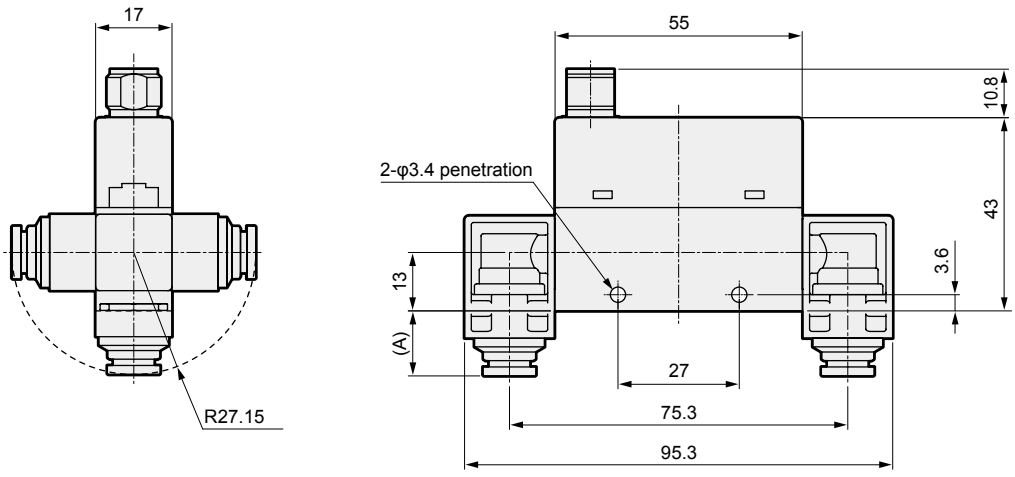
●FSM3-C[B][C]1/BH2/CH2/HH2/AA2/AB2/AC2 (Full scale flow rate: 500 mL/min, 1, 2, 5, 10, 20, 50 L/min)



Model No.	Fitting	Dimension (A)
FSM3-C□□1BH2	Push-in φ4 mm	(9.1)
FSM3-C□□1CH2	Push-in φ6 mm	(10.7)
FSM3-C□□1HH2	Push-in 1/4"	(14.7)
FSM3-C□□1AA2	Rc1/8	(14.5)
FSM3-C□□1AB2	G1/8	(20.5)
FSM3-C□□1AC2	NPT1/8	(14.5)

Port size: elbow φ8 mm, φ10 mm, 3/8", Rc1/4, G1/4, NPT1/4

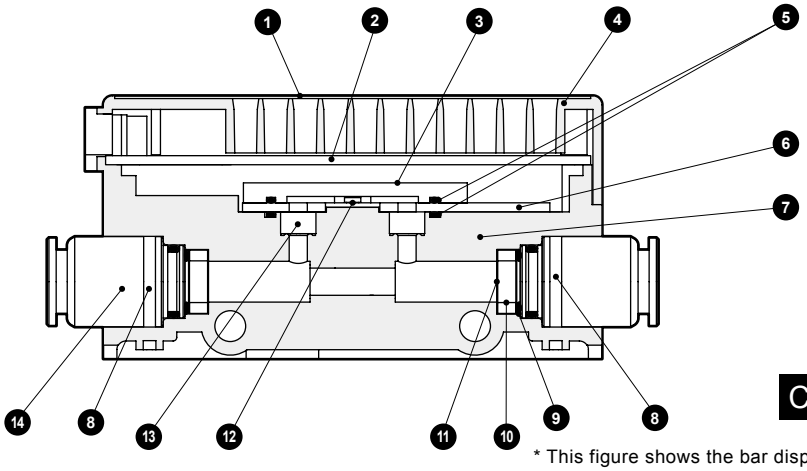
●FSM3-C[B][C]1/DH2/EH2/JH2/BA2/BB2/BC2 (Full scale flow rate: 50, 100, 200 L/min)



Model No.	Fitting	Dimension (A)
FSM3-C□□1DH2	Push-in φ8 mm	(13.4)
FSM3-C□□1EH2	Push-in φ10 mm	(19.2)
FSM3-C□□1JH2	Push-in 3/8"	(19.8)
FSM3-C□□1BA2	Rc1/4	(15.8)
FSM3-C□□1BB2	G1/4	(22.8)
FSM3-C□□1BC2	NPT1/4	(15.8)

Internal structure

● FSM3-B005 to 500

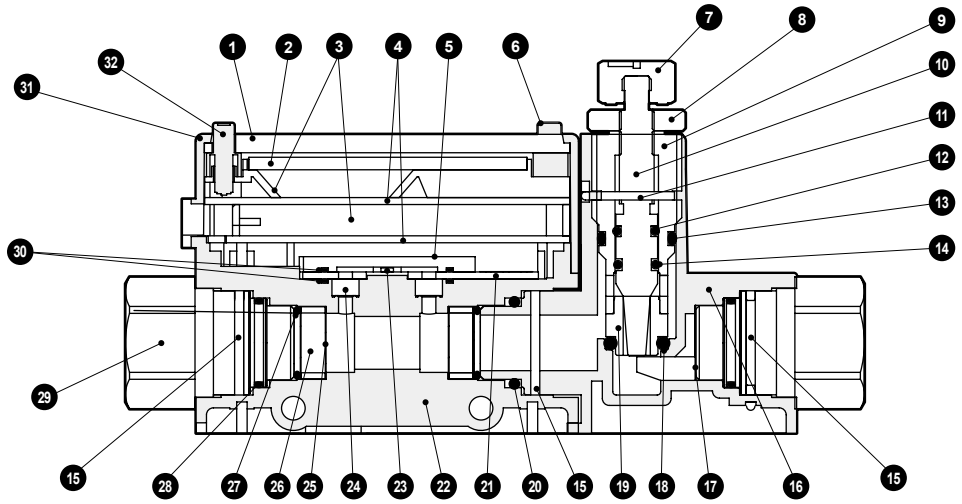


Cannot be disassembled

* This figure shows the bar display with straight fitting.
* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Front sheet	PET film	8	Fitting fixing pin	Stainless steel
2	Electronic circuit board	Glass epoxy resin	9	O-ring	Fluoro rubber
3	Sensor flow path	Stainless steel	10	Spacer	Aluminum
4	Case	Polyamide resin	11	Port filter	Stainless steel
5	Gasket	Fluoro rubber	12	Sensor chip	Semiconductor silicon
6	Sensor board	Glass epoxy resin	13	Bypass filter	Stainless steel
7	Sensor body	Polyamide resin	14	Fitting	-

● FSM3-L500 to 201



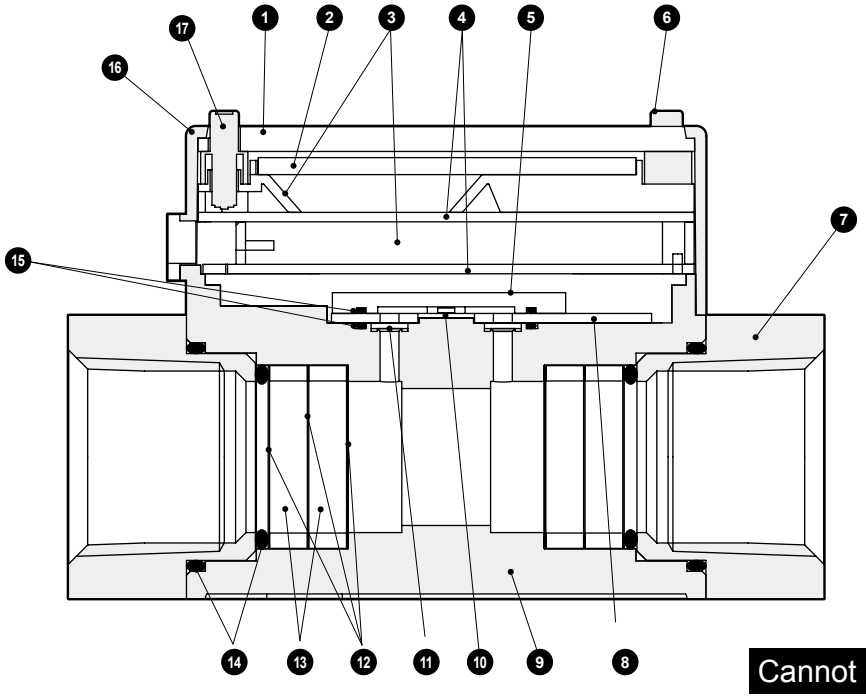
Cannot be disassembled

* This figure shows the LCD display with needle valve.
* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Liquid crystal cover	Acrylic resin	17	Port filter	Stainless steel
2	Liquid crystal	-	18	O-ring	Fluoro rubber
3	Base spacer	Polycarbonate resin	19	Orifice	Copper alloy/nickeling *2
4	Electronic circuit board	Glass epoxy resin	20	O-ring	Stainless steel
5	Sensor flow path	Stainless steel	21	Sensor board	Glass epoxy resin
6	Switch	Ethylene/propylene rubber	22	Sensor body	Polyamide resin
7	Knob	Polybutylene terephthalate	23	Sensor chip	Semiconductor silicon
8	Lock nut	Copper alloy/nickeling	24	Bypass filter	Stainless steel
9	Needle guide	Copper alloy/nickeling	25	Port filter	Stainless steel
10	Needle	Copper alloy/nickeling *1	26	Spacer	Aluminum
11	Fixing pin	Stainless steel	27	O-ring	Fluoro rubber
12	O-ring	Fluoro rubber	28	O-ring	Fluoro rubber
13	O-ring	Fluoro rubber	29	Fitting (Rc1/4)	Aluminum
14	O-ring	Fluoro rubber	30	Gasket	Fluoro rubber
15	Fitting fixing pin	Stainless steel	31	Case	Polyamide resin
16	Needle valve body	Polyamide resin	32	Switch	Ethylene/propylene rubber

Internal structure

● FSM3-L501/102

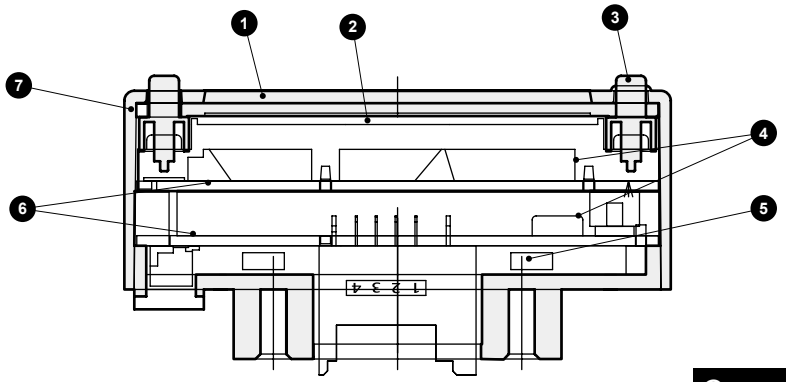


Cannot be disassembled

* This figure shows the LCD display.
* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Liquid crystal cover	Acrylic resin	10	Sensor chip	Semiconductor silicon
2	Liquid crystal	-	11	Bypass filter	Stainless steel
3	Base spacer	Polycarbonate resin	12	Port filter	Stainless steel
4	Electronic circuit board	Glass epoxy resin	13	Spacer	Aluminum
5	Sensor flow path	Stainless steel	14	O-ring	Fluoro rubber
6	Switch	Ethylene/propylene rubber	15	Gasket	Fluoro rubber
7	Fitting (Rc1/2)	Aluminum	16	Case	Polyamide resin
8	Sensor board	Glass epoxy resin	17	Switch	Ethylene/propylene rubber
9	Sensor body	Polyamide resin			

● Separate display FSM2-D-□



Cannot be disassembled

Main parts list

* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Liquid crystal cover	Acrylic resin	5	Back surface cover	Polyamide resin
2	Liquid crystal	-	6	Electronic circuit board	-
3	Switch	Ethylene/propylene rubber	7	Case	ABS Resin
4	Base spacer	Polycarbonate resin			

Compact flow rate sensor RAPIFLOW

FSM2 Series

Separate display

RoHS

Separated display specifications

Descriptions				Separate display FSM2-D-[*1][*2]-□-[*3]	
Settable flow rate range		*1	mℓ	5, 10, 50, 100, 500	
			ℓ	1, 2, 4, 5, 10, 12, 20, 25, 32, 50, 100, 200, 500, 1000, 1500	
Operating ambient temperature/humidity				0 to 50°C	
Display				4-digit + 4-digit 2-color LCD	
Input voltage				1 to 5V	
Output	Switch output	*1	N	Output 2-points (NPN open collector output, 50 mA or less, voltage drop 2.4 V or less)	
			P	P Output 2-points (PNP open collector output, 50 mA or less, voltage drop 2.4 V or less)	
	Analog output	*2	V	1 to 5 V voltage output 1-point (connecting load impedance 50 kΩ and over) *6	
			A	4 to 20 mA current output 1-point (connecting load impedance 0 to 300 Ω)	
Power supply voltage		*2	V	12 to 24 VDC (10.8 to 26.4V)	
			A	24 VDC (21.6 to 26.4V)	
Current consumption		*2		40 mA or less (when 24 VDC is connected, and no load is connected)	
Lead wire				φ3.7, 26 AWG or equivalent x 5-conductor (connector), insulator outer diameter φ1.0	
Functions				Flow rate display, flow rate display peak hold, switch output, analog output	
Degree of protection				IEC standards IP40-equivalent	
Protection circuit		*3		Power supply reverse connection protection	
EMC Directive				EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8	
Accessory				1 sensor connection connector (e-con), conforming cable AWG24 to 26, insulator outer diameter φ1.0 to 1.2	
Weight (main body only)				Approx. 40 g	
Clean-room specifications *4		*3	P70	Anti-dust generation	

*1: The flow rate range, flow direction and gas type are automatically recognized only when the FSM2 display separated is connected. (Default state)
The FSM3 bar display, FSM-H Series, FSM-V Series, and WFK3000 Series flow rate ranges are supported, but automatic recognition is not supported. Always set the product's flow rate range, flow direction and gas type before use.
The connectable flow rate ranges are shown in "Display for each flow rate range" below.
When the sensor section is changed, the previous flow rate range settings, etc., will still be recorded. Always reset the settings before using.
*2: Current for when 24 VDC is connected, and no load is connected. The current consumption will vary depending on how the load is connected.
*3: This product's protection circuit is effective only for specific mis-connections and a load short-circuit. It does not provide protection against various mis-connections.
*4: [P70] Anti-dust generation (product surface is degreased and cleaned before packing. Heat sealed into antistatic bag in clean bench (Class 1000 and over).)
*5: When connecting to the FSM-V Series or WFK3000 Series, the cable size is different so the separate compatible sensor connection connector (e-con) will be required. Contact your nearest CKD sales office or dealer.
The enclosed sensor connection connector (e-con) can be used with the FSM Series and FSM-H Series.
*6: The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output and error increase. Check error with the impedance of the connecting load before using.

Display for each flow rate range

Flow rate display																								
Display range	Uni-direction	0 to 500 mℓ/min	0 to 1000 mℓ/min	0 to 2.00 ℓ/min	0 to 4.00 ℓ/min	0 to 5.00 ℓ/min	0 to 10.00 ℓ/min	0 to 12.0 ℓ/min	0 to 20.0 ℓ/min	0 to 25.0 ℓ/min	0 to 32.0 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	0 to 1.50 m^3/min	0 to 5.00 mℓ/min	0 to 10.00 mℓ/min	0 to 50.0 mℓ/min	0 to 100.0 mℓ/min
	Bi-direction	−500 to 500 mℓ/min	−1000 to 1000 mℓ/min	−2.00 to 2.00 ℓ/min	—	−5.00 to 5.00 ℓ/min	−10.00 to 10.00 ℓ/min	—	−20.0 to 20.0 ℓ/min	—	—	−50.0 to 50.0 ℓ/min	−100.0 to 100.0 ℓ/min	−200 to 200 ℓ/min	−500 to 500 ℓ/min	−1000 to 1000 ℓ/min	−1.50 to 1.50 m^3/min	−5.00 to 5.00 mℓ/min	−10.00 to 10.00 mℓ/min	−50.0 to 50.0 mℓ/min	−100.0 to 100.0 mℓ/min
Display resolution		1m ℓ/min		0.01 ℓ/min				0.1 ℓ/min						1 ℓ/min			0.01 m^3/min	0.01 mℓ/min		0.1 mℓ/min			
Integrating function *2 Display range		9999999 mℓ		99999.99 ℓ				999999.9 ℓ						9999999 ℓ			99999.99 m^3	99999.99 mℓ		999999.9 mℓ			
Display resolution		1 mℓ		0.01 ℓ				0.1 ℓ						1 ℓ			0.01 m^3	0.01 mℓ		0.1 mℓ			
Integrated pulse output rate		5 mℓ	10 mℓ	0.02 ℓ	0.04 ℓ	0.05 ℓ	0.1 ℓ	0.12 ℓ	0.2 ℓ	0.25 ℓ	0.32 ℓ	0.5 ℓ	1 ℓ	2 ℓ	5 ℓ	10 ℓ	15 ℓ	0.05 mℓ	0.1 mℓ	0.5 mℓ	1 mℓ		

* The corresponding sensor is the voltage output (1 to 5 V). If the current output or other voltage output is connected, it will not operate properly.

*1: The flow rate display is rounded off at approx. ±1% or less (forced zero).
*2: The accumulated flow is a calculated (reference) value. It is reset when the power is turned OFF.

How to order

FSM2 - D - N V - 3 P - P70

- Ⓐ Output
- Ⓑ Analog output
- Ⓒ Cable
- Ⓓ Bracket
- Ⓔ Clean-room specifications

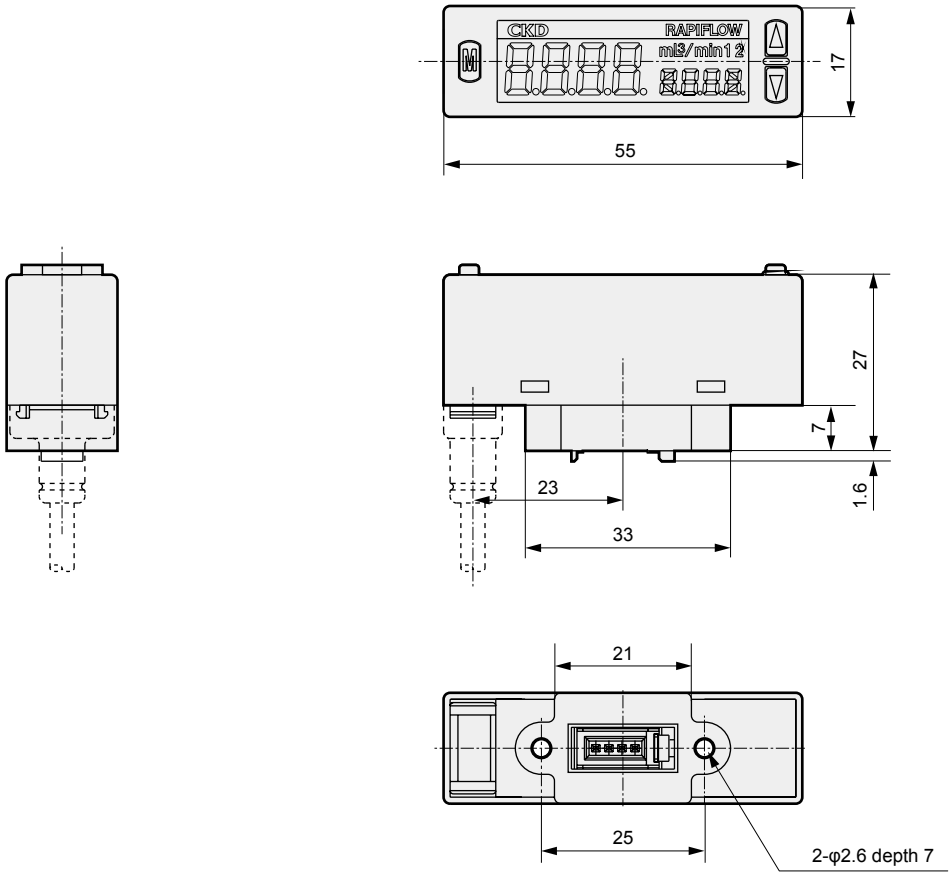
Code	Content
Ⓐ Output	
N	Switch output (NPN) 2-points, analog output 1-point
P	Switch output (PNP) 2-points, analog output 1-point
Ⓑ Analog output	
V	Voltage output (1-5 V)
A	Current output (4 to 20 mA)
Ⓒ Cable	
Blank	None
1	1 m
3	3 m
Ⓓ Bracket	
Blank	None
P	Panel mounting kit
Ⓔ Clean-room specifications	
Blank	None
P70	Anti-dust generation

⚠ CAUTION

The corresponding sensor is the voltage output (1 to 5 V). If the current output or other voltage output is connected, it doesn't operate properly. When using FSM3, use the bar display voltage output.

Separated display dimensions

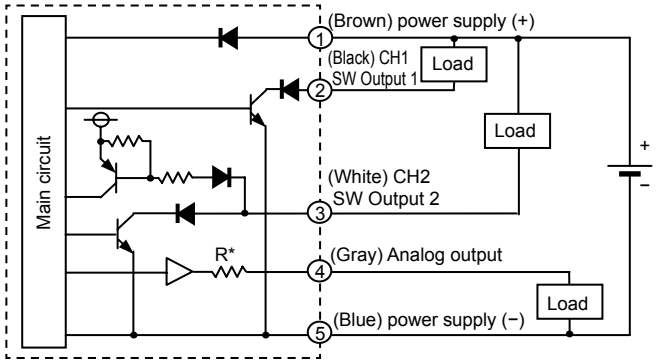
● FSM2-D-□



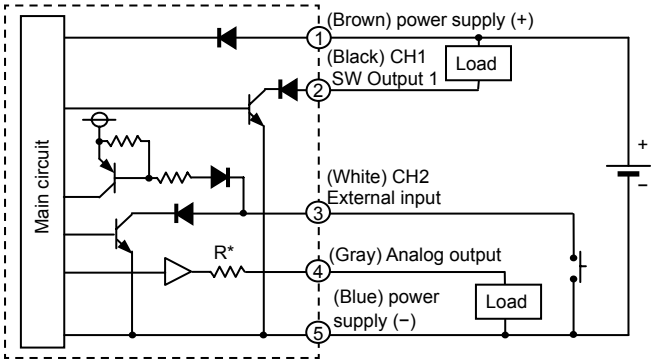
Example of internal circuit and load connection

● FSM3-L□□□□□B/F/□□ (LCD display NPN output)
FSM3-D-N□-□ (separated display NPN output)

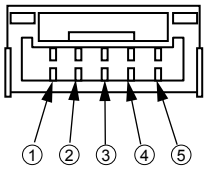
[CH2 is used as SW output]



[CH2 is used as external input]



* Analog output voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

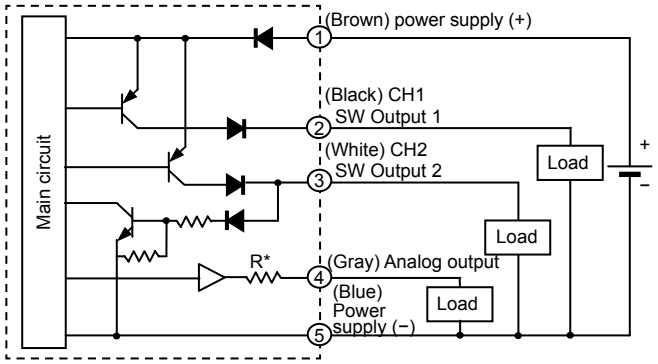


(FSM3 side)

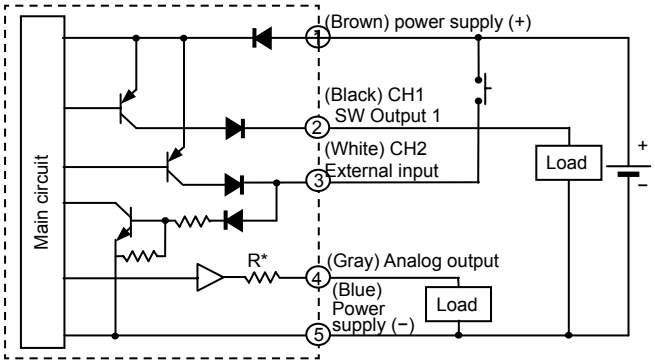
Terminal No.	Option cable color	Name
①	Brown	Power supply (+) (voltage output: 12 to 24 V, current output: 24 V)
②	Black	CH1 (switch output 1: max. 50 mA)
③	White	CH2 (switch output 2: max. 50 mA, or external input)
④	Gray	Analog output Voltage output: 1 to 5 V load impedance: 50 kΩ or more Current output: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

● FSM3-L□□□□□D/H/□□ (LCD display PNP output)
FSM3-D-P□-□ (separated display PNP output)

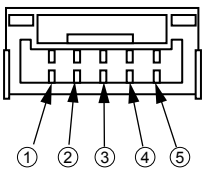
[CH2 is used as SW output]



[CH2 is used as external input]



* Analog output voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

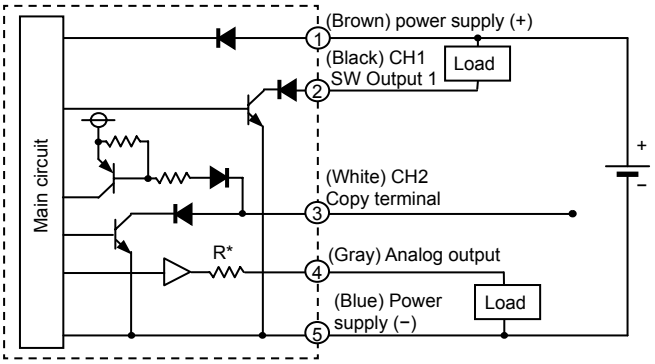


(FSM3 side)

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

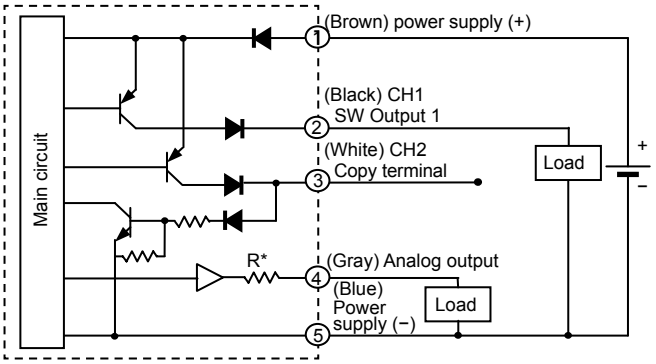
Example of internal circuit and load connection

● FSM3-L□□□□□A/E/□□
(LCD display, NPN output, copy function)

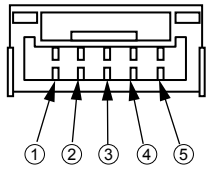


* Analog output voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

● FSM3-L□□□□□C/G/□□
(LCD display, PNP output, copy function)



* Analog output voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

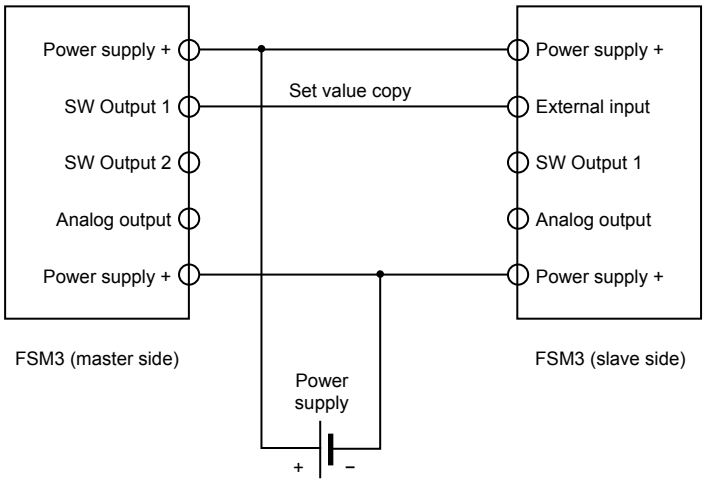


(FSM3 side)

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

● FSM3-L□□□□□A/C/E/G/□□ (LCD display, copy function)

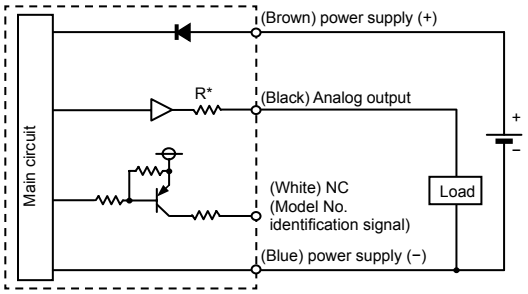
[When using set value copy function]



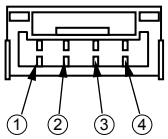
Connect the master side SW output 1 terminal and the slave side exterior input terminal.

Example of internal circuit and load connection

● FSM3-B□□□□□J/K/□□(bar display)



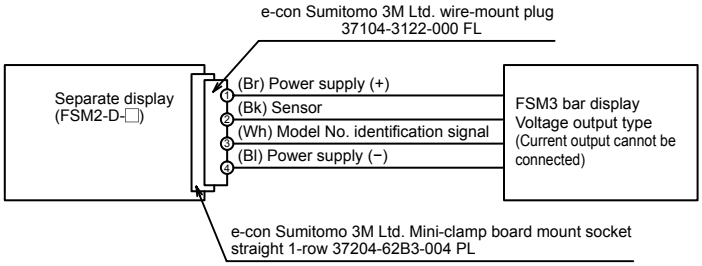
* Analog output voltage output R: approx. 1 kΩ
Analog output current output R: approx. 100 Ω



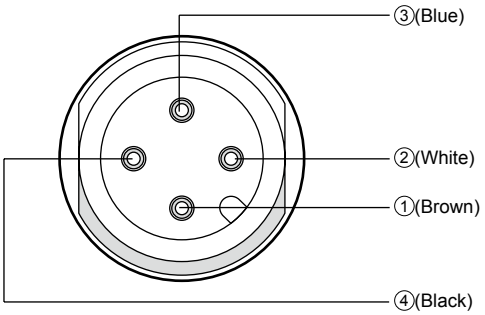
(FSM3 side)

Terminal No.	Option cable color	Name
①	Brown	Power supply (+) (voltage output: 12 to 24 V, current output: 24 V)
②	Black	Analog output Voltage output: 1-5 V Load impedance 50 kΩ and over Current output: 4 to 20 mA Load impedance 300 Ω or less
③	White	NC (model identification signal; do not connect when using as single part)
④	Blue	Power supply - (GND)

● Connecting the separate display and the FSM3 bar display

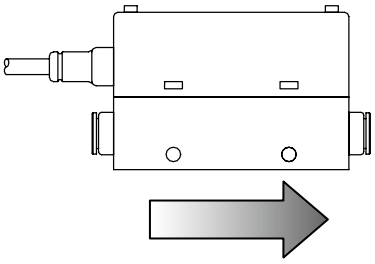
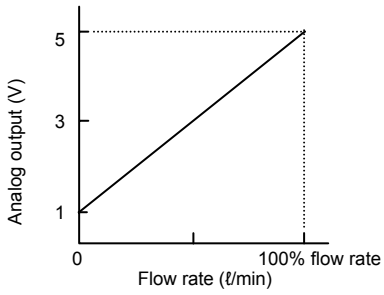
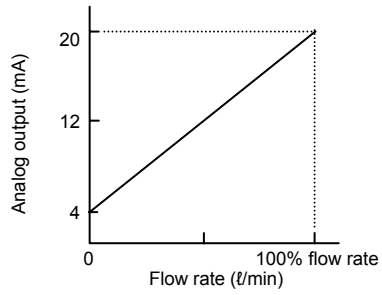
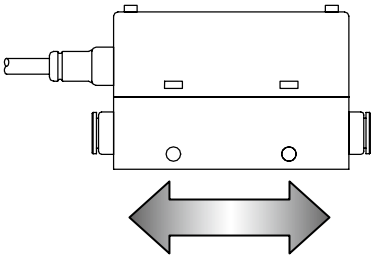
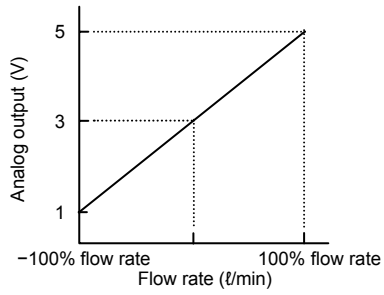
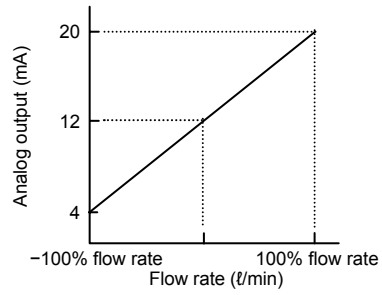


● FSM3-C□□□□□L□□(IO-Link)



Terminal No.	Cable color	Name
①	Brown	Power supply + (18 to 30 V)
②	White	N.C.
③	Blue	Power supply - (GND)
④	Black	C/Q (IO-Link)

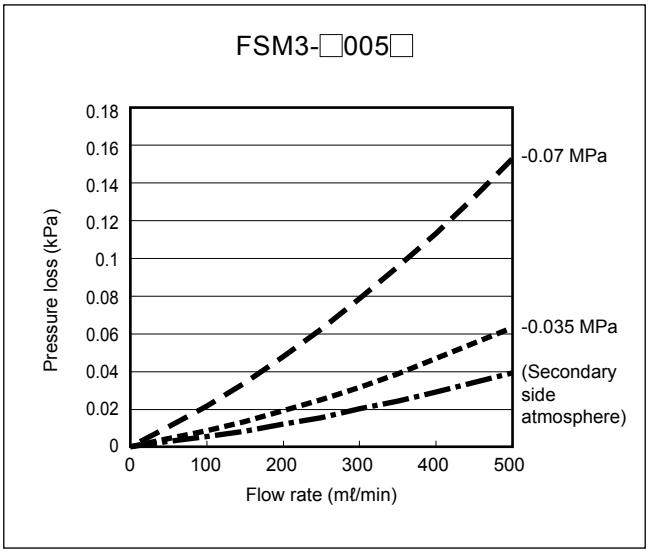
Analog output characteristics

Flow direction	Voltage output	Current output
[Uni-direction] 		
[Bi-directional] 		

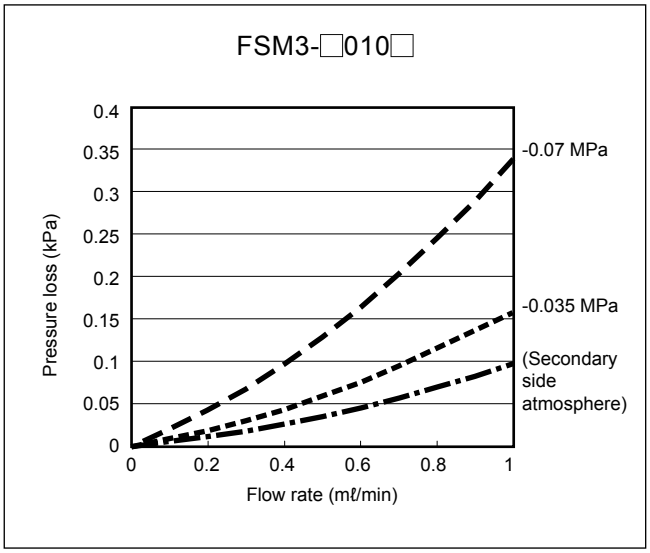
*1: When uni-directional full scale is 0% to 100%, the bi-directional is −100% to 100%.
With the display integrated bi-directional, output can be changed to uni-direction. The value after switching is a reference value.
Refer to page 34 for details.
*2: Refer to page 2 for analog output when switching to carbon dioxide.

Pressure loss characteristics

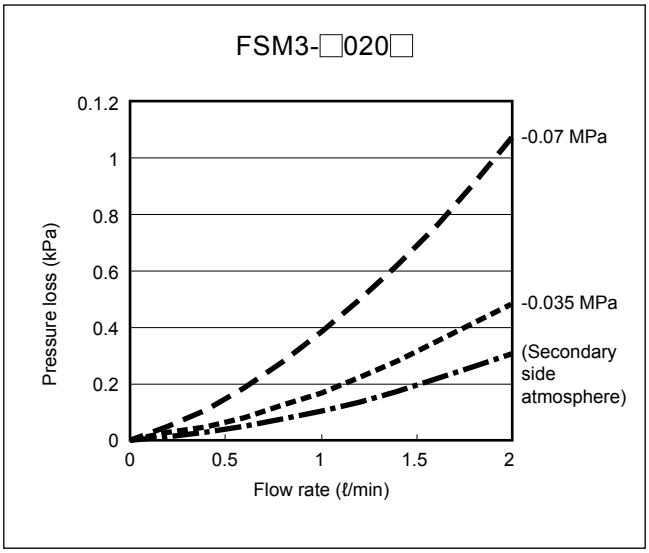
FSM3-□005□



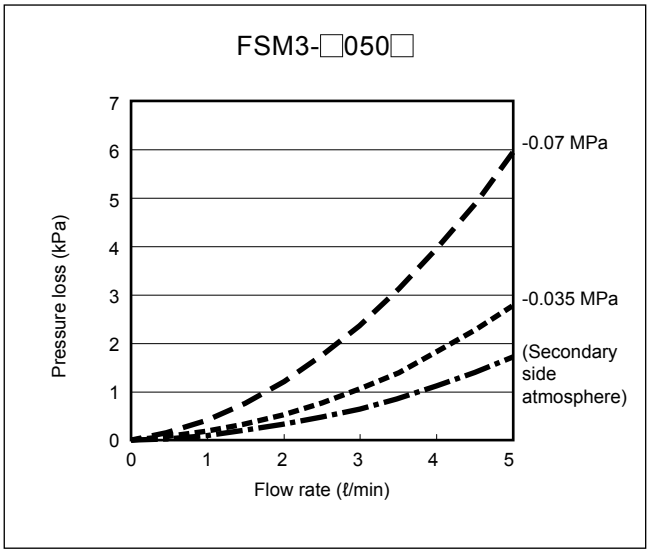
FSM3-□010□



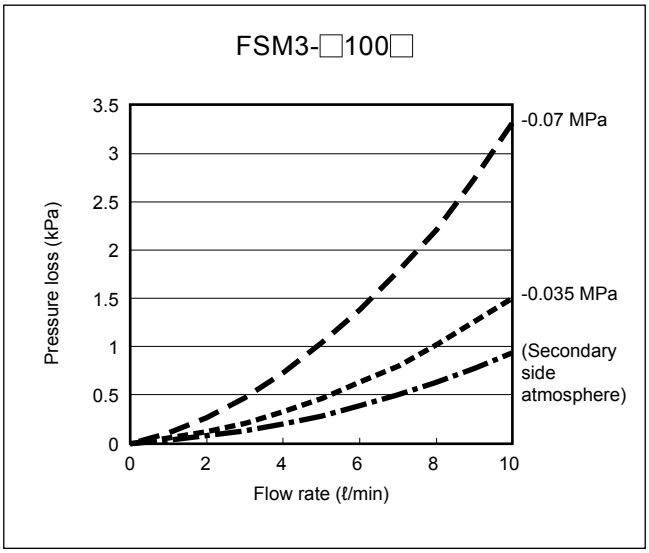
FSM3-□020□



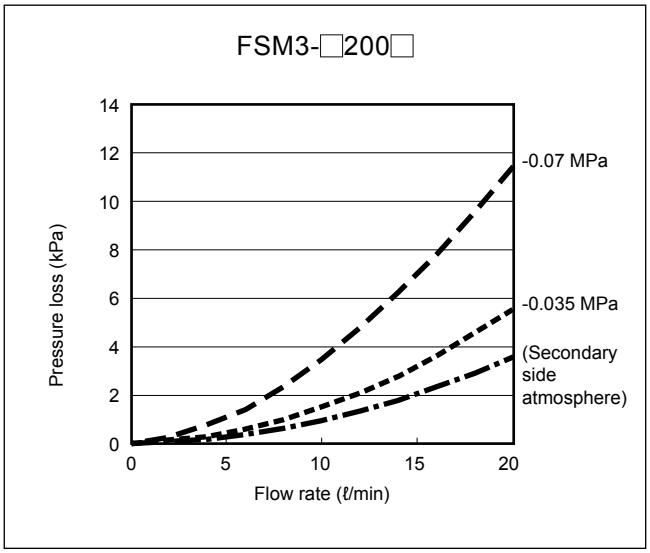
FSM3-□050□



FSM3-□100□

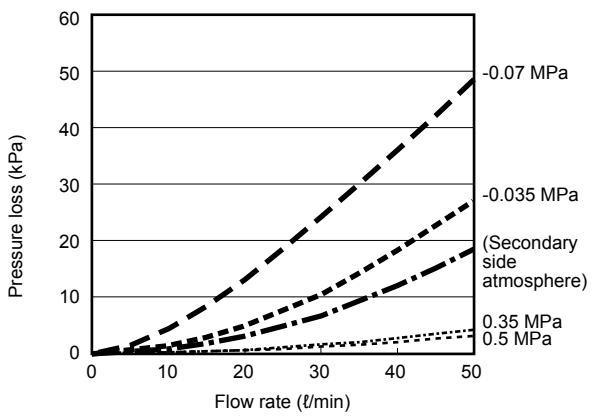


FSM3-□200□

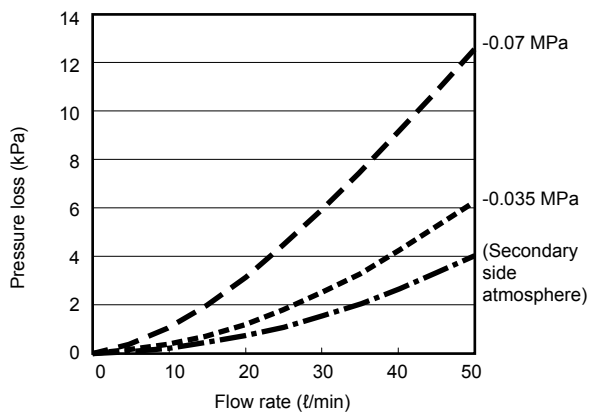


Pressure loss characteristics

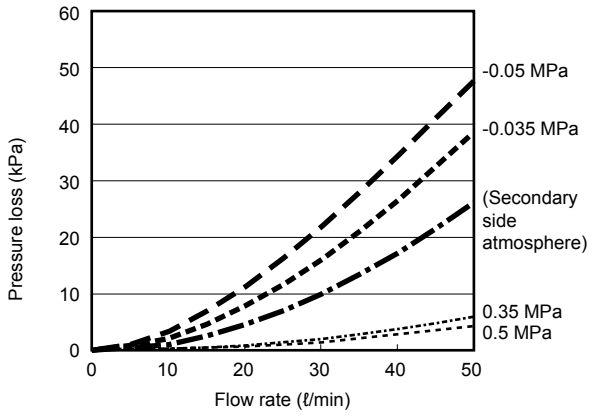
FSM3-□500□ (small body)



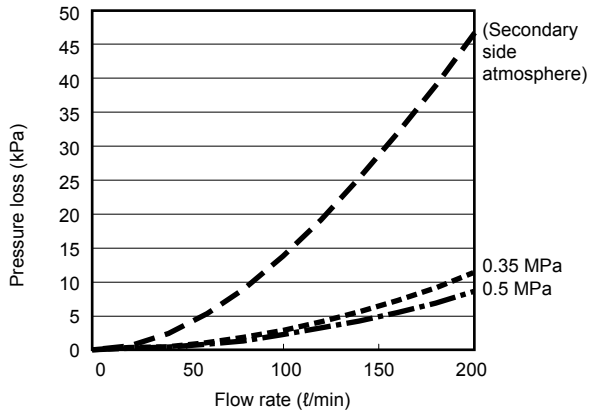
FSM3-□500□ (medium body)



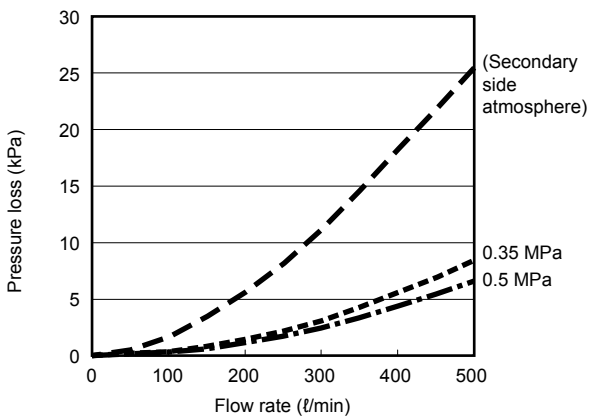
FSM3-□101□



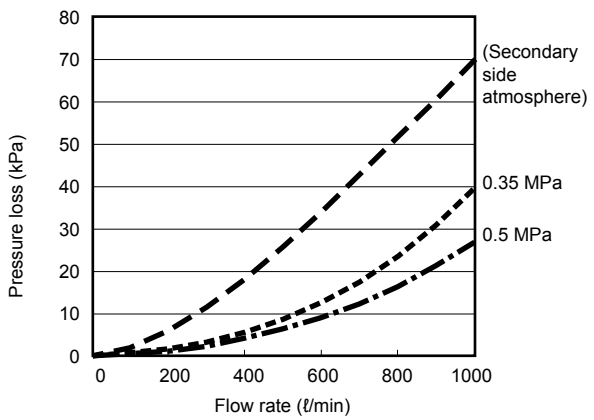
FSM3-□201□



FSM3-□501□



FSM3-□102□



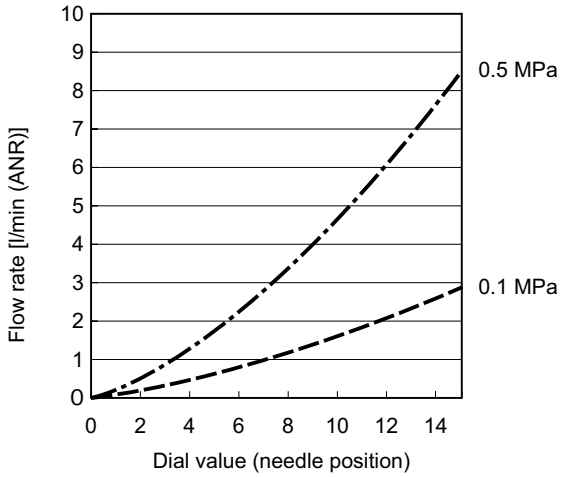
Pressure loss characteristics

The graphs show data when using air.
For gases other than air, multiply by the specific gravities below.

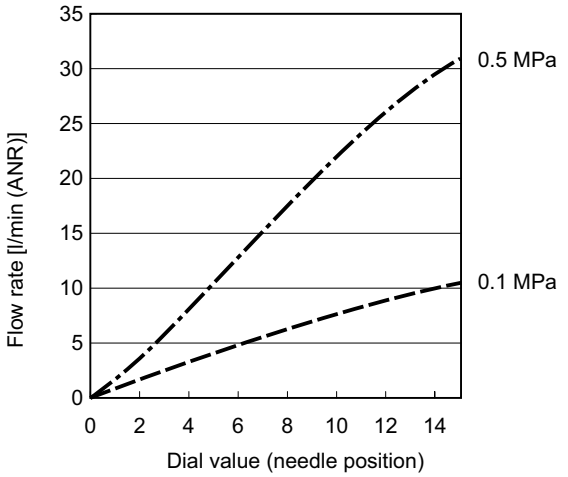
Gas	Specific gravity
Argon	1.38
Carbon dioxide	1.53
Argon 80% Carbon dioxide 20%	1.41

Needle valve flow characteristics (for air, nitrogen gas)

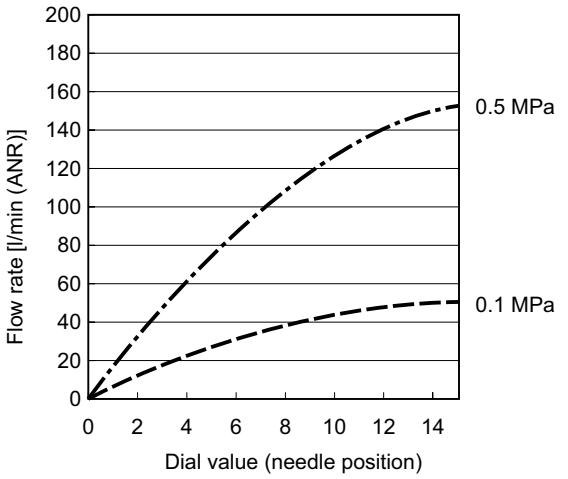
● FSM3-L005/010/020



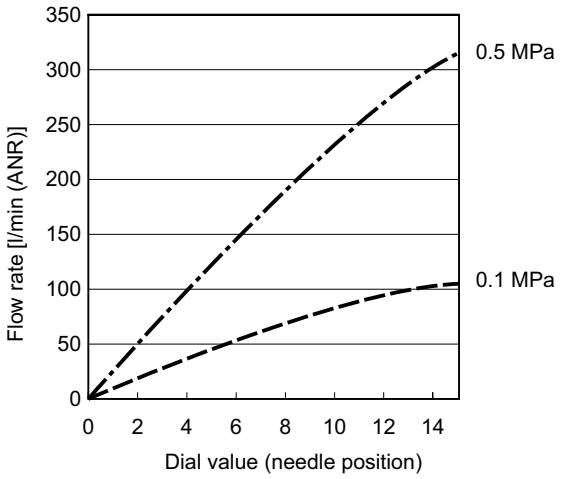
● FSM3-L050/100



● FSM3-L200/500-H04/H06

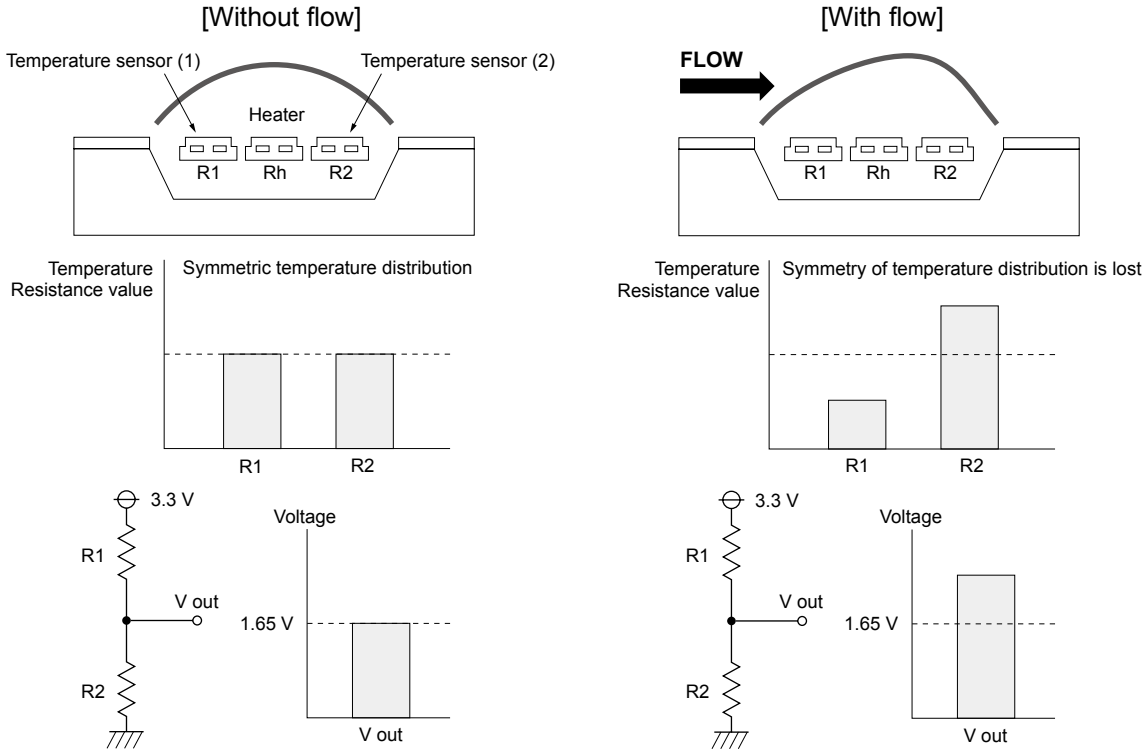


● FSM3-L500/101/201-H08/H10



Measurement principle of FSM3 Series

The FSM3 Series incorporates a platinum sensor chip machined with silicon micro-machining. The sensor is thermally insulated from the silicon substrate. The heating capacity is extremely low, enabling high sensitivity with a high-speed response.
At the sensor, two temperature sensors are arranged with a heater in between. Platinum, which has a resistance that changes based on temperature, is used for the temperature sensor. When the heater is turned ON and heating occurs, the temperature distribution is symmetrical to the center of the heater if there is no flow. When flow is received, the symmetrical property of the temperature distribution is lost, temperature upstream from the heater drops, and temperature downstream rises. This temperature difference appears as the difference in temperature sensor resistance, and varies with the flow rate. When the flow is reversed, the temperature difference (difference in resistance) will be inverted. By using this method, the bi-directional flow rate can be detected. This method is suitable for detecting a relatively small flow rate.



1 Flow rate sensor selection method

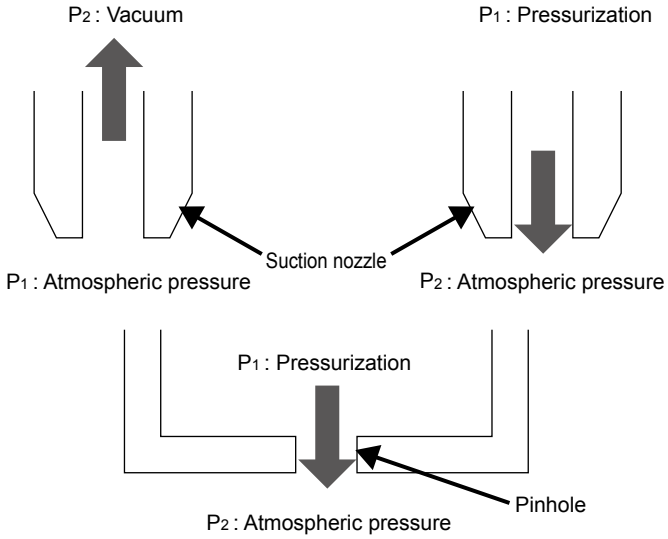
Use as a guide for selection of the flow rate range when using the flow rate sensor for suction/unload confirmation or leakage inspection, etc., with the suction nozzle.

The flow rate can be calculated using the effective cross-sectional area of nozzle (pinhole) and the pressure difference inside and outside of nozzle.

● For $P1 \geq 1.89P_2$ (acoustic velocity)
$Q = 113.2 \times S \times P_1$

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

Q : Flow rate ℓ/min
P_1 : Primary side absolute pressure MPa
P_2 : Secondary side absolute pressure MPa
S : Effective cross-sectional area of nozzle (pinhole) mm^2



● Example of calculation

The figure below shows the calculated value of flow rate when the nozzle diameter is φ0.1 to φ2 and P2 is varied.

	P_1 (MPa) Absolute pressure	P_1 (MPa) Gauge pressure	P_2 (MPa) Absolute pressure	P_2 (MPa) Gauge pressure	Acoustic velocity/ subsonic velocity	Calculated flow rate value (ℓ/min)								
						φ0.1	φ0.2	φ0.3	φ0.4	φ0.5	φ0.7	φ1	φ1.5	φ2
Vacuum	0.1013	0	0.0313	−0.07	Acoustic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007
	0.1013	0	0.0413	−0.06	Acoustic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007
	0.1013	0	0.0513	−0.05	Acoustic velocity	0.090	0.360	0.810	1.440	2.250	4.411	9.002	20.254	36.007
	0.1013	0	0.0613	−0.04	Subsonic velocity	0.088	0.352	0.792	1.408	2.200	4.312	8.800	19.801	35.202
	0.1013	0	0.0713	−0.03	Subsonic velocity	0.082	0.329	0.740	1.315	2.055	4.028	8.220	18.494	32.878
	0.1013	0	0.0813	−0.02	Subsonic velocity	0.072	0.287	0.645	1.147	1.792	3.512	7.166	16.125	28.666
	0.1013	0	0.0913	−0.01	Subsonic velocity	0.054	0.215	0.483	0.859	1.343	2.631	5.370	12.083	21.480
Blow (leakage inspection)	0.1113	0.01	0.1013	0	Subsonic velocity	0.057	0.226	0.509	0.905	1.414	2.772	5.657	12.727	22.626
	0.1213	0.02	0.1013	0	Subsonic velocity	0.080	0.320	0.720	1.280	2.000	3.920	8.000	17.999	31.998
	0.1413	0.04	0.1013	0	Subsonic velocity	0.113	0.453	1.018	1.810	2.828	5.543	11.313	25.454	45.252
	0.1613	0.06	0.1013	0	Subsonic velocity	0.139	0.554	1.247	2.217	3.464	6.789	13.856	31.175	55.423
	0.1813	0.08	0.1013	0	Subsonic velocity	0.160	0.640	1.440	2.560	4.000	7.840	15.999	35.998	63.996
	0.2013	0.1	0.1013	0	Acoustic velocity	0.179	0.716	1.610	2.862	4.472	8.765	17.888	40.248	71.552
	0.3013	0.2	0.1013	0	Acoustic velocity	0.268	1.071	2.410	4.284	6.694	13.119	26.774	60.242	107.096
	0.4013	0.3	0.1013	0	Acoustic velocity	0.357	1.426	3.209	5.706	8.915	17.474	35.660	80.236	142.641
	0.5013	0.4	0.1013	0	Acoustic velocity	0.445	1.782	4.009	7.127	11.137	21.828	44.547	100.230	178.186
	0.6013	0.5	0.1013	0	Acoustic velocity	0.534	2.137	4.809	8.549	13.358	26.182	53.433	120.224	213.731

(CAUTION)
● When there is a leakage in the piping, etc., the actual flow rate becomes larger than the calculated value. When selecting the flow rate, consider the amount of leakage in the piping.
● When there is a portion narrower than the suction nozzle diameter in the middle of the piping, the flow rate may be reduced to lower than the calculated value. In addition, suction confirmation, etc., may become impossible.
● The effective cross-sectional area is just a guideline. When the nozzle is long and thin, the effective cross-sectional area becomes smaller than the opening area.
● The response time is determined by the inner volume of the piping from the flow rate sensor to suction nozzle (pinhole). For high-speed detection, reduce the inner volume of the piping as much as possible by installing a flow rate sensor near the suction nozzle, etc.

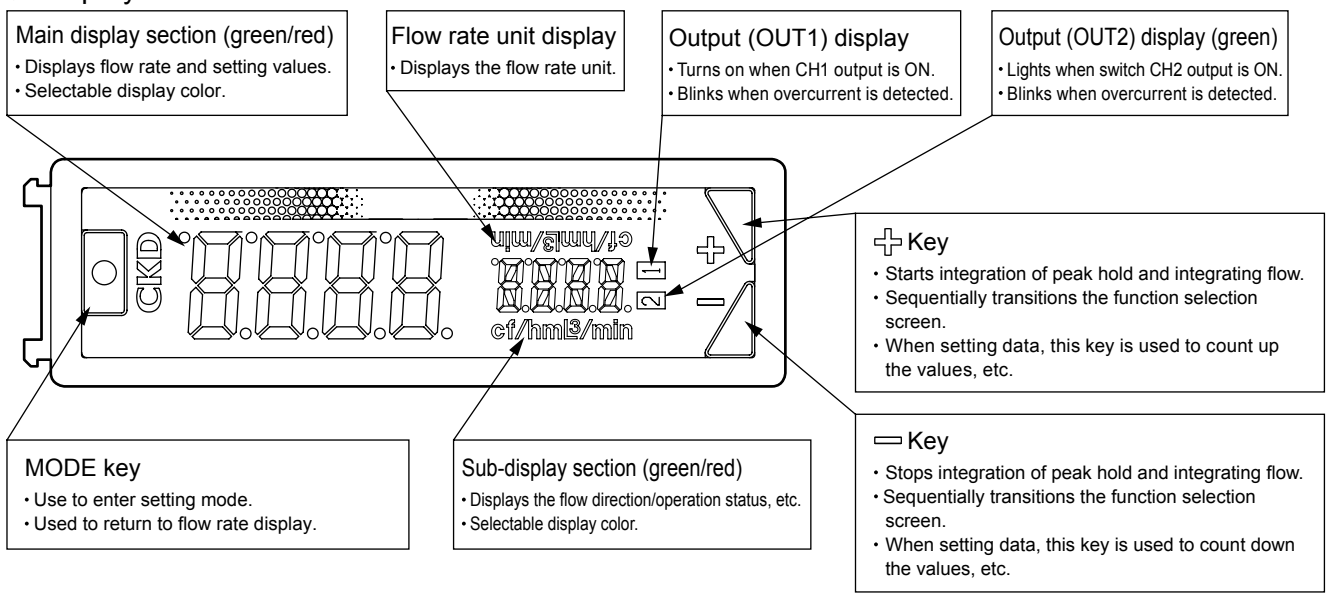
Product weight

[Unit: g]

Fitting			LCD display	Bar display	IO-Link
Model No.		Content			
BH	1	Push-in (for φ4 mm straight)	60	50	50
CH	1	Push-in (for φ6 mm straight)	50	40	50
DH	1	Push-in (for φ8 mm straight)	80	70	80
EH	1	Push-in (for φ10 mm straight)	80	70	80
HH	1	Push-in (for φ1/4" straight)	60	50	50
JH	1	Push-in (for φ3/8" straight)	80	70	80
AA	1	Rc1/8 Straight	60	50	50
BA	1	Rc1/4 Straight	60	50	60
CA	1	Rc1/2 Straight	120	110	120
AB	1	G1/8 Straight	60	50	60
BB	1	G1/4 Straight	70	60	70
CB	1	G1/2 Straight	140	130	140
AC	1	NPT1/8 Straight	50	50	50
BC	1	NPT1/4 Straight	60	50	60
CC	1	NPT1/2 Straight	120	110	120
BH	2	Push-in (for φ4 mm elbow)	70	60	60
CH	2	Push-in (for φ6 mm elbow)	60	50	60
DH	2	Push-in (for φ8 mm elbow)	100	90	90
EH	2	Push-in (for φ10 mm elbow)	100	90	100
HH	2	Push-in (for φ1/4" elbow)	70	60	60
JH	2	Push-in (for φ3/8" elbow)	100	90	100
AA	2	Rc1/8 Elbow	70	60	60
BA	2	Rc1/4 Elbow	80	70	80
AB	2	G1/8 Elbow	70	60	70
BB	2	G1/4 Elbow	90	80	90
AC	2	NPT1/8 Elbow	70	60	60
BC	2	NPT1/4 Elbow	80	70	80

Names and functions of display/operation section (LCD display)

● Display section name



● Error code

Error code	Cause	Countermeasures
	The flow rate exceeds the flow rate display range.	Reduce the instantaneous flow rate value to within the flow rate range.
	Sensor is damaged.	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
	The flow rate is below the lower limit of the flow rate display range.	Increase the instantaneous flow rate value to within the flow rate range.
	Sensor is damaged.	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
	An error occurred during CPU processing.	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
	The range at which zero adjustment is possible is exceeded.	Make sure to set the flow rate to zero, and then perform the zero adjustment.
	An error occurred during EEPROM reading or writing.	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
	An error occurred during memory reading or writing.	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
	Sensor failure has occurred.	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
	Setting copy failed.	Check the connection and try again.
	Button operations are locked.	Release the lock before operation.
	A PIN number is set.	Enter the set PIN number. * Be careful not to forget your PIN number.
Blinking of output display (Switch output is not output)	The switch output's overcurrent protection circuit has operated.	Check whether load current exceeds the rating. Correctly connect, then turn the power ON again.

Names and functions of display/operation section (LCD display)

The functions and various settings are made during the normal flow rate display and during the various modes.
The modes are also divided into Maintenance mode, SET mode and Setting Monitor mode depending on the frequency of use.

● Normal operation (RUN mode)

Descriptions	Explanation	Default setting
Instantaneous flow rate display	The instantaneous flow rate is displayed.	Instantaneous flow rate display
Peak hold function	Max. and min. values for the flow rate within a set interval are displayed.	
CO_2 discharge rate display	By setting the power, discharge pressure, and flow rate of the compressor, as well as the power to CO_2 conversion coefficient, you can learn how much CO_2 is being discharged.	
Integrating flow display	The integrated flow can be displayed. The switch output function includes a function to turn the switch ON/OFF at a level higher than the recommended cumulative value, and an integrated pulse function to output the pulse at a set cumulative value. Can be reset with button operations or external input.	

● SET Mode

No.	Descriptions	Explanation	Default setting
F.01	Selection of CH1 operation	Select the CH1 setting. You can set switch output operation and integrated pulse.	No switch output
F.02	Selection of CH2 operation	Select the CH2 setting. Select whether to use CH2 as a switch output, or to use as an external input (integrated value auto reference).	No switch output
F.03	Integrating functions setting	You can choose to acquire integrating flow values consecutively or at set times. You can also decide whether or not to hold that data.	Consecutive acquisition: hold data OFF
F.04	Sub-screen display setting	Set the sub-display section's display method. The display can be switched to flow direction, reference state, or numbering display.	Flow direction
F.05	Display color setting	Set the display color. (Red, green) The color for a normal display and for switch output ON can be set.	Red
F.06	Flow rate direction setting (Bi-directional only)	Setting the flow rate direction. Setting available for bi-directional, one-side forward direction or one-side reverse direction.	Bi-direction
F.07	Display inversion function	The LCD display can be vertically inverted.	Standard display
F.08	Reference state setting	Select from the standard state or reference state. Standard state (ANR): Converted into volumetric flow rate at 20°C, 1 barometric pressure, relative humidity 65% Reference state (NOR): Converted into volumetric flow rate at 0°C, 1 barometric pressure	ANR
F.09	Unit setting (For overseas only)	You can set the unit. Select from L/min and scf/min.	For Japan: L/min For overseas: L/min
F.10	Display cycle setting	The digital display refresh cycle can be set in three stages from 0.25 s to 1 s. If the display flickers, it may be improved by setting a longer display refresh cycle.	0.25 sec
F.11	Analog output setting response time	Set the response time. Response can be set in seven stages from 0.05 s to approx. 1.50 s. Chattering and mis-operation caused by sudden flow rate changes or noise are prevented.	0.05 sec
F.12	Numbering setting	You can set the numbering.	0000
F.13	Change gas type	The measured gas can be changed. (Model with full scale flow rate of 200 L/min or below)	Air
F.14	Setting ECO mode	ECO mode can be set. If the buttons are not operated for approx. one minute, the ECO mode will activate and turn off the display's backlight. Current consumption can be reduced with this mode.	OFF
F.15	CO_2 discharge rate calculation setting	CO_2 discharge rate calculation can be set. Set your compressor's power, discharge pressure, and flow rate.	0000
F.16	Lock setting	Key lock method and PIN number method can be set. Change use according to the working environment.	OFF
F.17	Peak hold setting	You can choose to acquire peak bottom values consecutively or at set times. You can also decide whether or not to hold that data.	Consecutive acquisition: hold data OFF

● Maintenance mode

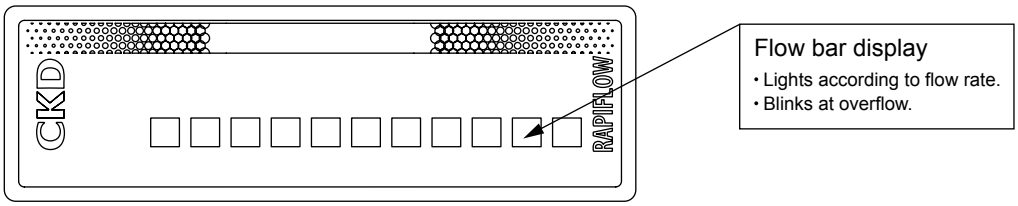
No.	Descriptions	Explanation	Default setting
F.91	Forced output function	Use this function to forcibly turn the switch output ON and confirm the wiring connection or initial operation of the input device.	-
F.92	Zero adjustment	The zero point deviation is corrected.	Adjust value: 0
F.93	Copy function	For eligible model nos., operations and set values can be easily copied between two FSM3. (Copying is only possible between products with the same model no.)	-
F.99	Reset function	Returns the settings to the default settings.	-

● Setting monitor mode

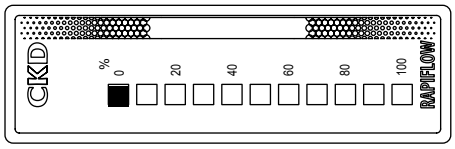
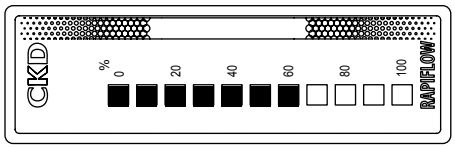
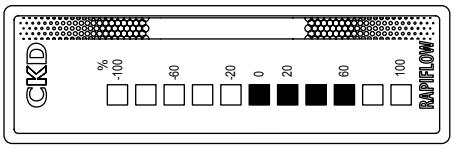
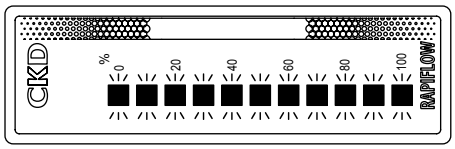
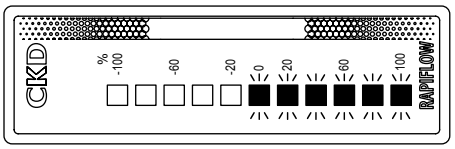
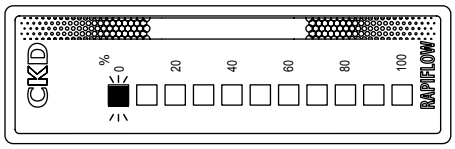
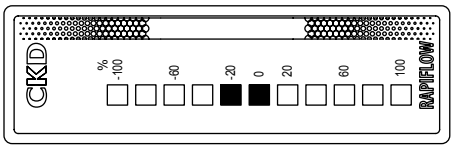
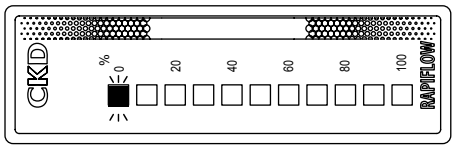
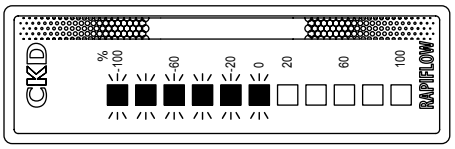
Descriptions	Explanation	Default setting
Setting Monitor function	SET mode setting details can be checked in Setting Monitor mode. (Setting details cannot be edited.)	-

Names and functions of display/operation section (bar display)

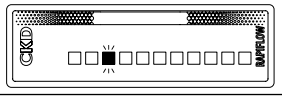
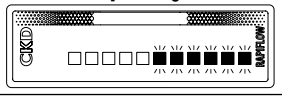
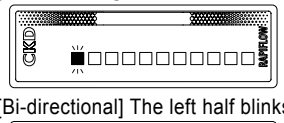
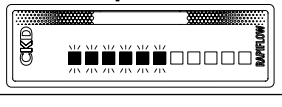
● Display section name



[Example] Display in the case of FSM3-B101□□□□□□□

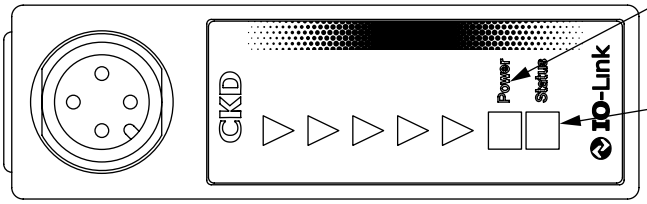
Flow rate	Uni-direction	Bi-directional
0%		
+60% (Forward direction)		
+110% (Forward direction) Blinks at overflow. * Blinks at +110% F.S. and over.		
−10% (Reverse direction)		
−110% (Reverse direction)		

● Error code

Error code	Cause	Countermeasures
The third from left blinks 	An error occurred during memory reading or writing.	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
[Uni-direction] All blink 	The flow rate exceeds the flow rate display range.	Reduce the instantaneous flow rate value to within the flow rate range.
[Bi-directional] The right half blinks 	Sensor failure	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.
[Uni-direction] The leftmost blinks 	The flow rate is below the flow rate display range.	Increase the instantaneous flow rate value to within the flow rate range.
[Bi-directional] The left half blinks 	Sensor failure	Then turn power on again. If the error is not resolved, contact your CKD branch or dealer.

Names and functions of display/operation section (IO-Link)

● IO-Link



Power lamp (green)
- Lights when power supply is ON.
- Blinks during IO-Link communication.

Status lamp (green, orange, red)
- Green..... Lights when within specified flow rate range
- Orange... Lights when flow rate exceeds specified range by less than 10%.
- Red ..... Lights when flow rate exceeds specified range by 10% or more.

● Communication specifications

Descriptions	Details
Communication protocol	IO-Link
Communication protocol version	V1.1
Transmission bit rate	COM2 (38.4 kbps)
Port	Class A
Process data length (input)	4 byte
Process data length (output)	0 byte
Shortest cycle time	5 ms
Data storage	1 kbyte
SIO mode support	None

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Data name	MSB															LSB
	Instantaneous flow rate															
Data range	Refer to Table 1															
Format	Integer 16															

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data name	Error	WARNING	-	-	-	-	Switch output		Vacant							
							2	1								
Data range	True/False															
Format	Boolean															

Data range (Table 1)

			005	010	020	050	100	200	500	101	201	501	102
Data range (□/min)	[B]	U	0 to 550 mL	0 to 1100 mL	0.00 to 2.20 L	0.00 to 5.50 L	0.00 to 11.00 L	0.0 to 22.0 L	0.0 to 55.0 L	0.0 to 110.0 L	0 to 220 L	0 to 550 L	0 to 1100 L
		B	−550 to 550 mL	−1100 to 1100 mL	−2.20 to 2.20 L	−5.50 to 5.50 L	−11.00 to 11.00 L	−22.0 to 22.0 L	−55.0 to 55.0 L	−110.0 to 110.0 L	−220 to 220 L	−550 to 550 L	−1100 to 1100 L

* IODD files can be downloaded from CKD's website.

Optional products

Discrete option model No. method

FSM3 - **K** - **P70**

Ⓐ Option

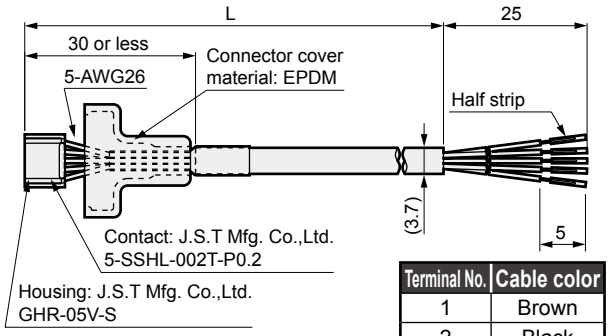
Ⓑ Clean-room specifications

Code	Content
Ⓐ Option	
A	5 conductor cable 1 m (for LCD display)
B	5 conductor cable 3 m (for LCD display)
C	4 conductor cable 1 m (for bar display)
D	4 conductor cable 3 m (for bar display)
G	M12 both ends connector cable (3 m) (for IO-Link)
H	Bracket 1 (for models with a flow rate range below 200 L/min)
J	Bracket 2 (for models with a flow rate range of 500 L/min or 1000 L/min)
K	Panel mounting kit 1 (for sensor unit models with a flow rate range below 200 L/min)
L	Panel mounting kit 2 (for needle valve integrated models with a flow rate range below 200 L/min)
M	DIN rail mounting kit (for models with a flow rate range below 200 L/min)
Ⓑ Clean-room specifications	
Blank	None
P70	Anti-dust generation (FSM3-G-P70 cannot be selected.)

Cable optional dimensions

● FSM3-A, B

5 conductor cable (for LCD display and separate display)



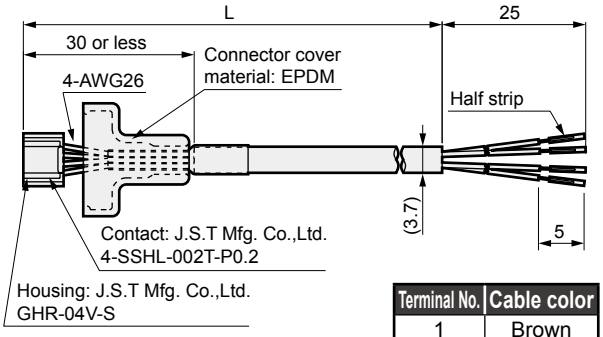
Model No.	L dimensions	Weight g
FSM3-A	1040 ±20	21
FSM3-B	3040 ±20	57

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

Cable optional dimensions

● FSM3-C, D

4 conductor cable (for bar display)

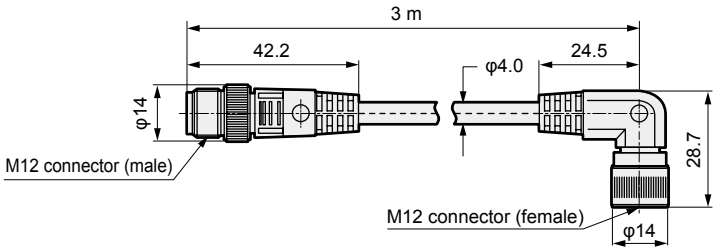


Model No.	L dimensions	Weight g
FSM3-C	1040 ±20	19
FSM3-D	3040 ±20	52

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

● FSM3-G

(M12 both ends connector cable)

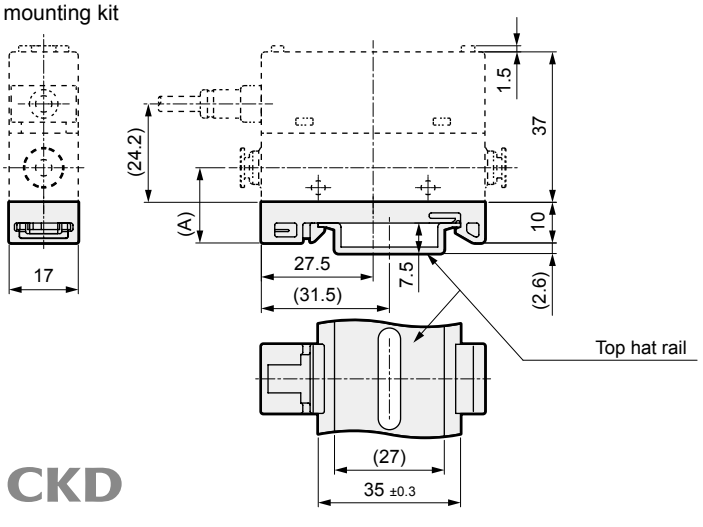


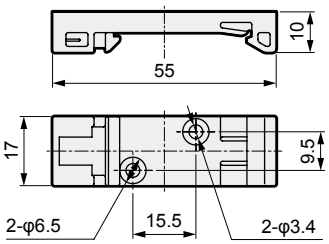
Terminal No.	Cable color
1	Brown
2	White
3	Blue
4	Black

Dimensions with options

● FSM3-M

DIN rail mounting kit





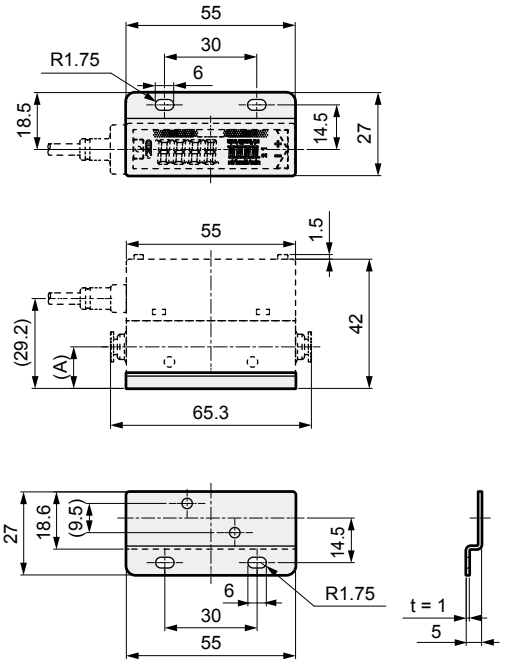
Model No.	Dimension (A)
FSM3-□□1/BH1/CH1/HH1/AA1/AB1/AC1	18.5
FSM3-□□1/DH1/EH1/JH1/BA1/BB1/BC1	23.0

CKD

Dimensions with options

● FSM3-H

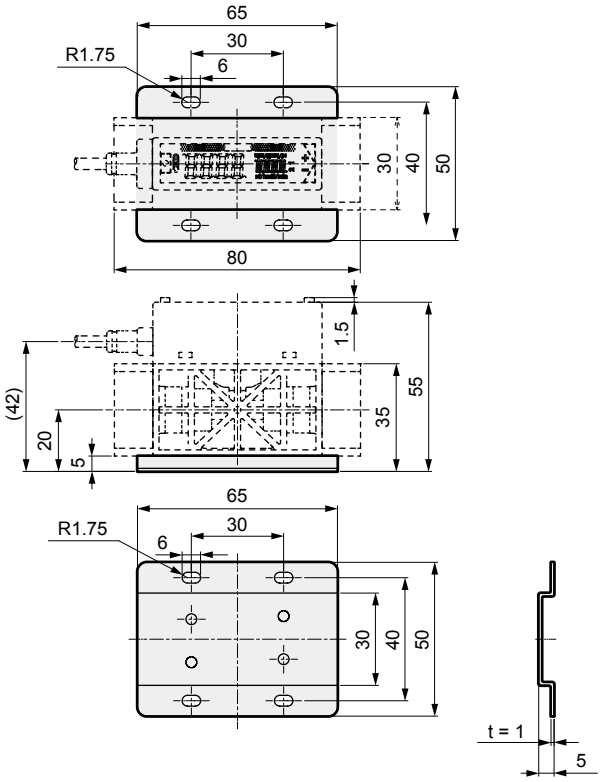
Bracket 1 (for models 200 L or less)



Model No.	Dimension (A)
FSM3-□□□1/BH1/CH1/HH1/AA1/AB1/AC1	13.5
FSM3-□□□1/DH1/EH1/JH1/BA1/BB1/BC1	18.0

● FSM3-J

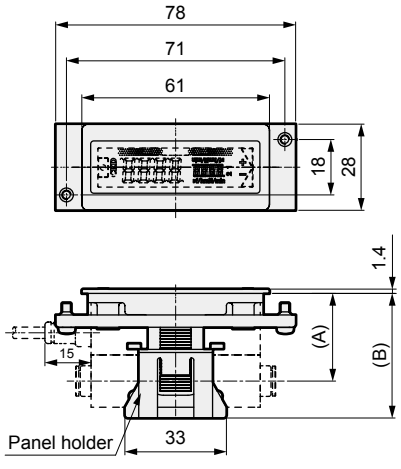
Bracket 2 (for models 500 or 1000 L)



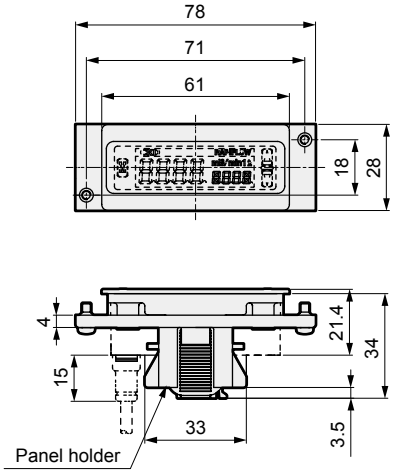
● FSM3-K

Panel mounting kit 1 (for LCD display/separate display)

• LCD display



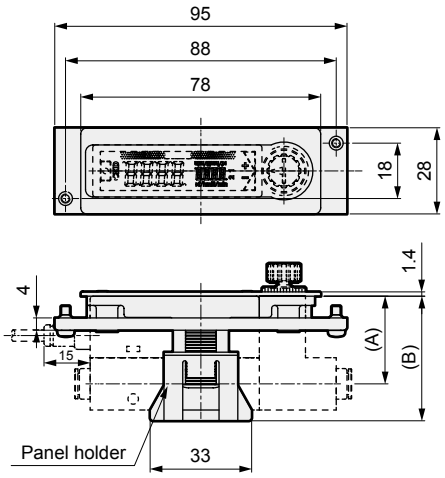
• Separate display



● FSM3-L

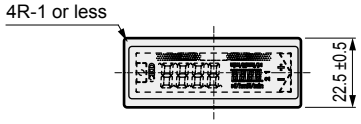
Panel mounting kit 2 (for needle valve integrated)

• Needle valve integrated

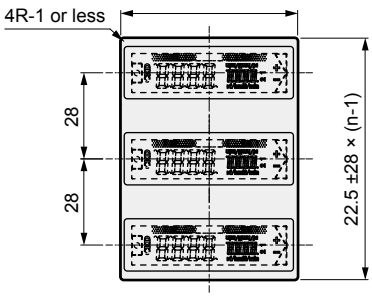


[Panel cut dimensions]

For single unit mounting



For close contact mounting



Model No.	Dimension (A)	Dimension (B)
FSM3-□□□1/BH2/CH2/HH2/AA2/AB2/AC2/□□□/N/T	28.5	40.5
FSM3-□□□1/DH2/EH2/JH2/BA2/BB2/BC2/□□□/N/T	30	46.5

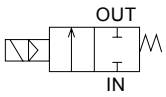
Pilot operated 2-port solenoid valve for compressed air

EXA Series screw-in connection body

- NC
- Port size: Rc1/4, 3/8

JIS symbol

- NC



How to order

EXA - 02 - 1 2C - 3

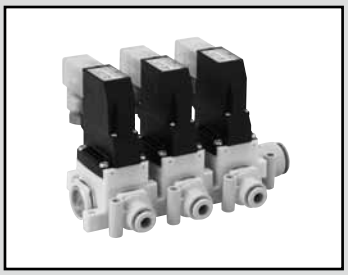
- 02 — Model No. / Port size (A)
- 1 — Sealant/pilot operated combination (B)
- 2C — Coil option (C)
- 3 — Voltage (D)

[Example of model No.]
EXA-02-12C-3

- A Port size: Rc1/4
- B Sealant/pilot operated combination
  : H-NBR/external exhaust specifications
- C Coil option
  : Lead wire (without light or surge suppressor)
- D Voltage: 24 VDC

Code		Content
A Port size		
02		Rc1/4
03		Rc3/8
B Sealant/pilot operated combination		
0		H-NBR, internal exhaust specifications
1		H-NBR, external exhaust specifications *1
C Coil option *2		
2C	Standard	Lead wire (without surge suppressor)
2G	Option	DIN terminal box (Pg7) without lamp
D Voltage *2		
1		100 VAC
3		24 VDC
4		12 VDC

*1: Check the pressure specifications.
*2: Contact CKD for G thread and NPT thread support.



Pilot operated 2-port solenoid valve for compressed air, manifold

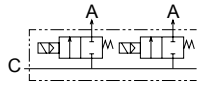
GEXA Series

- NC
- Port size: Push-in fitting φ6, φ8, φ10, φ12
- Diaphragm drive

JIS symbol

- NC

Common supply/port C pressurization



How to order

GEXA - C10 C8 - 3 - 1 2HS - 3

- C10 — Model No. / Port C connected tube outer diameter (A)
- C8 — Port A connected tube outer diameter (B)
- 3 — Manifold station No. (C)
- 1 — Sealant/pilot operated combination (D)
- 2HS — Coil option (E)
- 3 — Voltage (F)

[Example of model No.]
GEXA-C10C8-3-12HS-3

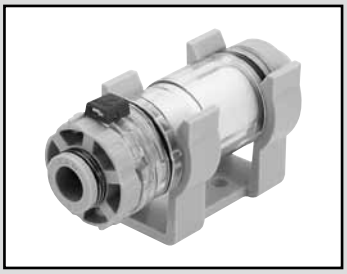
- A Port C connected tube outer diameter: φ10
- B Port A connected tube outer diameter : φ8
- C Manifold station No. : 3 stations
- D Sealant/pilot operated combination : H-NBR/external exhaust specifications
- E Coil option : DIN terminal box (Pg7) With lamp/surge suppressor (inside terminal box)
- F Voltage : 24 VDC

Code		Content
A Port C connected tube outer diameter		
C10		φ10
C12		φ12
B Port A connected tube outer diameter		
C6		φ6
C8		φ8
C10		φ10
C12		φ12
C Manifold station No.		
2		2 stations
to		to
5		5 stations
D Sealant/pilot operated combination		
0		H-NBR/internal exhaust specifications
1		H-NBR/external exhaust specifications *1
E Coil option *2		
2C	Standard	Lead wire (without surge suppressor)
F Voltage *2		
1		100 VAC
3		24 VDC
4		12 VDC

*1: Check the pressure specifications.

Precautions for model No. selection

*1: If using under conditions with a small pressure differential before and after the solenoid, select code 1 for the sealant and pilot combination.
*2: Due to the conditions of the connection space, the DIN terminal box for EXA series single units cannot be selected.



Inline filter

FSL Series

● Port size: φ4 to φ10

JIS symbol 

RoHS

Specifications

Descriptions		FSL100		FSL200		FSL500		
Port size	mm	φ4	φ6	φ4	φ6	φ6	φ8	φ10
Working fluid		Air						
Operating ambient temperature range	°C	0 to 50 (no freezing)						
Max. working pressure	MPa	0.8 (*1)						
Vacuum working pressure	kPa	−100						
Proof pressure	MPa	1.2						
Nominal filtration rating	μm	10 (Collection efficiency 95%)						
Filtration area	cm^2	4.7		7.5		12.7		
Recommended processing flow rate (*2)	L/min (ANR)	10		15	20	25	50	60
Weight	g	8	8.5	20.5	21.5	34.5	33.5	39

*1: The max. working pressure is the value at 20°C.
When using in other temperature ranges, refer to the "Relation of working temperature and max. working pressure" on the "Pneumatic, Vacuum and Auxiliary Components (catalog No. CB-024SA)" page.

*2: Initial flow rate at initial pressure loss 3 kPa or less under negative pressure.

How to order

FSL **500** - **1010** - **B**

Ⓐ Series
Ⓑ Vacuum side port size - Pad side port size
Ⓒ Attachment options

Code	Content
Ⓐ Series	
100	FSL100 Series
200	FSL200 Series
500	FSL500 Series
Ⓑ Vacuum side port size - Pad side port size	
44	Push-in fitting φ4 - Push-in fitting φ4
66	Push-in fitting φ6 - Push-in fitting φ6
88	Push-in fitting φ8 - Push-in fitting φ8
1010	Push-in fitting φ10 - Push-in fitting φ10
Ⓒ Attachment options	
Blank	None
B	Bracket

◆ Series port size combination table

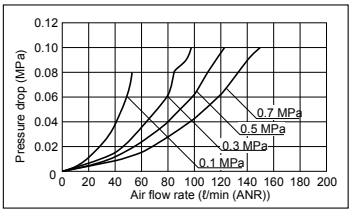
Port size / Model No.	44	66	88	1010
FSL100	●	●		
FSL200	●	●		
FSL500		●	●	●

indicates not available.

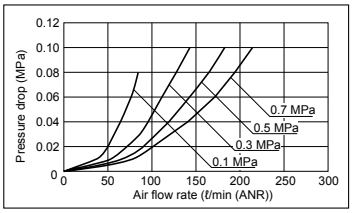
Flow characteristics

* The flow characteristics graph gives reference values and does not guarantee the values.

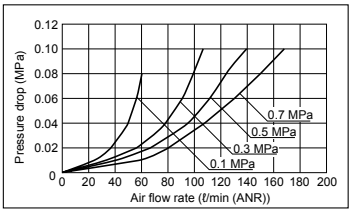
● FSL100-44



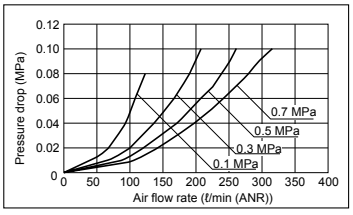
● FSL100-66



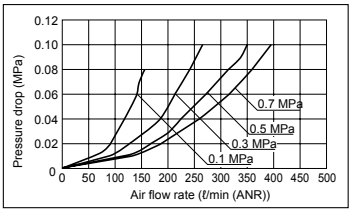
● FSL200-44



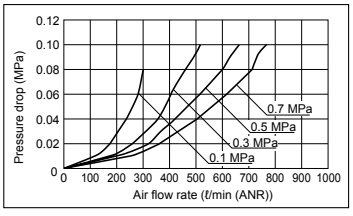
● FSL200-66



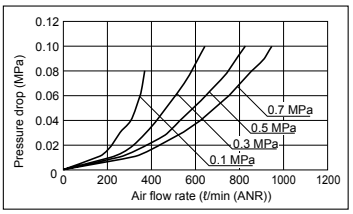
● FSL500-66



● FSL500-88



● FSL500-1010



Safety Precautions

Always read this section before use.

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

WARNING

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

2 Use this product in accordance with specifications.

This product must be used within its stated specifications. In addition, never modify or additionally machine this product.
This product is intended for use in general industrial machinery equipment or parts. It is not intended for use outdoors (except for products with outdoor specifications) or for use under the following conditions or environments.
(Note that this product can be used when CKD is consulted prior to its usage and the customer consents to CKD product specifications. The customer should provide safety measures to avoid danger in the event of problems.)

❶ Use for applications requiring safety, including nuclear energy, railways, aircraft, marine vessels, vehicles, medical devices, devices or applications in contact with beverages or foodstuffs, amusement devices, emergency cutoff circuits, press machines, brake circuits, or safety devices or applications.
❷ Use for applications where life or assets could be significantly affected, and special safety measures are required.

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

ISO4414, JIS B 8370 (General rules for pneumatic systems)
JFPS2008 (Principles for pneumatic cylinder selection and use)
Including High Pressure Gas Safety Act, Industrial Safety and Health Act, other safety rules, body standards and regulations, etc.

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

❶ Inspect and service the machine and devices after confirming safety of all systems related to this product.
❷ Note that there may be hot or charged sections even after operation is stopped.
❸ When inspecting or servicing the device, turn OFF the energy source (air supply or water supply), and turn OFF power to the facility. Discharge any compressed air from the system, and pay attention to possible water leakage and leakage of electricity.
❹ When starting or restarting a machine or device that incorporates pneumatic components, make sure that the system safety, such as pop-out prevention measures, is secured.

5 Observe warnings and cautions in the following pages to prevent accidents.

■The precautions 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, and when there is a high degree of emergency to a warning.

WARNING: If handled incorrectly, a dangerous situation may occur, resulting in death or serious injury.

CAUTION: When a dangerous situation may occur if handling is mistaken leading to minor injuries or physical damage.

Note that some items described as "CAUTION" may lead to serious results depending on the situation.
Every item provides important information and must be observed.

Limited warranty and disclaimer

1 Warranty period

This warranty shall be valid for one year after delivery to the customer's designated site.

2 Scope of warranty

If any faults, found to be the responsibility of CKD, occur during the above warranty term, the product shall be replaced, the required replacement parts provided free of charge, or shall be repaired at the CKD factory free of charge.
This Limited Warranty will not apply to:
(1) Failures due to use outside the conditions and environments set forth in the catalog or these specifications.
(2) Failures resulting from factors other than this product.
(3) Failures caused by improper use of the product.
(4) Failures resulting from modifications or repairs made without CKD consent.
(5) Failures caused by matters that could not be predicted with the technologies in practice when the product was delivered.
(6) Failures resulting from natural disasters or accidents for which CKD is not liable.
The warranty covers the actually delivered product, and does not cover any damage resulting from losses induced by faults in the delivered product.

3 Compatibility check

The customer is responsible for confirming the compatibility of CKD products with the customer's systems, machines and equipment.

Pneumatic components: Warning and Cautions

Always read this section before use.

Design/selection

Working fluids

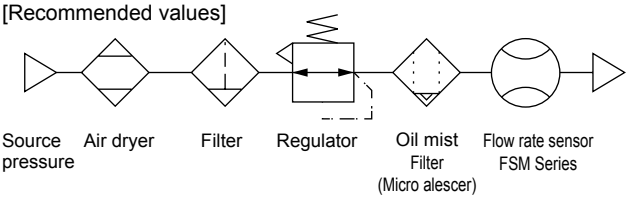
DANGER

- Do not use this product for flammable fluids.

WARNING

- This product cannot be used as a business meter.
  Do not use this product for commercial transactions as it is not compliant with the Measurement Act. Intended applications include industrial sensors.
- Do not use fluids other than the applicable fluid because accuracy cannot be guaranteed.
- Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist.
- Depending on the fluid, retaining the fluid for long periods could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.
- When using compressed air, use clean air that complies with JIS B 8392-1: 2012 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oil oxide, foreign matter, etc.). So install a filter, air dryer, and oil mist filter (micro alescer) on the primary side (upstream side) of the sensor. The sensor's mesh rectifies flow in the pipe. It does not filter out foreign matter, so provide a filter.

[Recommended values]



- Working pressure/flow rate range
  Applications exceeding the max. working pressure and specified flow rate range may result in faults. Use this product only within the specified range. If energized in a vacuum state of -0.09 MPa or less, the sensor's heat dissipation will suffer, leading to degradation of the sensor.
- When using a valve on the primary side of the sensor, use only valves with oil-prohibited specifications. This sensor could malfunction or fail if exposed to splattering grease, oil, etc. As friction powder may be generated depending on the valve, mount a filter to prevent the powder from entering the sensor.

Working environment

DANGER

- Explosion-proof environments
  Never use this product in an explosive gas atmosphere. The structure is not explosion-proof, and explosions or fires could occur.

WARNING

- Corrosive environments
  Do not use this product in an atmosphere containing corrosive gases such as sulfur dioxide.
- Ambient/fluid temperatures
  Use ambient temperature/fluid temperature from 0 to 50°C within specified range.
  Even if the temperature is within the specified range, do not use this product if the ambient temperature and fluid temperature could suddenly change and cause dew to condense.
- Drip-proof environments
  The degree of protection of this product is equivalent to IP40. Do not install this product where water, salt, dust, or swarf is present or in a pressurized or depressurized environment. The product cannot be used with large temperature variations or high temperature/humidity since condensation may occur inside the body.

Flow rate unit

CAUTION

- This product's flow rate is measured at a mass flow rate unaffected by temperature or pressure. The unit is ℓ/min, the display used when the mass flow rate is converted to volumetric flow rate at 20°C, 1 barometric pressure (101 kPa), relative humidity 65%.

Overflow

CAUTION

- With each series, the sensor can handle an overflow double the measured range. If dynamic pressure is applied near the maximum working pressure (when a pressure difference exceeding the max. working pressure is applied between primary and secondary sides), the sensor may operate abnormally. If dynamic pressure is applied, such as when a workpiece is filled for leakage inspection, provide a bypass circuit or restrictor so that dynamic pressure is not applied to the sensor.

Needle valve integrated

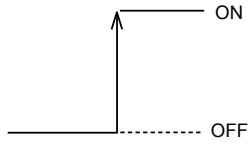
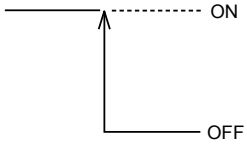
⚠ CAUTION

- This valve cannot be used as a stop valve that requires no leakage. Slight leakage is allowed for in this product's specifications.
- The flow path in the needle valve is not completely free of dust generation. A final clean filter should be used in circuits where dust generation could be a problem.

Use for suction confirmation, etc.

⚠ CAUTION

- Mount an air filter upstream from suction in compliance with use conditions to prevent the entry of foreign matter.
- Consider the atmospheric dew point and the product's ambient temperature, and use the product under conditions in which dew does not condense in pipes.
- When this product is used for vacuum applications such as air suction, do not bend the tube near the push-in fitting. If stress is applied to the tube near the push-in fitting, insert an insert ring into the tube, and connect the tube to the push-in fitting.
- Select the flow rate range based on the operating vacuum pressure and suction nozzle.
- Response speed may be delayed by the piping volume between the suction nozzle and this product. In this case, take countermeasures to reduce piping capacity.
- When the suction confirmation sensor is switched from a pressure sensor (switch) to a flow rate sensor (switch), sensor output (switch output) logic will be reversed. Refer to the drawing below.
  Note that the PLC sequence program must be changed or revised.
  If source pressure or vacuum source is not supplied when device power is turned on, "flow rate 0" = "sensor output (switch output) ON" status is set at the flow rate sensor (switch). Check that this is not a problem with the PLC sequence program, etc.

	Pressure sensor (switch)	Flow rate sensor (switch)
Suction confirmation	ON at setting value or more	ON at setting value or less
		
	Atmospheric pressure side / High vacuum side	Flow rate 0 side / High flow rate side

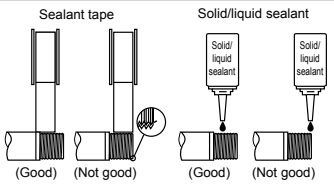
Mounting, installation and adjustment

Piping

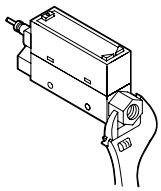
⚠ CAUTION

- Always attach the pipes before starting wiring.
- Align the fluid flow direction to the direction indicated on the pipe when connecting the pipes.
- Do not install the regulator/solenoid valve, etc., immediately before this product. Generated drift may cause errors. Provide a straight piping section if required.
- Before installing piping, clean out the pipes using air blower to remove all foreign matter and cutting chips from the pipes. The rectifier or sensor chip could be damaged if a large amount of foreign matter, cutting chips, etc., enters.
- Check that sealant tape or sealant material does not get inside during piping.
  *When using for clean room specifications, make sure that the sealant material matches the system.

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



- The screw-in fittings of this product are compliant with push-in fittings for pneumatic pressure. Do not use this product for pneumatic pressure circuits with steel pipe connections. If this product is used for steel pipe connection, the misalignment of the IN side steel pipe bore and OUT side steel pipe bore will cause excessive force to be applied to the body, as well as external leakage, risking damage to the product.
- Attach a wrench to metal sections when tightening pipes so that force is not applied to the resin section.



- Refer to the torque below so as not to apply excessive screw-in torque or load torque to the connection port.

[Reference value]

Port thread	Tightening torque N·m
Rc1/8(G1/8)	**3 to 5**
Rc1/4	**6 to 8**
Rc1/2	**16 to 18**

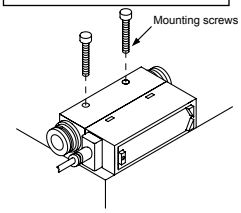
- When using a push-in fitting, accurately insert tube and confirm that it cannot be pulled out. Cut the tube at a right angle with a dedicated cutter before use.
- Make sure that the leakage detection solution does not enter the product when inspecting the pipe for leaks.
- Do not turn the fitting while the product fluid pressure is on, since it may cause external leakage.

Mounting

⚠ CAUTION

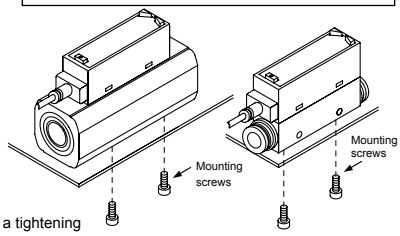
- The LCD display type flow rate display meter uses a liquid crystal display. This may be difficult to read depending on the angle.
- Do not install multiple product bodies in close contact. The generation of heat on each part could cause the product's temperature to rise, hastening changes in characteristics or deterioration of the resin material. When using the products in a row, set intervals of distance of 10 mm and over.
- Although the mounting is "unrestricted in vertical/ horizontal direction", the flow rate may vary depending on difference in the mounting orientation or piping conditions.

Lateral mounting (use of through hole)

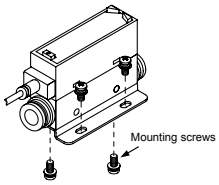


Tighten the mounting screw with a tightening torque of 0.5 N·m.

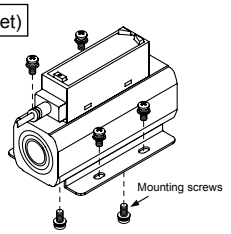
Vertical mounting (use of female thread on bottom surface)



Bracket mounting (use of dedicated bracket)

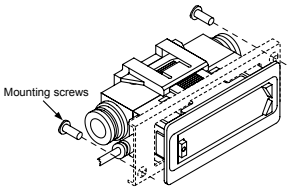


For FSM3-□005 to 201
Single bracket model No.: FSM3-B1
Tighten the mounting screw with a tightening torque of 0.5 N·m.

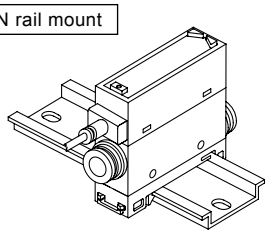


For FSM3-□501 and 102
Single bracket model No.: FSM3-B2

Panel mounting



DIN rail mount



Tighten the set screw with a tightening torque of 0.06 N·m.
Complete the piping before assembly.
If the pipes are connected after assembly, excessive stress will be applied and may damage the product parts.
When using the panel mounting method, make sure that vibration is not applied to the product. When using on a stainless steel body, the vibration will be amplified and could damage the product.

■ Note that if you mount the elbow fitting in a downward position, it may interfere with the DIN rail mounting.

■ Note that the bracket mounting position may interfere with the elbow fitting.

Wiring

⚠ DANGER

■ Use power supply voltage and output within the specified voltage.
If voltage exceeding the specified voltage is applied, the sensor could malfunction or be damaged, or electrical shock or fire could occur. Do not use any load that exceeds the rated output. Otherwise, output damage or fire may result.

■ Stop the control device and equipment and turn power OFF before wiring. Starting operation suddenly could cause unpredictable and dangerous operation. Conduct an energized test with controls and machine devices stopped, and set target switch data. Be sure to discharge any accumulated electrostatic charge among personnel, tools, or equipment before and during work. Connect and wire bending resistant material, such as robot wire material for movable sections.

⚠ WARNING

■ Install the product and wiring away from sources of noise, such as power distribution wires. Provide separate countermeasures for surge applied to the power cable. The display or output could fluctuate.

■ Do not short-circuit the load. Failure to observe this could result in rupture or burning.

■ The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output error increases. Check error with the impedance of the connecting load before using. (The analog output current output is excluded.)

Example of calculation

(FSM3-□V Output impedance : Ro = 1 KΩ
Load internal impedance : Rx = 1 MΩ

$$\text{Output value} = \left(1 - \frac{Ro}{Ro + Rx}\right) \times 100\%$$

$$= \left(1 - \frac{1\ K\Omega}{1\ K\Omega + 1\ M\Omega}\right) \times 100\% \Rightarrow \text{Output value error approx. 0.1\%}$$

■ Check wiring insulation.
Check that wires do not come into contact with other circuits, that no ground faults occur, and that the insulator between terminals is not defective. Overcurrent could flow in and damage the sensor.

■ Check line color when wiring. As incorrect wiring could result in sensor damage and malfunctions, check wire color against the instruction manual before wiring.

■ Use a stabilized DC power supply within the specified rating that has been insulated from the AC power supply. A non-insulated power supply could result in electrical shock. If power is not stabilized, the peak value could be exceeded. This could damage the product or impair accuracy.

■ Do not use at levels exceeding the power supply voltage range. If voltage exceeding this range or AC power is applied, the controller could rupture or burn.

■ Check that stress (7 N and over) is not applied to cable leadouts or connectors.

■ Always attach the connector bar after connecting the connector cover.

During adjustment

⚠ CAUTION

■ If switches are operated when fluid is pulsating or flow rate is otherwise unstable, operation may be unstable. In this case, provide sufficient margin between the two setting values and avoid setting switches in an unstable area. Confirm that switch operation is stable before use.

Needle valve integrated

⚠ CAUTION

■ Do not turn the knob forcibly when fully closing or opening it (0.05 N·m or less). Do not use the lock nut to adjust the needle. Otherwise this could cause needle galling or damage.

■ The set flow rate may be unstable if turning the dial of the needle valve forcibly when fully closing. Do not overly tighten the dial.

During Use & maintenance

⚠ WARNING

■ Working conditions for CE compliance
This product is CE-marked, indicating conformity with the EMC Directives. EN61000-6-2; regulation matched to immunity applies to this product. Conditions below are necessary to comply with these standards.
Conditions
- The assessment of this product is performed by using a cable pairing a power supply line and a signal line, treating this cable as a signal line.
- This product is not equipped with surge immunity. Implement surge protection measures on the system side.

■ Do not disassemble or modify this product. Doing so could result in faults.

■ Output accuracy is affected by temperature characteristics and heat generated when energized. Provide a standby time (5 minutes or more) after turning the power ON for use.

■ Immediately after power is turned ON, this product does not start flow rate detection switch operation for approx. 5 seconds to complete self-diagnosis. Provide a control circuit/program that ignores signals for at least five seconds after power is turned ON.

⚠ CAUTION

■ If a problem occurs during operation, immediately turn power off, stop use, and contact your dealer.

■ This product uses a micro-sensor chip, and must be installed where it will not be subject to dropping, impact or vibration. Handle this product as a precision component during installation and transportation.

■ Keep this product's flow rate within the rated flow range.

■ Use this product within the working pressure range.

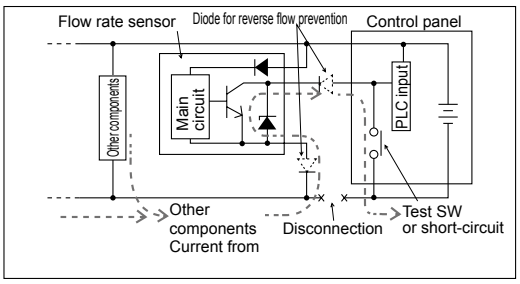
■ If the output setting value is changed, control system devices could operate unintentionally. Stop devices before changing settings.

■ Analog output continues even if the flow rate range is exceeded. With the display integrated, "Hi" or "Lo" will be displayed. With display separated, the bar display will blink.
Note that this is outside guaranteed precision.

■ The accuracy may vary from the initial status depending on the working environment or working conditions. It is recommended to check the operation of the product periodically.

■ The sensor chip will degrade when used for a long time and cause the detected flow rate to vary. Periodically inspect the sensor chip.

■ Pay attention to the reverse current caused by disconnected wires/wiring resistance. If other devices, including a flow rate sensor, are connected to the same power sensor as the flow rate sensor, and the switch output wire and power cable minus (−) side are short-circuited to check the operation of the control panel's input unit, or if the power cable's minus (−) side is disconnected, reverse current could flow to the flow rate sensor's switch output circuit and cause damage.



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

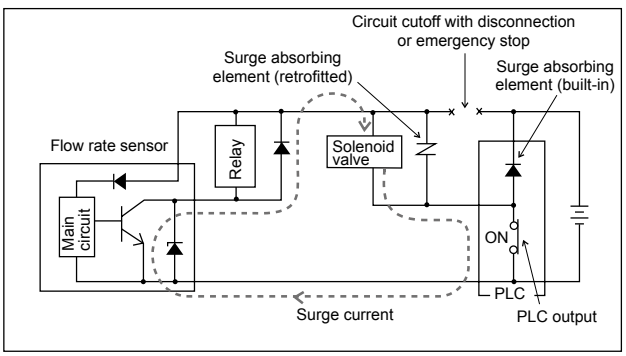
① Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.

② Limit the number of devices connected to the same power supply as the flow rate sensor.

③ Insert a diode parallel to the flow rate sensor's output line to prevent the reverse current.

④ Insert a diode parallel to the flow rate sensor power wire's minus (−) side to prevent the reverse current.

■ Care must be taken for surge current leading.
When flow rate sensor power is shared with an inductive load that generates surges, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, surge current could enter the switch output circuit and cause damage depending on where the surge absorbing element is installed.

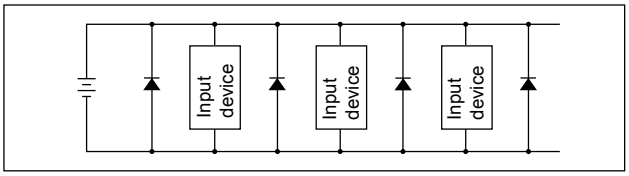


Take the following countermeasures as followings to prevent damages caused by reverse current.

① Separate the power supply for output including the inductive load, such as the solenoid valve and relay, and input, such as the flow rate sensor.

② If a separate power supply cannot be used, directly install a surge absorption element for all inductive loads. Consider that the surge absorption element connected to the PLC, etc., protects only the individual device.

③ Connect a surge absorption element to the following places on the power wiring as shown below as a measure against disconnections in unspecific areas.



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

■ When using the LCD display, do not press down on the display section. This may lead to failure.

■ The case is made of resin. Do not use solvent, alcohol or detergent in cleaning, since the resin could absorb it. There is a risk of affecting the resin. Wipe off dirt with a rag soaked in a diluted neutral detergent solution and wrung out well.

Needle valve integrated

⚠ CAUTION

■ Vibration could cause the needle to turn and the flow rate to change.

Separated display FSM2-D Series

Design/selection

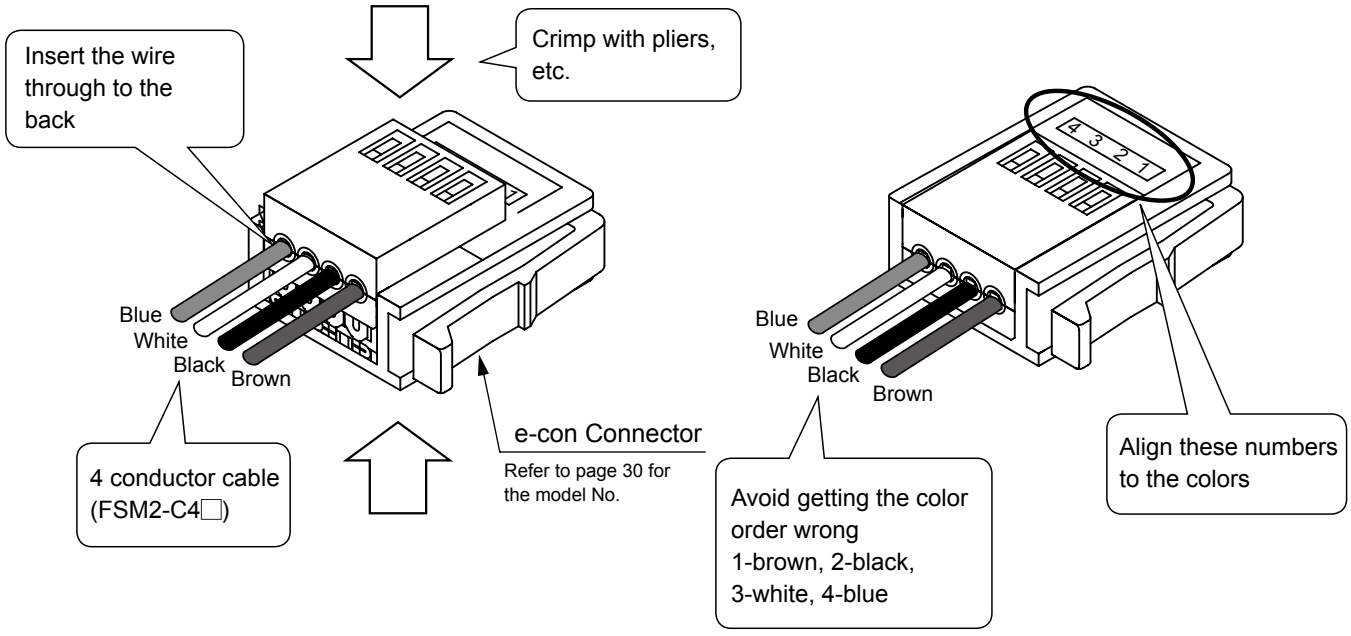
⚠ CAUTION

■ The corresponding sensor is the voltage output (1 to 5 V) type. If the current output type or other voltage output type is connected, it doesn't operate properly. When using FSM3, use the bar display type voltage output.

Mounting, installation and adjustment

⚠ CAUTION

■ Cut the half-strip section at the end of the e-con connector wiring before use. Insert the wire through to the back of the connector, and securely crimp with pliers, etc.
The wire sheath does not need to be removed.
Check that the pin No. and wire color are correct before crimping.
Incorrect wiring can lead to sensor or separated indicator damage, faults or malfunction.



* The e-con connector is attached with the separated display.

■ When attaching or removing the cable, hold the connector instead of the cable.
Holding the cable could result in a contact fault, broken wire or short-circuit, etc., could damage the sensor or separated indicator, or cause malfunctions.

■ Do not apply a load of 15 N and over onto the cable.

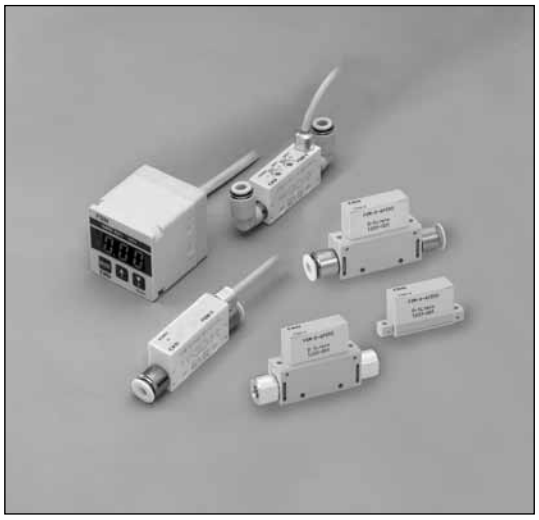
MEMO

MEMO

Related products

Compact flow rate sensor RAPIFLOW® FSM Series

Catalog No. CB-024SA



Compact flow rate sensor 2 series for various applications

FSM-X Series

- Miniature/lightweight/high-speed response
- Positive and negative pressure

FSM-V Series

- Miniature/ultra-high-speed response
  Capable of 5 ms high speed response

Compact flow rate controller (RAPIFLOW) FCM Series

Catalog No. CB-024SA

- Compact/high speed/high precision
- Compatible with various fluids
- Capable of 0.5 sec high speed control
- Built-in digital display to check control state at a glance
- Built-in microcomputer enables various types

Inline clean filter FCS500/FCS1000 Series

Catalog No. CB-024SA

Ideal as a final filter for clean applications.
(For air and inert gas)

- 0.01 µm high precision filtration, 99.99% removal efficiency
  Hollow fiber membrane element has enabled 0.01 µm high precision filtration and 99.99% removal efficiency.
- Long service life
  Considerably longer service life. Approximately five times longer than the flat membrane.
- Compact/lightweight/large flow rate
  Three to ten times filtration area enables larger flow rate and less pressure loss than the flat membrane of the same capacity. If the flow rate is the same, the hollow fiber membrane can be more compact and lighter.
- Oil-prohibited specifications
  Parts are all degreased and cleaned. The manufacturing processes from assembling to packaging are performed in clean room.
- Easy maintenance
  As the case of resin is transparent, it is easy to visually check for dirt of the element.
- Wide range of choices
  Two kinds of flow rate (500 and 1000 Series), resin and stainless steel materials, and the mounting options of push-in fitting, male thread piping and female thread piping are available.

Related products

Electro pneumatic regulator EVS2 Series

Catalog No. CC-993A

■ Compact and lightweight
A compact electro pneumatic regulator with a size of W 30 × D 50 × H 39 and a weight of 90 g. Downsize and lighten your equipment with this model.

■ Long service life
Three times longer service life than our conventional model.

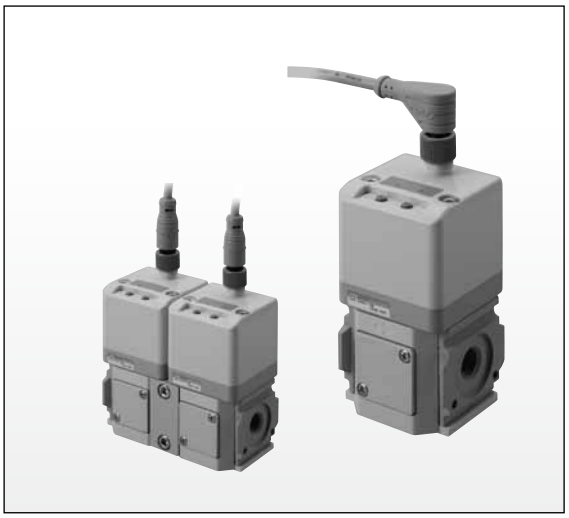
■ High precision/high-speed response
High precision and high-speed response control of fluid pressure using electric signals.
Provides 0.3% F.S. repeatability, 0.1% F.S. resolution, and 0.1 sec. response time (without load).

■ 2-color display of the operational status
On the 2-color operation indicator, green means the pressure is within the set value and red means the pressure is outside the set value or an error status.

■ Easy to pipe/wire
Push-in cartridge fitting and M12 connector have improved work efficiency.

High precision electro pneumatic regulator EVR series

Catalog No. CC-1174A



■ High precision pressure accuracy
- Hysteresis: 0.3% F.S., Linearity: ±0.5% F.S., Resolution: 0.1% F.S., Repeatability: 0.2% F.S.

■ Improvement of temperature stability and durability
- Hysteresis: 0.3% F.S., Linearity: ±0.5 % F.S., Resolution: 0.1% F.S., Repeatability: 0.2% F.S.

■ New built-in feature
- Residual pressure 0 when the input signal is 0% F.S. Select control pattern.

■ Easy operation
- "point adjustment", "span point adjustment", and "pressure control pattern" can be operated with two buttons.

■ Compatibility/installation
- Compatible mounting with the conventional product (EV2500).
- Two types of connectors are available. (Straight, L-type, 1 m, 3 m)

Digital pressure sensor PPX Series

Catalog No. CB-024SA

■ Increased visibility

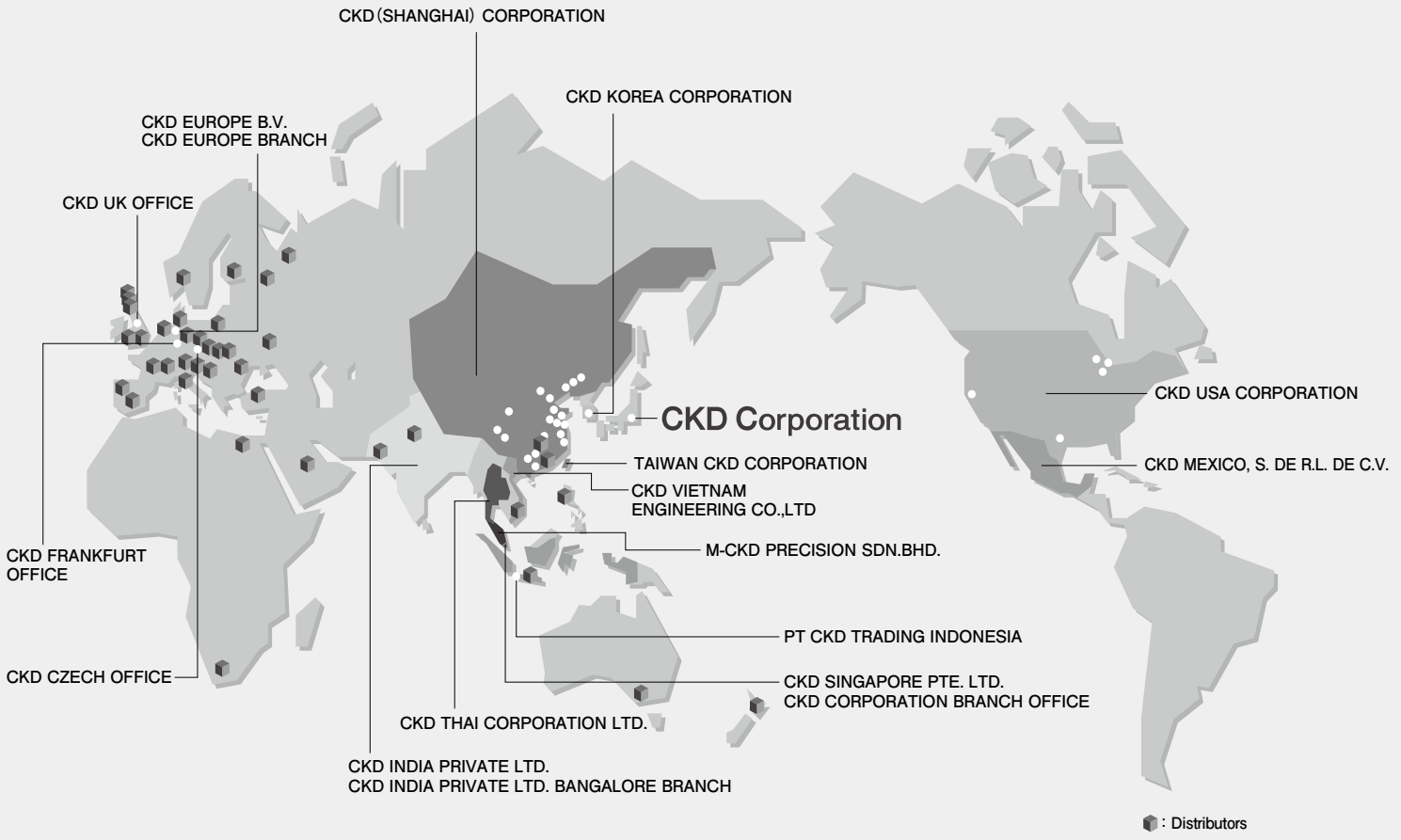
■ Analog current output is added to the high-function

■ Power consumption is further reduced

■ Direct setting with 2-screen display

■ Copy function helpful for reducing work processes and preventing misoperation.

WORLD-NETWORK



CKD Corporation

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

□ 2-250, Ouji, Komaki City, Aichi, 485-8551 Japan
□ PHONE +81-(0)568-74-1338 FAX +81-(0)568-77-3461

U.S.A.

CKD USA CORPORATION
●CHICAGO HEADQUARTERS
4080 Winnetka Avenue, Rolling Meadows, IL 60008, USA
PHONE +1-847-368-0539 FAX +1-847-788-0575
・CINCINNATI OFFICE
・SAN ANTONIO OFFICE
・SAN JOSE OFFICE
・DETROIT OFFICE

Mexico

CKD MEXICO, S. DE R.L. DE C.V.
Cerrada la Noria No. 200 Int. A-01, Querétaro Park II, Parque Industrial Querétaro, Santa Rosa Jáuregui, Querétaro, C.P. 76220, México
PHONE +52-442-161-0624

Europe

CKD EUROPE B.V.
Beechavenue 125A, 1119 RB Schiphol-Rijk, The Netherlands
PHONE +31-23-554-1490
・GERMANY OFFICE

CKD CORPORATION EUROPE BRANCH
●SALES HEADQUARTERS
Beechavenue 125A, 1119 RB Schiphol-Rijk, The Netherlands
PHONE +31-23-554-1490
・CZECH OFFICE
・UK OFFICE

Malaysia

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

Thailand

CKD THAI CORPORATION LTD.
●SALES HEADQUARTERS
Suwan Tower, 14/1 Soi Saladaeng 1, North Sathorn Road, Kwaeng Silom, Khet Bangrak, Bangkok 10500, Thailand
PHONE +66-(0)2-267-6300 FAX +66-(0)2-267-6305
・RAYONG OFFICE
・NAVANAKORN OFFICE
・EASTERN SEABOARD OFFICE
・LAMPHUN OFFICE
・KORAT OFFICE
・AMATANAKORN OFFICE
・PRACHINBURI OFFICE
・SARABURI OFFICE

Singapore

CKD SINGAPORE PTE. LTD.
No.33 Tannery Lane #04-01 Hoesteel Industrial Building, Singapore 347789, Singapore
PHONE +65-67442623 FAX +65-67442486

CKD CORPORATION BRANCH OFFICE
No.33 Tannery Lane #04-01 Hoesteel Industrial Building, Singapore 347789, Singapore
PHONE +65-67447260 FAX +65-68421022

India

CKD INDIA PRIVATE LTD.
Unit No. 607, 6th Floor, Welldone Tech Park, Sector 48, Sohna Road, Gurgaon-122018, Haryana, India
PHONE +91-(0)124-418-8212

CKD INDIA PRIVATE LTD. BANGALORE BRANCH
No. 201/B, 2nd Floor, Museum Terraces Apartment, No. 29, Museum Road, Bangalore-560001, Karnataka, India
PHONE +91-(0)80-4212-7008/7009 FAX +91-(0)80-4212-7007

Indonesia

PT CKD TRADING INDONESIA
●SALES HEADQUARTERS
Menara Bidakara 2, 18th Floor, Jl. Jend. Gatot Subroto Kav. 71-73, Pancoran, Jakarta 12870, Indonesia
PHONE +62-(0)21-2938-6601 FAX +62-(0)21-2906-9470
・BEKASI OFFICE
・KARAWANG OFFICE
・SURABAYA OFFICE

Vietnam

CKD VIETNAM ENGINEERING CO.,LTD.
18th Floor, CMC Tower, Duy Tan Street, Cau Giay District, Hanoi, Vietnam
PHONE +84-(0)24-3795-7631 FAX +84-(0)24-3795-7637

Taiwan

台湾喜開理股份有限公司
TAIWAN CKD CORPORATION
16F-3, No. 7, Sec. 3, New Taipei Blvd., Xinzhuang Dist., New Taipei City 242, Taiwan
PHONE +886-(0)2-8522-8198 FAX +886-(0)2-8522-8128
・新竹営業所 (HSINCHU OFFICE)
・台中営業所 (TAICHUNG OFFICE)
・台南営業所 (TAINAN OFFICE)

China

喜開理(上海)機器有限公司
CKD(SHANGHAI)CORPORATION
●営業部 / 上海浦西事務所(SALES HEADQUARTERS / SHANGHAI PUXI OFFICE)
Room 601, 6th Floor, Yuanzhongkeyan Building, No. 1905 Hongmei Road, Xinhui District, Shanghai 200233, China
PHONE +86-(0)21-61911888 FAX +86-(0)21-60905356
・上海浦東事務所 (SHANGHAI PUDONG OFFICE)
・無錫事務所 (WUXI OFFICE)
・杭州事務所 (HANGZHOU OFFICE)
・寧波事務所 (NINGBO OFFICE)
・南京事務所 (NANJING OFFICE)
・蘇州事務所 (SUZHOU OFFICE)
・昆山事務所 (KUNSHAN OFFICE)
・北京事務所 (BEIJING OFFICE)
・天津事務所 (TIANJIN OFFICE)
・長春事務所 (CHANGCHUN OFFICE)
・大連事務所 (DALIAN OFFICE)
・青島事務所 (QINGDAO OFFICE)
・済南事務所 (JINAN OFFICE)
・烟台事務所 (YANTAI OFFICE)
・瀋陽事務所 (SHENYANG OFFICE)
・重慶事務所 (CHONGQING OFFICE)
・成都事務所 (CHENGDU OFFICE)
・西安事務所 (XIAN OFFICE)
・武漢事務所 (WUHAN OFFICE)
・鄭州事務所 (ZHENGZHOU OFFICE)
・長沙事務所 (CHANGSHA OFFICE)
・広州事務所 (GUANGZHOU OFFICE)
・深圳西事務所 (WEST SHENZHEN OFFICE)
・深圳東事務所 (EAST SHENZHEN OFFICE)
・東莞事務所 (DONGGUAN OFFICE)
・厦門事務所 (XIAMEN OFFICE)

Korea

CKD KOREA CORPORATION
●HEADQUARTERS
(3rd Floor), 44, Sinsu-ro, Mapo-gu, Seoul 121-856, Korea
PHONE +82-(0)2-783-5201~5203 FAX +82-(0)2-783-5204
・水原営業所 (SUWON OFFICE)
・天安営業所 (CHEONAN OFFICE)
・蔚山営業所 (ULSAN OFFICE)

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