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Compact flow rate sensor

FSM2 (RAPIFLOW®)

■ Sensor controller/flow rate sensor

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FSM2-D Series is on sale.
Please refer to FSM3 Series

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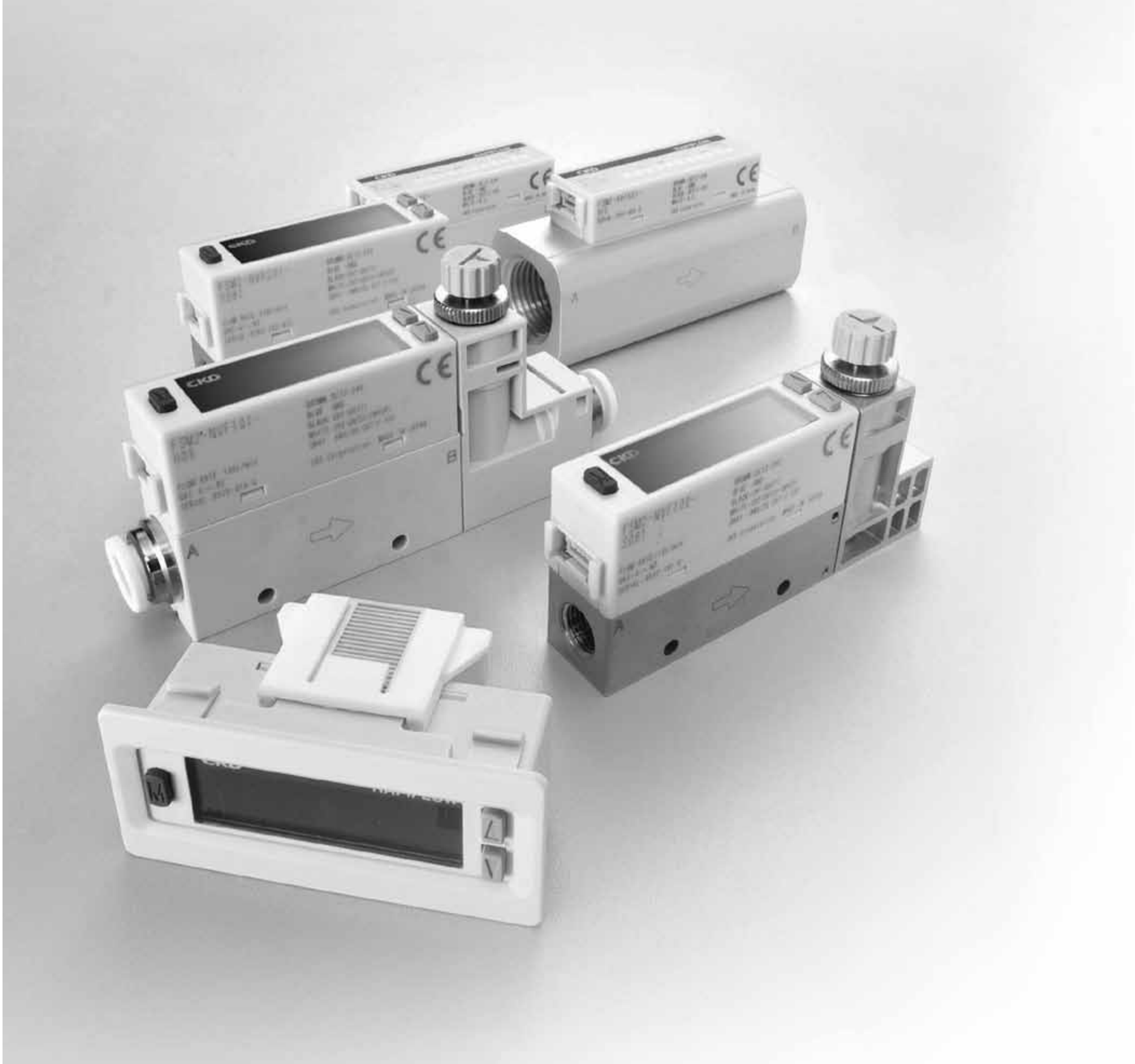
Small size flow rate sensor/RAPIFLOW FSM2 Series

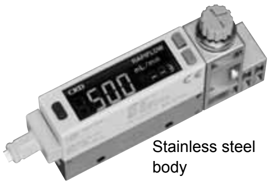
Line-up to match your every need



Needle valve integrated

The needle valve, which can adjust the flow rate, has been integrated with the sensor to simplify piping. Space-saving installation is also possible.

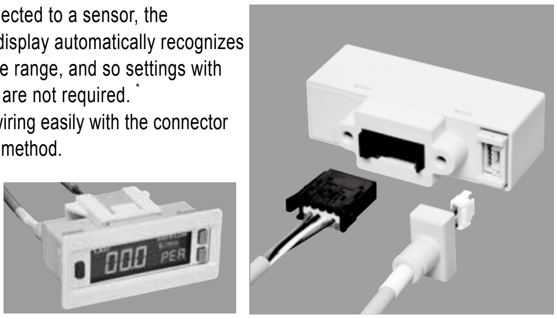
Stainless steel bodies also available


Stainless steel body

Resin body

Separated display

When connected to a sensor, the separated display automatically recognizes the flow rate range, and so settings with the display are not required.*
Complete wiring easily with the connector connection method.



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* Only in the default state or when settings are reset. Refer to "Explanation of functions" on page 1276 for details.

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Functions which pursue the operability of the small flow rate sensor provide the best selections for various contexts and applications.

Clean-room specifications (P70,P80)

The P70 (anti-dust generation) and P80 (oil-prohibited) specifications are available as standard. These models are perfect for semiconductor and liquid crystal manufacturing applications.

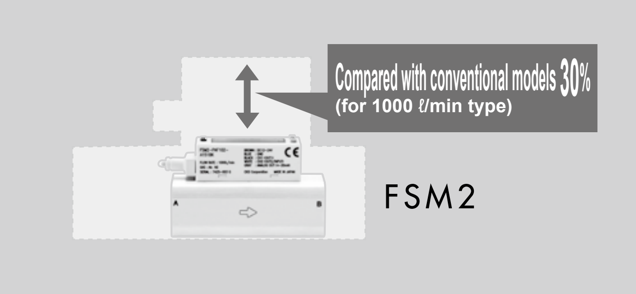
Panel mounting possible

A panel mounting bracket is available. The separated display, sensor body (up to display integrated 200 ℓ/min) and needle valve integrated can be mounted onto a panel.
Close mounting with one panel opening is possible, allowing man-hours and space to be reduced when using multiple units.

Capable of continuous Installation

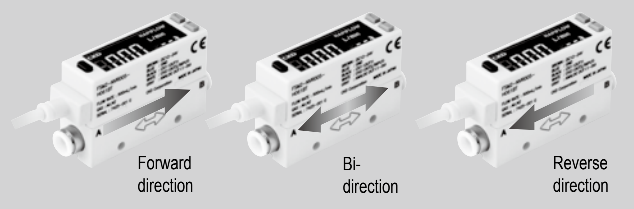
Compact even with large flow rate

With the 500 and 1000 ℓ/min types, the body size has been reduced by 30% compared to conventional models, attaining the highest downsizing in the industry. Downsize and lighten your equipment with this model.



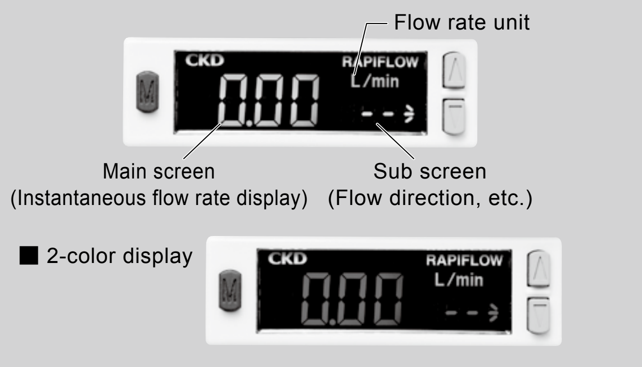
Bi-directional fluid measurement

The flow direction can be randomly set for measurement with the display integrated bi-directional. This increases the freedom of piping installation, and can be used for detecting reverse flows.



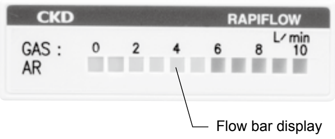
Twin display/2-color display function

A main screen and sub screen can be provided with the display integrated, improving operability. The errors can be seen at a glance with the 2-color display.



Bar display function

On the separated display, the reference flow rate can be seen at a glance with the flow bar display.



Improvement of accuracy Within ±3% F.S.

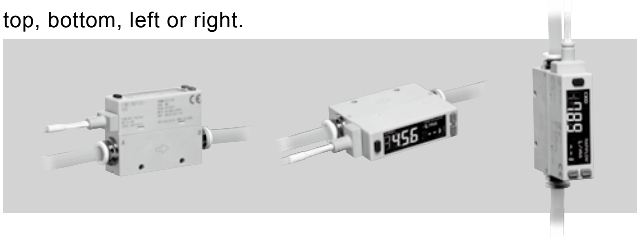
An accuracy of ±3% F.S. allows for a more accurate flow rate measurement.

High-speed response 50 msec or less

The platinum sensor chip manufactured with silicon micromachining realizes a high speed response. Contributes to reducing tact time.

Unrestricted in the mounting orientations

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



Straight piping section not required

The newly proposed rectifying mechanism eliminates the need for straight piping at either the upstream or downstream side.

Elbow OK

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Diverse lineup to match your needs

Flow rate range/port size/body material

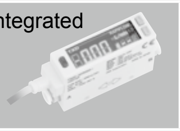
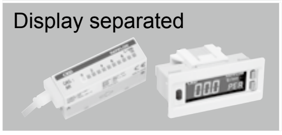
Body material	Port size	Full scale flow rate										
		500 mℓ/min	1 ℓ/min	2 ℓ/min	5 ℓ/min	10 ℓ/min	20 ℓ/min	50 ℓ/min	100 ℓ/min	200 ℓ/min	500 ℓ/min	1,000 ℓ/min
Resin	φ4 push-in	●	●	●	●	●	●					
	φ6 push-in	●	●	●	●	●	●	●				
	φ8 push-in							●	●	●		
	φ10 push-in								●	●		
Stainless steel	Rc1/8	●	●	●	●	●	●	● *1				
	Rc1/4							●	●	● *2		
	M5	●	●	●	●	●	● *1					
Aluminum	Rc1/2										●	●

*1: Excluding carbon dioxide models. *2: Excluding argon models and carbon dioxide models.

Applicable fluids

Applicable fluids	Body material	Full scale flow rate										
		500 mℓ/min	1 ℓ/min	2 ℓ/min	5 ℓ/min	10 ℓ/min	20 ℓ/min	50 ℓ/min	100 ℓ/min	200 ℓ/min	500 ℓ/min	1,000 ℓ/min
Air, nitrogen	Resin	●	●	●	●	●	●	●	●	●		
	Stainless steel	●	●	●	●	●	●	●	●	●		
	Aluminum										●	●
Argon	Stainless steel	●	●	●	●	●	●	●	●			
Carbon dioxide	Stainless steel	●	●	●	●	●	●	●	●			

Output

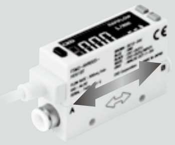
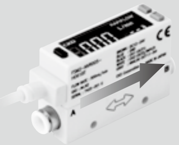
Type	Output
Display integrated 	Analog output 1 point (1 to 5 V or 4 to 20 mA) Switch output 2 points (NPN or PNP)
Display separated 	Analog output 1 point (1 to 5 V or 4 to 20 mA) Capable of connecting separated display

Needle valve integrated (option)

Supporting up to full scale 200 ℓ/min (only for display integrated)

- Resin body
- Stainless steel body

Flow direction

Bi-directional	Uni-direction
 Flow direction can be selected with button operations (display integrated)	

Clean-room specifications (Option)

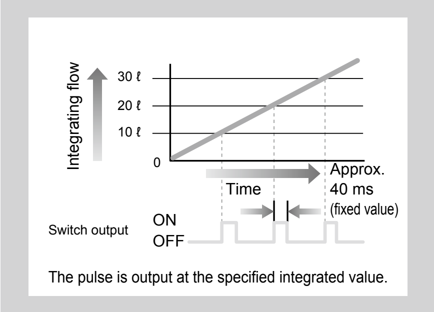
- P70 specifications: Countermeasures for dust generation
- P80 specifications: Oil-prohibited

Discontinue

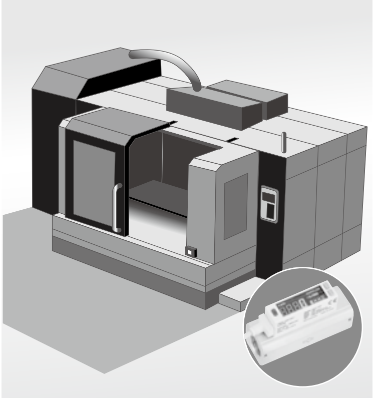
Applications

Air consumption flow rate control

The air consumed by the discrete equipment can be seen by monitoring the integrated pulse output or analog output.

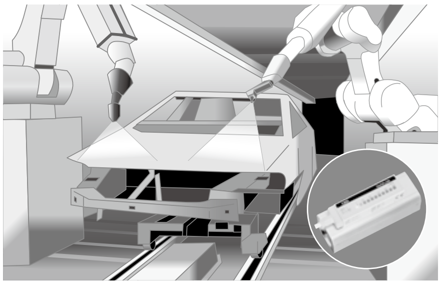


The pulse is output at the specified integrated value.



Painting air flow rate control

P80 (oil-prohibited specifications) are perfect for controlling the flow rate of painting air. FSM2 is free of siloxane (organic silicone), so the paint quality is stable.

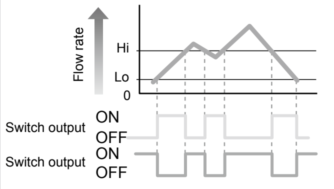


Semiconductor manufacturing system purge gas flow rate control

Control of the purge gas is indispensable for maintaining the performance of a semiconductor manufacturing system.
The stainless steel body is suitable for applications which are susceptible to discharged gases. Errors can be detected by using the switch output.

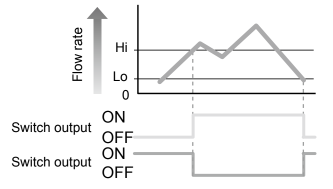
Window operation

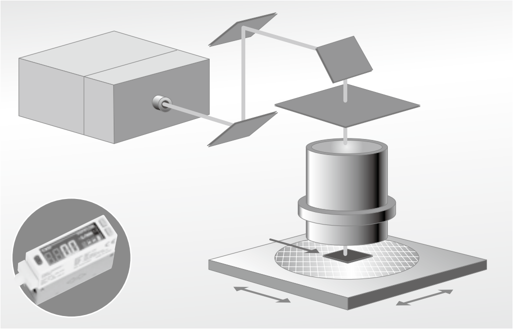
This mode turns the switch output ON or OFF at the flow rate within the set range.



Hysteresis operation

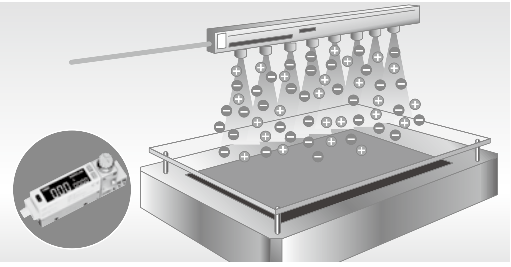
In this mode, the switch output hysteresis is randomly set to control the ON and OFF settings.





Ionizer flow rate control

The flow rate can be easily adjusted with the needle valve integrated. The P80 (oil-prohibited specifications) are suitable for clean applications. Errors can be detected by using the switch output.

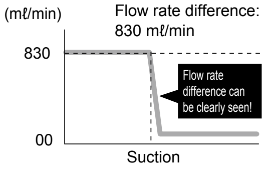


Suction confirmation

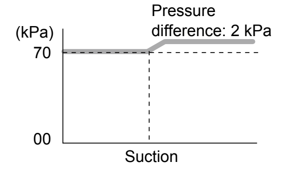
Since the flow rate is detected, there is no need to make adjustments according to pressure fluctuations and incorrect detections are eliminated.
Capable of managing detection of a clogged nozzle or filter and of a suction failure such as oblique suction.

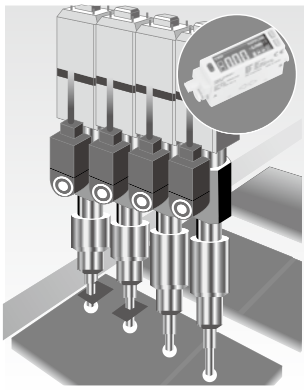
■ Comparison with pressure sensor (at nozzle diameter φ0.3, vacuum pressure -70 kPa)

RAPIFLOW



Pressure sensor





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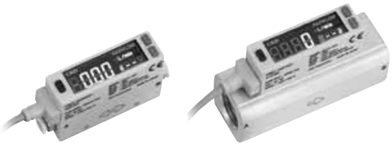
Small flow rate sensor RAPIFLOW
display integrated/display separated

FSM2 Series

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

Display integrated (resin/aluminum body) specifications



Descriptions				Display integrated (resin/aluminum body) specifications FSM2-[*1][*2][*3][*4]-[*5][*6]-[*7]										
			Full scale flow rate	005	010	020	050	100	200	500	101	201	501	102
Flow rate range *1	*4	005	500 mℓ/min	●										
		010	1 ℓ/min		●									
		020	2 ℓ/min			●								
		050	5 ℓ/min				●							
		100	10 ℓ/min					●						
		200	20 ℓ/min						●					
		500	50 ℓ/min							●				
		101	100 ℓ/min								●			
		201	200 ℓ/min									●		
		501	500 ℓ/min										●	
		102	1000 ℓ/min											●
Port size/ body material	*5	H04	φ4 Push-in / resin	●	●	●	●	●	●					
		H06	φ6 Push-in / resin	●	●	●	●	●	●	●				
		H08	φ8 Push-in / resin							●	●	●		
		H10	φ10 Push-in / resin								●	●		
		A15	Rc1/2 / aluminum										●	●
Needle valve integrated *1		*6	N	●	●	●	●	●	●	●	●	●		
Flow rate display *2, *3	Display			4 digit + 4 digit 2 color LCD										
	Display range	*3	F	0 to 500 mℓ/min	0 to 1000 mℓ/min	0 to 2.00 ℓ/min	0 to 5.00 ℓ/min	0 to 10.00 ℓ/min	0 to 20.0 ℓ/min	0 to 50.0 ℓ/min	0 to 100.0 ℓ/min	0 to 200 ℓ/min	0 to 500 ℓ/min	0 to 1000 ℓ/min
			R	-500 to 500 mℓ/min	-1000 to 1000 mℓ/min	-2.00 to 2.00 ℓ/min	-5.00 to 5.00 ℓ/min	-10.00 to 10.00 ℓ/min	-20.0 to 20.0 ℓ/min	-50.0 to 50.0 ℓ/min	-100.0 to 100.0 ℓ/min	-200 to 200 ℓ/min	-500 to 500 ℓ/min	-1000 to 1000 ℓ/min
	Display resolution			1 mℓ/min		0.01 ℓ/min			0.1 ℓ/min			1 ℓ/min		
Integrating functions *4	Display range			9999999 mℓ		99999.99 ℓ			999999.9 ℓ			9999999 ℓ		
	Display resolution			1 mℓ		0.01 ℓ			0.1 ℓ			1 ℓ		
	Integrated 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 fluid	*5		Clean air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 5:6:2]), compressed air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 1:6:2]), nitrogen gas										
	Max. working pressure			0.7 MPa (≈100 psi, 7 bar)										
	Min. working pressure			-0.09 MPa (≈-13 psi, -0.9 bar)										
	Proof pressure			1 MPa (≈150 psi, 10 bar)										
	Operating ambient temperature/humidity			0 (32°F) to 50°C (122°F), 90% RH or less										
	Fluid temperature			0 (32°F) to 50°C (122°F) (no condensation)										
Accuracy *6	Working range			Uni-direction: 3 to 100% F.S., bi-direction: -100 to -3% F.S., 3 to 100% F.S.										
	Linearity (display/analog output)			Within ±3% F.S. (Secondary side released to atmosphere)										
	Pressure characteristics			Within ±5% F.S. (-0.09 to 0.7 MPa, where secondary side is released to atmosphere)										
	Temperature characteristics			Within ±0.2% F.S./°C (15 to 35°C, 25°C reference)										
	Repeatability			Within ±1% F.S.										
Response time		*7		50 ms or less										
Output	Switch output	*1	N	Output 2 points (NPN open collector output, 50 mA or less, voltage drop 2.4 V or less)										
			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) *8										
			A	4 to 20 mA current output 1 point (connecting load impedance 0 to 300 Ω)										
Power supply voltage *9		*2	V	12 to 24 VDC(10.8 to 26.4 V)										
			A	24 VDC (21.6 to 26.4 V)										
Current consumption		*10		50 mA or less										
Cable				φ3.7, AWG26 or equivalent x 5-conductor (connector connection), insulator outer diameter φ1.0										
Functions				Flow rate display, flow rate display peak hold, switch output, analog output, etc.										
Mounting	Mounting orientation			Unrestricted in vertical/horizontal direction										
	Straight piping section			Not required										
Degree of protection				IEC standards IP40 or equivalent										
Protection circuit		*11		Power reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection										
EMC Directive				EN55011,EN61000-6-2,EN61000-4-2/3/4/6/8										
Weight (main body only)		*5	H04	Approx. 50 g (approx. 80 g with needle valve)										
			H06	Approx. 50 g (approx. 80 g with needle valve)										
			H08	Approx. 70 g (approx. 110 g with needle valve)										
			H10	Approx. 75 g (approx. 115 g with needle valve)										
			A15	Approx. 155 g										
Clean-room specifications		*7	P70	Anti-dust generation *12										
			P80	Oil free *13										

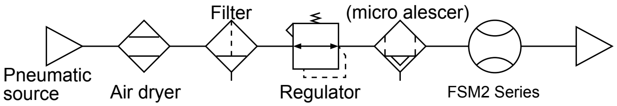
Discontinue

Display integrated (stainless steel body) specifications

1 MPa = 10 bar

Descriptions				**Display integrated (stainless steel body)** **FSM2-[*1][*2][*3][*4]-[*5][*6][*7]-[*8]**								
			Full scale flow rate	005	010	020	050	100	200	500	101	201
Flow rate range *1	*4	005	500 mℓ/min	●								
		010	1 ℓ/min		●							
		020	2 ℓ/min			●						
		050	5 ℓ/min				●					
		100	10 ℓ/min					●				
		200	20 ℓ/min						●			
		500	50 ℓ/min							●		
		101	100 ℓ/min								●	
		201	200 ℓ/min									●
Port size/ body material	*5	S06	Rc1/8 Stainless steel	●	●	●	●	●	●	● (Not for CO_2)		
		S08	Rc1/4 Stainless steel							●	●	● Only air/N_2 gas
		SM5	M5 Stainless steel (Custom order product)	●	●	●	●	●	● (Not for CO_2)			
Needle valve integrated *1		*7	N	●	●	●	●	●	●	●	●	●
Flow rate display *2, *3	Display			4 digit + 4 digit 2 color LCD								
	Display range	*3	F	0 to 500 mℓ/min	0 to 1000 mℓ/min	0 to 2.00 ℓ/min	0 to 5.00 ℓ/min	0 to 10.00 ℓ/min	0 to 20.0 ℓ/min	0 to 50.0 ℓ/min	0 to 100.0 ℓ/min	0 to 200 ℓ/min
			R	-500 to 500 mℓ/min	-1000 to 1000 mℓ/min	-2.00 to 2.00 ℓ/min	-5.00 to 5.00 ℓ/min	-10.00 to 10.00 ℓ/min	-20.0 to 20.0 ℓ/min	-50.0 to 50.0 ℓ/min	-100.0 to 100.0 ℓ/min	-200 to 200 ℓ/min
	Display resolution			1 mℓ/min		0.01 ℓ/min			0.1 ℓ/min			1 ℓ/min
Integrating functions *4	Display range			9999999 mℓ		99999.99 ℓ			999999.9 ℓ			9999999 ℓ
	Display resolution			1 mℓ		0.01 ℓ			0.1 ℓ			1 ℓ
	Integrated pulse output rate			5 mℓ	10 mℓ	0.02 ℓ	0.05 ℓ	0.1 ℓ	0.2 ℓ	0.5 ℓ	1 ℓ	2 ℓ
Working conditions	Applicable fluid *5	*6	Blank	Clean air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 5:6:2]), compressed air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 1:6:2]), nitrogen gas								
			AR	Argon								
			C2	Carbon dioxide (CO_2)								
	Max. working pressure			1.0 MPa (≈150 psi, 10 bar)								
	Min. working pressure			-0.09 MPa (≈-13 psi, -0.9 bar)								
	Proof pressure			1.5 MPa (≈220 psi, 15 bar)								
	Operating ambient temperature/humidity			0 (32°F) to 50°C (122°F), 90% RH or less								
	Fluid temperature			0 (32°F) to 50°C (122°F) (no condensation)								
Accuracy *6	Working range			Uni-direction: 3 to 100% F.S., bi-direction: -100 to -3% F.S., 3 to 100% F.S.								
	Linearity (display/analog output)			Within ±3% F.S. (Secondary side released to atmosphere)								
	Pressure characteristics			Within ±5% F.S. (-0.09 (≈-13 psi) to 0.7 MPa (≈100 psi), where secondary side is released to atmosphere)								
	Temperature characteristics			Within ±0.2% F.S./°C (15 (59°F) to 35°C (95°F), 25°C (77°F) reference)								
	Repeatability			Within ±1% F.S.								
Response time			*7	50 ms or less								
Output	Switch output	*1	N	Output 2 points (NPN open collector output, 50 mA or less, voltage drop 2.4 V or less)								
			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) *8								
			A	4 to 20 mA current output 1 point (connecting load impedance 0 to 300 Ω)								
Power supply voltage *9		*2	V	12 to 24 VDC(10.8 to 26.4 V)								
			A	24 VDC (21.6 to 26.4 V)								
Current consumption			*10	50 mA or less								
Lead wire				φ3.7, AWG26 or equivalent x 5-conductor (connector connection), insulator outer diameter φ1.0								
Functions				Flow rate display, flow rate display peak hold, switch output, analog output, etc.								
Mounting	Mounting orientation			Unrestricted in vertical/horizontal direction								
	Straight piping section			Not required								
Degree of protection				IEC standards IP40 or equivalent								
Protection circuit			*11	Power reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection								
EMC Directive				EN55011,EN61000-6-2,EN61000-4-2/3/4/6/8								
Weight (main body only)		*5	S06	Approx. 95 g (approx. 160 g with needle valve)								
			S08	Approx. 115 g (approx. 200 g with needle valve)								
			SM5	Approx. 140 g								
Clean-room specifications		*8	P70	Anti-dust generation *12								
			P80	Oil free *13								

*1: This valve cannot be used as a stop valve that requires no leakage. Slight leakage is allowed for in the specifications.
*2: The value converted to volumetric flow rate at standard condition (20°C 1 barometric pressure (101 kPa) relative humidity 65%)
*3: The flow rate display is rounded off at approx. ±1% F.S. or less (forced zero).
*4: The integrating flow is a calculated (reference) value. It is reset when the power is turned OFF.
*5: 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 compliant with JIS B8392-1: 2012 Grade (1:1:1 to 1:6:2). Compressed air from the compressor contains drainage (water, oil oxides, foreign matter, 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.
[Recommended circuit]



[Recommended device]
Air filter: F series
Oil mist filter: M series

*6: Calibration of this product is performed within specified range. Accuracy conditions: Temperature 25±3 ˚C, power supply voltage 24±0.01 VDC. F.S. stands for full scale flow rate.
*7: Response time can be set in seven steps from 50 ms. or less to approx. 1.5 s.
*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: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.
*12: [P70] Anti-dust generation (product surface is degreased and cleaned before packing. Heat sealed into antistatic bag in clean bench (Class 1000 and over).)
*13: [P80] Oil free (In addition to P70 specifications, gas-contact sections are degreased and cleaned. Refer to the "Internal structure and parts list" for details on the gas-contact materials.)

Discontinue

Display separated (resin/aluminum body) specifications

1 MPa = 10 bar

Descriptions				Display separated (resin/aluminum body) FSM2-A[*1][*2][*3]-[*4]-[*5]										
				Full scale flow rate	005	010	020	050	100	200	500	101	201	501	102
Flow rate range *1		*3	005	500 mℓ/min	●										
			010	1 ℓ/min		●									
			020	2 ℓ/min			●								
			050	5 ℓ/min				●							
			100	10 ℓ/min					●						
			200	20 ℓ/min						●					
			500	50 ℓ/min							●				
			101	100 ℓ/min								●			
			201	200 ℓ/min									●		
			501	500 ℓ/min										●	
			102	1000 ℓ/min											●
Port size/ body material		*4	H04	φ4 Push-in / resin	●	●	●	●	●	●					
			H06	φ6 Push-in / resin	●	●	●	●	●	●	●				
			H08	φ8 Push-in / resin							●	●	●		
			H10	φ10 Push-in / resin								●	●		
			A15	Rc1/2 / aluminum										●	●
Flow direction		*2	F		Uni-direction										
			R		Bi-direction										
Working conditions	Applicable fluid	*2			Clean air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 5:6:2]), compressed air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 1:6:2]), nitrogen gas										
	Max. working pressure				0.7 MPa (≈100 psi, 7 bar)										
	Min. working pressure				-0.09 MPa (≈-13 psi, -0.9 bar)										
	Proof pressure				1 MPa (≈150 psi, 10 bar)										
	Operating ambient temperature/humidity				0 (32°F) to 50°C (122°F), 90% RH or less										
	Fluid temperature				0 (32°F) to 50°C (122°F) (no condensation)										
Accuracy *3	Working range				Uni-direction: 3 to 100% F.S., bi-direction: -100 to -3% F.S., 3 to 100% F.S.										
	Linearity (analog output)				Within ±3% F.S. (Secondary side released to atmosphere)										
	Pressure characteristics				Within ±5% F.S. (-0.09 (≈-13 psi) to 0.7 MPa (≈100 psi), where secondary side is released to atmosphere)										
	Temperature characteristics				Within ±0.2% F.S./°C (15 (59°F) to 35°C (95°F), 25°C (77°F) reference)										
	Repeatability				Within ±1% F.S.										
Response time					50 ms or less										
Display					Flow bar display										
Output	Analog output	*1	V		1 to 5 V voltage output 1 point (connecting load impedance 50 kΩ and over) *4										
			A		4 to 20 mA current output 1 point (connecting load impedance 0 to 300 Ω)										
Power supply voltage *5		*1	V		12 to 24 VDC(10.8 to 26.4 V)										
			A		24 VDC (21.6 to 26.4 V)										
Current consumption		*6			50 mA or less										
Lead wire					φ3.7, AWG26 or equivalent x 4-conductor (connector connection), insulator outer diameter φ1.0										
Functions					Analog output, flow bar display, error display										
Mounting	Mounting orientation				Unrestricted in vertical/horizontal direction										
	Straight piping section				Not required										
Degree of protection					IEC standards IP40 or equivalent										
Protection circuit		*7			Power reverse connection protection										
EMC Directive					EN55011,EN61000-6-2,EN61000-4-2/3/4/6/8										
Weight (main body only)		*4	H04		Approx. 40 g										
			H06		Approx. 40 g										
			H08		Approx. 60 g										
			H10		Approx. 65 g										
			A15		Approx. 145 g										
Clean-room specifications		*5	P70		Anti-dust generation *8										
			P80		Oil free *9										

Discontinue

Display separated (stainless steel body) specifications

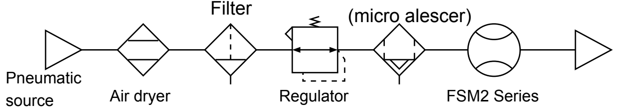
1 MPa = 10 bar

Descriptions				Display separated (stainless steel body) FSM2-A[*1][*2][*3]-[*4][*5]-[*6]								
			Full scale flow rate	005	010	020	050	100	200	500	101	201
Flow rate range *1	*3	005	500 mℓ/min	●								
		010	1 ℓ/min		●							
		020	2 ℓ/min			●						
		050	5 ℓ/min				●					
		100	10 ℓ/min					●				
		200	20 ℓ/min						●			
		500	50 ℓ/min							●		
		101	100 ℓ/min								●	
		201	200 ℓ/min									●
Port size/ body material	*4	S06	Rc1/8 Stainless steel	●	●	●	●	●	●	● (Not for CO_2)		
		S08	Rc1/4 Stainless steel							●	●	● Only air/N_2 gas
		SM5	M5 Stainless steel (custom order)	●	●	●	●	●	● (Not for CO_2)			
Flow direction	*2	F		Uni-direction								
		R		Bi-direction								
Working conditions	Applicable fluid *2	*5	Blank	Clean air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 5:6:2]), compressed air (JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 1:6:2]), nitrogen gas								
			AR	Argon								
			C2	Carbon dioxide (CO_2)								
	Max. working pressure			1.0 MPa (≈150 psi, 10 bar)								
	Min. working pressure			-0.09 MPa (≈-13 psi, -0.9 bar)								
	Proof pressure			1.5 MPa (≈220 psi, 15 bar)								
	Operating ambient temperature/humidity			0 (32°F) to 50°C (122°F), 90% RH or less								
	Fluid temperature			0 (32°F) to 50°C (122°F) (no condensation)								
Accuracy *3	Working range			Uni-direction: 3 to 100% F.S., bi-direction: -100 to -3% F.S., 3 to 100% F.S.								
	Linearity (analog output)			Within ±3% F.S. (Secondary side released to atmosphere)								
	Pressure characteristics			Within ±5% F.S. (-0.09 (≈-13 psi) to 0.7 MPa (≈100 psi), where secondary side is released to atmosphere)								
	Temperature characteristics			Within ±0.2% F.S./°C (15 (59°F) to 35°C (95°F), 25°C (77°F) reference)								
	Repeatability			Within ±1% F.S.								
Response time				50 ms or less								
Display				Flow bar display								
Output	Analog output	*1	V	1 to 5 V voltage output 1 point (connecting load impedance 50 kΩ and over) *4								
			A	4 to 20 mA current output 1 point (connecting load impedance 0 to 300 Ω)								
Power supply voltage *5		*1	V	12 to 24 VDC(10.8 to 26.4 V)								
			A	24 VDC (21.6 to 26.4 V)								
Current consumption *6				50 mA or less								
Lead wire				φ3.7, AWG26 or equivalent x 4-conductor (connector connection), insulator outer diameter φ1.0								
Functions				Analog output, flow bar display, error display								
Installation	Mounting orientation			Unrestricted in vertical/horizontal direction								
	Straight piping section			Not required								
Degree of protection				IEC standards IP40 or equivalent								
Protection circuit *7				Power reverse connection protection								
EMC Directive				EN55011,EN61000-6-2,EN61000-4-2/3/4/6/8								
Weight (main body only)		*4	S06	Approx. 85 g								
			S08	Approx. 105 g								
			SM5	Approx. 130 g								
Clean-room specifications		*6	P70	Anti-dust generation *8								
			P80	Oil free *9								

*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 compliant with JIS B8392-1: 2012 Grade [1:1:1 to 1:6:2]. Compressed air from the compressor contains drainage (water, oil oxides, foreign matter, 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.

[Recommended circuit]



[Recommended device]
Air filter: F series
Oil mist filter: M series

*3: Calibration of this product is performed within specified range. Accuracy conditions: Temperature 25±3 ˚C, power supply voltage 24±0.01 VDC. F.S. stands for full scale flow rate.

*4: 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.

*5: The power supply voltage specifications differ for the voltage output and current output.

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

*8: [P70] Anti-dust generation (product surface is degreased and cleaned before packing. Heat sealed into antistatic bag in clean bench (Class 1000 and over).)

*9: [P80] Oil-free (In addition to P70 specifications, gas-contact sections are degreased and cleaned. Refer to the “Internal structure and parts list” for details on the gas-contact materials.)

F.R.L
F (Filtr)
R (Reg)
L (Lub)
PresSW
Shutoff
SlowStart
FlmResistFR
Oil-ProhR
MedPresFR
No Cu/ PTFE FRL
Outdrs FR
F.R.L (Related)
CompFRL
LgFRL
PrecsR
VacF/R
Clean FR
ElecPneuR
AirBoost
SpdContr
Silncr
CheckV/ other
Jnt/tube
AirUnt
PrecsCompn
Mech/ ElecPressw
ContactSW
AirSens
PresSW Cool
AirFloSens/ Contr
WaterRtSens
TotAirSys (Total Air)
TotAirSys (Gamma)
RefrDry
DesicDry
HiPolymDry
MainFiltr
Dischrg etc
Ending

Discontinue

Separated display specifications

Descriptions				Separated 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 (32°F) to 50°C (122°F)
Display				4 digit + 4 digit 2 color LCD
Input voltage				1 to 5 V
Output	Switch output	*1	N	Output 2 points (NPN open collector output, 50 mA or less, voltage drop 2.4 V or less)
			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 26.4 V)
			A	24 VDC (21.6 to 26.4 V)
Current consumption		*2		40 mA or less (when 24 VDC is connected, and no load is connected)
Cable				φ3.7, AWG26 or equivalent x 5-conductor (connector connection), insulator outer diameter φ1.0
Functions				Flow rate display, flow rate display peak hold, switch output, analog output
Degree of protection				IEC standards IP40 or equivalent
Protection circuit		*3		Power 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 FSM-H Series, FSM-V Series and WFK3000 Series flow rate ranges are supported in addition to the FSM2 Series, but automatic recognition is supported only with the FSM2 Series. Always set the product's flow rate range, flow direction and gas type before use.
The connectable flow rate ranges are shown in "Display by 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 misconnections and load short-circuits. It does not provide protection for all misconnections.

*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 a 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 *1	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		1 mℓ/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	
Integ func *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

*1: The flow rate display is rounded off at approx. ±1% F.S. or less (forced zero).

*2: The integrating flow is a calculated (reference) value. It is reset when the power is turned OFF.

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

MEMO

Discontinue

How to order

● Display integrated, display separated, needle valve integrated

FSM2 - A V R 005 - S06 AR 1 B K N - P70

Ⓐ Output

Ⓑ Analog output *2

Ⓒ Flow direction

Ⓓ Flow rate

* Refer to the table on the next page for the flow rate, port size (body material), and gas combinations.

Ⓔ Port size (body material) *3

Ⓕ Applicable fluid

Ⓖ Cable

Ⓗ Bracket

Ⓘ Traceability

Ⓙ With needle valve

Ⓚ Clean-room specifications

Code	Content
Ⓐ Output	
A *1	External display (1 analog output)(Setting invalid for needle valve)
N	Integrated display (2 switch outputs (NPN), 1 analog output)
P	Integrated display (2 switch outputs (PNP), 1 analog output)
Ⓑ Analog output	
V	Voltage output (1 to 5 V)
A	Current output (4 to 20 mA)
Ⓒ Flow direction	
F	Uni-direction
R	Bi-direction (Setting not valid for type with needle valve)
Ⓓ Flow rate (full scale flow rate)	
005	500 mℓ/min
010	1 ℓ/min
020	2 ℓ/min
050	5 ℓ/min
100	10 ℓ/min
200	20 ℓ/min
500	50 ℓ/min
101	100 ℓ/min
201	200 ℓ/min
501	500 ℓ/min (Setting invalid for needle valve)
102	1000 ℓ/min (Setting invalid for needle valve)
Ⓔ Port size (body material)	
H04	Push-in φ4 (resin)
H06	Push-in φ6 (resin)
H08	Push-in φ8 (resin)
H10	Push-in φ10 (resin)
S06	Rc1/8 (stainless steel)
S08	Rc1/4 (stainless steel)
A15	Rc 1/2 (aluminum) (Setting invalid for needle valve)
SM5	M5 (stainless steel) (custom order product) (Setting invalid for needle valve)
Ⓕ Applicable fluid	
Blank	Air, nitrogen gas
AR	Argon
C2	Carbon dioxide
Ⓖ Cable	
Blank	None
1	1 m
3	3 m
Ⓗ Bracket	
Blank	None
B	With bracket
P *1	Panel mounting kit
Ⓘ Traceability	
Blank	None
T	Traceability with series variation diagram/company cert.
K	With company certification
Ⓙ With needle valve	
Blank	None
N	Needle valve integrated
Ⓚ Clean-room specifications	
Blank	None
P70	Anti-dust generation
P80	Oil free

[Example of model No.]

FSM2-NVF005-S06AR1BKN-P70

Model: RAPIFLOW FSM2

Ⓐ Output : Display integrated (NPN)
Ⓑ Analog output : Voltage output (1 to 5 V)
Ⓒ Flow direction : Uni-direction
Ⓓ Flow rate : 500 mℓ/min
Ⓔ Port size (body material) : Rc 1/8 (stainless steel)
Ⓕ Applicable fluid : Argon
Ⓖ Cable : 1 m
Ⓗ Bracket : With bracket
Ⓘ Traceability : With company certification
Ⓙ With needle valve : With needle valve
Ⓚ Clean-room specifications : Anti-dust generation

⚠ Precautions for model No. selection

*1: For the Ⓐ Output "A", the Ⓗ Panel mounting option "P" cannot be selected.
The separated display is not enclosed with the Item Ⓐ output "A".

*2: When using the FSM2-D for the separated display with the display separated, select "V".

*3: For the Ⓔ Port size "A15", the Ⓗ Panel mounting option "P" cannot be selected.

Discontinue

FSM2-D Series is on sale.
Please refer to FSM3 Series for details.

Flow rate, port size (body material), and compatible needle valve combinations

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

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

Ⓙ With needle valve
◆ : Needle valve integrated

Combination of port size and clean-room specifications

		Ⓔ Port size (body material)							
		H04	H06	H08	H10	S06	S08	A15	SM5
Ⓚ Clean-room specifications	P70	●	●	●	●	●	●	●	●
	P80	●	●	▨	▨	●	●	●	●

● : Available
▨ : Not available

Discrete option model No.

FSM2 - LB1 - P70

Ⓐ Option
Ⓑ Clean-room specifications

Code	Content
Ⓐ Option	
LB1	Bracket (for φ4, φ6, φ8, φ10, Rc1/8, Rc1/4, M5)
LB2	Bracket (for Rc1/2)
KHS	Panel mounting kit (for display integrated, for separated display) *
KHS-N	Panel mounting kit (for needle valve integrated)
C51	5-conductor cable 1 m (integrated/non-integrated display)
C53	5-conductor cable 3 m (integrated/non-integrated display)
C41	4-conductor cable 1 m (for display separated)
C43	4-conductor cable 3 m (for display separated)

Code	Content
Ⓑ Clean-room specifications	
Blank	None
P70	Anti-dust generation

* The panel mounting kit cannot be mounted on the FSM2-☐-A15☐.

● Separated display

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 to 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

Discrete option model No.

FSM2 - KHS - P70

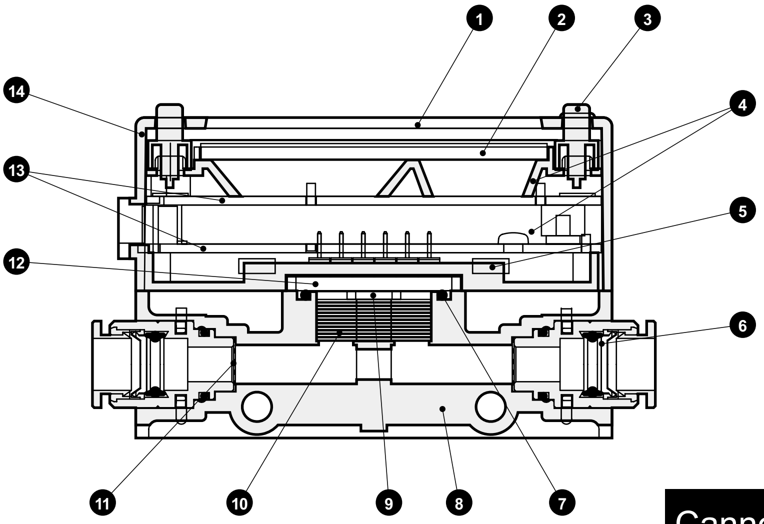
Ⓐ Option
Ⓑ Clean-room specifications

Code	Content
Ⓐ Option	
KHS	Panel mounting kit set
C51	5-conductor cable 1 m (for display integrated, for separated display)
C53	5-conductor cable 3 m (for display integrated, for separated display)
EC	Sensor connection connector (e-con) 5pcs. set
Ⓑ Clean-room specifications	
Blank	None
P70	Anti-dust generation

⚠ CAUTION The corresponding sensor is the voltage output (1-5 V). If the current output or other voltage output is connected, it doesn't operate properly. Use the FSM2-AV ☐ when using the FSM2.

Internal structure and parts list

● Display integrated resin body port size φ6 push-in



Cannot be disassembled

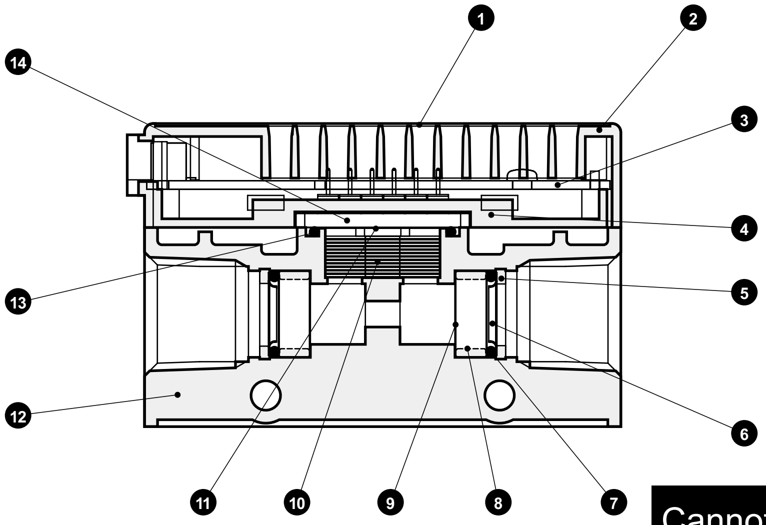
Main parts list

* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Liquid crystal cover	Acrylic resin	8	Resin body (*)	Polyamide resin
2	Liquid crystal	-	9	Sensor chip (*)	Semiconductor chip
3	Switch	Ethylene/propylene diene rubber	10	Rectification plate (*)	Stainless steel
4	Base spacer	Polycarbonate resin	11	Port filter (*)	Stainless steel
5	Module holder	PPS resin	12	Sensor board (*)	Alumina
6	Push-in fitting	-	13	Electronic circuit board	-
7	Sensor gasket (*)	Fluoro rubber	14	Case	ABS resin

(*)...Cleaning parts for P80 specifications

● Display separated stainless steel body port size Rc1/4



Cannot be disassembled

Main parts list

* The part materials are subject to change without notice.

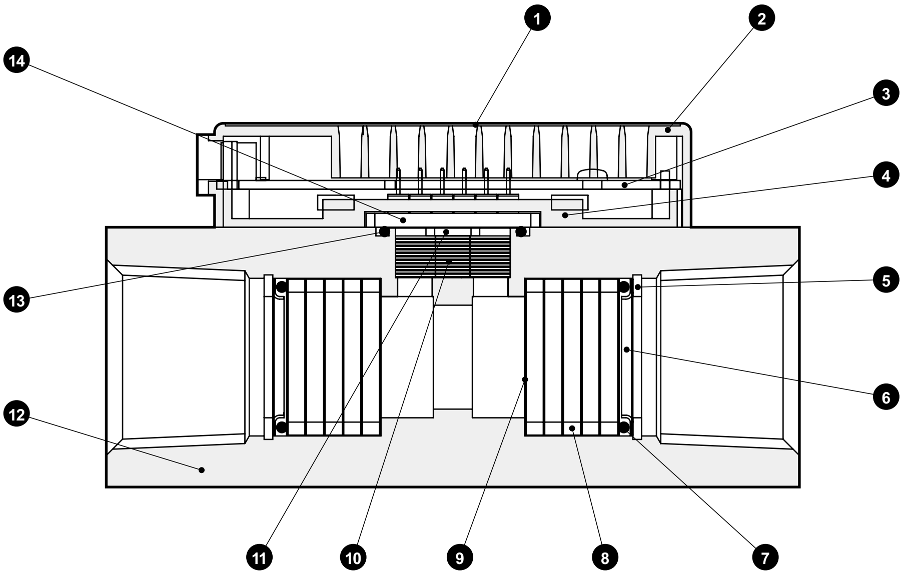
No.	Part name	Material	No.	Part name	Material
1	Front sheet	Polyethylene film	8	Spacer (*)	Stainless steel
2	Case	ABS resin	9	Port filter (*)	Stainless steel
3	Electronic circuit board	-	10	Rectification plate (*)	Stainless steel
4	Module holder	PPS resin	11	Sensor chip (*)	Semiconductor chip
5	C-ring (*)	Stainless steel	12	Stainless steel body (*)	Stainless steel
6	O-ring holder (*)	Stainless steel	13	Sensor gasket (*)	Fluoro rubber
7	O-ring (*)	Fluoro rubber	14	Sensor board (*)	Alumina

(*)...Cleaning parts for P80 specifications

Discontinue

Internal structure and parts list

● Display separated aluminum body port size Rc1/2



Cannot be disassembled

Main parts list

* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Front sheet	Polyester film	8	Spacer (*)	Aluminum alloy
2	Case	ABS resin	9	Port filter (*)	Stainless steel
3	Electronic circuit board	-	10	Rectification plate (*)	Stainless steel
4	Module holder	PPS resin	11	Sensor chip (*)	Semiconductor chip
5	C-ring (*)	Stainless steel	12	Aluminum body (*)	Aluminum
6	O-ring holder (*)	Stainless steel	13	Sensor gasket (*)	Fluoro rubber
7	O-ring (*)	Fluoro rubber	14	Sensor board (*)	Alumina

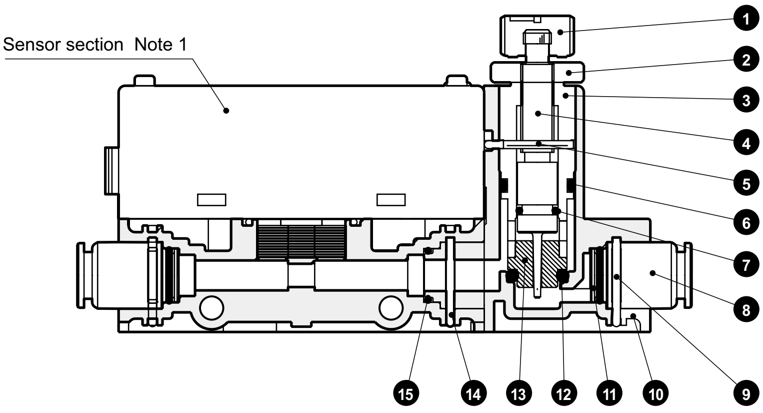
(*)...Cleaning parts for P80 specifications

Discontinue

F.R.L
F (Filtr)
R (Reg)
L (Lub)
PresSW
Shutoff
SlowStart
FlmResistFR
Oil-ProhR
MedPresFR
No Cu/ PTFE FRL
Outdrs FR
F.R.L (Related)
CompFRL
LgFRL
PrecsR
VacF/R
Clean FR
ElecPneuR
AirBoost
SpdContr
Silncr
CheckV/ other
Jnt/tube
AirUnt
PrecsCompn
Mech/ ElecPresSw
ContactSW
AirSens
PresSW Cool
AirFloSens/ Contr
WaterRtSens
TotAirSys (Total Air)
TotAirSys (Gamma)
RefrDry
DesicDry
HiPolymDry
MainFiltr
Dischrg etc
Ending

Internal structure and parts list

● With needle valve (resin body) FSM2-☐-H☐N



Cannot be disassembled

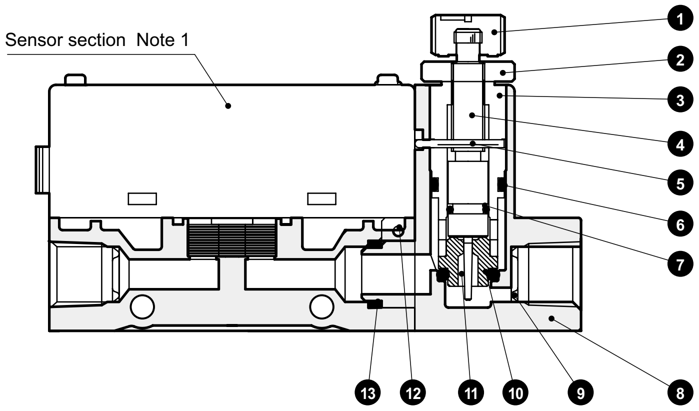
Main parts list

* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Knob	Polybutylene terephthalate	9	Fitting fixing pin	Stainless steel
2	Lock nut	Copper alloy/nickeling	10	Needle valve body	Polyamide resin
3	Needle guide	Copper alloy/nickeling	11	Port filter	Stainless steel
4	Needle	Copper alloy/nickeling *2	12	O-ring	Fluoro rubber
5	Fixing pin	Stainless steel	13	Orifice	Copper alloy/nickeling *3
6	O-ring	Fluoro rubber (fluoro resin coating)	14	Fitting fixing pin	Stainless steel
7	O-ring	Fluoro rubber (fluoro resin coating)	15	O-ring	Fluoro rubber (fluoro resin coating)
8	Cartridge fitting	-			

*1: Refer to page 1246 for details on the sensor's main components.
*2: The needle is stainless steel for FSM2-☐005/010/020.
*3: The orifice is PTFE for FSM2-☐005/010/020.

● With needle valve (stainless steel body) FSM2-☐-S☐N



Cannot be disassembled

Main parts list

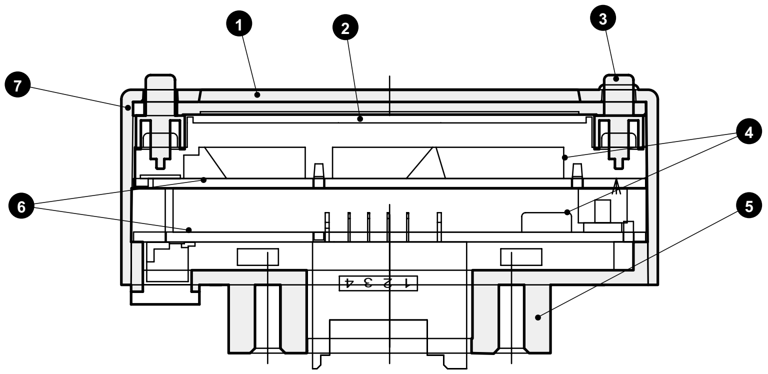
* The part materials are subject to change without notice.

No.	Part name	Material	No.	Part name	Material
1	Knob	Polybutylene terephthalate	8	Needle valve body	Stainless steel
2	Lock nut	Copper alloy/nickeling	9	Port filter	Stainless steel
3	Needle guide	Stainless steel	10	O-ring	Fluoro rubber
4	Needle	Stainless steel	11	Orifice	Tetra fluoro resin
5	Fixing pin	Stainless steel	12	Spring pin	Stainless steel
6	O-ring	Fluoro rubber (fluoro resin coating)	13	O-ring	Fluoro rubber (fluoro resin coating)
7	O-ring	Fluoro rubber (fluoro resin coating)			

*1: Refer to page 1246 for details on the sensor's main components.

Internal structure and parts list

● Separated display FSM2-D-☐



Cannot be disassembled

Main parts list

* The part materials are subject to change without notice.

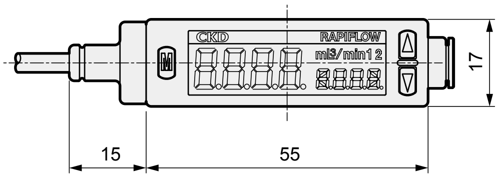
No.	Part name	Material	No.	Part name	Material
1	Liquid crystal cover	Acrylic resin	5	Back surface cover	Polyamide resin
2	Liquid crystal	-	6	Electronic circuit board	-
3	Switch	Ethylene/propylene rubber	7	Case	ABS resin
4	Base spacer	Polycarbonate resin			

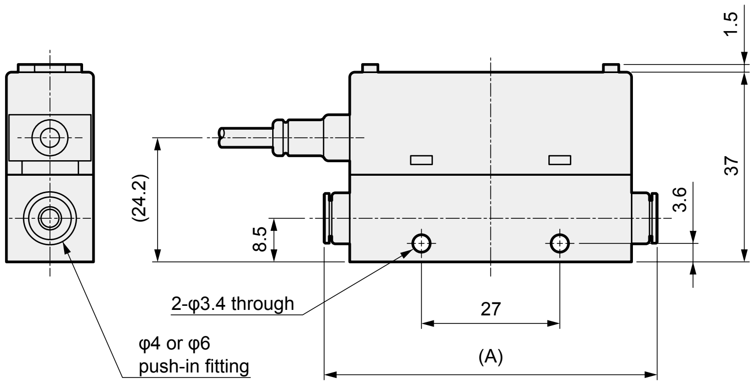
F.R.L
F (Filtr)
R (Reg)
L (Lub)
PresSW
Shutoff
SlowStart
FlmResistFR
Oil-ProhR
MedPresFR
No Cu/ PTFE FRL
Outdrs FR
F.R.L (Related)
CompFRL
LgFRL
PrecsR
VacF/R
Clean FR
ElecPneuR
AirBoost
SpdContr
Silncr
CheckV/ other
Jnt/tube
AirUnt
PrecsCompn
Mech/ ElecPresSw
ContactSW
AirSens
PresSW Cool
AirFloSens/ Contr
WaterRtSens
TotAirSys (Total Air)
TotAirSys (Gamma)
RefrDry
DesicDry
HiPolymDry
MainFiltr
Dischrg etc
Ending

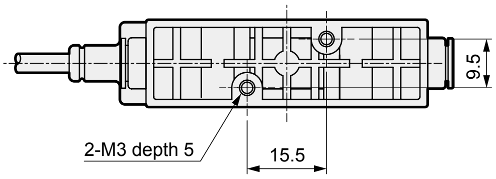
Dimensions (display integrated)

Display integrated, port size: push-in φ4, φ6

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


CKD
RAPIFLOW
17
15
55

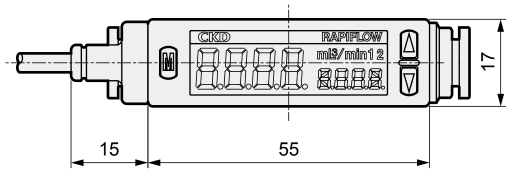

1.5
37
3.6
(24.2)
8.5
2-φ3.4 through
27
φ4 or φ6
push-in fitting
(A)

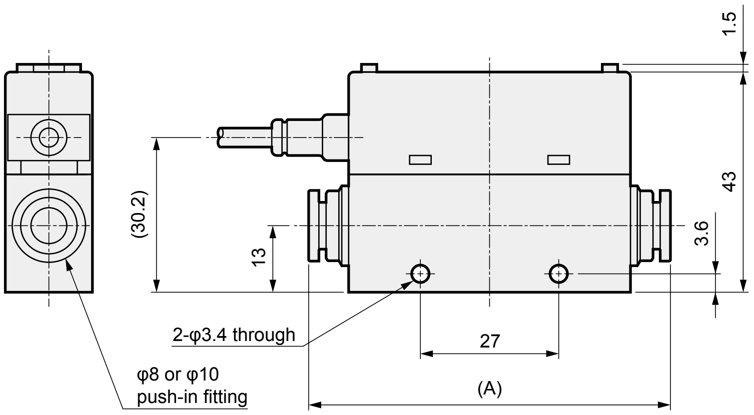

9.5
2-M3 depth 5
15.5

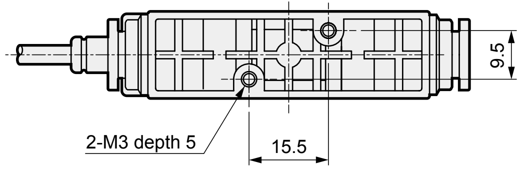
Model No.	Fitting	Dimension (A)
FSM2-N/P□-H04□	Push-in φ4	64.9
FSM2-N/P□-H06□	Push-in φ6	67.2

Display integrated, port size: push-in φ8, φ10

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


CKD
RAPIFLOW
17
15
55


1.5
43
3.6
(30.2)
13
2-φ3.4 through
27
φ8 or φ10
push-in fitting
(A)

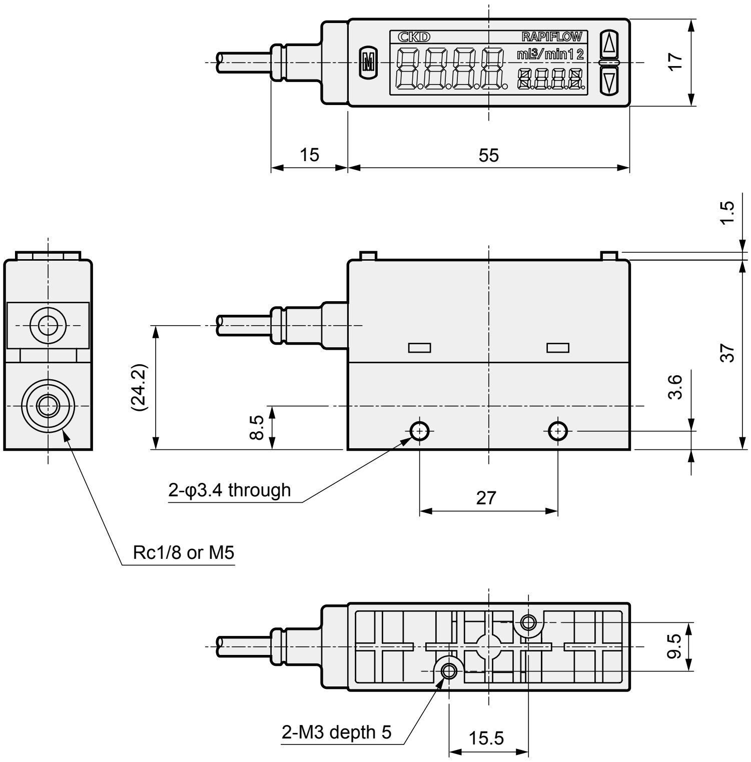

9.5
2-M3 depth 5
15.5

Model No.	Fitting	Dimension (A)
FSM2-N/P□-H08□	Push-in φ8	70.6
FSM2-N/P□-H10□	Push-in φ10	82.2

Dimensions (display integrated)

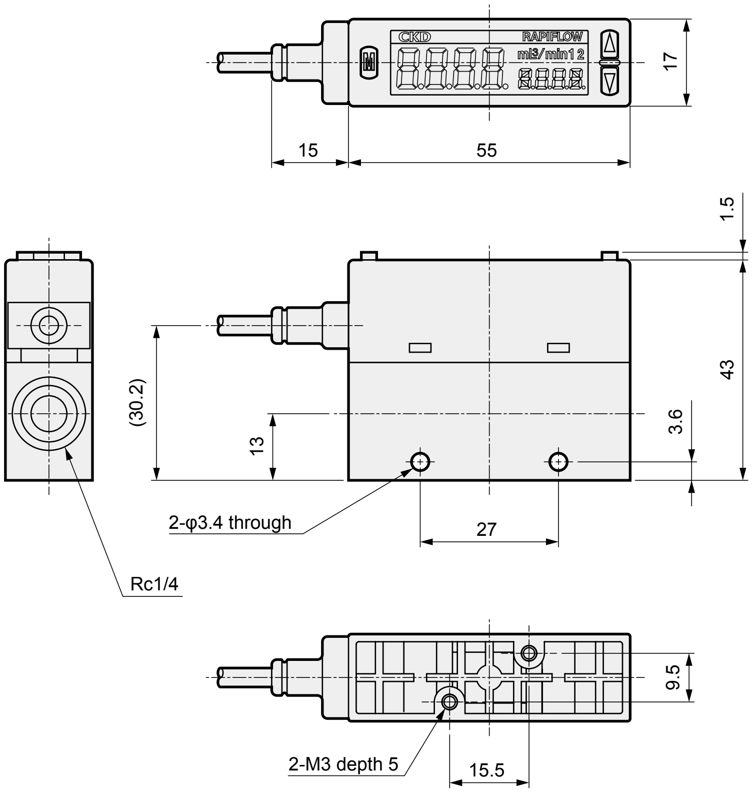
Display integrated, port size: Rc1/8, M5

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


CKD
RAPIFLOW
m³/min 1 2
17
15
55
1.5
37
3.6
(24.2)
8.5
2-φ3.4 through
27
Rc1/8 or M5
9.5
2-M3 depth 5
15.5

Display integrated, port size: Rc1/4

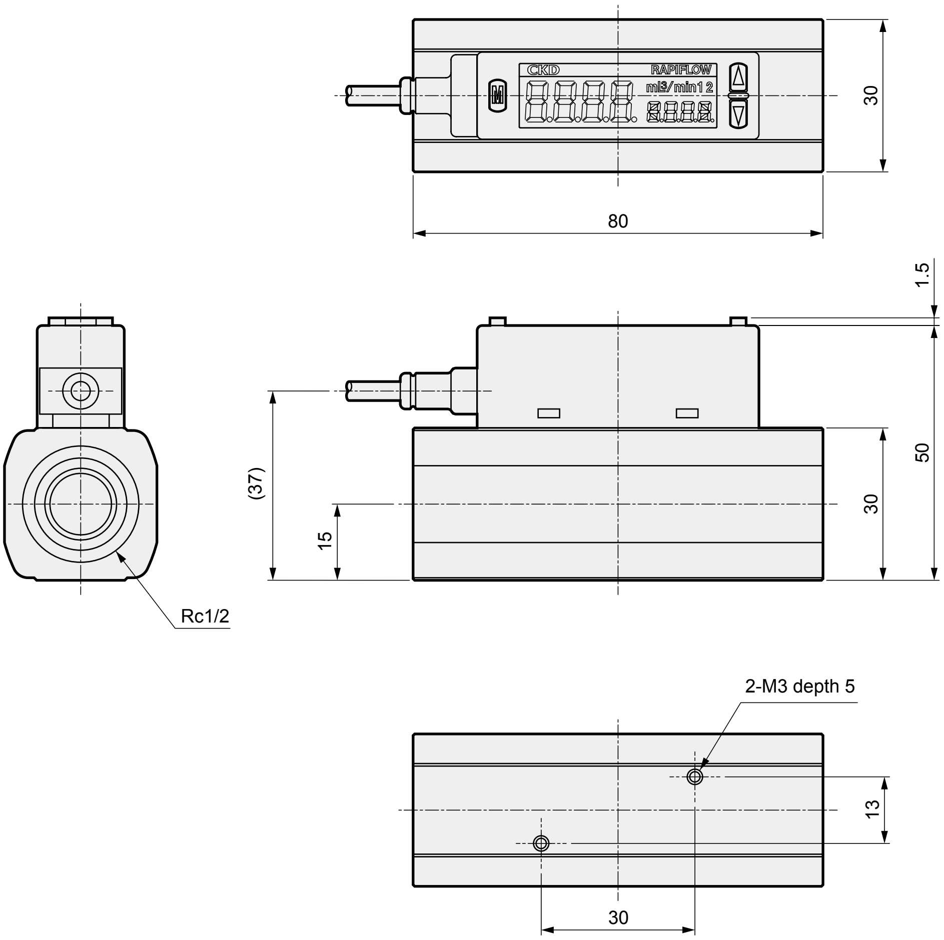
- ● FSM2-N/P ☐ -S08 ☐ (full scale flow rate: 50, 100, 200 ℓ/min)


CKD
RAPIFLOW
m³/min 1 2
17
15
55
1.5
43
3.6
(30.2)
13
2-φ3.4 through
27
Rc1/4
9.5
2-M3 depth 5
15.5

Dimensions (display integrated)

Display integrated, port size: Rc1/2

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

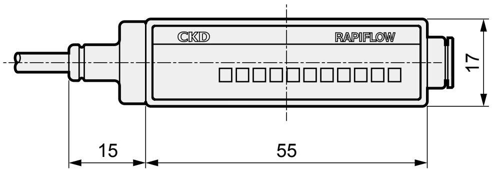


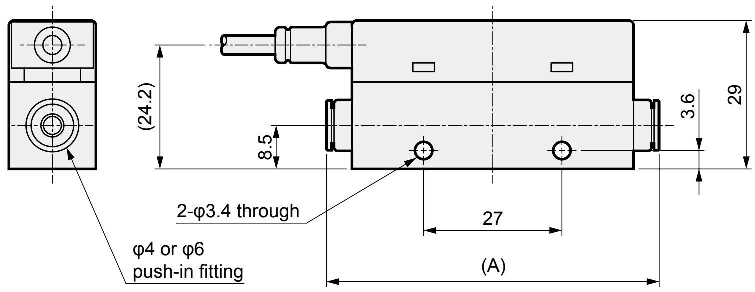
Discontinue

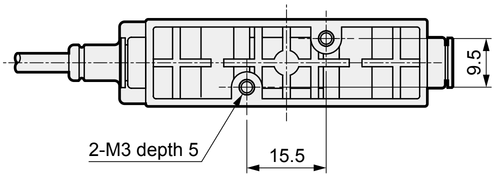
Dimensions (display separated)

Display separated, port size: push-in φ4, φ6

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


CKD
RAPIFLOW
17
15
55

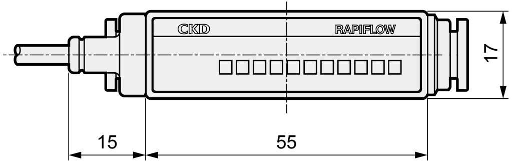

(24.2)
8.5
3.6
29
2-φ3.4 through
27
φ4 or φ6
push-in fitting
(A)

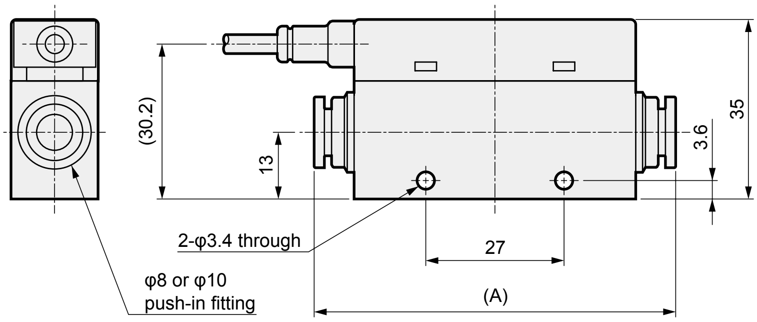

9.5
2-M3 depth 5
15.5

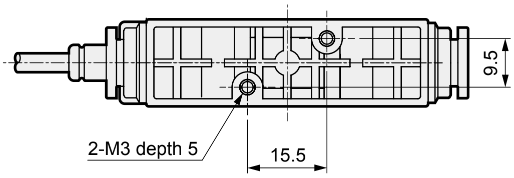
Model No.	Fitting	Dimension (A)
FSM2-A☐-H04☐	Push-in φ4	64.9
FSM2-A☐-H06☐	Push-in φ6	67.2

Display separated, port size: push-in φ8, φ10

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


CKD
RAPIFLOW
17
15
55


(30.2)
13
3.6
35
2-φ3.4 through
27
φ8 or φ10
push-in fitting
(A)

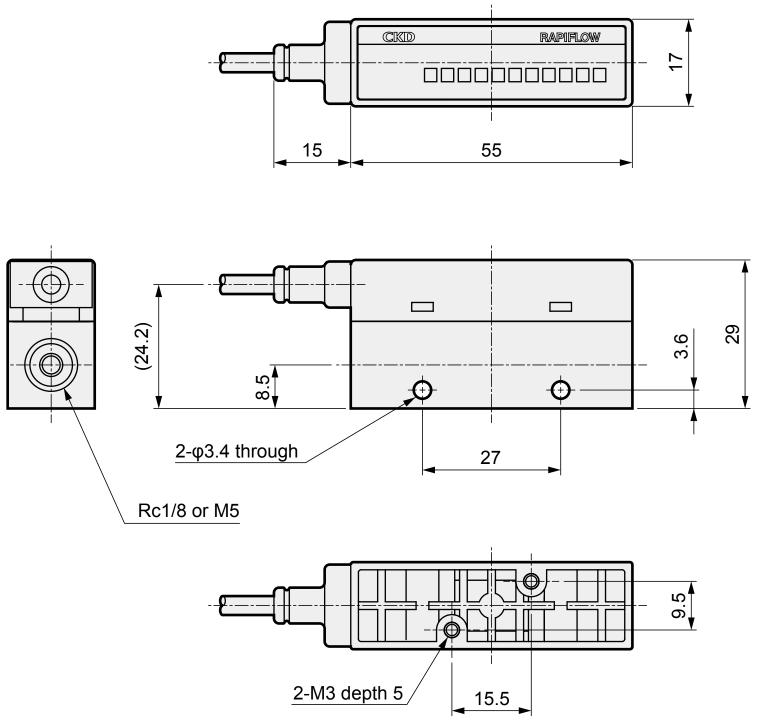

9.5
2-M3 depth 5
15.5

Model No.	Fitting	Dimension (A)
FSM2-A☐-H08☐	Push-in φ8	70.6
FSM2-A☐-H10☐	Push-in φ10	82.2

Dimensions (display separated)

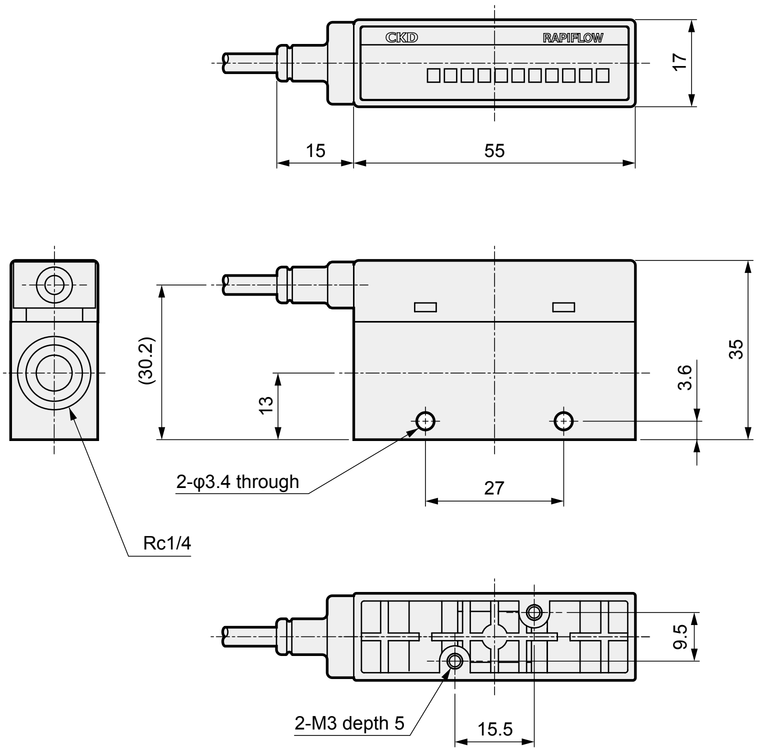
Display separated, port size: Rc1/8, M5

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


CKD
RAPIFLOW
17
15
55
(24.2)
8.5
3.6
29
2-φ3.4 through
27
Rc1/8 or M5
9.5
2-M3 depth 5
15.5

Display separated, port size: Rc1/4

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

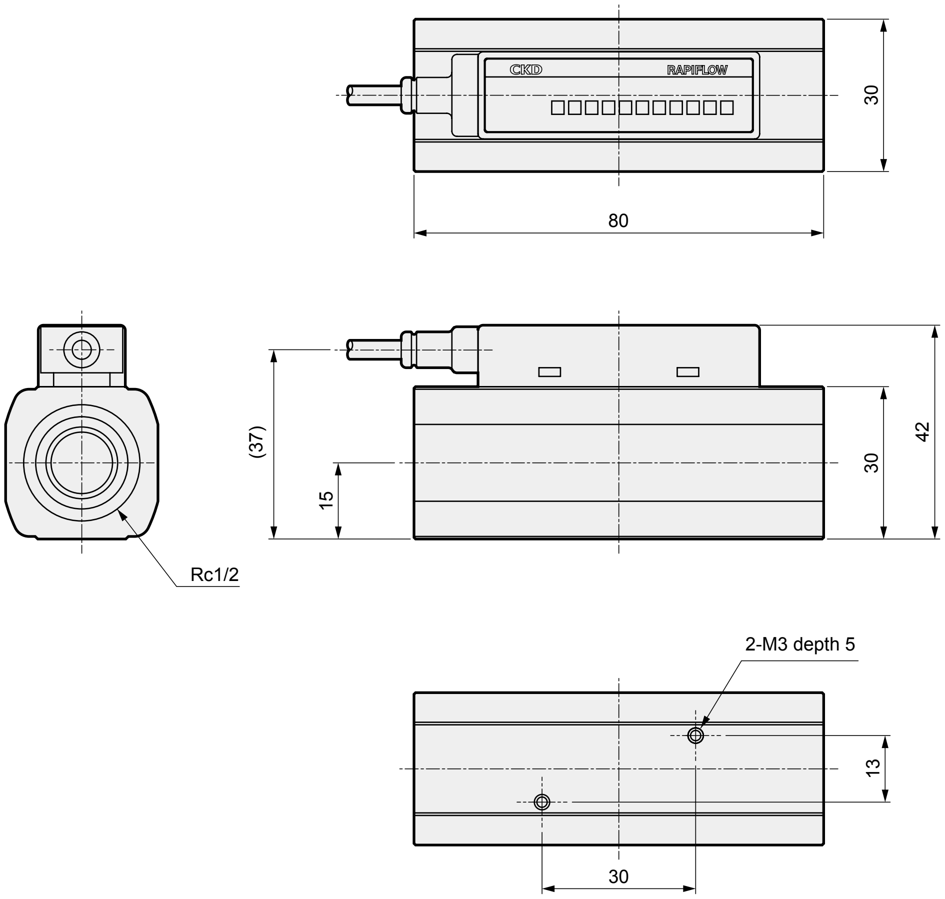

CKD
RAPIFLOW
17
15
55
(30.2)
13
3.6
35
2-φ3.4 through
27
Rc1/4
9.5
2-M3 depth 5
15.5

Discontinue

Dimensions (display separated)

Display separated, port size: Rc1/2

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



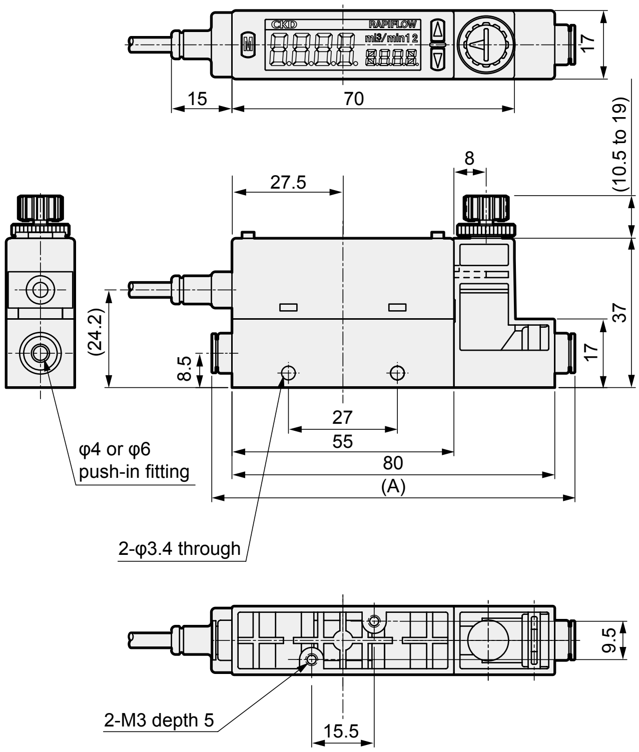
Discontinue

Dimensions (display integrated, needle valve integrated)

CAD

Display integrated, port size: push-in φ4, φ6

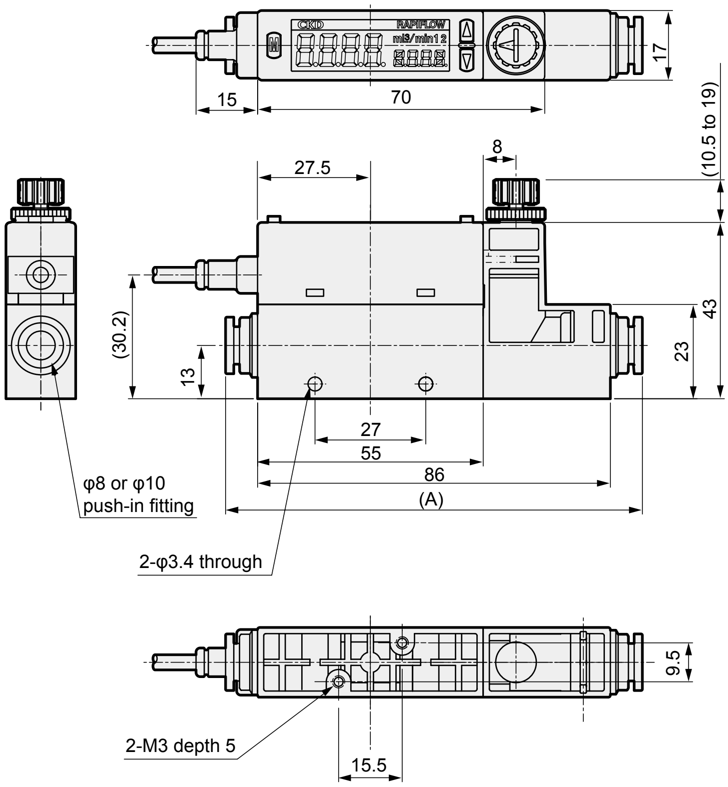
- FSM2-N/P ☐ -H04/H06 ☐ N (full scale flow rate: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min)


CKD
RAPIFLOW
15
70
17
(10.5 to 19)
8
27.5
37
17
(24.2)
8.5
27
55
80
(A)
φ4 or φ6
push-in fitting
2-φ3.4 through
9.5
2-M3 depth 5
15.5

Model No.	Fitting	Dimension (A)
FSM2-N/P☐-H04☐	Push-in φ4	89.9
FSM2-N/P☐-H06☐	Push-in φ6	92.2

Display integrated, port size: push-in φ8, φ10

- FSM2-N/P ☐ -H08/H10 ☐ N (full scale flow rate: 50, 100, 200 ℓ/min)


CKD
RAPIFLOW
15
70
17
(10.5 to 19)
8
27.5
43
23
(30.2)
13
27
55
86
(A)
φ8 or φ10
push-in fitting
2-φ3.4 through
9.5
2-M3 depth 5
15.5

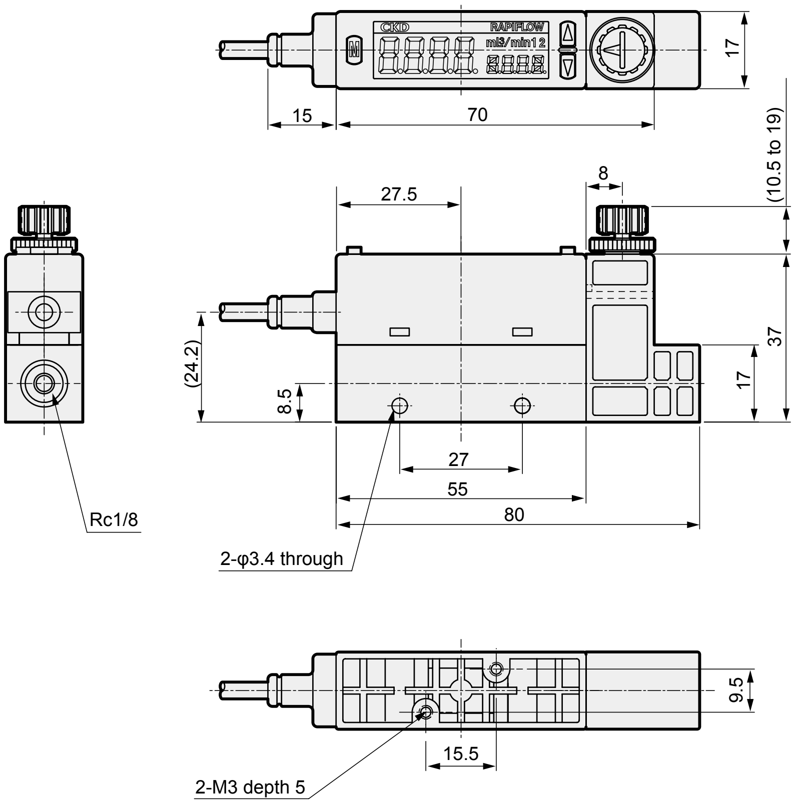
Model No.	Fitting	Dimension (A)
FSM2-N/P☐-H08☐	Push-in φ8	101.6
FSM2-N/P☐-H10☐	Push-in φ10	113.2

Discontinue

Dimensions (display integrated, needle valve integrated)

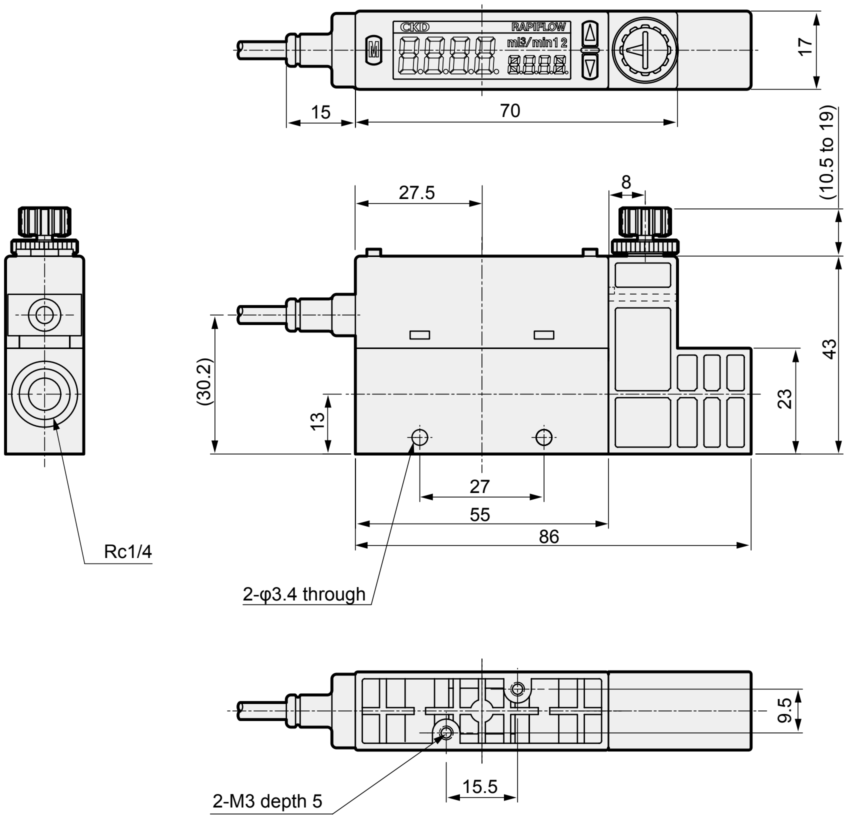
Display integrated, port size: Rc1/8

- FSM2-N/P ☐ -S06 ☐ N (full scale flow rate: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min)


17
15
70
(10.5 to 19)
27.5
8
(24.2)
8.5
37
17
27
55
80
Rc1/8
2-φ3.4 through
9.5
15.5
2-M3 depth 5

Display integrated, port size: Rc1/4

- FSM2-N/P ☐ -S08/ ☐ N (full scale flow rate: 50, 100, 200 ℓ/min)

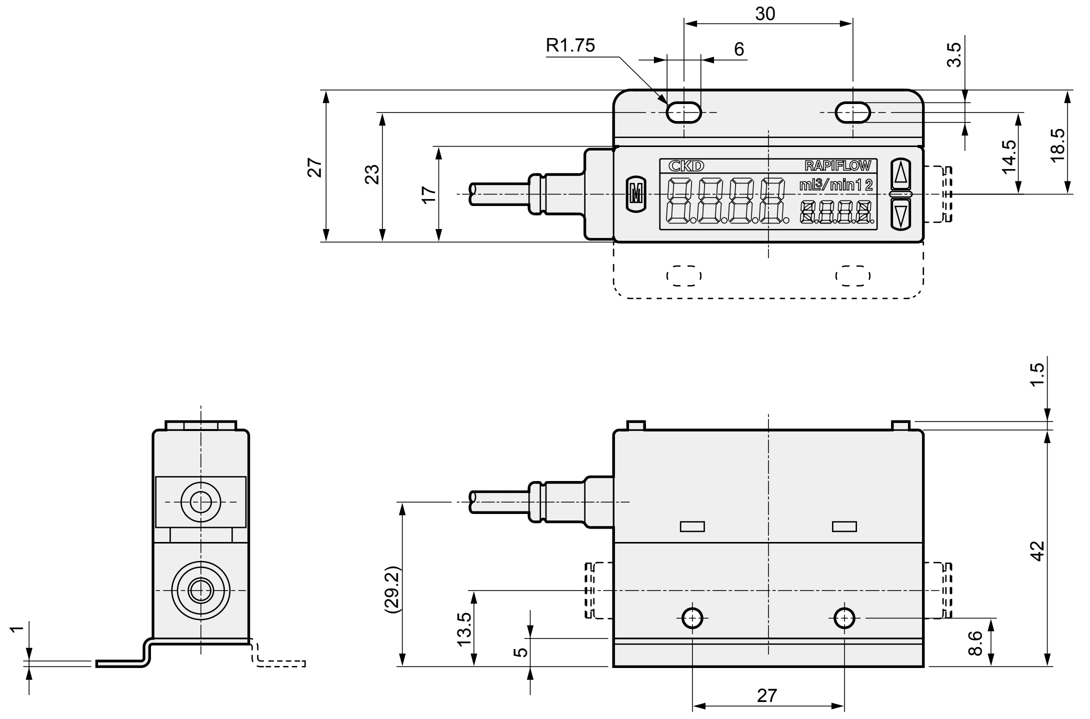

17
15
70
(10.5 to 19)
27.5
8
(30.2)
13
43
23
27
55
86
Rc1/4
2-φ3.4 through
9.5
15.5
2-M3 depth 5

Discontinue

Dimensions with options (B: With bracket)

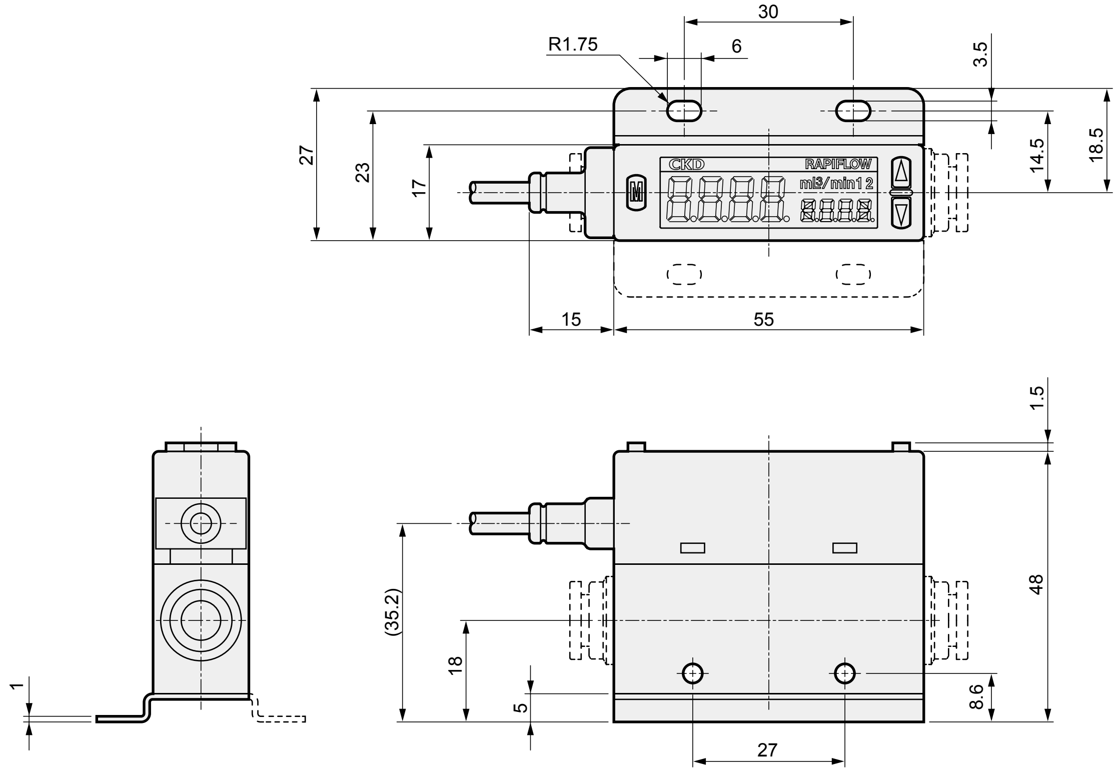
Display integrated, port size: push-in φ4, φ6, Rc1/8, M5

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


30
R1.75
6
3.5
27
23
17
14.5
18.5
CKD
RAPIFLOW
ml3/min1 2
M
1.5
42
(29.2)
13.5
5
1
8.6
27

Display integrated, port size: push-in φ8, φ10, Rc1/4

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

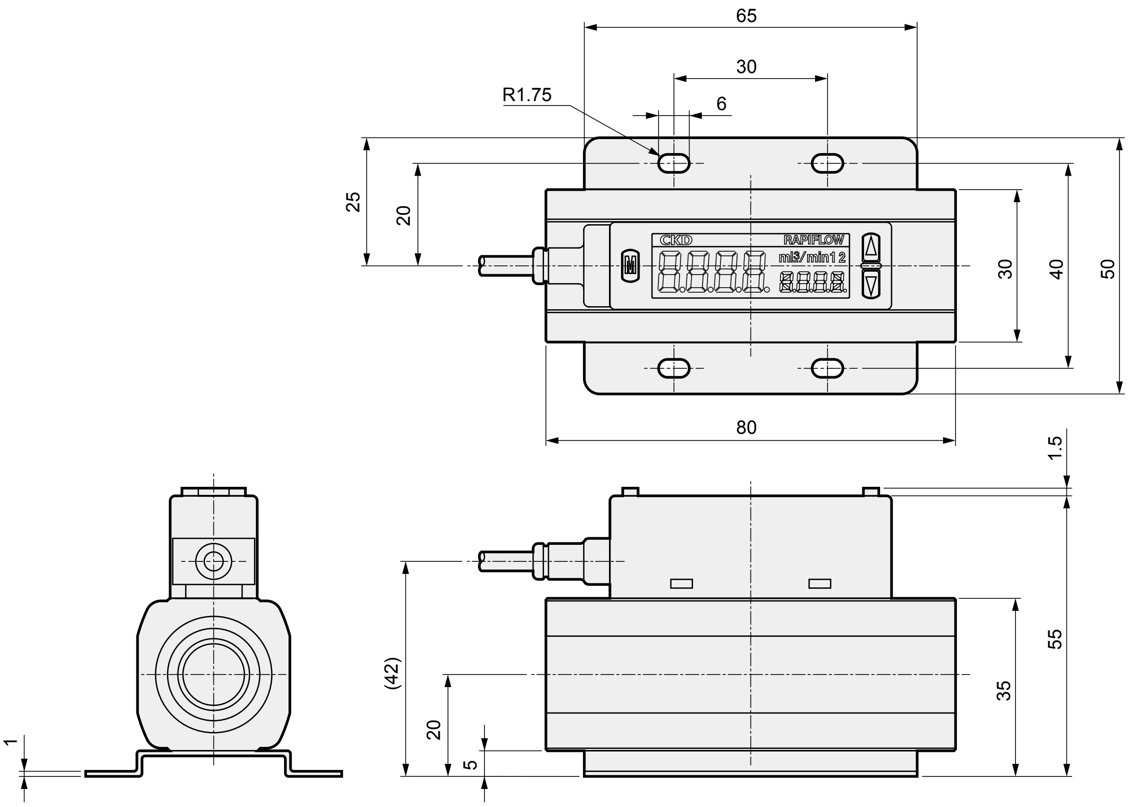

30
R1.75
6
3.5
27
23
17
14.5
18.5
CKD
RAPIFLOW
ml3/min1 2
M
15
55
1.5
48
(35.2)
18
5
1
8.6
27

Discontinue

Dimensions with options (B: With bracket)

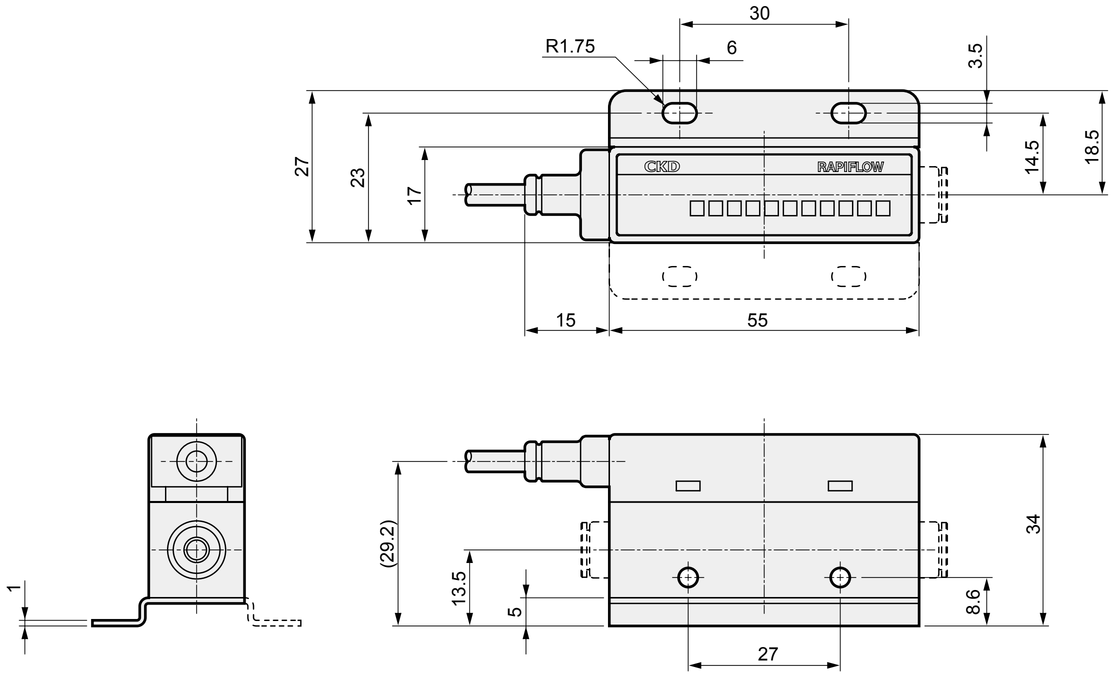
Display integrated, port size: Rc1/2

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


65
30
6
R1.75
25
20
CKD
RAPIFLOW
m3/min1 2
30
40
50
80
1.5
55
(42)
35
20
5
1

Display separated, port size: push-in φ4, φ6, Rc1/8, M5

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

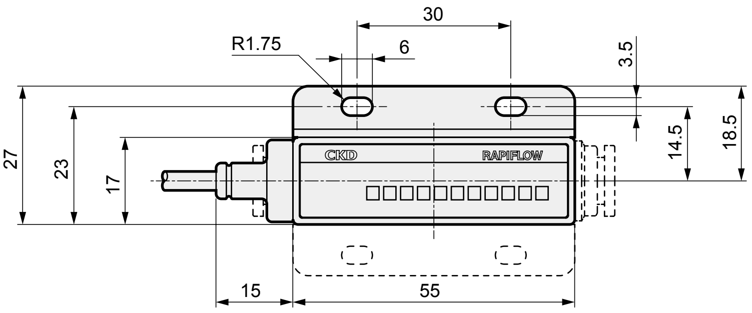

30
R1.75
6
3.5
27
23
17
CKD
RAPIFLOW
14.5
18.5
15
55
1
(29.2)
13.5
5
34
8.6
27

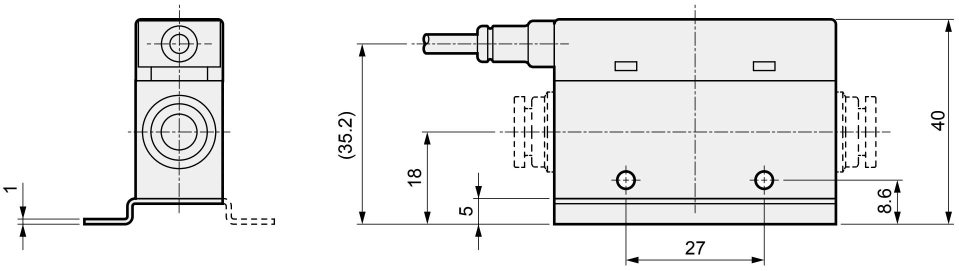
Discontinue

Dimensions with options (B: With bracket)

Display separated, port size: push-in φ8, φ10, Rc1/4

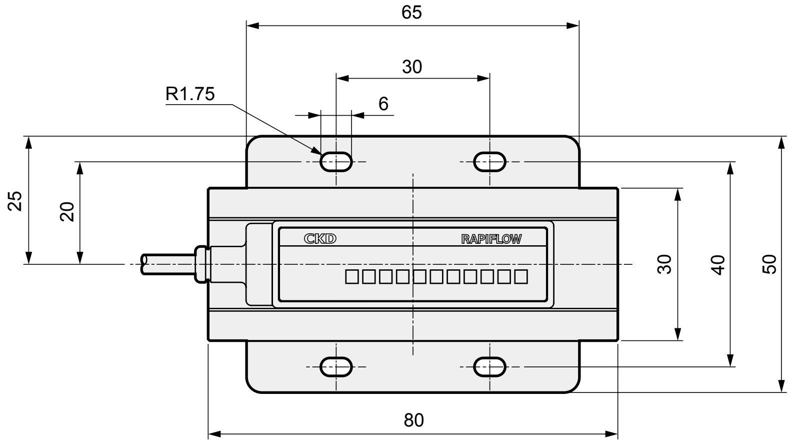
● FSM2-A ☐ -H08/H10/S08 ☐ B (full scale flow rate: 50, 100, 200 ℓ/min)

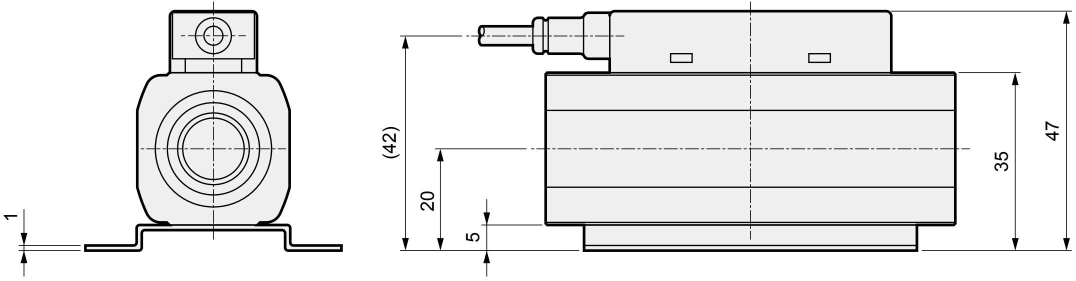

30
R1.75
6
3.5
27
23
17
CKD
RAPIFLOW
14.5
18.5
15
55


1
(35.2)
18
5
40
8.6
27

Display separated, port size: Rc1/2

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

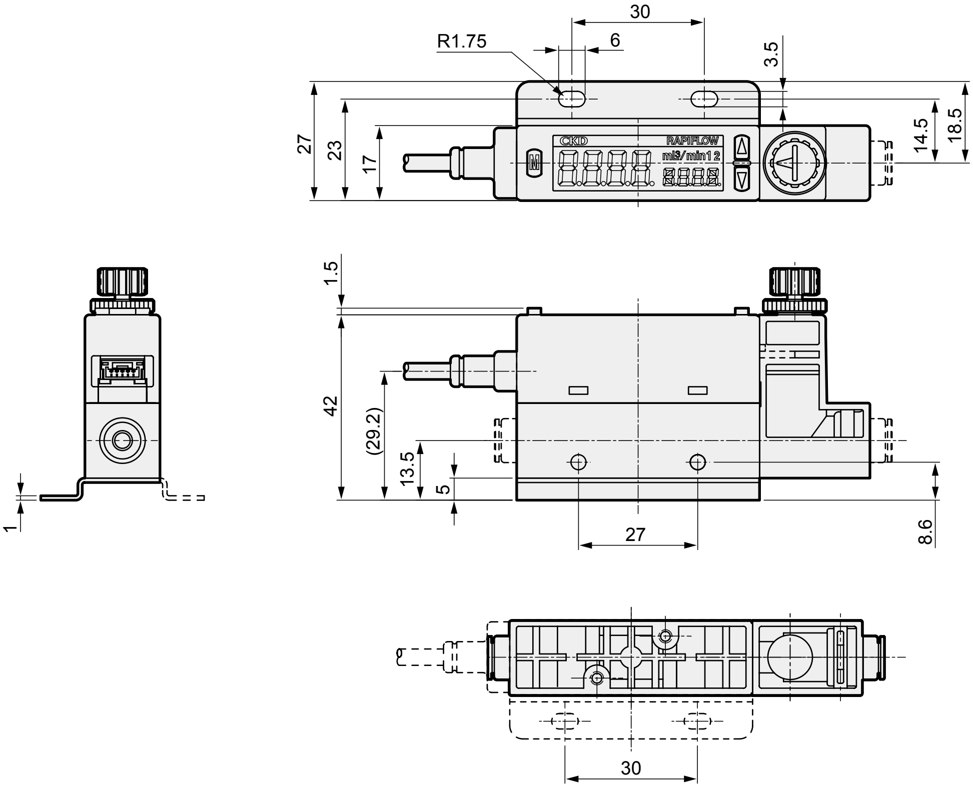

65
30
R1.75
6
25
20
CKD
RAPIFLOW
30
40
50
80


1
(42)
20
5
35
47

Dimensions with options (B: With bracket)

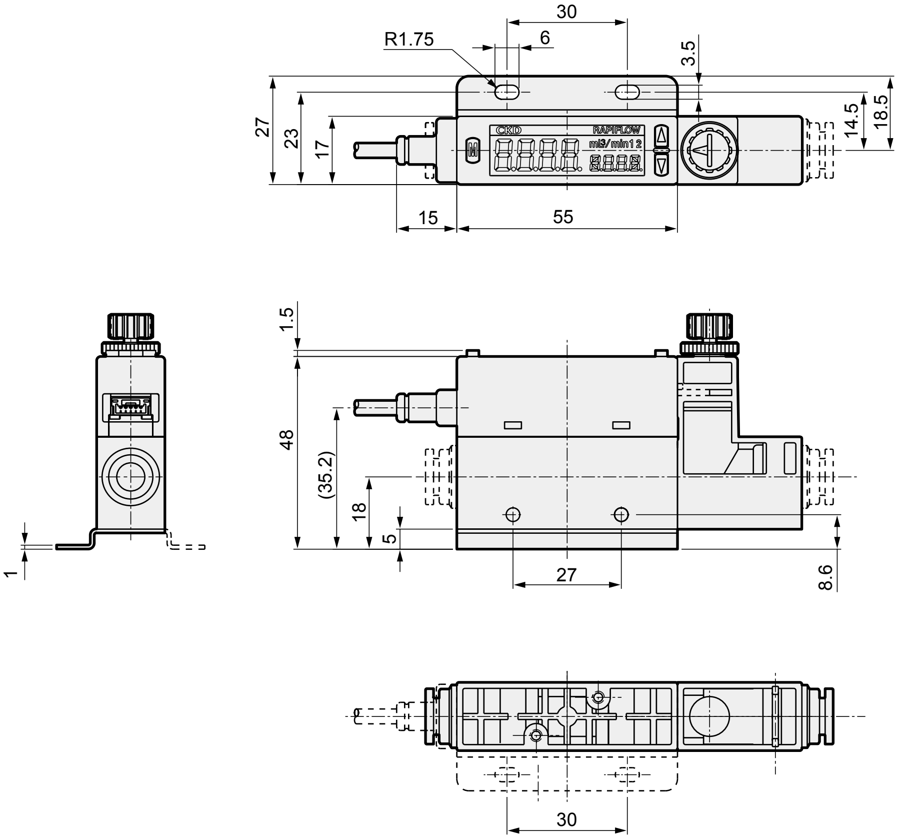
Needle valve integrated, port size: push-in φ4, φ6, Rc1/8

- FSM2-N/P ☐ -H04/H06/S06 ☐ BN (full scale flow rate: 0.5, 1, 2, 5, 10, 20, 50 ℓ/min)


30
R1.75
6
3.5
27
23
17
14.5
18.5
CKD
RAPIFLOW
1.5
42
(29.2)
13.5
5
27
8.6
1
30

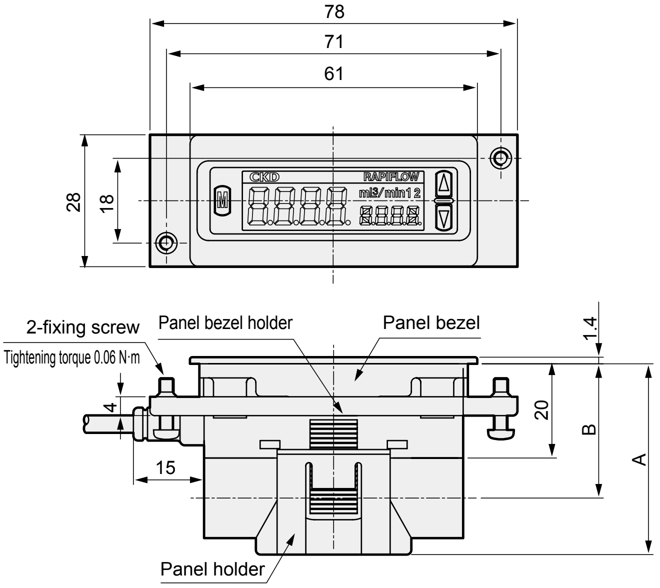
Needle valve integrated, port size: push-in φ8, φ10, Rc1/4

- FSM2-N/P ☐ -H08/H10/S08 ☐ BN (full scale flow rate: 50, 100, 200 ℓ/min)


30
R1.75
6
3.5
27
23
17
14.5
18.5
CKD
RAPIFLOW
15
55
1.5
48
(35.2)
18
5
27
8.6
1
30

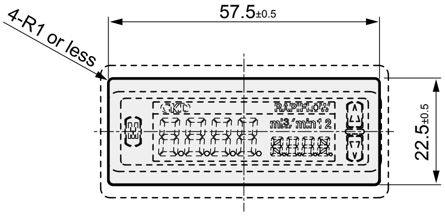
Dimensions with options (P: panel mounting kit with options)

● Display integrated

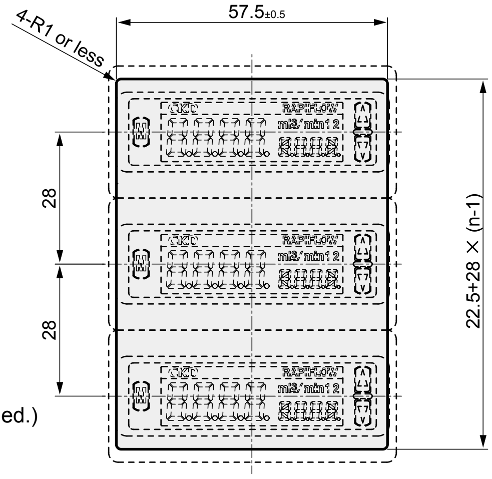

78
71
61
28
18
CKD
RAPIFLOW
m3/min1 2
2-fixing screw
Tightening torque 0.06 N·m
Panel bezel holder
Panel bezel
1.4
4
20
B
A
15
Panel holder

[Panel cut dimension]

In case of single installation


4-R1 or less
57.5±0.5
22.5±0.5

In case of continuous installation


4-R1 or less
57.5±0.5
28
28
22.5+28 × (n-1)

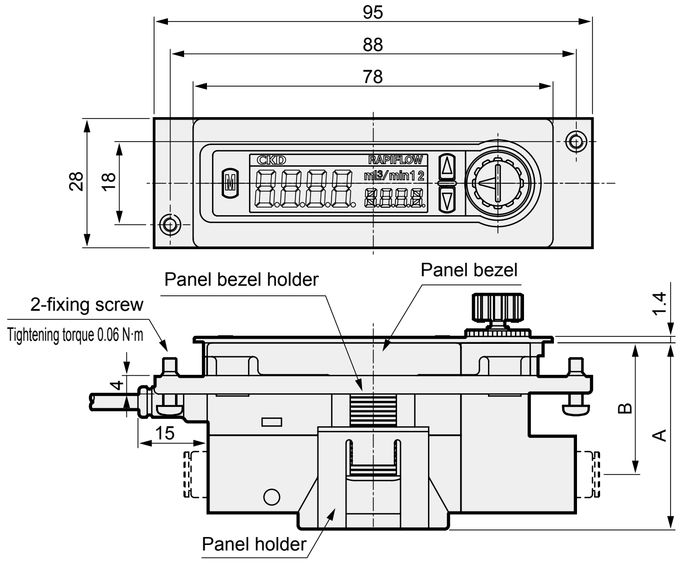
Panel thickness 6mm or less

Model No.	A	B
FSM2-N/P☐-H04/H06/S06/SM5☐	40.5	28.5
FSM2-N/P☐-H08/H10/S08☐	46.5	30.0

* Cannot be mounted on FSM-N/P☐-A15☐.

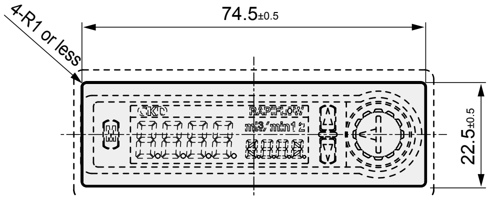
Weight: 23g
(Body is not included.)

● Needle valve integrated

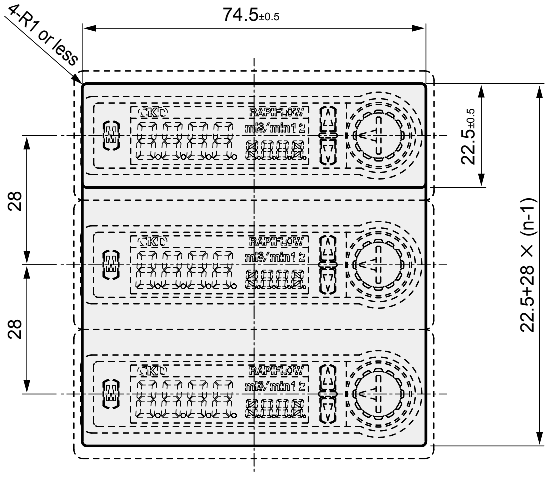

95
88
78
28
18
CKD
RAPIFLOW
m3/min1 2
Panel bezel holder
Panel bezel
2-fixing screw
Tightening torque 0.06 N·m
1.4
4
15
B
A
Panel holder

[Panel cut dimension]

In case of single installation


4-R1 or less
74.5±0.5
22.5±0.5

In case of continuous installation


4-R1 or less
74.5±0.5
22.5±0.5
28
28
22.5+28 × (n-1)

Panel thickness 6mm or less

Model No.	A	B
FSM2-N/P☐-H04/H06/S06☐N	40.5	28.5
FSM2-N/P☐-H08/H10/S08☐N	46.5	30.0

Weight: 25g
(Body is not included.)

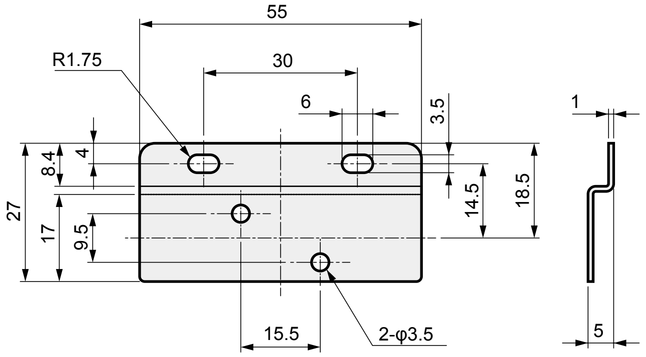
Discontinue

Optional dimensions

● Bracket

Model No.: FSM2-LB1

(Full scale flow rate: 0.5, 1, 2, 5, 10, 20, 50, 100, 200 ℓ/min)

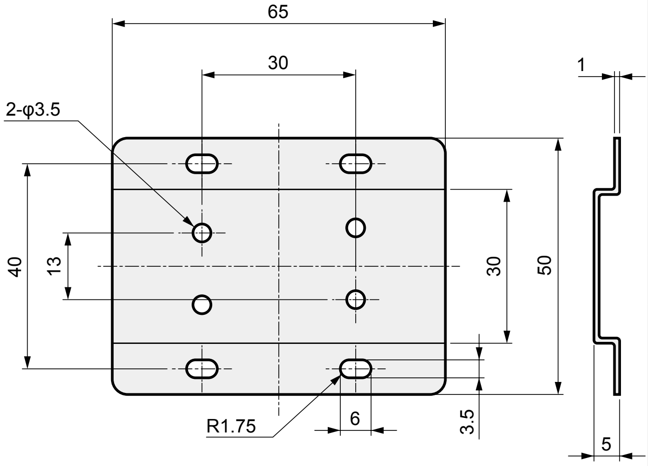

55
R1.75
30
6
3.5
1
8.4
4
27
17
9.5
14.5
18.5
15.5
2-φ3.5
5

* 2 M3 fixing screws (length 6 mm) attached

Material: Steel
Weight: 13g

Model No.: FSM2-LB2

(Full scale flow rate: 500, 1000 ℓ/min)


65
30
1
2-φ3.5
40
13
30
50
R1.75
6
3.5
5

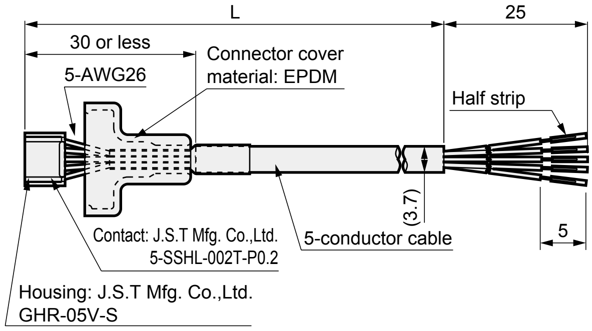
* 2 M3 fixing screws (length 6 mm) attached

Material: Steel
Weight: 28g

● Cable option

Model No.: FSM2-C51, C53

5-conductor cable (for display integrated FSM2-N/P ☐ - ☐ , for separated display FSM2-D)

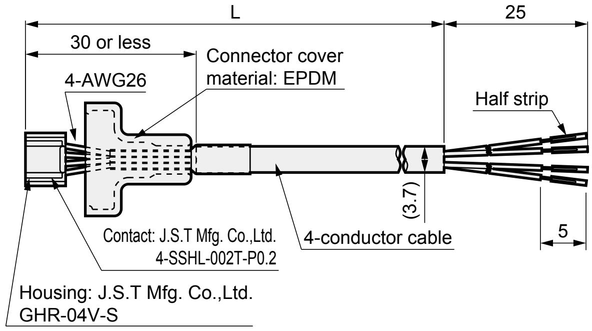

L
25
30 or less
Connector cover
material: EPDM
5-AWG26
Half strip
(3.7)
5
Contact: J.S.T Mfg. Co.,Ltd.
5-SSHL-002T-P0.2
5-conductor cable
Housing: J.S.T Mfg. Co.,Ltd.
GHR-05V-S

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

Model No.	L dimensions	Weight g
FSM2-C51	1040±20	21
FSM2-C53	3040±20	57

Model No.: FSM2-C41, C43

4-conductor cable (for display separated FSM2-A ☐ - ☐)


L
25
30 or less
Connector cover
material: EPDM
4-AWG26
Half strip
(3.7)
5
Contact: J.S.T Mfg. Co.,Ltd.
4-SSHL-002T-P0.2
4-conductor cable
Housing: J.S.T Mfg. Co.,Ltd.
GHR-04V-S

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

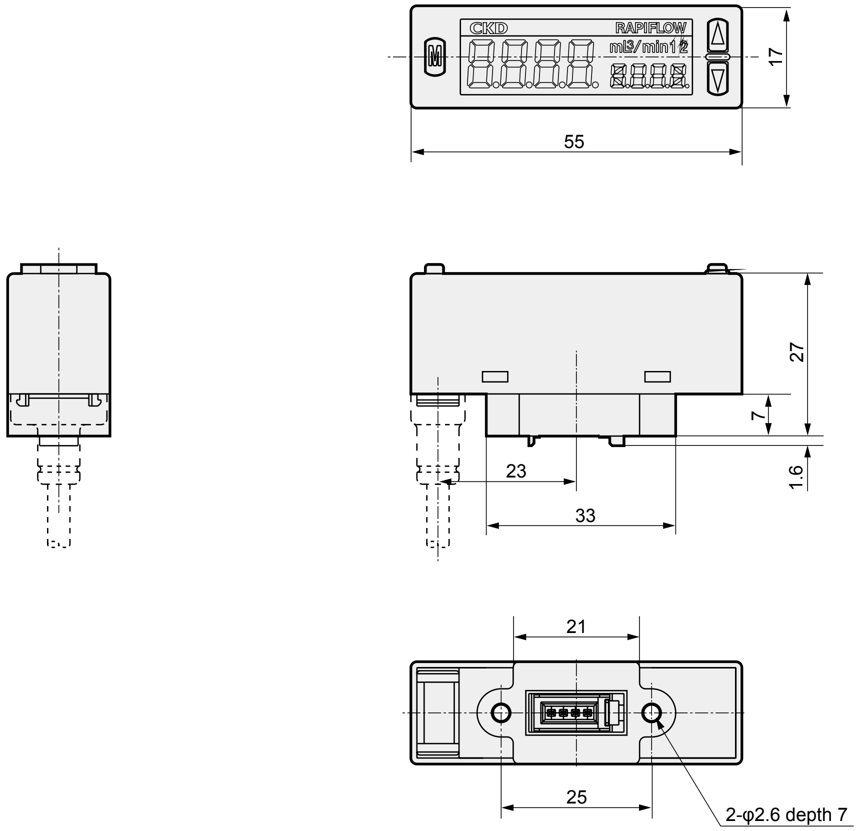
Model No.	L dimensions	Weight g
FSM2-C41	1040±20	19
FSM2-C43	3040±20	52

F.R.L
F (Filtr)
R (Reg)
L (Lub)
PresSW
Shutoff
SlowStart
FlmResistFR
Oil-ProhR
MedPresFR
No Cu/ PTFE FRL
Outdrs FR
F.R.L (Related)
CompFRL
LgFRL
PrecsR
VacF/R
Clean FR
ElecPneuR
AirBoost
SpdContr
Silncr
CheckV/ other
Jnt/tube
AirUnt
PrecsCompn
Mech/ ElecPresSw
ContactSW
AirSens
PresSW Cool
AirFloSens/ Contr
WaterRtSens
TotAirSys (Total Air)
TotAirSys (Gamma)
RefrDry
DesicDry
HiPolymDry
MainFiltr
Dischrg etc
Ending

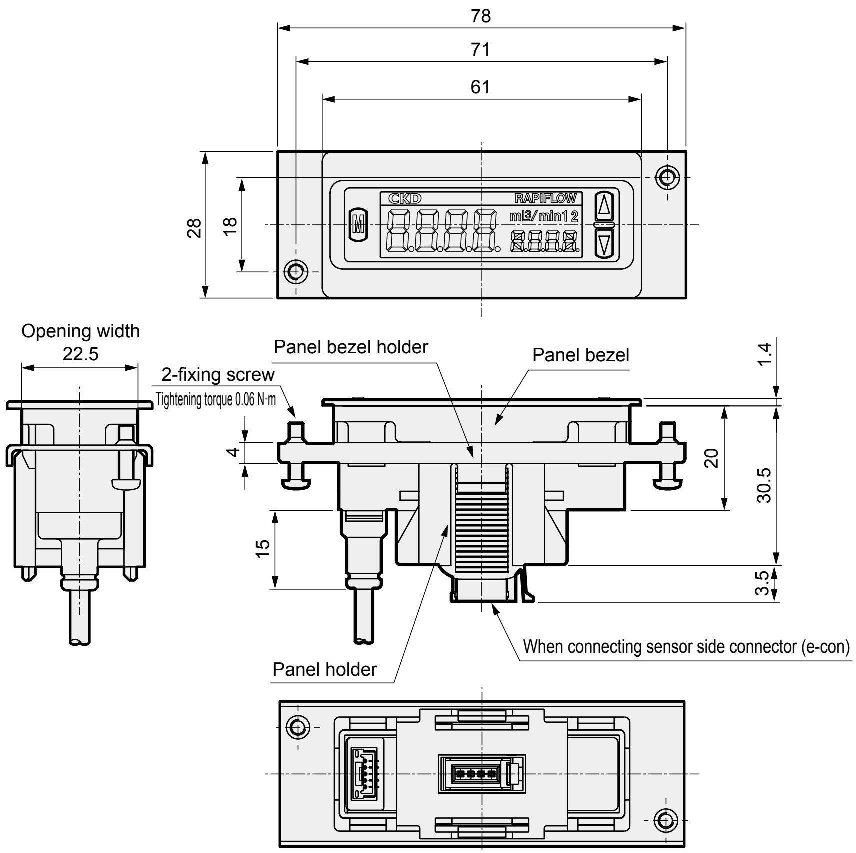
Discontinue

Separated display dimensions

● FSM2-D-☐

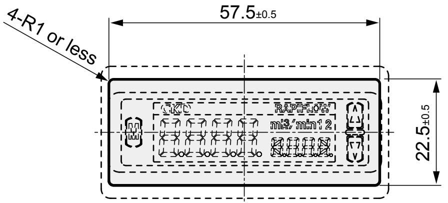

CKD
RAPIFLOW
ml3/min1 2
M
17
55
27
7
1.6
23
33
21
25
2-φ2.6 depth 7

● Panel mounting kit with options dimensions

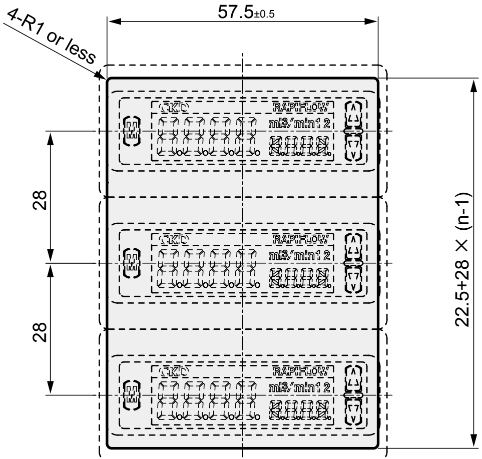

78
71
61
28
18
CKD
RAPIFLOW
ml3/min1 2
M
Opening width
22.5
Panel bezel holder
Panel bezel
2-fixing screw
Tightening torque 0.06 N·m
1.4
4
20
30.5
15
3.5
When connecting sensor side connector (e-con)
Panel holder

[Panel cut dimension]

In case of single installation


4-R1 or less
57.5±0.5
22.5±0.5

In case of continuous installation


4-R1 or less
57.5±0.5
28
28
22.5+28 × (n-1)

Panel thickness 6mm or less

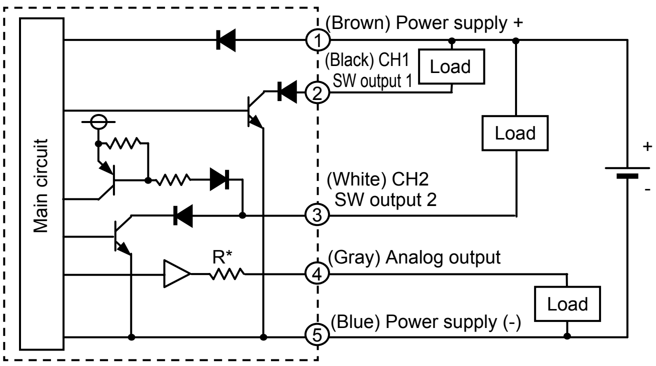
Discontinue

MEMO

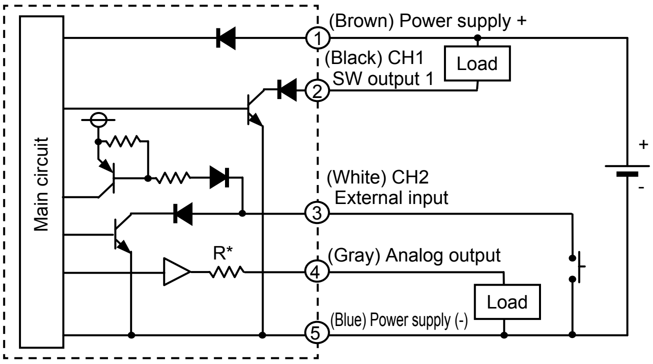
Example of internal circuit and load connection

- ● FSM2-N ☐ - ☐ (display integrated NPN output)
  FSM2-D-N ☐ - ☐ (separated display NPN output)

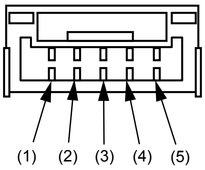
[CH2 is used as SW output]


Main circuit
(Brown) Power supply +
①
(Black) CH1
SW output 1
②
Load
Load
(White) CH2
SW output 2
③
R*
(Gray) Analog output
④
Load
(Blue) Power supply (-)
⑤
+
-

[CH2 is used as external input]


Main circuit
(Brown) Power supply +
①
(Black) CH1
SW output 1
②
Load
(White) CH2
External input
③
R*
(Gray) Analog output
④
Load
(Blue) Power supply (-)
⑤
+
-

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

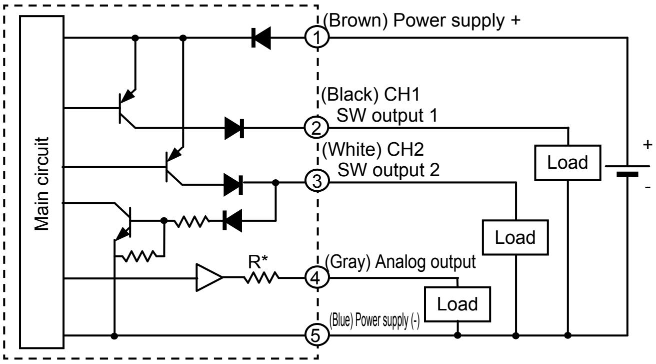


(FSM2 side)

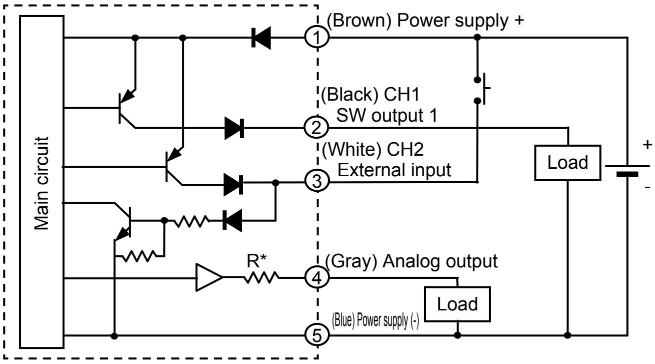
Terminal No.	Option cable color	Name
(1)	Brown	Power supply (+) (voltage output: 12 to 24 V, current output: 24 V)
(2)	Black	CH1 (Switch output 1: max. 50 mA)
(3)	White	CH2 (switch output 2: max. 50 mA, or external input)
(4)	Gray	Analog output Voltage output: 1 to 5 V load impedance 50 kΩ or more Current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

- ● FSM2-P ☐ - ☐ (display integrated PNP output)
  FSM2-D-P ☐ - ☐ (separated display PNP output)

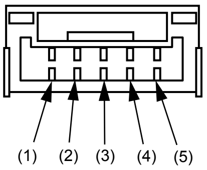
[CH2 is used as SW output]


Main circuit
(Brown) Power supply +
①
(Black) CH1
SW output 1
②
(White) CH2
SW output 2
③
Load
Load
R*
(Gray) Analog output
④
Load
(Blue) Power supply (-)
⑤
+
-

[CH2 is used as external input]


Main circuit
(Brown) Power supply +
①
(Black) CH1
SW output 1
②
(White) CH2
External input
③
Load
R*
(Gray) Analog output
④
Load
(Blue) Power supply (-)
⑤
+
-

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

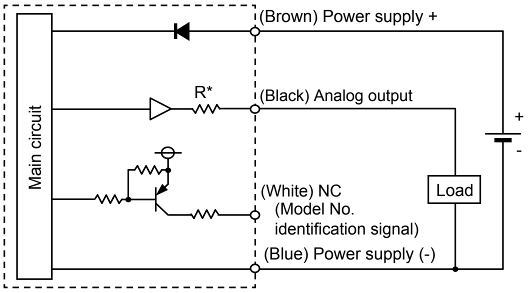


(FSM2 side)

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)

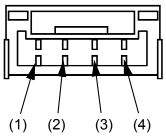
Example of internal circuit and load connection

- FSM2-A ☐ - ☐ (display separated)


Main circuit
(Brown) Power supply +
R*
(Black) Analog output
+
-
Load
(White) NC
(Model No. identification signal)
(Blue) Power supply (-)

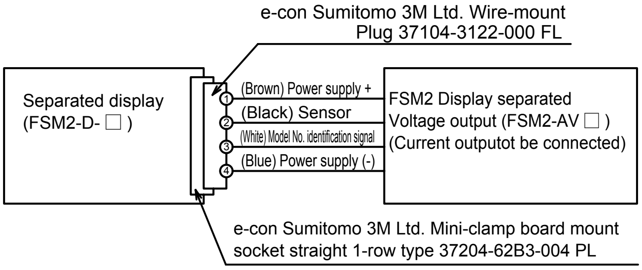
* Analog output: Voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

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 to 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)

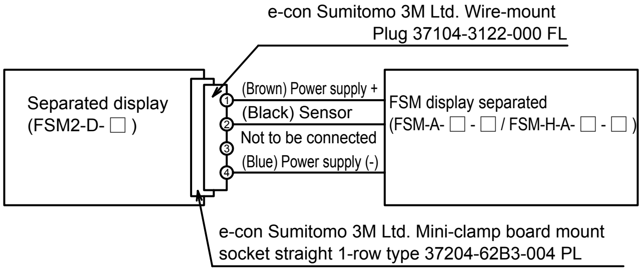


(FSM2 side)

- Connecting the separated display and FSM2 display separated


e-con Sumitomo 3M Ltd. Wire-mount
Plug 37104-3122-000 FL
Separated display
(FSM2-D- ☐)
①
②
③
④
(Brown) Power supply +
(Black) Sensor
(White) Model No. identification signal
(Blue) Power supply (-)
FSM2 Display separated
Voltage output (FSM2-AV ☐)
(Current outputot be connected)
e-con Sumitomo 3M Ltd. Mini-clamp board mount
socket straight 1-row type 37204-62B3-004 PL

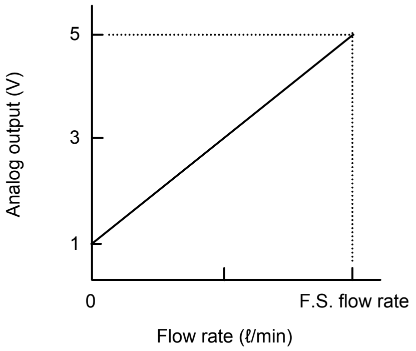
- Connecting the separated display and FSM display separated


e-con Sumitomo 3M Ltd. Wire-mount
Plug 37104-3122-000 FL
Separated display
(FSM2-D- ☐)
①
②
③
④
(Brown) Power supply +
(Black) Sensor
Not to be connected
(Blue) Power supply (-)
FSM display separated
(FSM-A- ☐ - ☐ / FSM-H-A- ☐ - ☐)
e-con Sumitomo 3M Ltd. Mini-clamp board mount
socket straight 1-row type 37204-62B3-004 PL

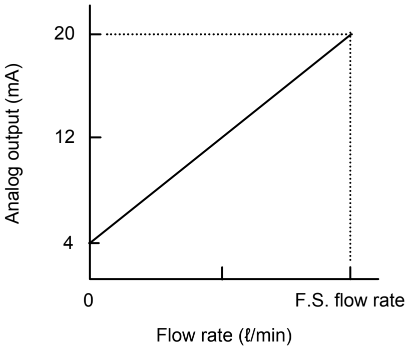
When connecting to the FSM-V Series or WFK Series, the cable size is different so a separate compatible sensor connection connector (e-con) will be required.

Analog output characteristics

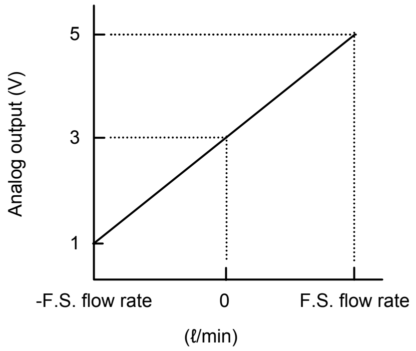
Voltage output flow rate uni-direction



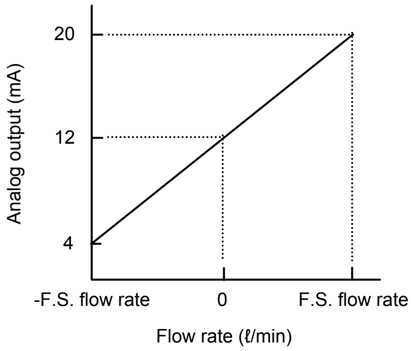
Current output flow rate uni-direction



Voltage output flow rate bi-directional



Current output flow rate bi-directional

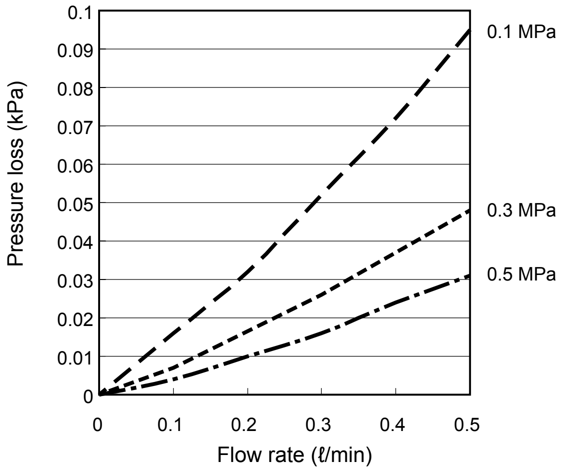


With the display integrated bi-directional, output can be changed to uni-direction output with the button settings.
Refer to page 1278 for details.

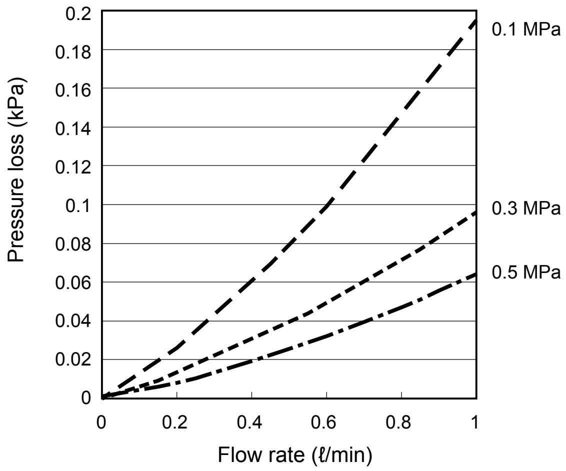
Discontinue

Pressure loss characteristics (for air, nitrogen gas)

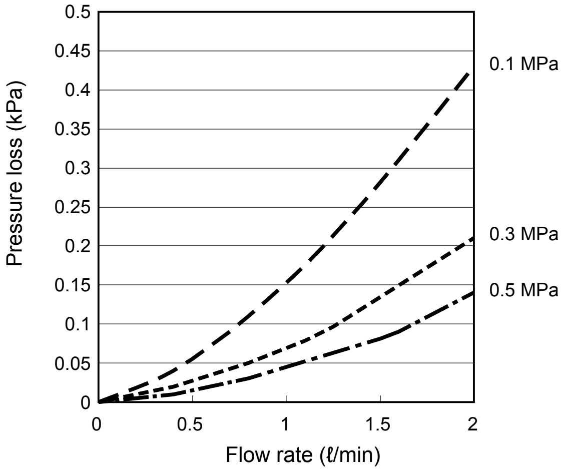
● FSM2-□005-□



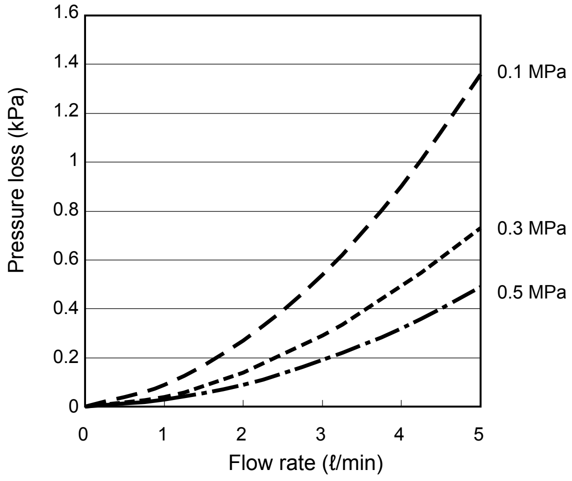
● FSM2-□010-□



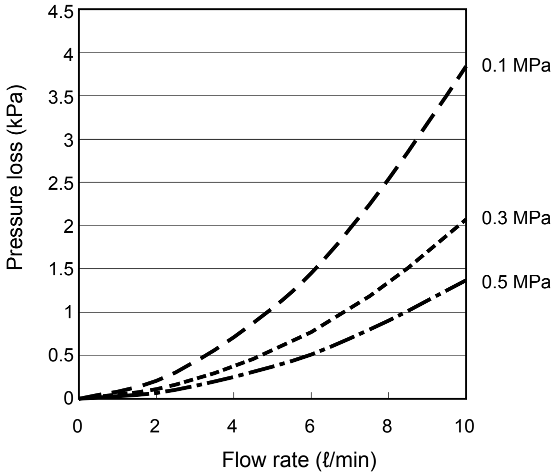
● FSM2-□020-□



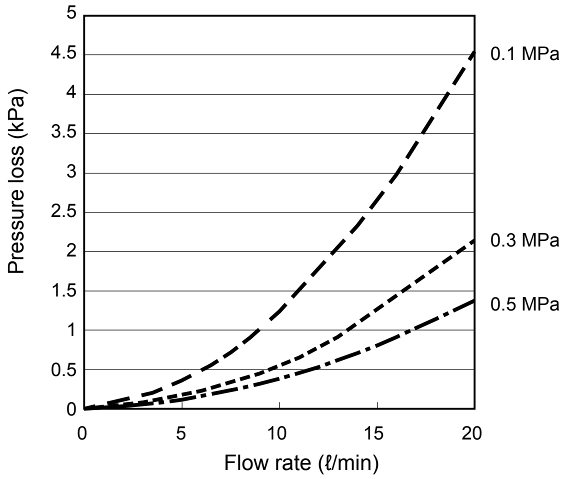
● FSM2-□050-□



● FSM2-□100-□



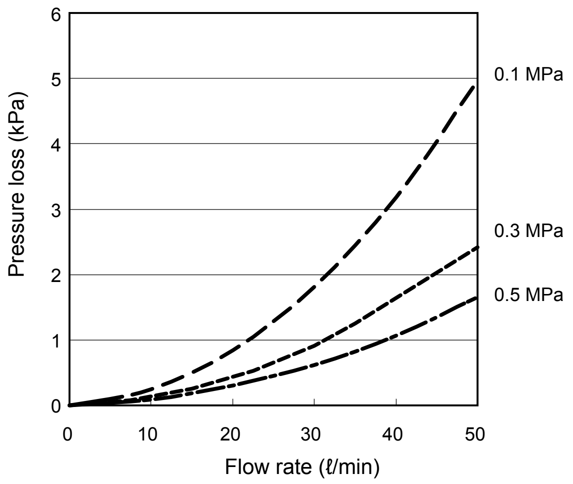
● FSM2-□200-□



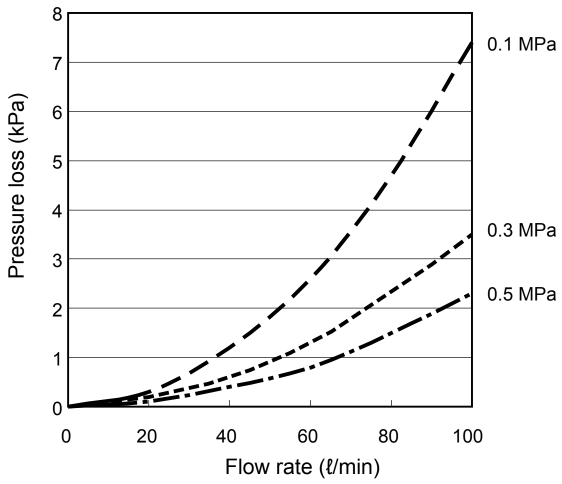
Discontinue

Pressure loss characteristics (for air, nitrogen gas)

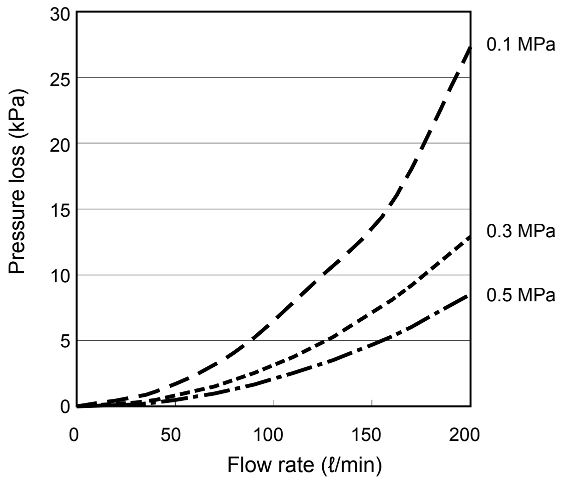
● FSM2-☐500-☐



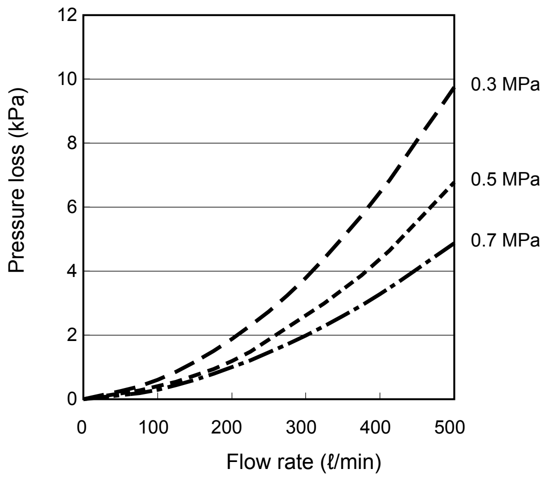
● FSM2-☐101-☐



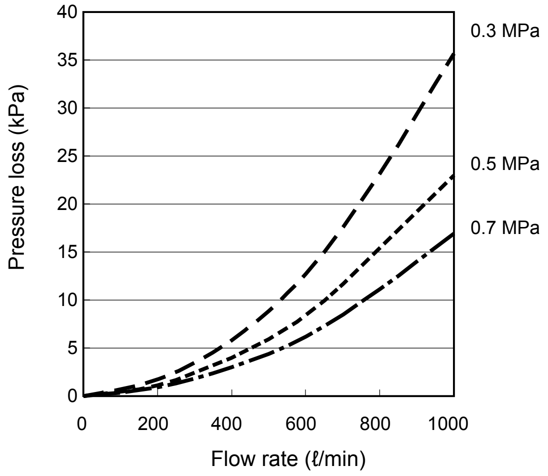
● FSM2-☐201-☐



● FSM2-☐501-☐



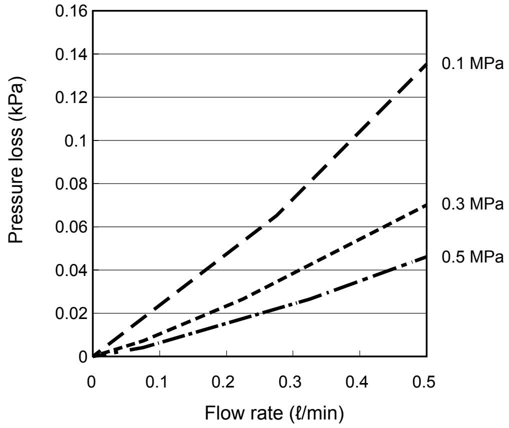
● FSM2-☐102-☐



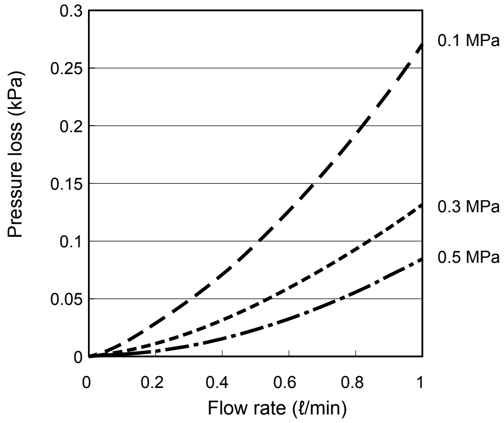
Discontinue

Pressure loss characteristics (for argon)

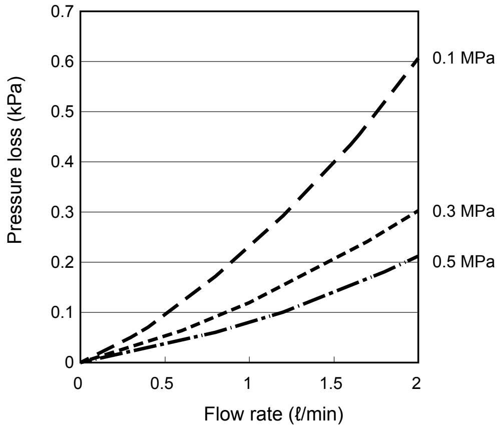
● FSM2-□005-□AR



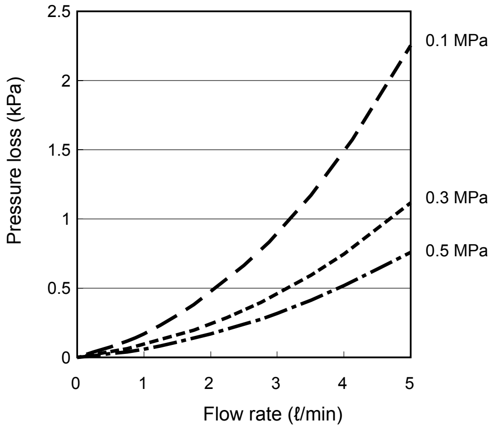
● FSM2-□010-□AR



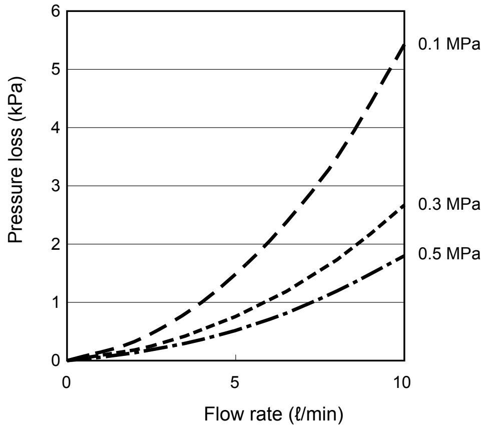
● FSM2-□020-□AR



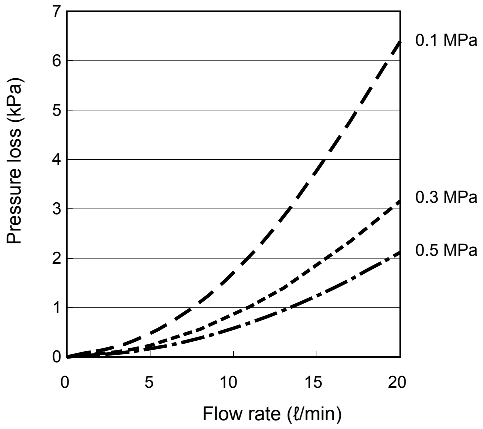
● FSM2-□050-□AR



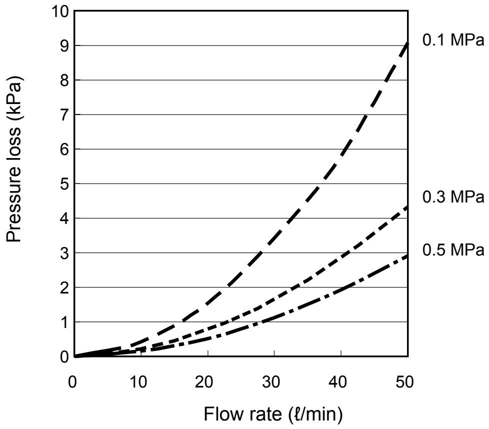
● FSM2-□100-□AR



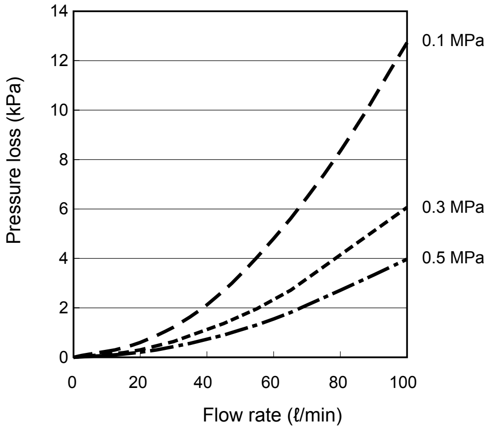
● FSM2-□200-□AR



● FSM2-□500-□AR



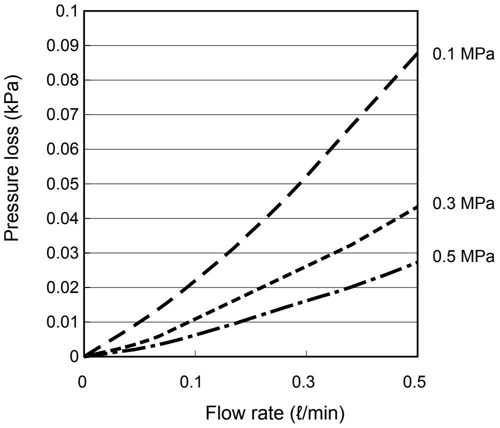
● FSM2-□101-□AR



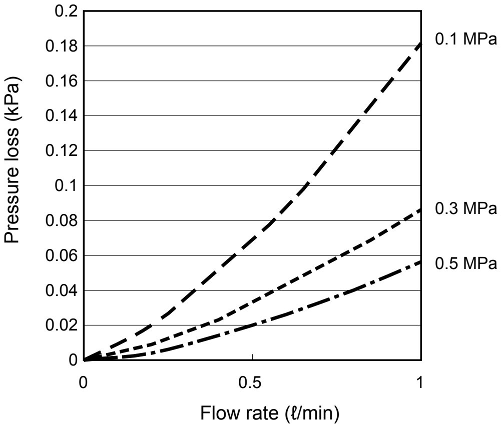
Discontinue

Pressure loss characteristics (for carbon dioxide)

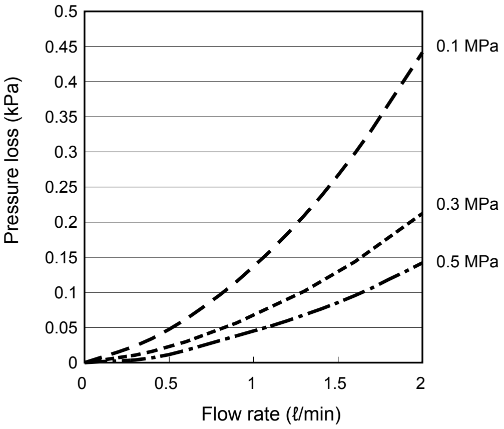
● FSM2-☐005-☐C2



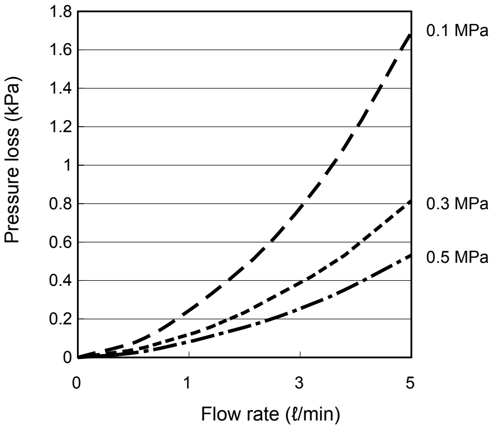
● FSM2-☐010-☐C2



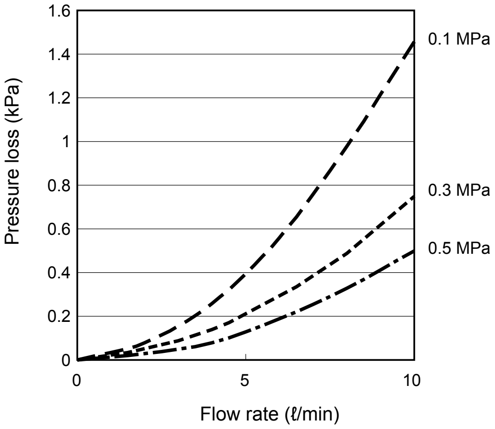
● FSM2-☐020-☐C2



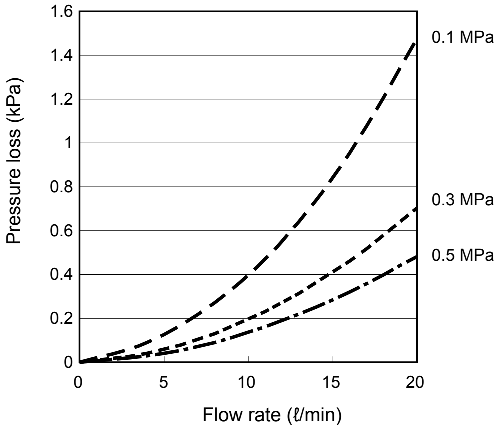
● FSM2-☐050-☐C2



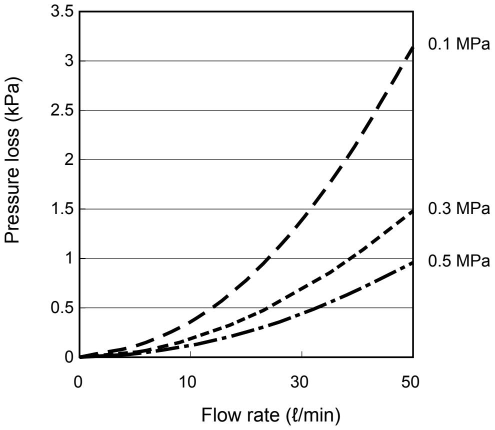
● FSM2-☐100-☐C2



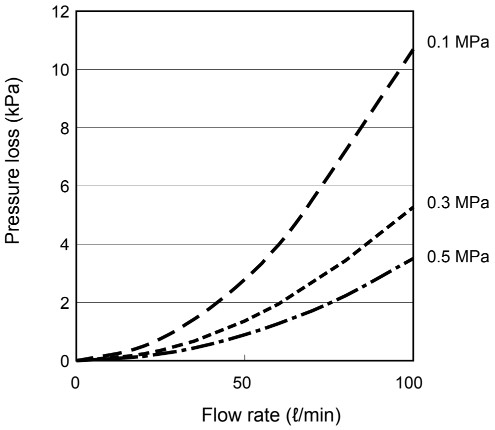
● FSM2-☐200-☐C2



● FSM2-☐500-☐C2



● FSM2-☐101-☐C2

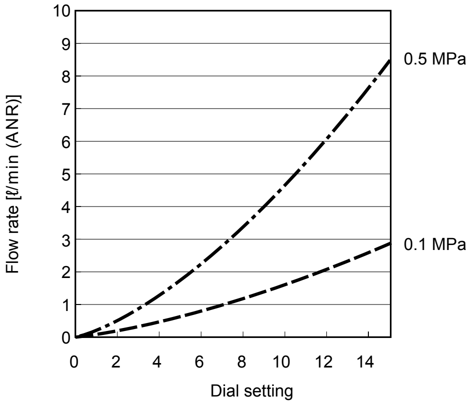


F.R.L
F (Filtr)
R (Reg)
L (Lub)
PresSW
Shutoff
SlowStart
FlmResistFR
Oil-ProhR
MedPresFR
No Cu/ PTFE FRL
Outdrs FR
F.R.L (Related)
CompFRL
LgFRL
PrecsR
VacF/R
Clean FR
ElecPneuR
AirBoost
SpdContr
Silncr
CheckV/ other
Jnt/tube
AirUnt
PrecsCompn
Mech/ ElecPresSw
ContactSW
AirSens
PresSW Cool
AirFloSens/ Contr
WaterRtSens
TotAirSys (Total Air)
TotAirSys (Gamma)
RefrDry
DesicDry
HiPolymDry
MainFiltr
Dischrg etc
Ending

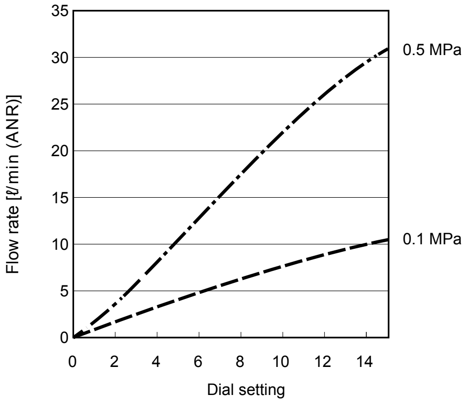
Discontinue

Needle valve flow characteristics (for air, nitrogen gas)

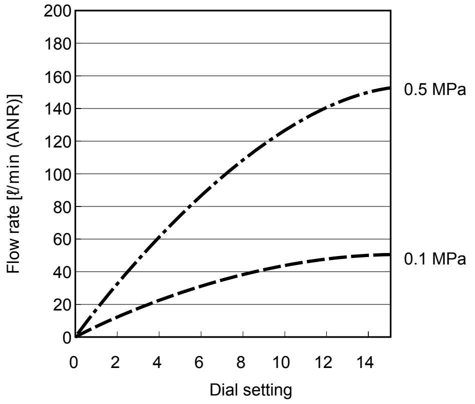
● FSM2- ☐ 005/010/020 (resin body)



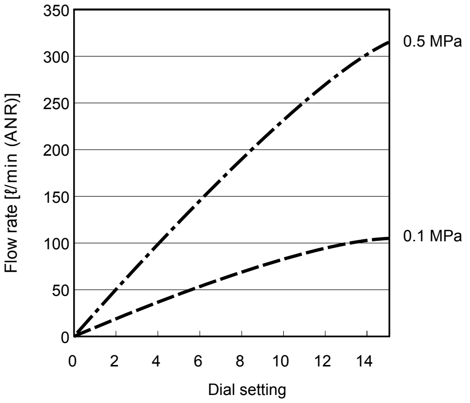
● FSM2- ☐ 050/100 (resin body)



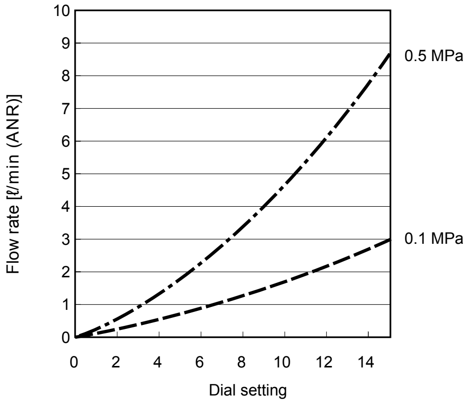
● FSM2- ☐ 200/500-H04/H06 (resin body)



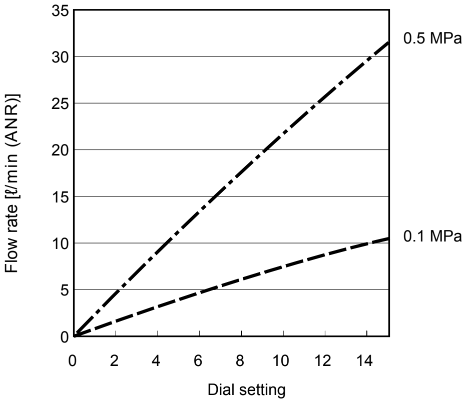
● FSM2- ☐ 500/101/201-H08/H10 (resin body)



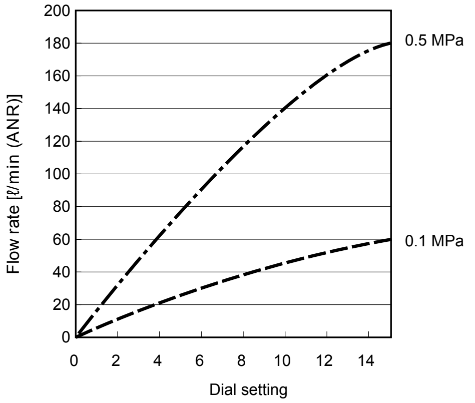
● FSM2- ☐ 005/010/020 (SUS body)



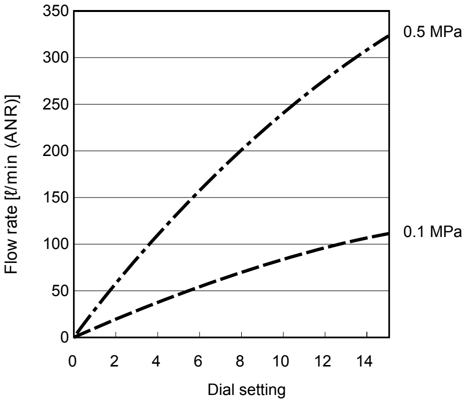
● FSM2- ☐ 050/100 (SUS body)



● FSM2- ☐ 200/500-S06 (SUS body)



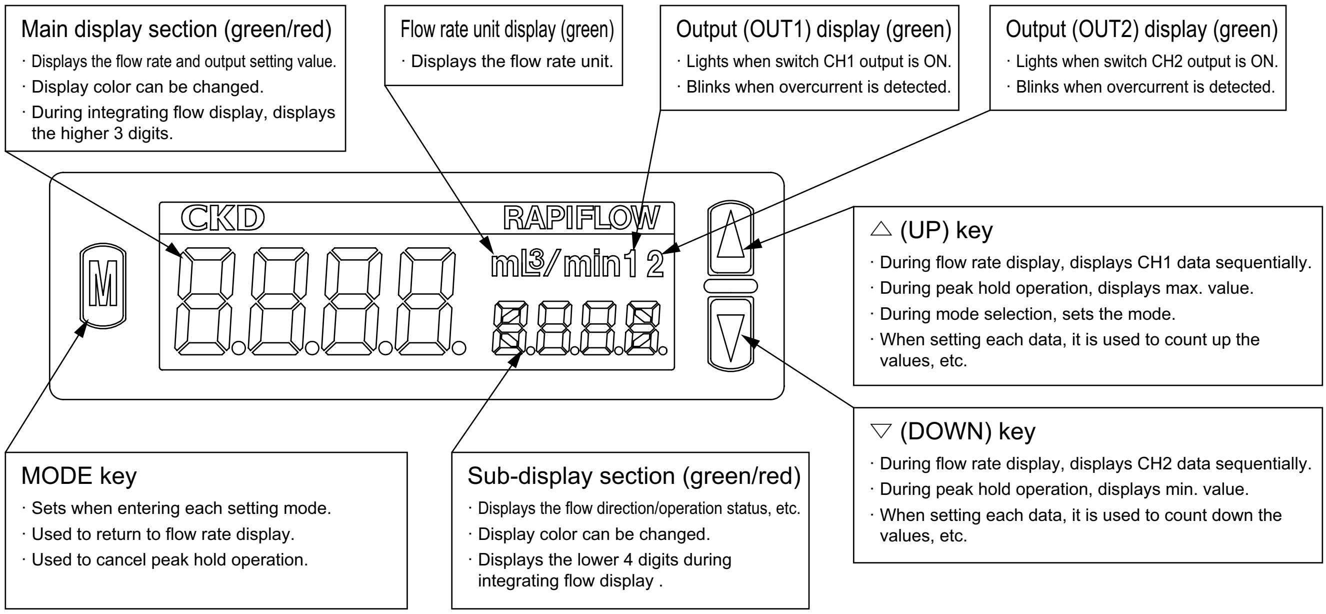
● FSM2- ☐ 500/101/201-S08 (SUS body)



CAUTION: This characteristic value is a typical value and is not a guaranteed value.

Names and functions of display/operation section

● Display integrated



Main display section (green/red)
- Displays the flow rate and output setting value.
- Display color can be changed.
- During integrating flow display, displays the higher 3 digits.

Flow rate unit display (green)
- Displays the flow rate unit.

Output (OUT1) display (green)
- Lights when switch CH1 output is ON.
- Blinks when overcurrent is detected.

Output (OUT2) display (green)
- Lights when switch CH2 output is ON.
- Blinks when overcurrent is detected.

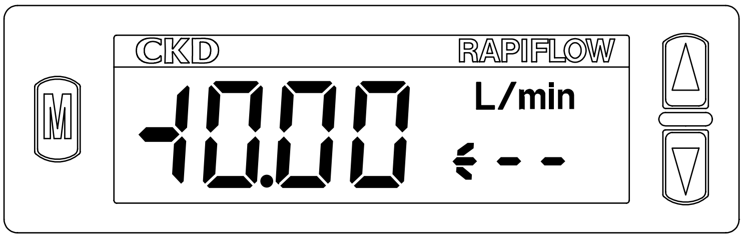
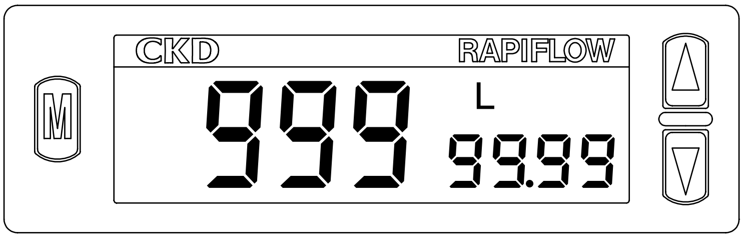
△ (UP) key
- During flow rate display, displays CH1 data sequentially.
- During peak hold operation, displays max. value.
- During mode selection, sets the mode.
- When setting each data, it is used to count up the values, etc.

▽ (DOWN) key
- During flow rate display, displays CH2 data sequentially.
- During peak hold operation, displays min. value.
- When setting each data, it is used to count down the values, etc.

MODE key
- Sets when entering each setting mode.
- Used to return to flow rate display.
- Used to cancel peak hold operation.

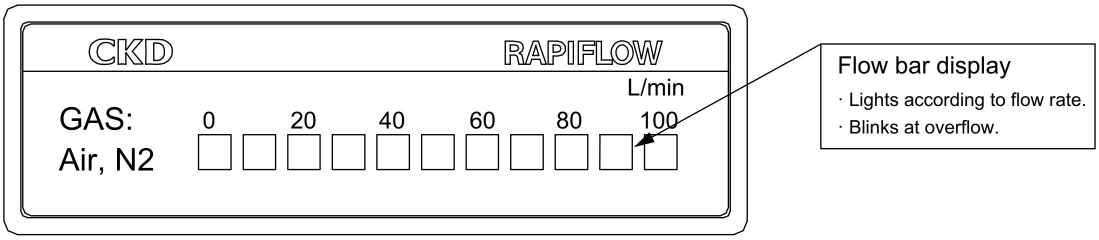
Sub-display section (green/red)
- Displays the flow direction/operation status, etc.
- Display color can be changed.
- Displays the lower 4 digits during integrating flow display .

[Example] In the case of Model FSM2-NVR100- ☐

Display	Liquid crystal display
Instantaneous flow rate display 10 ℓ/min (ANR) In the case of 10L/min (ANR) When an excess flow of 11.0L/min runs in the opposite direction, “Lo” will be displayed. (“Lo” will be displayed at ≤-11.0L/min) When an excess flow of 11.0L/min runs forward, “Hi” will be displayed. (“Hi” will be displayed at ≥+11.0L/min)	 * For bi-directional setting. (Note: In the case of a one-way type, “Lo” will be displayed at ≥1.0L/min in the opposite direction or ≤-1.0L/min)
How to display integrating flow For 99999.99ℓ	 * When the display range of “99999.99” is exceeded, the display returns to “0.00”. (It is reset)

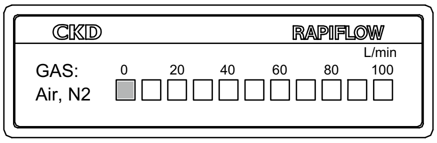
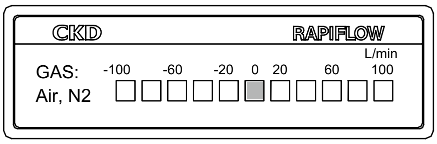
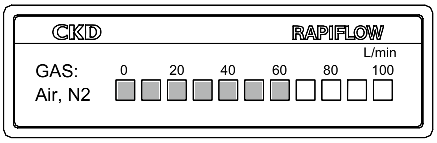
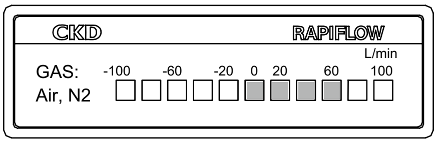
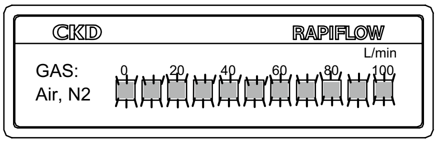
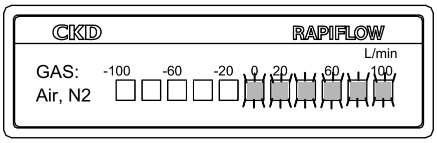
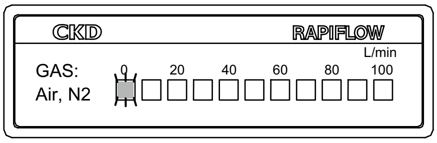
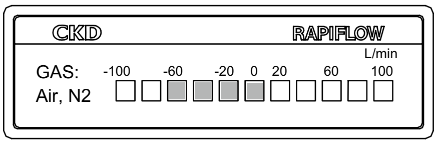
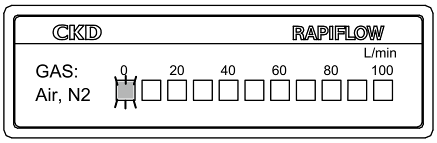
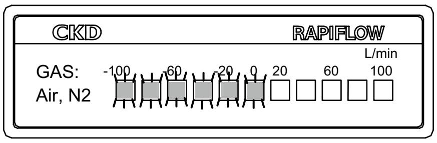
* In the case of a one-way 10L/min type, “Hi” will be displayed at ≥11L/min in the forward direction or ≥+11L/min.
“Lo” will be displayed at ≥1.0L/min in the opposite direction or ≤-1.0L/min.
In the case of a two-way 10L/min type, “Hi” will be displayed if ≥11.0L/min flows in the forward direction or ≥+11.0L/min.
“Lo” if ≥11.0L/min flows in the opposite direction or ≤-11.0L/min.

● Display separated



Flow bar display
· Lights according to flow rate.
· Blinks at overflow.

[Example] Display in the case of FSM2-A ☐ F101- ☐

Flow rate	Uni-direction	Bi-directional
0% F.S.		
+60% F.S. (Forward direction)		
+120% F.S. (Forward direction) Blinks at overflow * Blinks at +10% F.S. and over.		
-60% F.S. (Reverse direction)		
-120% F.S. (Reverse direction) Blinks at overflow * Blinks at -10% F.S. or less		

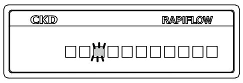
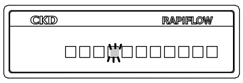
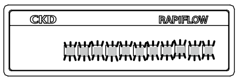
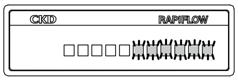
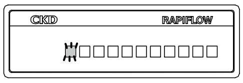
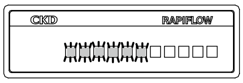
Discontinue

Error code

● Display integrated, needle valve integrated

Error code	Cause	Countermeasures
E 02	It was reset to not-corresponding flow rate when zero adjustment was performed.	Make sure to set the flow rate to zero, and then perform the zero adjustment.
E 03	An error occurred during EEPROM reading or writing.	Turn power ON again. If the error is not resolved, contact your CKD branch or dealer.
E 04	An error occurred during memory reading or writing.	Turn power ON again. If the error is not resolved, contact your CKD branch or dealer.
H i	The flow rate exceeds the flow rate display range.	Reduce the instantaneous flow rate value to within the flow rate range.
	Sensor failure	Turn power ON again. If the error is not resolved, contact your CKD branch or dealer.
Lo	The flow rate is below the flow rate display range.	Increase the instantaneous flow rate value to within the flow rate range.
	Sensor failure	Turn power ON again. If the error is not resolved, contact your CKD branch or dealer.
Blinking of output display (Switch output is not output)	The switch output's over-current protection circuit has functioned.	Check whether load current exceeds the rating. Correctly connect, then turn power ON again.

● Display separated

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

Explanation of functions (display integrated)

The functions and various settings are made during the normal flow rate display and during the setting mode. The setting mode is divided into the standard setting mode and detailed setting mode according to the frequency of use.

● Normal operation

Descriptions	Explanation	Default setting
Instantaneous flow rate display	Displays the instantaneous flow rate.	-
Integrating flow display	The integrating 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. Reset when powered OFF. Can also be reset with button operations or external inputs.	Instantaneous flow rate display
Peak hold function	Max. and min. values for the flow rate within a set interval is displayed.	Peak hold OFF
Key lock function	The key operations can be locked to prevent inadvertent operations.	Key operation possible
Error display function	The error status is displayed when a fault or error occurs.	-

● Standard setting mode

Descriptions	Explanation	Default setting
Switch output function	This product has 2-point switch output, and uses seven operation patterns and a stop operation.	Switch is set to OFF for both CH1 and CH2
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.	-
Zero adjustment	The zero point deviation is compensated. (Range: 0 ±10% F.S.)	Adjust value: 0

● Detailed setting mode

Descriptions	Explanation	Default setting
Select flow direction (only for bi-directional with display)	Setting the flow direction. Setting available for bi-directional, one-sided forward direction or one-sided reverse direction.	Bi-directional setting
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 reset/auto reference).	Switch output
Auto reference function	When CH2 is selected as auto reference, the switch's output threshold can be imported with external inputs or button operations. The threshold can be changed automatically if the switch threshold value changes, such as when the workpiece is changed.	Auto reference function OFF
Response time setting	Set the response time. The response can be set in seven steps from 50 ms to approx. 1.5 s. Chattering and mis-operation caused by sudden flow rate changes or noise are prevented.	Response time: 50 ms
Display speed setting	The digital display refresh cycle can be set in three stages from 250 ms to 1 s. If the display flickers, it may be improved by setting a longer display refresh cycle.	Display speed: 250 ms
Sub-display setting	Set the sub-display section's display method. The display can be changed to flow direction, flow rate unit or gas type display.	Flow direction display
Display color setting	Set the display color. The color for a normal display and for switch output ON can be set.	Both main and sub At normal display: Green At switch ON: Red
Setting hysteresis	Set the switch setting value hysteresis. Use this if the flow rate pulsates or if the switch chatters near the threshold, etc.	Hysteresis: 1% F.S.
Setting flow rate unit	Select the display unit from the standard state or reference state. Standard condition (ANR): Converted into volumetric flow rate at 20°C, 1 barometric pressure Reference state (NOR): Converted into volumetric flow rate at 0°C, 1 barometric pressure (*1)	Flow rate unit: ANR
Setting ECO MODE	An 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.	ECO MODE OFF
Reset setting	Returns the settings to the default settings. With the separated display, if the settings are reset and then the power is turned ON again with the FSM2 display separated (sensor section) connected, the flow rate range will be automatically recognized.	-
Model selection (separated display only)	Select the flow rate range, flow direction and gas type.	Not set (*2)

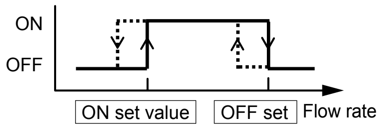
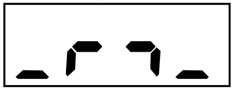
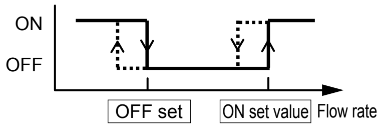
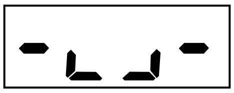
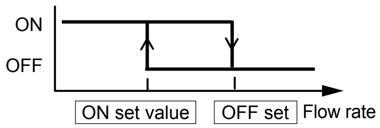
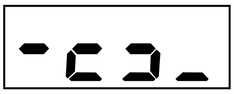
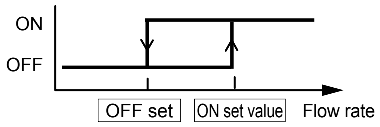
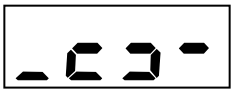
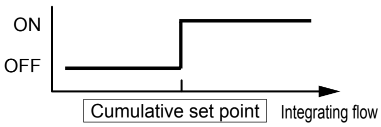
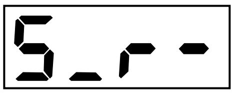
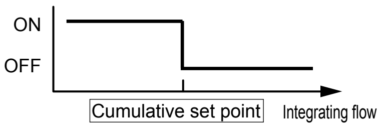
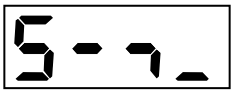
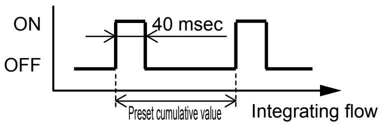
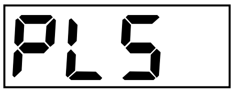
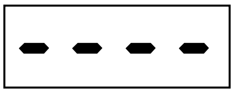
*1:The reference state display is a calculated (reference) value.

*2:The default setting is "Not set". If "Not set" is selected during use, the operation will start from the model selection mode after the power is turned ON. Always set the model before starting use.
The model is automatically recognized in the "Not set" state (default state) only when the FSM2 display separated (sensor) is connected.

Discontinue

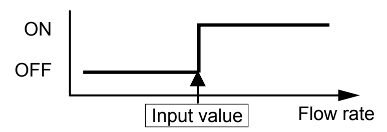
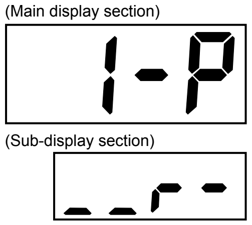
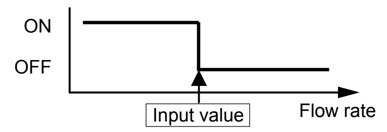
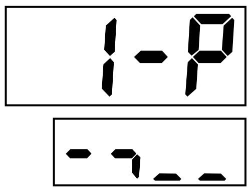
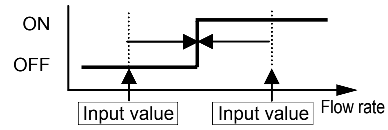
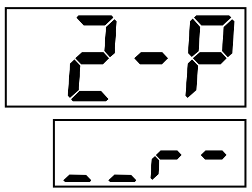
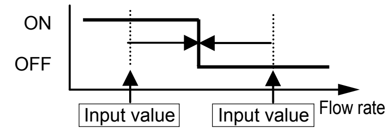
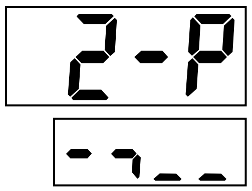
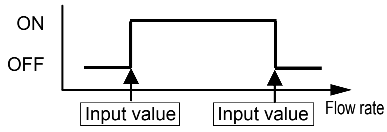
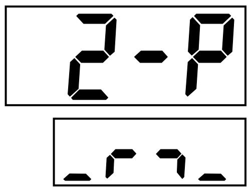
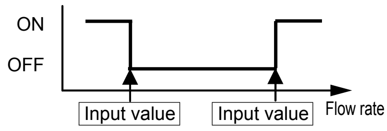
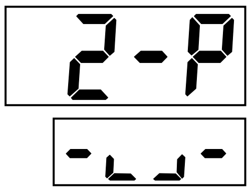
Switch output function

The output function can be selected from seven types of switch operations according to the required application. The functions are compatible with both CH1 and CH2.

Name of operation pattern	Explanation	Operation waveform	LCD display
Window operation (1) (ON when inside range)	The switch turns ON when the level is within the designated flow rate range.	 ON OFF ON set value OFF set Flow rate	(Sub-display section) 
Window operation (2) (ON when outside range)	The switch turns ON when the level is not within the designated flow rate range.	 ON OFF OFF set ON set value Flow rate	
Hysteresis operation (1) (ON at low flow rate side)	The hysteresis is randomly set, and the switch output turns OFF at the designated flow rate and higher.	 ON OFF ON set value OFF set Flow rate	
Hysteresis operation (2) (ON at high flow rate side)	The hysteresis is randomly set, and the switch output turns ON at the designated flow rate and higher. (The output is held even during the “Hi” display.)	 ON OFF OFF set ON set value Flow rate	
Cumulative value output (1) (ON at integrating flow or more)	Switch output turns ON at set cumulative value and higher.	 ON OFF Cumulative set point Integrating flow	
Cumulative value output (2) (OFF at integrating flow and over)	Switch output turns OFF at set cumulative value and higher.	 ON OFF Cumulative set point Integrating flow	
Integrated pulse output	The integrated pulse is output at the preset cumulative value. Refer to the “Integrating function” in the specifications for details on the preset integration value. (Pages 1238, 1239)	 ON OFF 40 msec Preset cumulative value Integrating flow	
Switch operation OFF	The switch operation is turned OFF.	-	

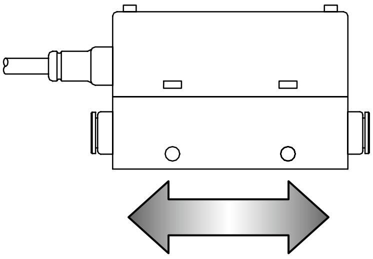
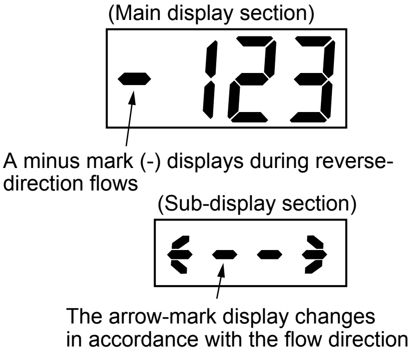
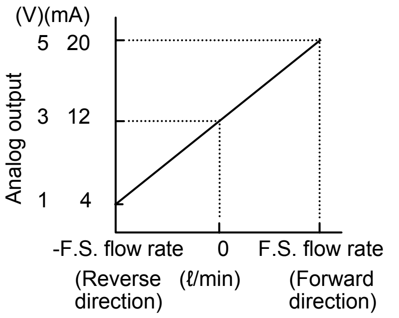
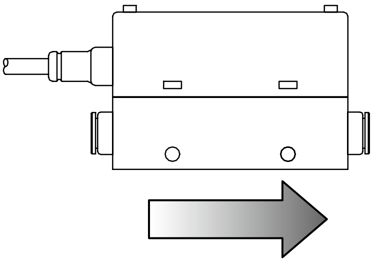
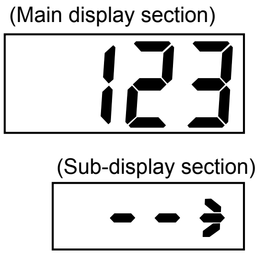
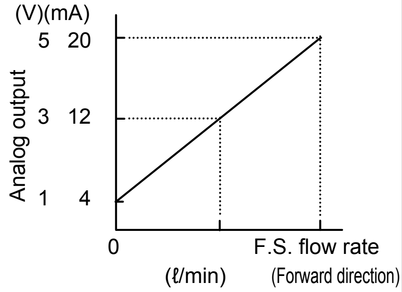
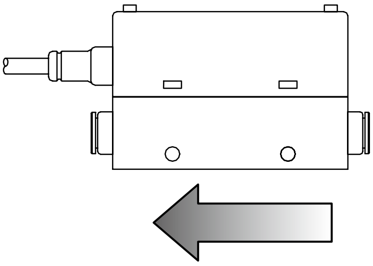
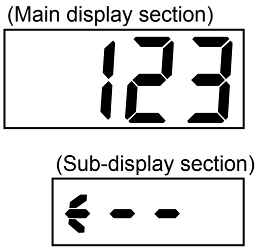
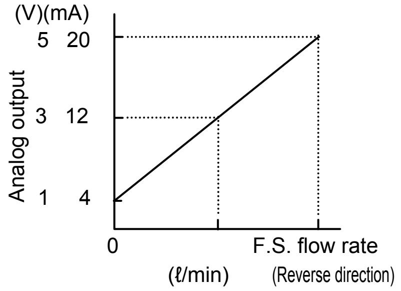
Automatic reference function

When CH2 is selected as auto reference, the switch's output threshold can be imported with external inputs or button operations. The threshold can be changed automatically if the switch threshold value changes, such as when the workpiece is changed. The flow rate value at the point where the external input is turned ON is read for the input value.
The CH2 switch settings are invalid during auto referencing.

Inputs No.	Name of operation pattern	Explanation	Operation waveform	LCD display
1 point	ON at input value or higher	ON when higher than imported value. (Threshold: input value)		
	OFF at input value or higher	OFF when higher than imported value. (Threshold: input value)		
2 points	ON when higher than middle value of two points	ON when higher than middle value of two imported points. (Threshold: (input (1) + input (2))/2)		
	OFF when higher than middle value of two points	OFF when higher than middle value of two imported points. (Threshold: (input (1) + input (2))/2)		
	ON between 2 points	ON when between two imported points. (Threshold (1): input value (1)) (Threshold (2): input value (2))		
	OFF between 2 points	OFF when between two imported points. (Threshold (1): input value (1)) (Threshold (2): input value (2))		

Selecting the flow direction (display integrated, bi-directional only)

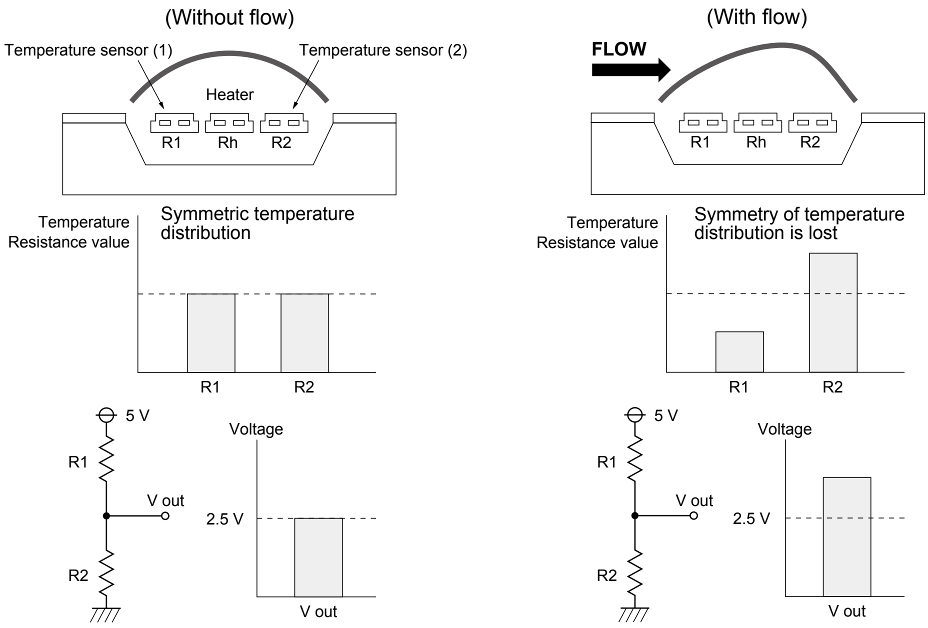
The flow rate for the display integrated, bi-directional can be set with buttons. The value after switching is a reference value.

Flow direction	LCD display	Analog output characteristics
[Bi-directional] 	 (Main display section) -123 (Sub-display section) A minus mark (-) displays during reverse-direction flows The arrow-mark display changes in accordance with the flow direction	
[Uni-direction (forward direction)] 	 (Main display section) 123 (Sub-display section)	
[Uni-direction (reverse direction)] 	 (Main display section) 123 (Sub-display section)	

Discontinue

Measurement principle of FSM2 Series

The FSM2 Series incorporates a platinum sensor chip (3 mm x 3.5 mm) 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.


(Without flow)
Temperature sensor (1)
Temperature sensor (2)
Heater
R1
Rh
R2
Temperature Resistance value
Symmetric temperature distribution
R1
R2
5 V
R1
V out
R2
Voltage
2.5 V
V out
(With flow)
FLOW
R1
Rh
R2
Temperature Resistance value
Symmetry of temperature distribution is lost
R1
R2
5 V
R1
V out
R2
Voltage
2.5 V
V out

Discontinue

MEMO

Discontinue

Safety precautions

Pneumatic components: Warning and Cautions

Be sure to read this section before use.
Refer to Intro Page 63 for precautions for general pneumatic components.

Design/selection

Working fluids

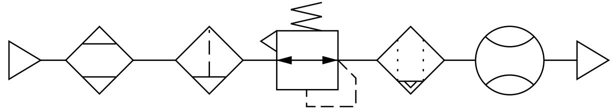
DANGER

- ■ Never use with a flammable fluid.

WARNING

- ■ This product cannot be used as a billing 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 fluids, because accuracy cannot be guaranteed.
- ■ When using compressed air, use clean air that complies with JIS B 8392-1: 2012 Class [1: 1: 1 to 1: 6: 2]. As compressed air from the compressor contains drainage (water, oil oxides, foreign matter, etc.), 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 circuit]



- ■ 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.
- ■ When using with liquefied gases such as carbon dioxide, always vaporize the gas. Failure may result if liquefied gas enters the product.
- ■ 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 a long time could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.

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 / fluid temperatures from 0 to 50°C within the specified range.
  Even if the temperature is within the specified range, do not use this product if the ambient / fluid temperatures could suddenly change and cause dew to condense.
- ■ 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.
- ■ 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., but this is the display when the mass flow rate is converted to volumetric flow rate at 20°C 1 barometric pressure (101 kPa) relative humidity 65%.

Proof pressure

CAUTION

- ■ Proof pressure differs depending on the series. Take note at selection.

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.

Discontinue

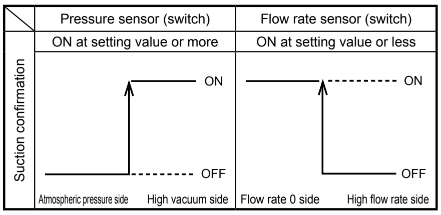
Use for suction confirmation, etc.

⚠CAUTION

- ■ When this product is used to confirm suction, etc., select the flow rate range based on the operating vacuum pressure and suction nozzle. Refer to "Flow rate sensor selection method" on page 1316 for details.
- ■ When this product is used to confirm suction, etc., provide an air filter upstream from suction to prevent the entry of foreign matter.
- ■ When this product is used to confirm suction, etc., 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 to confirm suction, etc., response time may be delayed by the piping volume between the suction nozzle and this product. In this case, take countermeasures to reduce piping capacity.
- ■ 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.

Use for leakage inspections

- ■ The working pressure range of this product is -0.09 to 1.00 MPa. If energized in a vacuum state of -0.09 MPa or less, the sensor's heat dissipation performance will suffer, leading to degradation of the sensor.
- ■ 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 figure 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.



Mounting, installation and adjustment

Piping

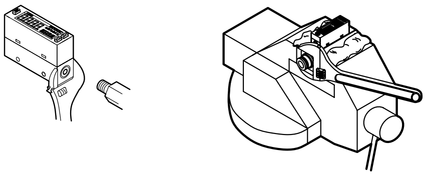
⚠CAUTION

- ■ Always attach the pipes before starting wiring.
- ■ Align the fluid flow direction to the direction indicated on the body when connecting the pipes.
- ■ When installing the sensor on piping, refer to the torque below so that excessive screw-in torque or load torque is not applied to the connection port.

  [Reference value]

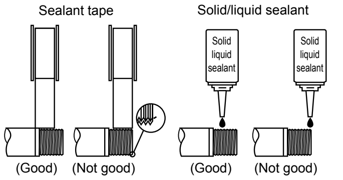
Port thread	Tightening torque N·m
M5	**1.0 to 1.5**
Rc1/8(G1/8)	**3 to 5**
Rc1/4	**6 to 8**
Rc1/2	**16 to 18**

- ■ 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.
- ■ Attach a wrench to metal sections when tightening pipes so that force is not applied to the resin section.



- ■ Check that the 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 being used.

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 a nail 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.



- ■ Be sure to connect a fitting even when using the metal body with the OUT side opened. The port filter could come Off.
- ■ 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 case when inspecting the pipe for leaks.
- ■ Do not install the regulator/solenoid valve, etc., immediately before this product. Generated drift may cause errors. Provide a straight piping section if required.
- ■ Although the mounting is "unrestricted in vertical/ horizontal direction", the flow rate may vary depending on difference in the mounting orientation or piping conditions.

Mounting

⚠CAUTION

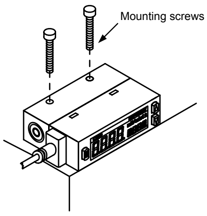
- ■ The display integrated flow rate meter uses a liquid crystal display. This may be difficult to read depending on the angle.
- ■ Do not install multiple product bodies in close contact. The generation of heat on each part could cause the product's temperature to rise, hastening changes in characteristics or deterioration of the resin material. When using the products in a row, set intervals of distance of 10 mm and over.

Discontinue

Mounting, installation and adjustment

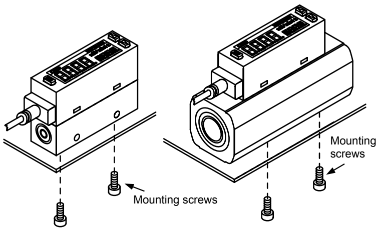
- ■ This product can be installed in any direction; top, bottom, left, or right.

Lateral mounting (use of through hole)

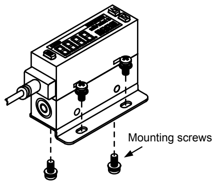


Tighten the set screw with a tightening torque of 0.5 N·m.

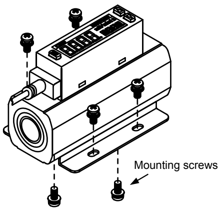
Vertical mounting (use of female thread on bottom surface)



Bracket mounting (use of dedicated bracket)

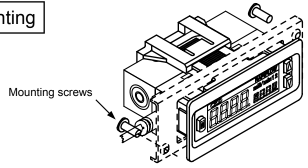


Port size: Push-in fitting φ4, φ6, φ8, φ10
Rc 1/8, Rc 1/4, M5
Single bracket model No.: FSM2-LB1
Tighten the set screw with a tightening torque of 0.5 N·m.



Port size: Rc 1/2
Single bracket model No.: FSM2-LB2

Panel mounting



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.
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.

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.

⚠WARNING

- ■ Check line color when wiring. As incorrect wiring could result in sensor damage and malfunctions, check wire color against the instruction manual before wiring.
- ■ Ensure that wires are properly insulated. 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.
- ■ 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.
- ■ Always attach the connector bar after connecting the connector.
- ■ Check that stress (7 N and over) is not directly applied to cable leadouts or connectors.
- ■ 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.
- ■ 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.
- ■ 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 power supply for the metal body (stainless steel body, aluminum body) is a DC stabilized power supply completely isolated from the AC primary side. Connect either the + side or - side of the power to the F.G. Between the metal body internal power circuit and metal body, a varistor (limit voltage approx. 40 V) is connected to prevent dielectric breakdown of the sensor. Do not conduct a withstand voltage test or insulation resistance test between the internal power circuit and metal body. Disconnect wiring first if this testing is required. An excessive potential difference between power and metal body will burn internal parts. After installing, connecting and wiring the metal body, electrical welding of the equipment/frame or short-circuit accidents, etc., could cause welding current, excessive high voltage caused by welding, or surge voltage, etc., to run through the wiring, ground wire, or fluid path connected between such devices, damaging wires or devices. Conduct any work such as electrical welding after removing this device and disconnecting all electric wires connected to the F.G.
- ■ Connecting load
  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

FSM2-☐V output impedance: Ro = 1 kΩ
Load internal impedance : Rx = 1 MΩ

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

$$= \left(1 - \frac{1\text{K}\Omega}{1\text{ k}\Omega + 1\text{ M}\Omega}\right) \times 100\% \Rightarrow$$

Output value error approx. 0.1%

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.

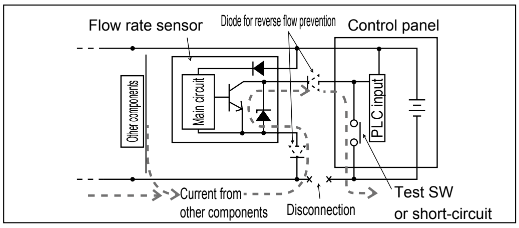
Use/maintenance

WARNING

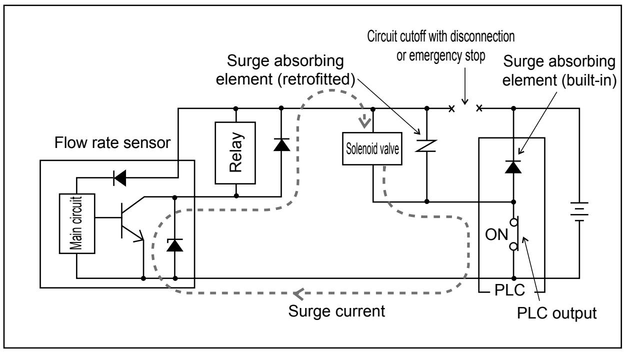
- ■ Output accuracy is affected by temperature characteristics and heat generated when energized. Provide a standby time (5 minutes or more) after turning the power ON for use.
- ■ Immediately after power is turned ON, this product does not start flow rate detection switch operation for approx. 4 seconds to complete self-diagnosis. Provide a control circuit/program that ignores signals for at least four seconds after power is turned ON.

CAUTION

- ■ 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.
- ■ If a problem occurs during operation, immediately turn the power OFF, stop use, and contact your dealer.
- ■ Keep this product's flow rate within the rated flow range.
- ■ Use this product within the working pressure.
- ■ When changing the output set value, turn OFF the equipment first in order to prevent unexpected operation in the control system equipment.
- ■ Do not disassemble or modify, as this may cause malfunction.
- ■ The case is made of resin. Do not use solvent, alcohol or detergent in cleaning, or 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.
- ■ 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 supply as the flow rate sensor, and the switch output wire and power cable negative (-) side are short-circuited to check the operation of the control panel input unit, or if the power cable negative (-) side is disconnected, reverse current could flow to the flow rate sensor's switch output circuit and cause damage.



- ■ Take the following measures to prevent damage 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 source as the flow rate sensor.
  - (3) Insert a diode parallel to the flow rate sensor's output line to prevent reverse current.
  - (4) Insert a diode parallel to the flow rate sensor power wire's negative (-) side to prevent reverse current.
- ■ Pay attention to 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.

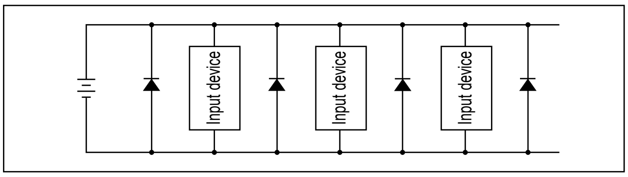

Circuit cutoff with disconnection or emergency stop
Surge absorbing element (retrofitted)
Surge absorbing element (built-in)
Flow rate sensor
Relay
Solenoid valve
Main circuit
ON
PLC
Surge current
PLC output

Take the measures below to prevent damage from sneak surge 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 places on the power wiring shown in the figure below, as a measure against disconnections in unspecified 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 power OFF before connecting or disconnecting the connector.

- ■ Analog output continues even if the flow rate range is exceeded. With the display integrated, "Hi" or "Lo" will be displayed. With the display separated, the bar display will flicker.
  Note that this is outside guaranteed precision.
- ■ When using the integrated display model, do not press down on the display section. This may lead to failure.
- ■ 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 fluctuate. Periodically inspect the sensor chip.
- ■ Working conditions for CE compliance
  This product is CE-marked, indicating conformity with the EMC Directives. The standard for the immunity for industrial environments applied to this product is EN61000-6-2; the following requirements must be satisfied in order to conform to this standard:
  Conditions
  - ● The assessment of this product is performed by using a cable pairing a power supply line and a signal line, assessing this cable as a signal line.
  - ● This product is not equipped with surge immunity. Implement surge protection measures on the system side.

Product-specific cautions: Needle valve integrated FSM2-☐N Series

Design/selection

⚠ 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.

Mounting, installation and adjustment

⚠ CAUTION

- ■ Do not turn the dial 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 vary if turning the dial of the needle valve forcibly when fully closing. Take care not to turn the dial forcibly when setting a very small flow rate.

Use/maintenance

⚠ CAUTION

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

Product-specific cautions: Separated display FSM2-D Series

Design/selection

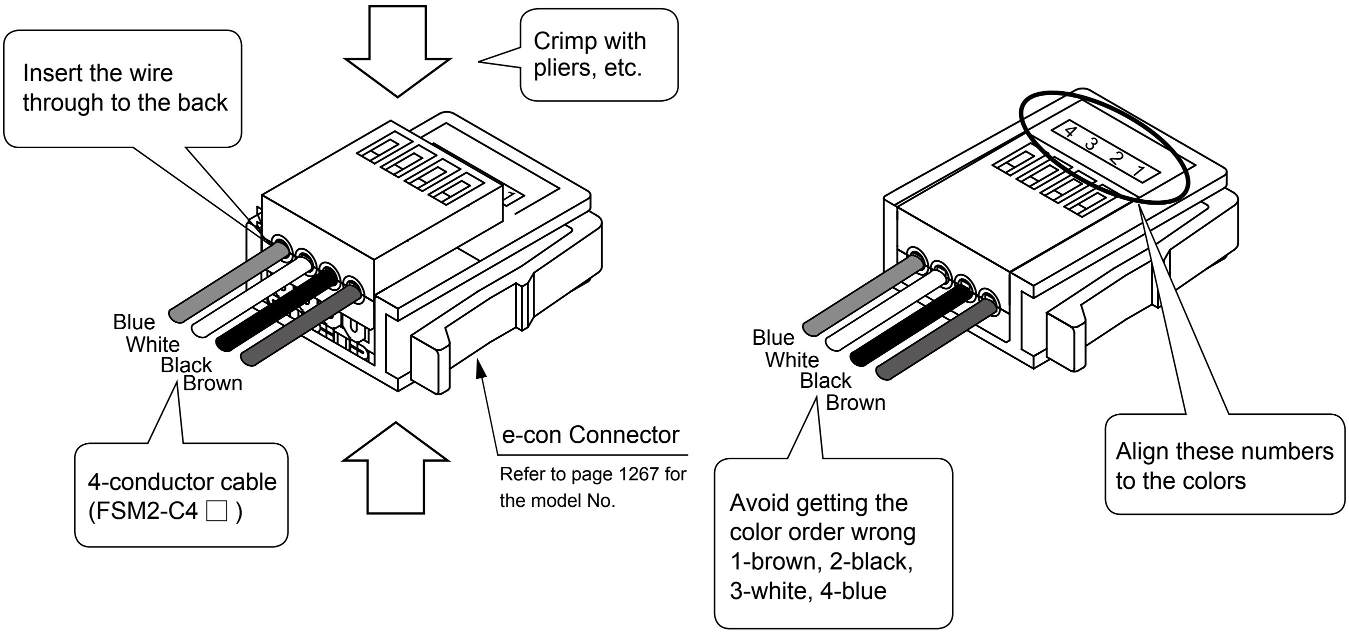
⚠ CAUTION

■ 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. Use the FSM2-AV ☐ when using the FSM2.

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 display damage, faults or malfunction.


Insert the wire through to the back
Crimp with pliers, etc.
Blue
White
Black
Brown
4-conductor cable (FSM2-C4 ☐)
e-con Connector
Refer to page 1267 for the model No.
4 3 2 1
Blue
White
Black
Brown
Avoid getting the color order wrong 1-brown, 2-black, 3-white, 4-blue
Align these numbers to the colors

* The e-con connector is enclosed 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, short-circuit, etc., could damage the sensor or separated display, or cause malfunctions.

■ Do not apply a load of 15 N or over on the cable.