CKD

New Products

Compact Flow Rate Sensor RAPIFLOW® FSM3 Series Environment-resistant specifications

CKD Corporation

CC-1537A 1

Dust/Water-resistant structure

Can be used in environments where it is exposed to dust or water

Has a degree of protection of IP65 or equivalent. Provides reliability in environments with dust, maintenance, and cleaning, during which it may be exposed to water splashing.

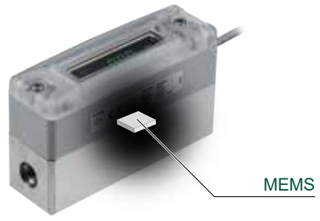
ATEX compliant (option)

Refer to "ATEX Compatibility" on page 26 for specifications.

With the LCD display, button operation is possible by opening the cover.

* Protective structure is not applicable when the cover is open.

High performance



MEMS stands for Micro Electro Mechanical Systems and refers to ultra-compact devices based on microfabrication technology used in the manufacture of semiconductor integrated circuits.

High precision/high-speed response

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

Clean-room specifications

Anti-dust generation packaging (P70) and oil-prohibited specifications (P80) are included in the product lineup as standard.
Usage according to the grade of the device is possible.

Bi-directional fluid measurement

Contributes to reducing tact time. The flow direction can be measured as desired.

Outgassing supported

Resin is not used in the flow path. Ideal for processes susceptible to outgassing.

Variety

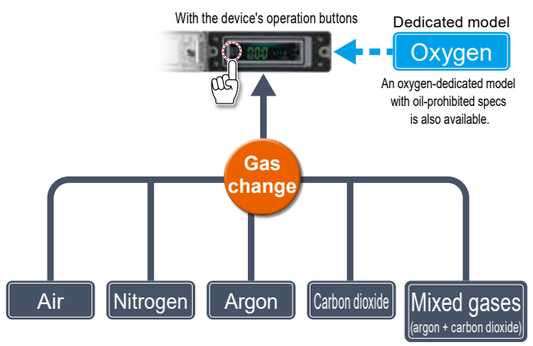
Five types of gases can be measured with just one unit

Gas switching function

(LCD display) (Model with full scale flow rate of 200L/min or below:)

Air, nitrogen, argon, carbon dioxide, gas mixture (mixture ratio Ar:CO_2(8:2)) is supported with this single flow rate sensor. Gases can be switched with operation buttons.

* If you have a request for mixing ratios, please contact our sales representative.



Solution examples

Painting air flow rate control

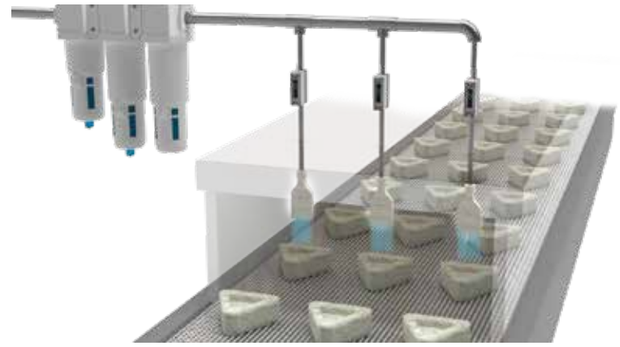
Change the air pressure and controls flow rate used during coating with the electro-pneumatic regulator.

Arc welding

Manages argon, gas mixtures (argon + carbon dioxide), and other shielding gases.

Cooling cooked rice

After cooking, rice is cooled over a short period using safe compressed air that has been filtrated with a bacteria removing filter to prevent bacteria growth.



Series variation

Appearance	Applicable fluid	Port size	Max. flow rate (L/min)	Page
 FSM3 Series	①Air Nitrogen Carbon dioxide Argon Mixed gases (Argon + Carbon dioxide) ②Oxygen	Rc1/8 Rc1/4 Rc1/2 G1/8 G1/4 G1/2 NPT1/8 NPT1/4 NPT1/2	0.5 1 2 5 10 20 50 100 200 500 1000	• LDC display Page 1 • Bar display Page 5

*Applicable fluids are air and nitrogen only.

Compatible with clean-room specifications P70 and P80 Series.

Compact flow rate sensor (RAPIFLOW) Environment-resistant specifications

FSM3 Series

LCD display

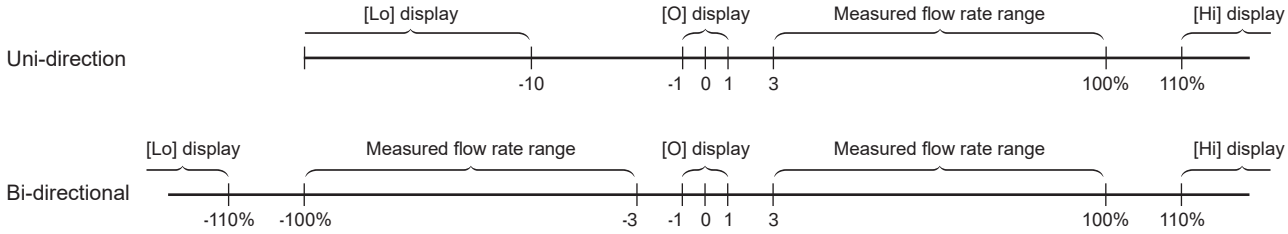
●Stainless steel body (flow rate range: 500mL/min to 1000L/min)

LCD display specifications

Item			FSM3-L[B][C][D][E][F][G][H][I]-[ ]										
			[B]										
			005	010	020	050	100	200	500	101	201	501	102
Flow direction	[C]	U	Uni-direction										
		B	Bi-direction										
Measured flow rate range (□/min) *1	[B]	U	15 to 500mL	30 to 1000mL	0.06 to 2.00L	0.15 to 5.00L	0.30 to 10.00L	0.6 to 20.0L	1.5 to 50.0L	3.0 to 100.0L	6 to 200L	15 to 500L	30 to 1000L
		B	-500 to -15, 15 to 500mL	-1000 to -30, 30 to 1000mL	-2.00 to -0.06, 0.06 to 2.00L	-5.00 to -0.15, 0.15 to 5.00L	-10.00 to -0.30, 0.30 to 10.00L	-20.0 to -0.6, 0.6 to 20.0L	-50.0 to -1.5, 1.5 to 50.0L	-100.0 to -3.0, 3.0 to 100.0L	-200 to -6, 6 to 200L	-500 to -15, 15 to 500L	-1000 to -30, 30 to 1000L
Display			4 digit + +4 digit 2 color LCD										
Flow rate display range (□/min) *2	[B]	U	-49 to 549mL	-99 to 1099mL	-0.19 to 2.19L	-0.49 to 5.49L	-0.99 to 10.99L	-1.9 to 21.9L	-4.9 to 54.9L	-9.9 to 109.9L	-19 to 219L	-49 to 549L	-99 to 1099L
		B	-549 to 549mL	-1099 to 1099mL	-2.19 to 2.19L	-5.49 to 5.49L	-10.99 to 10.99L	-21.9 to 21.9L	-54.9 to 54.9L	-109.9 to 109.9L	-219 to 219L	-549 to 549L	-1099 to 1099L
Integration display (*3)		Display range	0 to ±9999999mL		0.00 to ±99999.99L			0.0 to ±999999.9L			0 to ±9999999L		
		Pulse output rate	5mL	10mL	0.02L	0.05L	0.1L	0.2L	0.5L	1L	2L	5L	10L
Working conditions		Applicable fluids *4	Clean air (JIS B 8392-1:2012 1.1.1 to 5.6.2), compressed air (JIS B 8392-1:2012 1.1.1 to 1.6.2), nitrogen gas										
			Argon, carbon dioxide, and gas mixture (argon + carbon dioxide)										-
			Oxygen (When oxygen specification is selected,Ⓜ Clean-room specifications cannot be selected. Specifications automatically become oil-prohibited specifications.)										-
		Temperature range	0 to 50°C (no condensation)										
		Pressure range	-0.09 to 1.00 MPa										-0.09 to 0.75 MPa
		Proof pressure	1.5 MPa										
Operating ambient temperature/humidity			0 to 50 °C, 90% RH or less										
Storage temperature			-10 to 60°C										
Accuracy *5 (Fluid: in dry air)		Accuracy *6	Within ±3% F.S. (Secondary side released to atmosphere) (The scope of warranty is in accordance with the "measured flow rate range.")										
		Repeatability *7	Within ±1% F.S. (Secondary side released to atmosphere)										
		Temperature characteristics	Within ±0.2% F.S./°C (15 to 35°C, base temperature 25°C)										
		Pressure characteristics	Within ±5%F.S. (secondary side released to atmosphere reference)								Within ±5% F.S (0.35MPa reference)		
Response time *8			50 msec or less (setting response time OFF)										
Switch output	[G]	A, B, E, F	NPN open collector output (50 mA or less, voltage drop 2.4 V or less)										
		C, D, G, H	PNP open collector output (50 mA or less, voltage drop 2.4 V or less)										
Analog output *9		A, B, C, D	1 to 5 V voltage output (connecting load impedance 50 kΩ or more)										
		E, F, G, H	4 to 20 mA current output (connecting load impedance 0 to 300 Ω)										
Power supply voltage *10		A, B, C, D	12 to 24 VDC (10.8 to 26.4 V) ripple rate 1% or less										
		E, F, G, H	24 VDC (21.6 to 26.4 V) ripple rate 1% or less										
Current consumption *11			45 mA or less										
Lead wire			ø3.7 AWG26 equivalent x5-conductor, insulator outer diameter ø1.0										
Functions *12			①Gas switching, ②Copy function setting, ③Flow rate integration,④Peak hold, etc.										
Degree of protection *13			IP 65 or equiv.										
Protection circuit *14			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										
Mounting		Mounting orientation *15	Unrestricted in vertical/horizontal direction										
		Straight piping section *16	Not required										
Weight			Refer to page 16										

*1:The value converted to volumetric flow rate at standard condition (20°C 1 barometric pressure (101 kPa) 65% RH).
(For gases other than air: 20°C, 1 barometric pressure (101 kPa), relative humidity 0%Rh)

*2: Display at each flow rate is as follows.



*3:The accumulated flow is a calculated (reference) value. When using the integrated save function, take care to prevent the number of saves from exceeding the access count limit of the storage device (1 million times).(Changes to the settings are counted in number of accesses.)

$$\text{Number of saves} = \frac{\text{Usage time}}{\text{5 mins}} < \text{1 million times}$$

When instantaneous flow rate is below 1% it is not counted as integrating flow.

*4:Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist. When using compressed air, use clean air that complies with JIS B 8392-1:2012 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains 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 concentration 0.1 mg/m3) on the primary side (upstream side) of this product. (Refer to page 21 for details on recommended circuit.) The sensor for oxygen gas is a custom model. To prevent ignition accidents, do not allow oxygen to flow again when it has been used on fluids other than oxygen to flow even once.

*5: Compressed air is used for adjusting and inspecting this product. Accuracy for gas types other than air is only a guideline.

*6: Accuracy is based on a CKD standard flow rate meter. It does not indicate absolute accuracy. Repeatability, temperature characteristics, and pressure characteristics are not included for an accuracy of ±3% F.S. Consider separately according to the working environment and working conditions.

*7: Repeatability is calculated during a short period of time. Change over time is not included. (Refer to the product specifications sheet for details.)

*8: The actual response time changes depending on the piping conditions. As a guideline, the response time can be set within the range of 50 msec to 1.5 sec.

*9: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.

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

*11: Current for when 24 VDC is connected, and no load is applied. Please note that the current consumption changes depending on the load connection status.

*12:The gas type switching function enables switching to argon, carbon dioxide and a gas mixture of argon 80% + carbon dioxide 20%. Full scale flow rate and analog output after changing gas is as follows. (Note that the gas change function cannot be set with the oxygen, 500 L/min, and 1000 L/min models.)

Gas	Flow direction	Full scale flow rate	Analog output	
			Voltage	Current
・Air ・Nitrogen ・Argon ・Argon 80% +Carbon dioxide 20%	Uni-direction	0 to 100%	1 to 5 V	4 to 20mA
	Bi-direction	-100 to 100%		
・Carbon dioxide (Type A setting)	Uni-direction	0 to 50%	1 to 3 V	4 to 12mA
	Bi-direction	-50 to 50%	2 to 4 V	8 to 16mA
・Carbon dioxide (Type B setting)	Uni-direction	0 to 50%	1 to 5 V	4 to 20mA
	Bi-direction	-50 to 50%		

The enable/disable of the "Copy function setting" can be selected at "Ⓖ Output specifications".
Note that the “External input” function is not available on models on which the “Copy function setting” is enabled.

*13: Be sure to read the precautions in "Working environment" on page 21 and "ATEX compatible" on page 26.

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

*15: This product measures changes in heat distribution that are caused by flow. If installed vertically, the heat distribution may change due to the effect of convection, and the zero point may be shifted.

*16: Accuracy may be affected by the piping conditions. For more accurate measurements, use a straight pipe with a ten-times greater internal diameter. With the 500 L/min and 1000 L/min models, use piping with an internal diameter of 9 mm or more. If it is less than 9 mm, accuracy may be negatively affected.

How to order

FSM3 - L 005 U 4 AA 1 A 1 N - B J R - P80 - EX

Model No. FSM3

Ⓐ Display L

Ⓑ Flow rate range (Full scale flow rate) 005

Ⓒ Flow direction U

Ⓓ Body material/applicable fluids 4

Ⓔ Port size AA

Ⓕ Piping direction 1

Ⓖ Output specifications A

Ⓗ Unit specifications 1

Ⓘ Valve Option N

Ⓙ Lead wire B

Ⓚ Mounting attachment J

Ⓛ Included documents R

Ⓜ Clean Specifications P80

Option (ATEX Compliant) EX

Code	Description
Ⓐ Display	
L	Liquid crystal display

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

Ⓒ Flow direction	
U	Uni-direction
B	Bi-direction

Ⓓ Body material/applicable fluids		
	Body material	Applicable fluid
4	SUS (Environment-resistant specs)	Air (gas switchable)
5	SUS (Environment-resistant specs)	Oxygen (oil-prohibited specs)*2

Ⓔ Port size	
AA	Rc1/8
BA	Rc1/4
CA	Rc1/2
AF	G1/8 *3
BF	G1/4 *3
CF	G1/2 *3
AC	NPT1/8
BC	NPT1/4
CC	NPT1/2

Ⓕ Piping direction	
1	Straight

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

Ⓗ Unit specifications	
1	SI units only
2	With unit change function (only for overseas)*4

Ⓘ Valve option	
N	None

Ⓙ Lead wire	
A	5 conductor 1 m
B	5 conductor 3 m

Ⓚ Mounting attachment *5	
Blank	None
J	Bracket 2

Ⓛ Included documents	
Blank	None
R	inspection certificate
S	Company certification + Traceability certification

Ⓜ Clean-room specifications *8		
Blank	None	
P70	Anti-dust generation	*6
P80	Oil-prohibited	*7

# Option (ATEX Compliant)		
Blank	None	
EX	ATEX Compliant	*9

[Example of model No.]

FSM3-L005U4AA1A1N-BJR-P80-EX

Model: RAPIFLOW FSM3 Series

ⒶDisplay	L	: Liquid crystal display
ⒷFlow rate range	005	: 500mL/min
ⒸFlow direction	U	: Uni-direction
ⒹBody material/applicable fluids	4	: SUS (environment-resistant specs)/air
ⒺPort size	AA	: Rc1/8
ⒻPiping direction	1	: Straight
ⒼOutput specifications	A	: Analog voltage output X1, NPN switch output X1, With Copy function setting
ⒽUnit specifications	1	: SI units only
ⒾValve option	N	: None
ⒿLead wire	B	: 5 conductor 3 m
ⓀMounting attachment	J	: Bracket 2
ⓁIncluded documents	R	: inspection certificate
ⓂClean-room specifications	P80	: Oil-prohibited
#Option (ATEX Compliant)	EX	: ATEX Compliant

Precautions for model No. selection

*1: During selection, always check the compatibility table on the next page.
*2: 500L/min and 1000L/min cannot be selected with "3: Oxygen".
*3: The G thread connection shape is ISO16030-compliant.
*4: The model with unit change cannot be sold in Japan.
*5: Optional parts will come with the product. They are not pre-assembled.
*6: The product surface is degreased and cleaned before packaging, and heat-sealed into an antistatic bag on a clean bench (Class 1000 or more).
*7: P70 specifications and gas-contact sections are degreased and cleaned.
*8: This cannot be selected on an oxygen type (only "None" is available).
*9: Refer to "ATEX compatible" on page 26 for specifications.

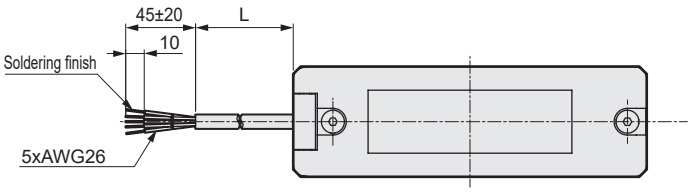
Flow rate range and port size

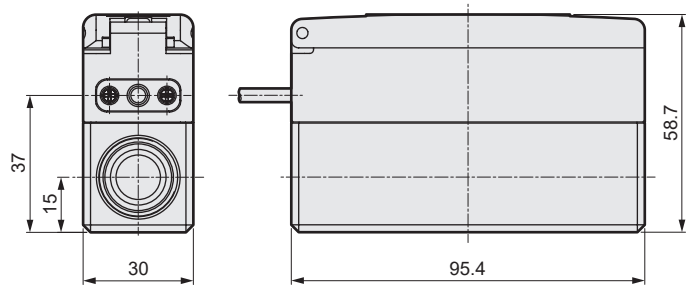
B Flow rate range	E Port size								
	AA	BA	CA	AF	BF	CF	AC	BC	CC
	Rc1/8	Rc1/4	Rc1/2	G1/8	G1/4	G1/2	NPT1/8	NPT1/4	NPT1/2
005	●			●			●		
010	●			●			●		
020	●			●			●		
050	●			●			●		
100	●			●			●		
200	●			●			●		
500		●			●			●	
101		●			●			●	
201		●			●			●	
501			●			●			●
102			●			●			●

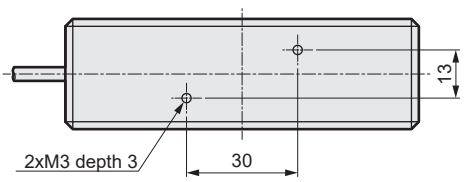
Dimensions

[Lead wire length]

Lead wire code	L dimensions
A	1000±20
B	3000±20



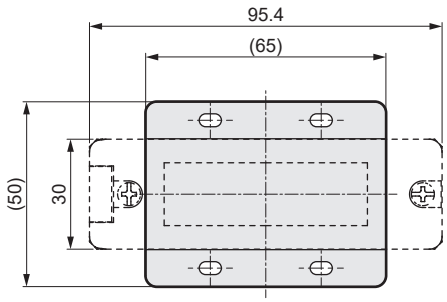


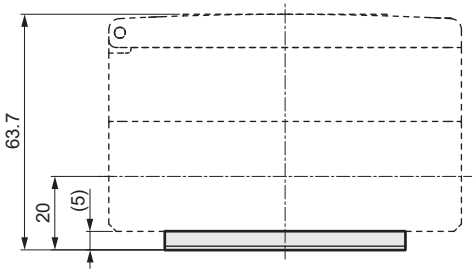


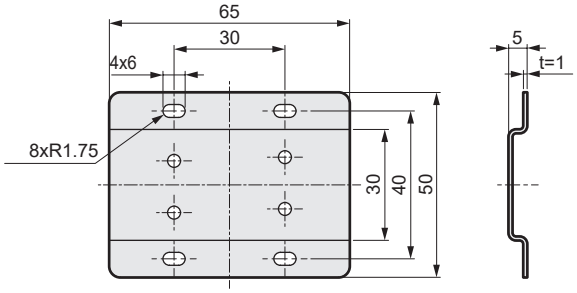
Optional dimensions

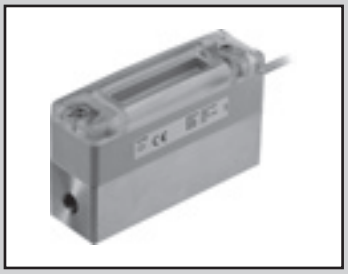
●FSM3-J

Bracket 2









Compact flow rate sensor (RAPIFLOW) Environment-resistant specifications

FSM3 Series

Bar display

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

Bar display specifications

Item			FSM3-B[B][C][D][E][F][G][H][I]-[ ]										
			[B]										
			005	010	020	050	100	200	500	101	201	501	102
Flow direction	[C]	U	Uni-direction										
		B	Bi-direction										
Measured flow rate range (□/min) *1	[B]	U	15 to 500mL	30 to 1000mL	0.06 to 2.00L	0.15 to 5.00L	0.30 to 10.00L	0.6 to 20.0L	1.5 to 50.0L	3.0 to 100.0L	6 to 200L	15 to 500L	30 to 1000L
		B	-500 to -15, 15 to 500mL	-1000 to -30, 30 to 1000mL	-2.00 to -0.06, 0.06 to 2.00L	-5.00 to -0.15, 0.15 to 5.00L	-10.00 to -0.30, 0.30 to 10.00L	-20.0 to -0.6, 0.6 to 20.0L	-50.0 to -1.5, 1.5 to 50.0L	-100.0 to -3.0, 3.0 to 100.0L	-200 to -6, 6 to 200L	-500 to -15, 15 to 500L	-1000 to -30, 30 to 1000L
Display			LED bar display										
Working conditions		Applicable fluids *2	Clean air (JIS B 8392-1:2012 1.1.1 to 5.6.2), compressed air (JIS B 8392-1:2012 1.1.1 to 1.6.2), nitrogen gas										
			Oxygen (When oxygen specification is selected,Ⓜ Clean-room specifications cannot be selected. Specifications automatically become oil-prohibited specifications.)									-	
		Temp range	0 to 50°C (no condensation)										
		Pressure range	-0.09 to 1.00 MPa									-0.09 to 0.75 MPa	
		Proof pressure	1.5 MPa										
Operating ambient temperature/humidity			0 to 50°C, 90% RH or less										
Storage temperature			-10 to 60°C										
Accuracy		Accuracy *3	Within ±3% F.S. (Secondary side released to atmosphere) (The scope of warranty is in accordance with the “measured flow rate range.”)										
		Repeatability *4	Within ±1% F.S. (Secondary side released to atmosphere)										
		Temp characteristics	Within ±0.2% F.S./°C (15 to 35°C, base temperature 25°C)										
		Pressure characteristics	Within ±5%F.S. (secondary side released to atmosphere reference)								Within ±5% F.S (0.35MPa reference)		
Response time *5			50 msec or less										
Analog output *6	[G]	J	1 to 5 V voltage output (connecting load impedance 50 kΩ or more)										
		K	4 to 20 mA current output (connecting load impedance 0 to 300 Ω)										
Power supply voltage *7		J	12 to 24 VDC (10.8 to 26.4 V) ripple rate 1% or less										
		K	24 VDC (21.6 to 26.4 V) ripple rate 1% or less										
Current consumption *8			45 mA or less										
Lead wire			ø3.7 AWG26 equivalent x4-conductor, insulator outer diameter ø1.0										
Degree of protection *9			IP 65 or equiv.										
Protection circuit *10			Power reverse connection protection										
EMC Directive			EN55011, EN61000-6-2, EN61000-4-2										
Mounting		Mounting orientation *11	Unrestricted in vertical/horizontal direction										
		Straight piping section *12	Not required										
Weight			Refer to page 16										

*1: The value converted to volumetric flow rate at standard condition (20°C 1 barometric pressure (101 kPa) 65% RH)
(For gases other than air, 20°C, 1 barometric pressure (101 kPa), relative humidity 0%RH.

*2: Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist. When using compressed air, use clean air that complies with JIS B 8392-1:2012 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains 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 concentration 0.1 mg/m3) on the primary side (upstream side) of this product. (Refer to the recommended circuit on page 21.) The sensor for oxygen gas is a custom model. To prevent ignition accidents, do not allow oxygen to flow again when it has been used on fluids other than oxygen to flow even once.

*3: Accuracy is based on CKD's standard flow rate meter. It does not show absolute accuracy. Repeatability, temperature characteristics, and pressure characteristics are not included for an accuracy of ±3% F.S. Consider separately according to the working environment and working conditions.

*4: Repeatability is calculated during a short period of time. Change over time is not included. (Refer to the product specifications for details.)

*5: The actual response time changes depending on the piping conditions.

*6: The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output and error increase. Check error with the impedance of the connecting load before using.

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

*8: Current for when 24 VDC is connected, and no load is applied. Please note that the current consumption changes depending on the load connection status.

*9: Be sure to read the precautions in "Working environment" on page 21 and "ATEX compatible" on page 26.

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

*11: This product measures changes in heat distribution that are caused by flow. If installed vertically, the heat distribution may change due to the effect of convection, and the zero point may be shifted.

*12: Piping conditions may affect accuracy. For more accurate measurements, use a straight pipe with a ten-times greater internal diameter. With the 500 L/min and 1000 L/min models, use piping with an internal diameter of 9 mm or more. If it is less than 9 mm, accuracy may be negatively affected.

How to order

FSM3 - B 005 U 4 AA 1 J 1 N - D J S - P70 - EX

Model No. FSM3

Ⓐ Display

Ⓑ Flow rate range (Full scale flow rate)

Ⓒ Flow direction

Ⓓ Body material/applicable fluids

Ⓔ Port size

Ⓕ Piping direction

Ⓖ Output specifications

Ⓗ Unit specifications

Ⓘ Valve Option

Ⓙ Lead wire

Ⓚ Mounting attachment

Ⓛ Included documents

Ⓜ Clean Specifications

Ⓝ Option (ATEX Compliant)

Code	Description
Ⓐ Display	
B	Bar display

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

Ⓒ Flow direction	
U	Uni-direction
B	Bi-direction

Ⓓ Body material/applicable fluids		
	Body material	Applicable fluid
4	SUS (Environment-resistant specs)	Air
5	SUS (Environment-resistant specs)	Oxygen (oil-prohibited specs) *3

Ⓔ Port size	
AA	Rc1/8
BA	Rc1/4
CA	Rc1/2
AF	G1/8 *4
BF	G1/4 *4
CF	G1/2 *4
AC	NPT1/8
BC	NPT1/4
CC	NPT1/2

Ⓕ Piping direction	
1	Straight

Ⓖ Output specifications *2	
J	Analog voltage outputx 1 point
K	Analog current outputx 1 point

Ⓗ Unit specifications	
1	SI units only

Ⓘ Valve option	
N	None

Ⓙ Lead wire	
C	4 conductor 1 m
D	4 conductor 3 m

Ⓚ Mounting attachment *5	
Blank	None
J	Bracket 2

Ⓛ Included documents	
Blank	None
R	inspection certificate
S	Company certification + traceability certificate

Ⓜ Clean-room specifications *8		
Blank	None	
P70	Anti-dust generation	*6
P80	Oil-prohibited	*7

Ⓝ Option (ATEX Compliant)		
Blank	None	
EX	ATEX Compliant	*9

[Example of model No.]

FSM3-B005U4AA1J1N-DJS-P70-EX

Model: RAPIFLOW FSM3 Series

ⒶDisplay	B	: Bar display
ⒷFlow rate range	005	: 500mL/min
ⒸFlow direction	U	: Uni-direction
ⒹBody material/applicable fluids	4	: SUS (environment-resistant specifications)/air
ⒺPort size	AA	: Rc1/8
ⒻPiping direction	1	: Straight
ⒼOutput specifications	J	: Analog voltage output X1
ⒽUnit specifications	1	: SI units only
ⒾValve option	N	: None
ⒿLead wire	D	: 4 conductor 3 m
ⓀMounting attachment	J	: Bracket 2
ⓁIncluded documents	S	: Company certification + traceability certificate
ⓂClean-room specifications	P70	: Anti-dust generation
ⓃOption (ATEX Compliant)	EX	: ATEX Compliant

Precautions for model No. selection

*1: Refer to the correspondence table on the following page when selecting the model.
*2: When using in combination with a separated display (FSM2-D), select “J”.
*3: 500L/min and 1000L/min cannot be selected with "3: Oxygen".
*4: The G thread connection shape is ISO16030-compliant.
*5: Optional parts are provided with the product. They are not pre-assembled.
*6: The product surface is degreased before packaging and heat sealed into an antistatic bag on the clean bench (Class 1000 and over).
*7: P70 specifications and gas-contact sections are degreased and cleaned.
*8: This cannot be selected on an oxygen type (blank only).
*9: Refer to "ATEX compatible" on page 26 for specifications.

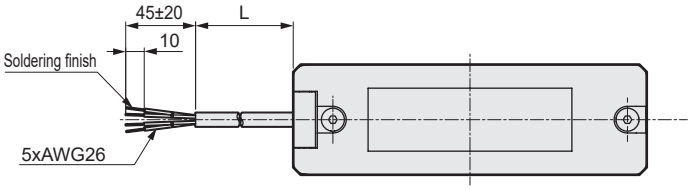
Flow rate range and port size

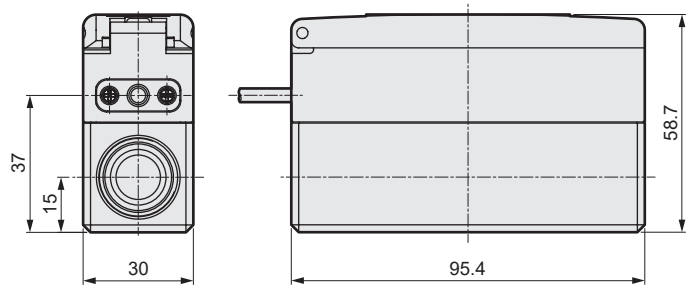
Ⓑ Flow rate range	Ⓔ Port size								
	AA	BA	CA	AF	BF	CF	AC	BC	CC
	Rc1/8	Rc1/4	Rc1/2	G1/8	G1/4	G1/2	NPT1/8	NPT1/4	NPT1/2
005	●			●			●		
010	●			●			●		
020	●			●			●		
050	●			●			●		
100	●			●			●		
200	●			●			●		
500		●			●			●	
101		●			●			●	
201		●			●			●	
501			●			●			●
102			●			●			●

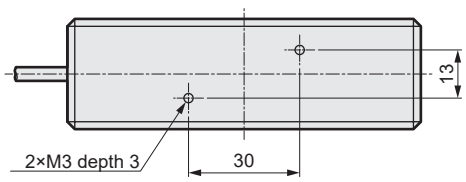
Dimensions

[Lead wire length]

Lead wire code	L dimensions
C	1000±20
D	3000±20



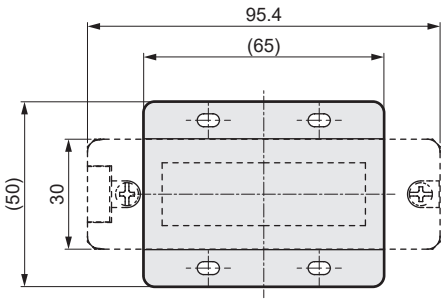


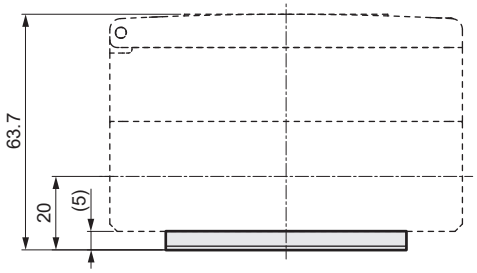


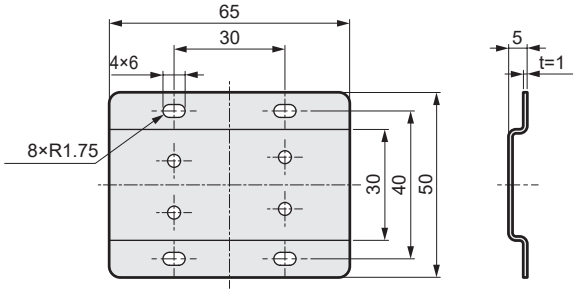
Optional dimensions

●FSM3-J

Bracket 2

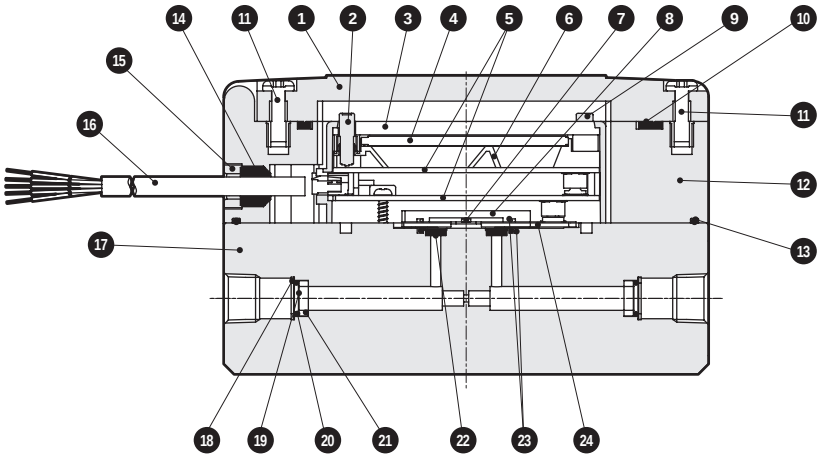






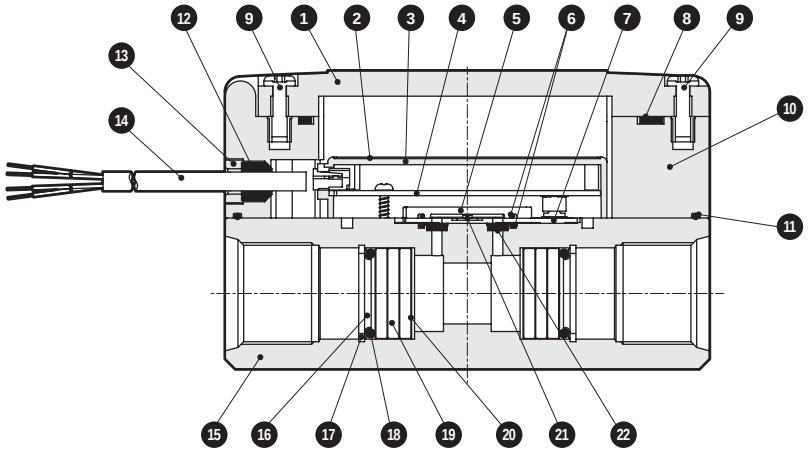
Internal structure

● LCD display FSM3-L



Part number	Part name	Material		Part number	Part name	Material	
1	Protective cover	PC	Polycarbonate resin	13	Packing	FKM	Fluoro rubber
2	Switch	EPDM	Ethylene propylene rubber	14	Cable packing	FKM	Fluoro rubber
3	Liquid crystal cover	PMMA	Acrylic resin	15	Packing holder	PC	Polycarbonate resin
4	Liquid crystal	-	-	16	Cable	-	-
5	Electronic circuit board	-	Glass epoxy resin	17	Sensor body	SUS316L	Stainless steel
6	Circuit board holder	PC	Polycarbonate resin	18	C-snap ring	SUS304	Stainless steel
7	Sensor chip	-	Semiconductor silicon	19	Filter	SUS304	Stainless steel
8	Sensor cover	SUS316 or equiv.	Stainless steel	20	O-ring	FKM	Fluoro rubber
9	Switch	EPDM	Ethylene propylene rubber	21	Spacer	SUS304	Stainless steel
10	Gasket	-	Silicone rubber sponge	22	Filter	SUS304	Stainless steel
11	Cover bolt	SUSXM7	Stainless steel	23	O-ring	FKM	Fluoro rubber
12	Protective case	PC	Polycarbonate resin	24	Sensor board	-	Alumina

● Bar display FSM3-B

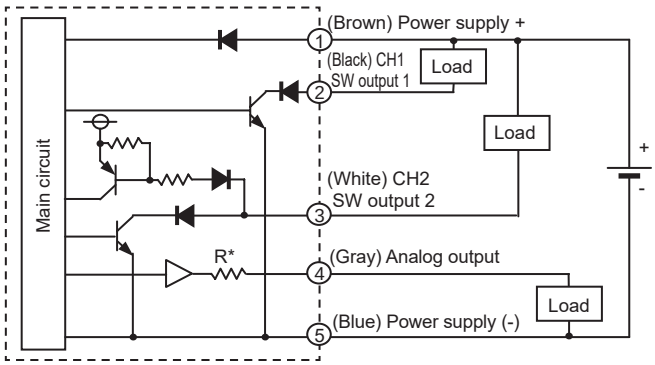


Part number	Part name	Material		Part number	Part name	Material	
1	Protective cover	PC	Polycarbonate resin	12	Cable packing	FKM	Fluoro rubber
2	Front sheet	-	PET film	13	Packing holder	PC	Polycarbonate resin
3	Case	PA	Polyamide resin	14	Cable	-	-
4	Electronic circuit board	-	Glass epoxy resin	15	Sensor body	SUS316L	Stainless steel
5	Sensor cover	SUS316 or equiv.	Stainless steel	16	O-ring holder	SUS304	Stainless steel
6	Gasket	FKM	Fluoro rubber	17	C-snap ring	SUS304	Stainless steel
7	Sensor board	-	Alumina	18	O-ring	FKM	Fluoro rubber
8	Gasket	-	Silicone rubber sponge	19	Spacer	SUS304	Stainless steel
9	Cover bolt	SUSXM7	Stainless steel	20	Filter	SUS304	Stainless steel
10	Protective case	PC	Polycarbonate resin	21	Sensor chip	-	Semiconductor silicon
11	Packing	FKM	Fluoro rubber	22	Filter	SUS304	Stainless steel

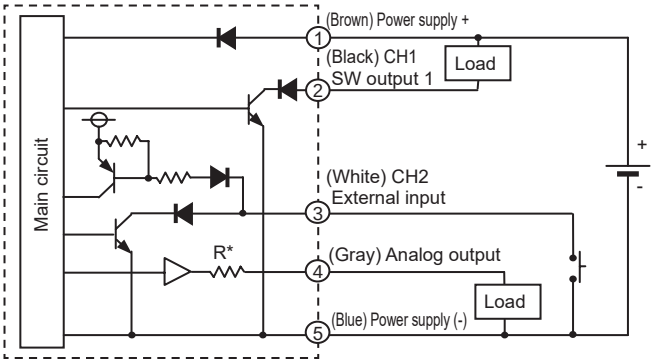
Example of internal circuit and load connection

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

[CH2 is used as SW output]



[CH2 is used as external input]

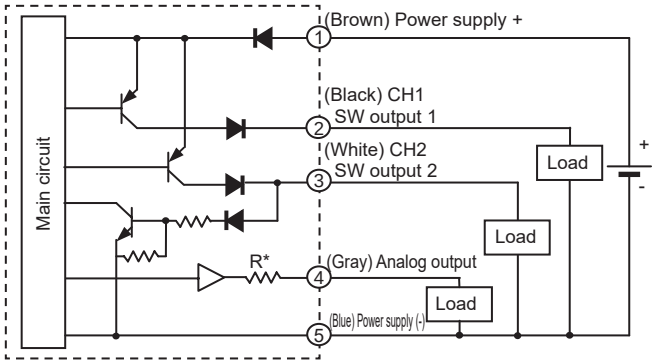


* Analog output voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

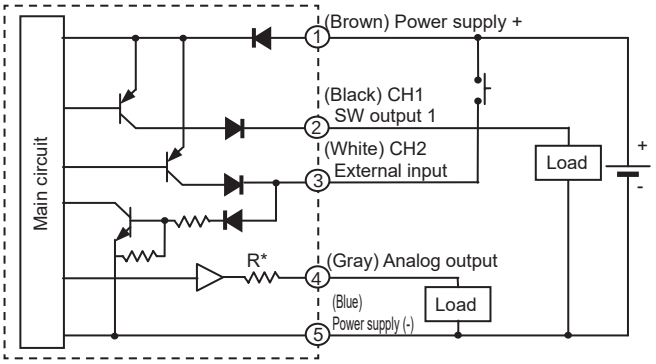
Terminal No.	Lead wire color	Name
①	Brown	Power supply (+) (voltage output: 12 to 24 V, current output: 24 V)
②	Black	CH1 (Switch output 1: max. 50 mA)
③	White	CH2 (switch output 2: max. 50 mA, or external input)
④	Gray	Analog output Voltage output: 1 to 5 V load impedance 50 kΩ or more Current output: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

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

[CH2 is used as SW output]



[CH2 is used as external input]

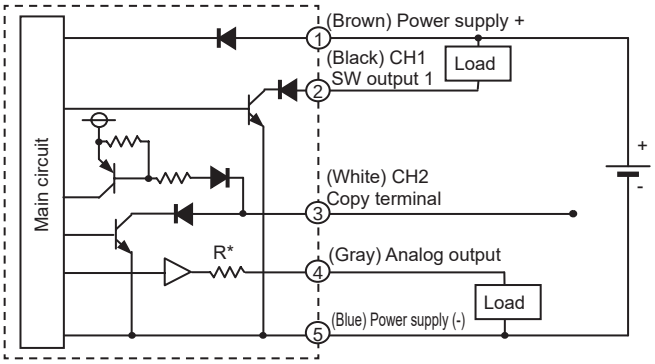


* Analog output voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

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

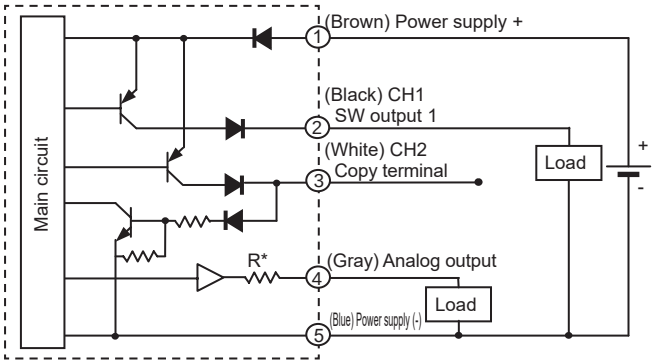
Example of internal circuit and load connection

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



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

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

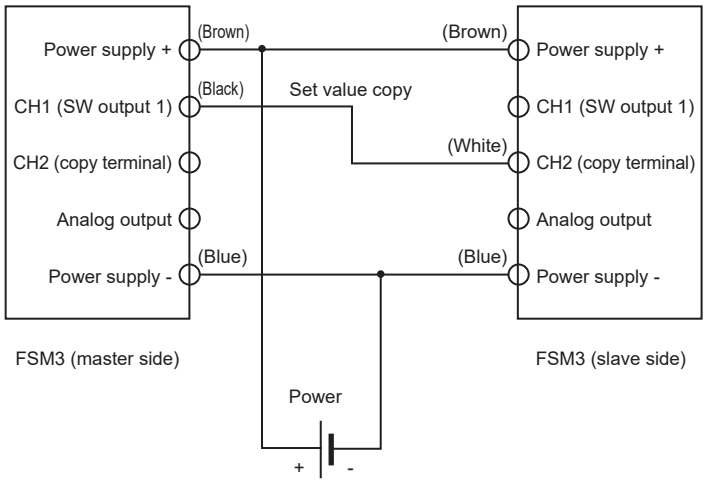


* Analog output voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω

Terminal No.	Lead wire 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 (copy terminal)
④	Gray	Analog output Voltage output: 1 to 5 V load impedance 50 kΩ or more Current output: 4 to 20 mA load impedance 300 Ω or less
⑤	Blue	Power supply - (GND)

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

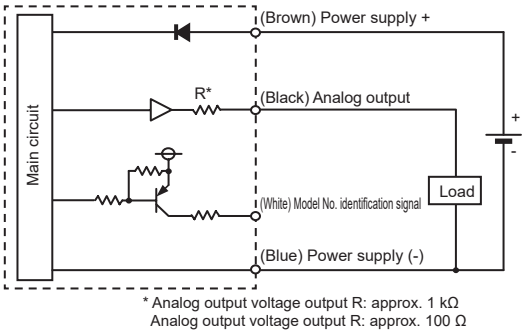
[When using copy function setting]



Connect CH1 (SW output 1) on the master side to CH2 (copy terminal) on the slave side and power ON the sensor to use the copy function setting (F93). Note that this connection can only be used when using the copy function setting. As in the above load connection example, if copying is performed with the load connected to CH1 or the switch is operated with CH1 and CH2 connected, the device may operate unexpectedly or the device and FSM3 may malfunction. Never use the product while connected to the copy terminal.

Example of internal circuit and load connection

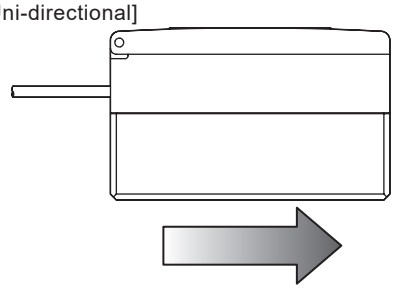
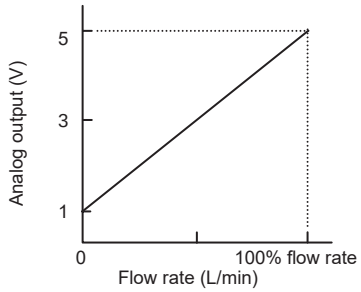
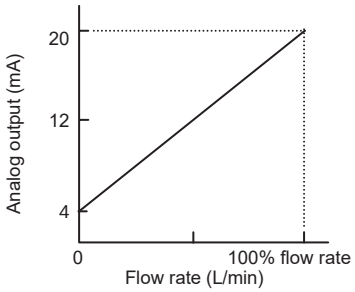
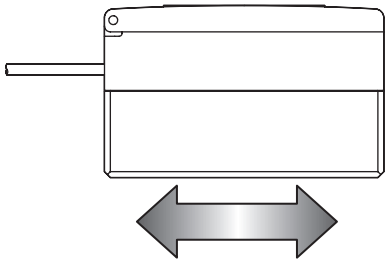
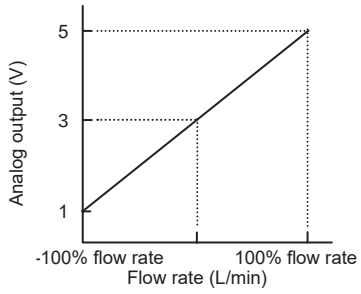
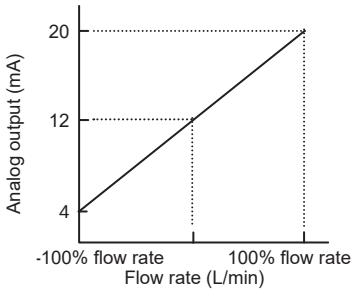
●FSM3-B □□□□□J/K/ □□ (bar display)



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

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

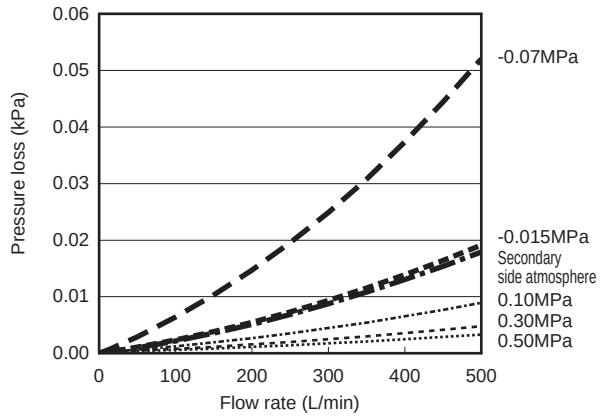
Analog output characteristics

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

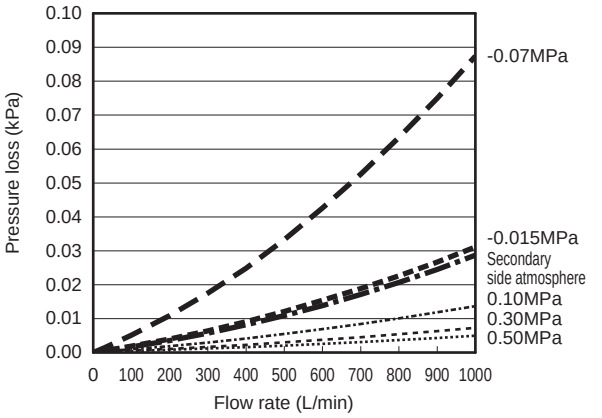
*1: The full scale of the uni-directional type is 0 to 100%, and full scale of the bi-directional type is -100% to 100%. With the integrated display bi-directional type, output can be changed to uni-direction. The value after switching is a reference value. Refer to page 18 for details.
*2: Refer to page 2 for analog output when switching to carbon dioxide.
*3: Analog output is available even outside the measurement flow rate range. Although the accuracy is not guaranteed, the lower and upper limits for voltage can be output at about 0.6V and 5.4V, respectively, while the lower and upper limits for current can be output at about 2.4mA and 21.6mA, respectively.

Pressure loss characteristics (air)

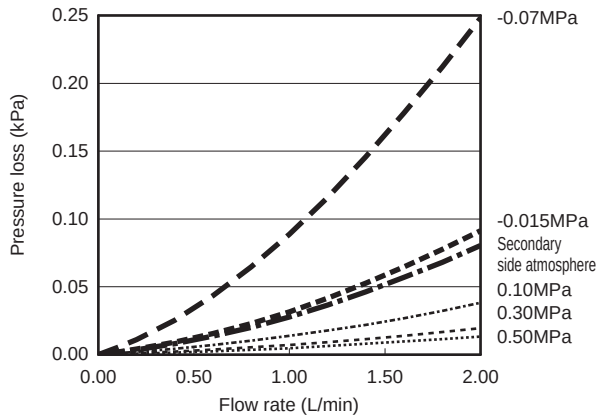
FSM3-□ 005U4□



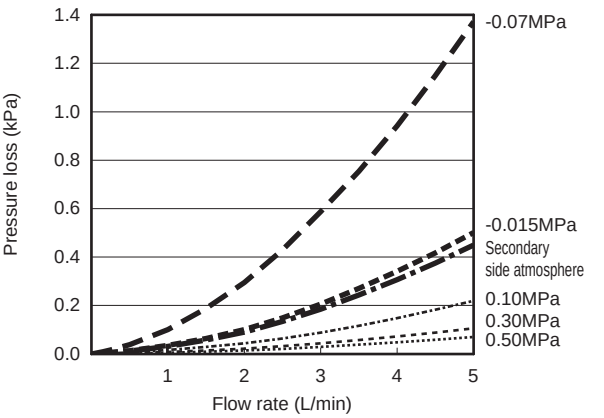
FSM3-□010U4□



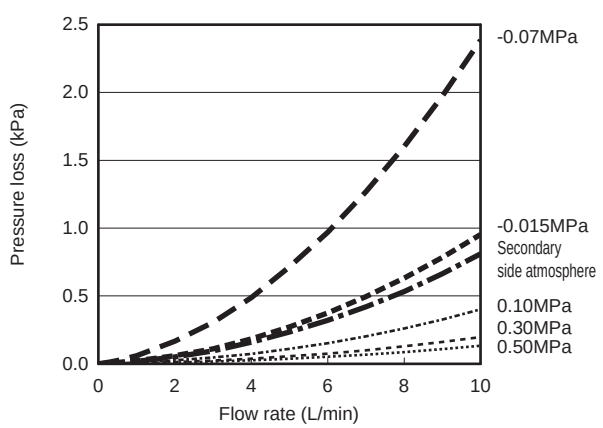
FSM3-□020U4□



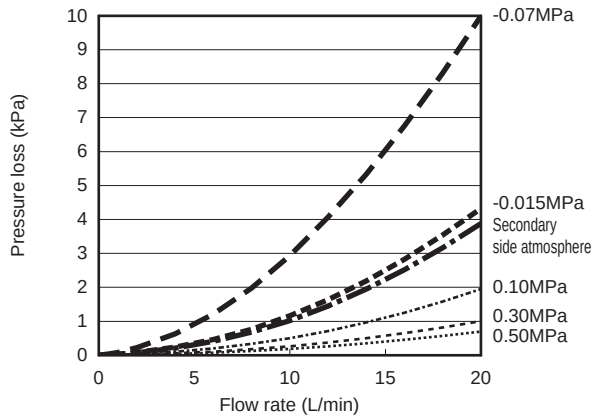
FSM3-□050U4□



FSM3-□100U4□



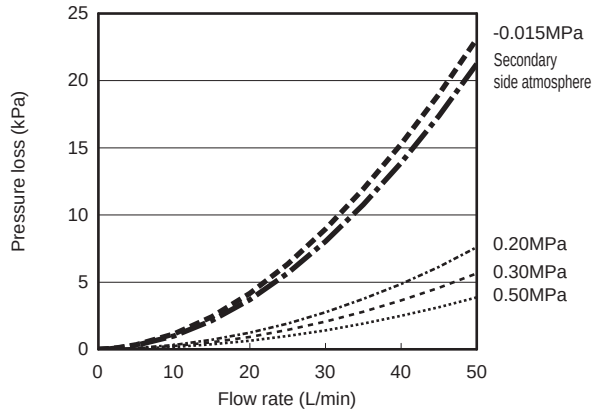
FSM3-□200U4□



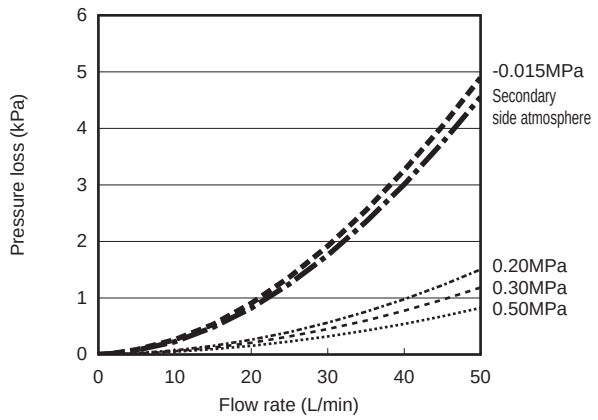
The graphs show data for air. For gases other than air, multiply by the following specific gravity as a guideline. Argon: 1.38, carbon dioxide: 1.53, argon 80% + carbon dioxide 20%: 1.41

Pressure loss characteristics (air)

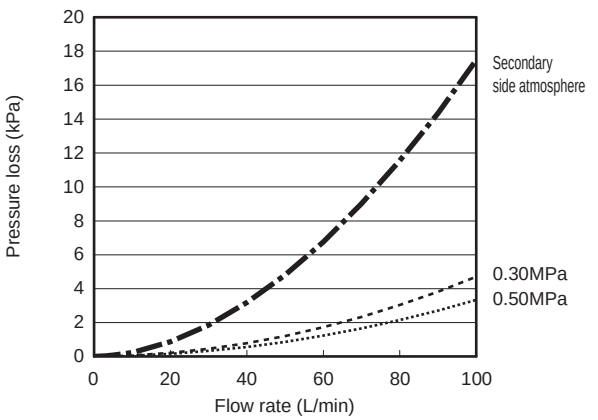
FSM3-□500U4□



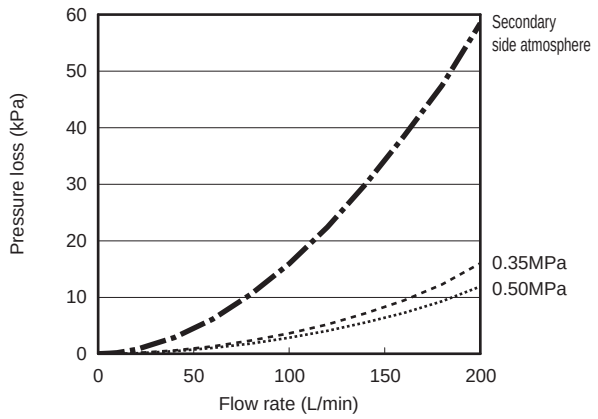
FSM3-□500U4□



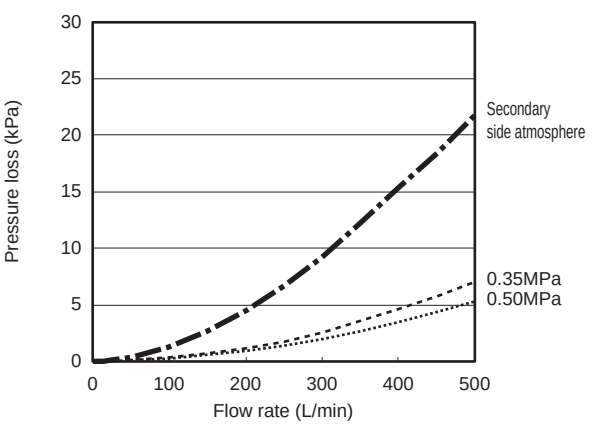
FSM3-□101U4□



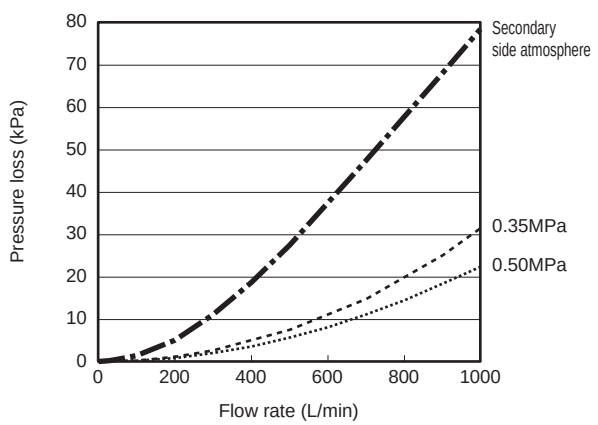
FSM3-□201U4□



FSM3-□501U4□



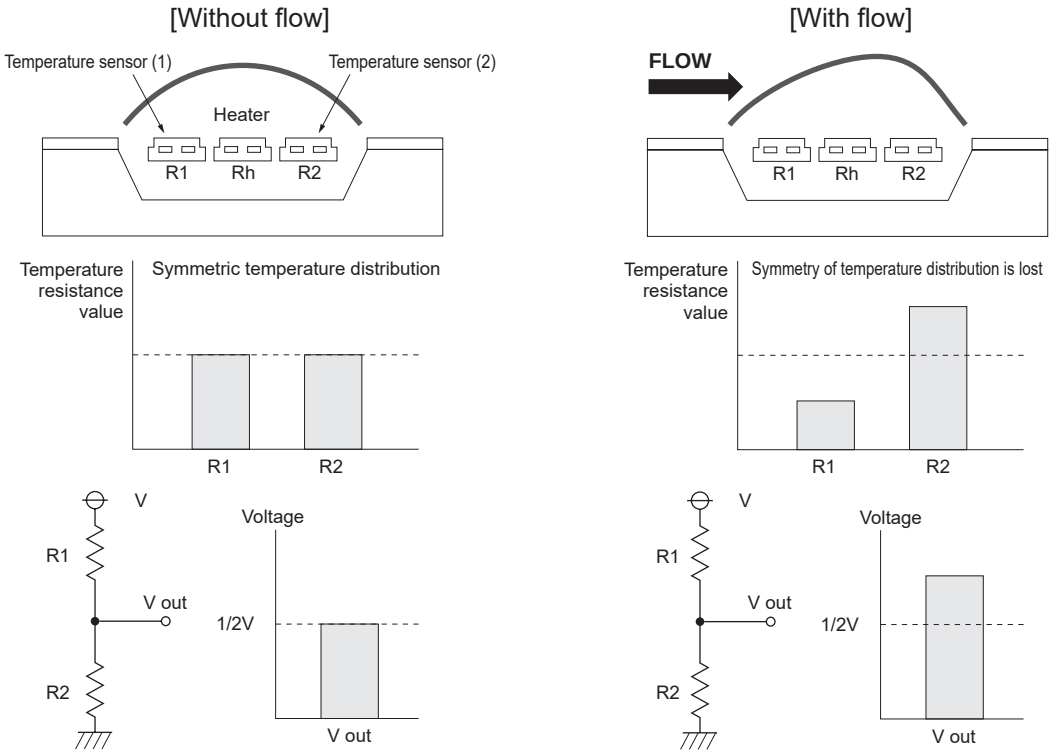
FSM3-□102U4□



The graphs show data for air. For gases other than air, multiply by the following specific gravity as a guideline. Argon: 1.38, carbon dioxide: 1.53, argon 80% + carbon dioxide 20% 1.41 (excluding flow rate range (full scale flow rate) of 501 and 102)

Measurement principle of FSM3 Series

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



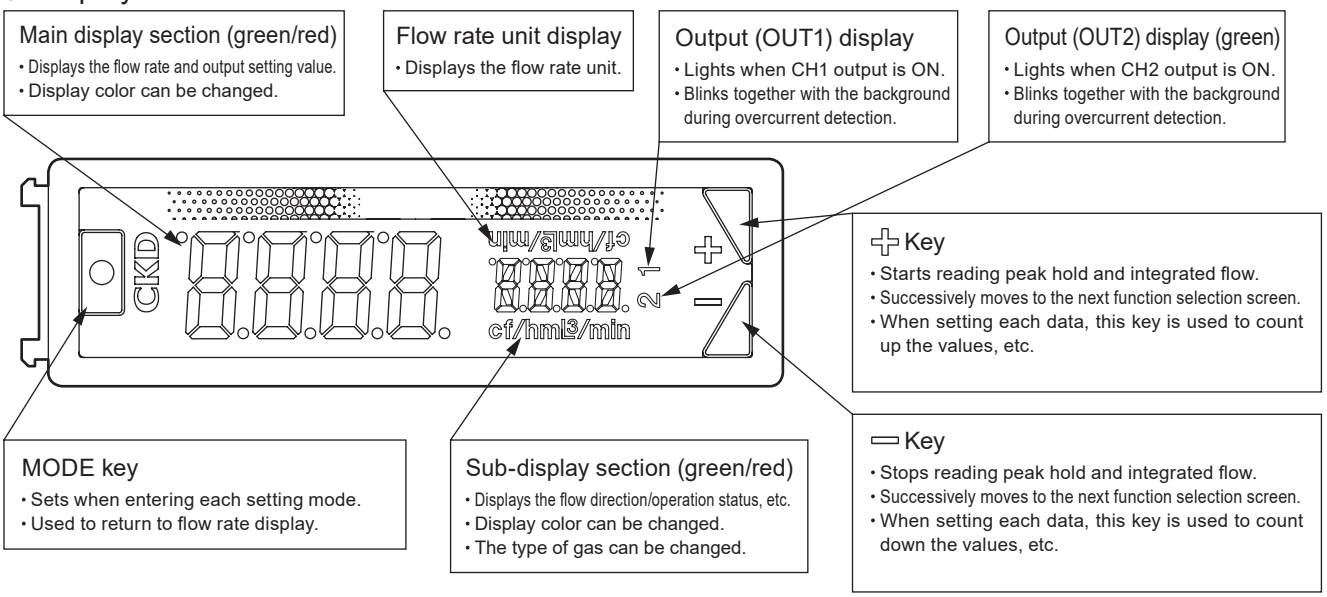
Product weight

[Unit: g]

Fitting		LCD display	Bar display
Model No.	Description		
AA1	Rc1/8 Straight	750	740
BA1	Rc1/4 Straight	690	680
CA1	Rc1/2 Straight	590	580
AF1	G1/8 Straight	750	740
BF1	G1/4 Straight	690	680
CF1	G1/2 Straight	590	580
1 VAC	NPT 1/8 Straight	750	740
BC1	NPT 1/4 Straight	690	680
CC1	NPT 1/2 Straight	590	580

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

● Display section name



●Error code

Error code	Cause	Countermeasures
	The flow rate exceeds the flow rate display range.	Reduce the instantaneous flow rate value to within the flow rate range.
	Sensor is damaged.	Confirm that the flow rate is within the flow rate range, and turn power ON again. If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
	The flow rate is below the lower limit of the flow rate display range.	Increase the instantaneous flow rate value to within the flow rate range.
	Sensor is damaged.	Confirm that the flow rate is within the flow rate range, and turn power ON again. If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
	An error occurred during CPU processing.	Turn power ON again. If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
	Exceeded the zero adjustment range.	Make sure to set the flow rate to zero, and then perform the zero adjustment.
	An error occurred during EEPROM reading or writing.	Turn power ON again. If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
	An error occurred during memory reading or writing.	Turn power ON again. If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
	Sensor failed.	Turn power ON again. If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
	Settings copy failed.	Check the connection and try again.
	Button operations are locked.	Release the lock before operation.
	A password has been set.	Enter the set PIN. * Make sure not to forget your PIN number.
Blinking of output display (Switch output is not output)	The switch output's overcurrent protection circuit has operated.	Check whether load current exceeds the rating. Correctly connect, then turn the power ON again.

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

The function and various settings may be performed during normal flow rate display or after entering each mode.
The modes are also divided into Maintenance mode, SET mode, and Setting Monitor mode according to the frequency of use.

● Normal operation (RUN mode)

Item	Explanation	Default setting
Instantaneous flow rate display	Displays the instantaneous flow rate.	Display (measurement)
Peak hold function	Max. and min. values for the flow rate within a set interval are displayed.	Hidden (Stopped)
CO_2 discharge rate display	By setting the power, discharge pressure, and flow rate of the compressor, as well as the power ↔CO_2 conversion coefficient, you can learn how much CO_2 is being discharged. (reference value obtained by calculation) Available only when the gas type is set to air.	Hidden (Stopped)
Accumulated flow display	The accumulated 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.	Non-display (measurement)

● SET mode

No.	Item	Explanation	Default setting
F.01	Selection of CH1 operation	Select the CH1 feature. Switch output operation and integrated pulse settings can be set.	No switch output
F.02	Selection of CH2 operation	Select the CH2 setting. Select whether to use CH2 as a switch output, or to use as an external input (integrated value reset/auto reference).	No switch output
F.03	Integrating function settings	You can choose to acquire integrating flow values consecutively or at set times. You can also choose to keep the data or not.	Continuous acquisition: Data hold OFF
F.04	Sub-screen display setting	Set the sub-display section's display method. The display can be switched to "flow direction", "reference state", "gas type", or "numbering display".	Flow direction
F.05	Display color setting	Set the display color. (red, green) The color for a normal display and for switch output ON can be set.	At normal: Green At switch ON: Red
F.06	Flow rate direction setting (Bi-directional only)	Setting the flow direction. Setting available for bi-directional, one-sided forward direction or one-sided reverse direction.	Bi-direction
F.07	Display inversion function	The LCD display can be vertically inverted.	Standard display
F.08	Reference state setting	Select from the standard state or reference state. Standard condition (ANR): Converted into volumetric flow rate at 20°C1, barometric pressure 65%RH (For gas types other than air: 20°C, 1 barometric pressure, 0% RH) Reference state (NOR): Converted into volumetric flow rate at 0°C1, barometric pressure 0%RH	ANR
F.09	Unit setting (For overseas only)	The units can be set. Can be selected from L/min, cf/h (cf/min).	Domestic model: L/min Overseas model: L/min
F.10	Display cycle setting	The digital display refresh cycle can be set in three stages from 0.25sec to 1sec. If the display flickers, it may be improved by setting a longer display refresh cycle.	0.5 sec
F.11	Analog output Setting response time	Set the response time. The response can be set in seven steps from 0.05sec to 1.50sec. Chattering and mis-operation caused by sudden flow rate changes or noise are prevented.	0.05 sec
F.12	Numbering setting	You can set the numbering.	0000
F.13	Gas switching	The measured gas can be switched. (Model with full scale flow rate of 200 L/min or below) (The gas type cannot be switched on an oxygen type.)	Air
F.14	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.	OFF
F.15	CO_2 discharge rate calculation setting	The CO_2 discharge calculation can be set. Please set the power, discharge pressure, flow rate, and CO_2 conversion factor of your compressor.	• POWER: 0.20 KW • Pressure: 0.10 MPa • Flow rate: 100 L/min • Conversion factor: 0.000 kg (CO_2)/kwh
F.16	Lock setting	You can set the key lock method and the PIN code method. Use selectively depending on the working environment.	OFF
F.17	Peak hold setting	You can choose to acquire peak bottom values consecutively or at set times. You can also choose to keep the data or not.	Continuous acquisition: Data hold OFF

● Maintenance mode

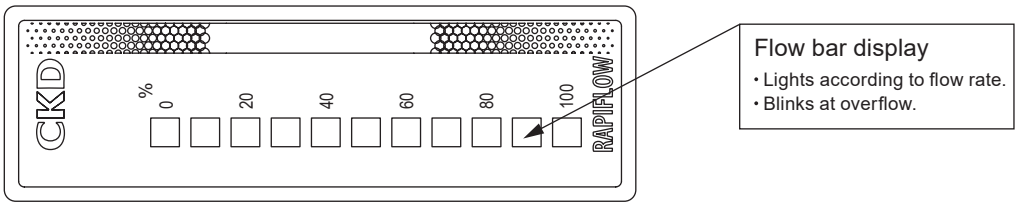
No.	Item	Explanation	Default setting
F.91	Forced output function	Use this function to forcibly turn the switch output ON and confirm the wiring connection or initial operation of the input device.	-
F.92	Zero adjustment	The zero point deviation is compensated.	Adjust value: 000
F.93	Copy function setting	Set values can be copied if the model supports copying between two FSM3's. (Copying is only possible between products with the same model No.)	-
F.99	Reset function	Returns the settings to the default settings.	-

● Setting monitor mode

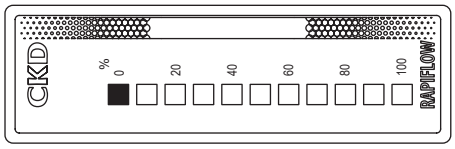
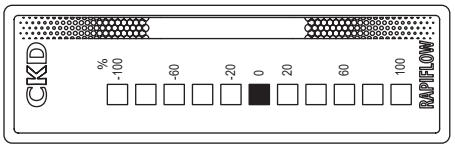
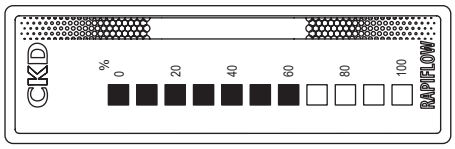
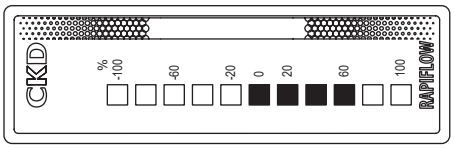
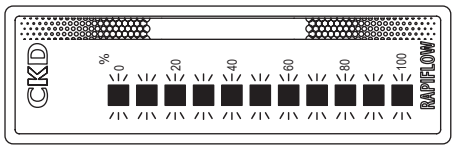
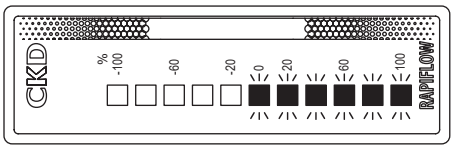
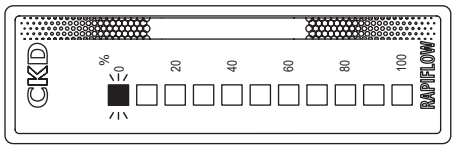
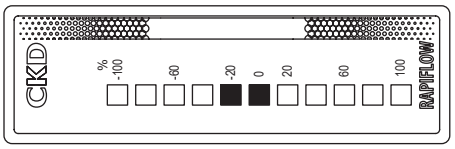
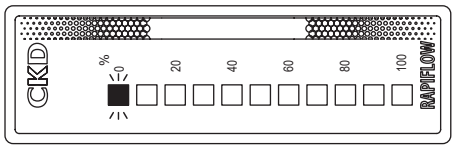
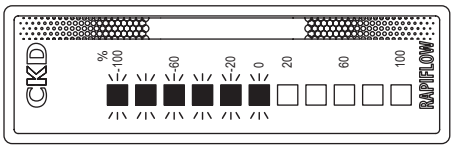
Item	Explanation	Default setting
Settings monitor function	SET mode setting details can be checked. (Setting details cannot be edited.)	-

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

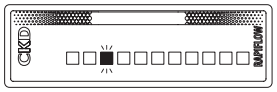
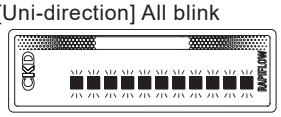
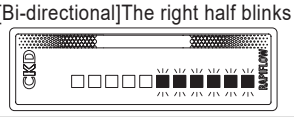
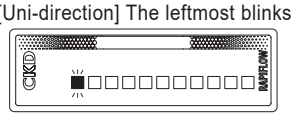
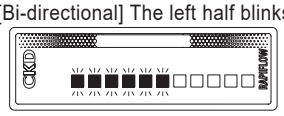
● Display section name



[Display example] Displayed is for FSM3-B101□□□□□□□.

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

●Error code

Error code	Cause	Countermeasures
The third from left blinks 	An error occurred during memory reading or writing.	Turn power ON again.If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
[Uni-direction] All blink 	The flow rate exceeds the flow rate display range.	Reduce the instantaneous flow rate value to within the flow rate range.
[Bi-directional]The right half blinks 	Sensor failure	Confirm that the flow rate is within the flow rate range, and turn power ON again.If the error is not resolved, a probable cause is a product failure. Replace the product.If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.
[Uni-direction] The leftmost 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.
[Bi-directional] The left half blinks 	Sensor failure	Confirm that the flow rate is within the flow rate range, and turn power ON again.If the error is not resolved, a probable cause is a product failure. Replace the product. If you feel that there is an abnormality with the product, stop use and contact your CKD branch or dealer.

Safety Precautions

Be sure to read this section before use.

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

WARNING

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

2 Use this product in accordance with specifications.

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

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

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

ISO4414, JIS B 8370 (Pneumatics fluid power - General rules and safety requirements for systems and their components)
JFPS2008 (Principles for pneumatic cylinder selection and use)
Including the High Pressure Gas Safety Act, Industrial Safety and Health Act, other safety rules, organization standards and regulations, etc.

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

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

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

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

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

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

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

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

Warranty

1 Warranty period

The product specified herein is warranted for one (1) year from the date of delivery to the location specified by the customer.

2 Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified above, CKD will promptly provide a replacement for the faulty product or a part thereof or repair the faulty product at one of CKD's facilities free of charge.
However, following failures are excluded from this warranty:

1) Failure caused by handling or use of the product under conditions and in environments not conforming to those stated in the catalog, the Specifications, or the Instruction Manual.
2) Failure caused by use of the product exceeding its durability (cycles, distance, time, etc.) or caused by consumable parts.
3) Failure not caused by the product.
4) Failure caused by use not intended for the product.
5) Failure caused by modifications/alterations or repairs not carried out by CKD.
6) Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
7) Failure caused by acts of nature and disasters beyond control of CKD.

The warranty stated herein covers only the delivered product itself. Any loss or damage induced by failure of the delivered product is excluded from this warranty.
Note: For details on the durability and consumable parts, contact your nearest CKD sales office.

3 Compatibility check

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

Pneumatic components: Warnings and Cautions

Be sure to read this section before use.

Product-specific cautions: Compact flow rate sensor FSM3 Series

Design/selection

Working fluids

DANGER

■ Never use with flammable fluids

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.

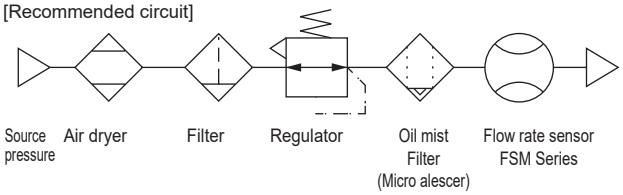
■ Do not use fluids which are not applicable.

■ Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist.

■ Depending on the fluid, retaining the fluid for long periods could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.

■ When using compressed air, use clean air that complies with JISB8392-1 Class 1.1.1 to 1.6.2. Since compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.), attach a filter, an air dryer and an oil mist filter (microalescer) to the primary side (upstream) 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]



■ Working pressure/flow rate range

Applications exceeding the max. working pressure and specified flow rate range may result in faults. If energized in a vacuum state of −0.09 MPa or less, the sensor's heat dissipation will suffer, leading to degradation of the sensor.

■ When using a valve on the primary side of this product, use only an oil-prohibited specification valve. 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.

■ The sensor for oxygen gas is a custom model. To prevent ignition accidents, treat the inside of the flow paths on oxygen models in accordance with oil free specifications. Do not allow oxygen gas to flow again when it has been used on fluids other than oxygen to flow even once.

■ When using liquefied gas such as carbon dioxide, always vaporize it first. Failure may result if liquefied gas enters the product.

Working environment

DANGER

■ Flammable environment

Refer to "ATEX Compliance" on page 26 for safety precautions.

WARNING

■ Corrosive environment

Do not use this product in an atmosphere containing corrosive gases such as sulfur dioxide.

■ Ambient/fluid temperatures

Use at ambient/fluid temperatures within the specified range of 0 to 50°C. Even if the temperature is within the specified range, do not use this product if the ambient temperature and fluid temperature could suddenly change and cause dew to condense.

■ Degree of protection

The degree of protection of this product is equivalent to IP65. This product employs a dust-proof, waterproof structure that provides reliability during maintenance and cleaning, during which it may be exposed to water splashing. Note that this product cannot be used in environments where it will be constantly exposed to water, or in water or where water or oil may radiate violently. Also refer to the precautions regarding the "explosion-proof structure and protective structure" on page 26 for design and selection.

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 atmosphere (101 kPa) relative humidity 65%RH.(For gases other than air: 20°C, 1 barometric pressure (101 kPa), relative humidity 0%RH)

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.

Use for suction confirmation, etc.

⚠ CAUTION

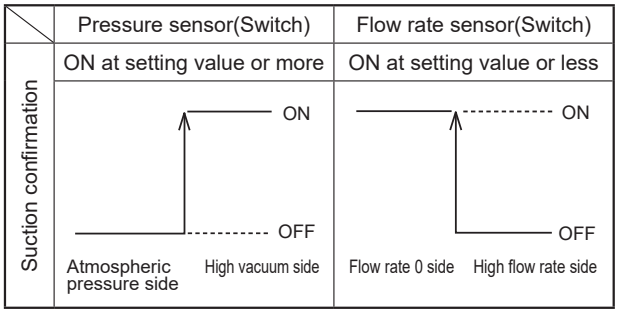
■ Mount an air filter upstream from suction in compliance with the working status to prevent the entry of foreign matter.

■ Consider the atmospheric dew point and the product's ambient temperature, and use the product under conditions in which dew does not condense in pipes.

■ Select the flow rate range based on the operating vacuum pressure and suction nozzle.

■ Response speed may be delayed by the piping volume between the suction nozzle and this product. In this case, take countermeasures to reduce piping capacity.

■ When the suction confirmation sensor is switched from a pressure sensor (switch) to a flow rate sensor (switch), sensor output (switch output) logic will be reversed. Refer to the drawing below. Note that the PLC sequence program must be changed or revised. If source pressure or vacuum source is not supplied when device power is turned ON, "flow rate 0" = "sensor output (switch output) ON" status is set at the flow rate sensor (switch). Check that this is not a problem with the PLC sequence program, etc.



Other

⚠ CAUTION

■ The flow path is not completely free of dust generation. A final clean filter should be used in circuits where dust generation could be a problem.

■ If the actual flow rate is fluctuating, the measured flow rate value will also fluctuate. Either increase the FSM3 display cycle or response time, or average the analog output on the device. In particular, note that control valves such as solenoid valves can be easily generated when used near a circuit or pump that opens and closes quickly and frequently.

■ Measuring the pulsating flow rate may cause errors in the measured flow rate. Restrict the flow rate with the fixed orifice and needle valve, etc., and use it in a laminar flow state (normal flow that does not include irregular fluctuations).

■ The flow rate measured with the gas type switching function is a reference value calculated inside the product based on the converted value. Accuracy other than the air mode is a guideline.

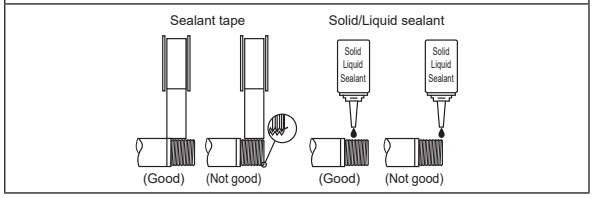
Mounting/Installation/During adjustment

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.
- Do not install the regulator/solenoid valve, etc., immediately before this product. Generated drift may cause errors. Provide a straight pipe with approx. 10 times the bore size when necessary.
- Before installing the piping, clean out the pipes using an air blower to remove all foreign matter and cutting chips from the pipes. The rectifier or sensor chip could be damaged if a large amount of foreign matter, cutting chips, etc., enters.
- Check that sealing tape or adhesive 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 your fingernail tip to stick it onto threads. When using liquid sealant, leave one to two threads open from the end, and avoid applying too much. Check that the sealant does not get on device threads.



- Refer to the torque on the right so that excessive screw-in torque or load torque is not applied to the connection port.

[Reference value]

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

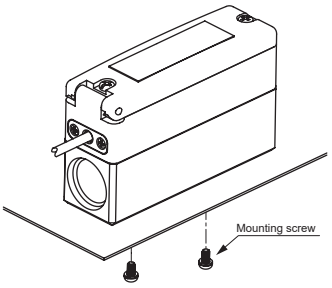
- When using a push-in fitting, accurately insert the tube and confirm that it does not become dislocated even when pulled. Cut the tube at a right angle with a dedicated cutter before use.
- Connect a fitting even when using with the OUT side opened. The port filter could come off.
- Make sure that the leakage detection solution does not enter the inside of this product when inspecting the pipe for leaks.
- Do not rotate fittings while fluid pressure is still applied to this product. The sealant parts could seize or wear, possibly resulting in external leakage.

Mounting

⚠ CAUTION

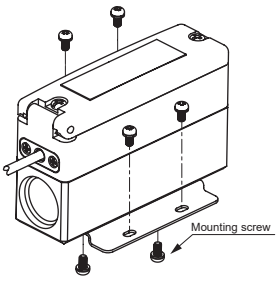
- The LCD display type flow rate meter uses a liquid crystal display. This may be difficult to read depending on the angle.
- Do not install multiple product bodies in close contact. The generation of heat on each part could cause the product's temperature to rise, hastening changes in characteristics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

Vertical mounting (use of female thread on bottom surface)



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

Bracket mounting (use of dedicated bracket)



Discrete bracket model No.: FSM3-J

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

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

⚠ WARNING

- Install the product and wiring as far away as possible from sources of noise such as power distribution wires. Provide separate countermeasures for surge applied to the power cable. The display or output could fluctuate.
- Do not short-circuit the load. Failure to observe this could result in rupture or burning.
- The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output error increases. Check error with the impedance of the connecting load before using. (The analog/current output type is excluded.)

Example of calculation

(FSM3-voltage output impedance: Ro=1kΩ
Load internal impedance: Rx = 1 MΩ

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

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

Output value error ⇨approx. 0.1%

- Check wiring insulation.
  Check that wires do not come into contact with other circuits, that no ground faults occur, and that the insulator between terminals is not defective. Overcurrent could flow in and damage the sensor.
- Check line color when wiring. As incorrect wiring could result in sensor damage and malfunctions, check wire color against the instruction manual before wiring.
- Use a DC stabilized power supply within the specified rating, insulated from the AC power supply. A non-isolated 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.
- The power supply is a DC stabilized power supply completely isolated from the AC primary side. Connect either the + side or - side of the power to the FG. Between the internal power circuit and metal body, a varistor (limit voltage approx. 40 V) is connected to prevent dielectric breakdown of the sensor. Do not perform withstand voltage or insulation resistance test between the internal power supply circuit and metal test. Disconnect wiring first if this testing is required. An excessive potential difference between power and metal body will burn internal parts. An excessive potential difference between the power supply and product housing will burn internal parts. After installing, connecting and wiring the unit, electrical welding of the device/ frame, short-circuit accidents, etc., could cause welding current, excessively high voltage caused by welding, or surge voltage, etc., to run through the wiring, ground wire, or fluid path connected between the above 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.
- Do not use this product at levels exceeding the power supply voltage. If voltage exceeding this range or AC power is applied, the controller could rupture or burn.
- Check that stress (10 N and over) is not directly applied to lead wire leadouts.

During adjustment

⚠ CAUTION

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

Usage/Maintenance

⚠ WARNING

■ CE-compliance working conditions

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 evaluation of this product is performed by using a lead wire that has a power supply line and a signal line paired to assess the product's performance.
- This product is not equipped with surge protection. Implement surge protection measures on the system side.

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

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

■ This product does not use flow rate control for five seconds after power is turned ON to complete self-diagnostics. Provide a control circuit/program that ignores signals for at approximately 5 seconds after power is turned ON.

⚠ CAUTION

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

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

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

■ Use this product within the working pressure.

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

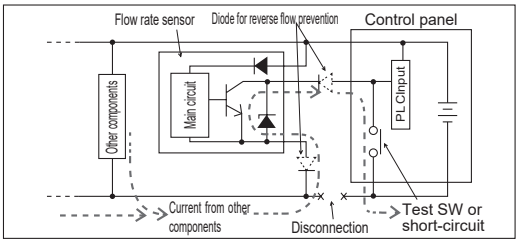
■ Analog output continues even if the flow rate range is exceeded. With the LCD display, "Hi" or "Lo" will be displayed. With the bar display, the bar display will blink. Note that this is outside the guaranteed precision.

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

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

■ Replace the working gas in the flow paths before changing the gas type.

■ Pay attention to reverse currents caused by disconnected wires and 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:

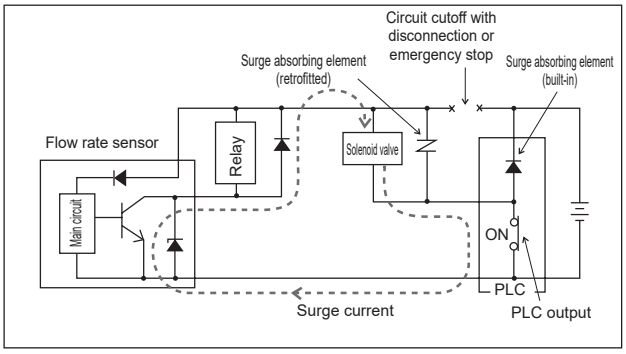
①Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.

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

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

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

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

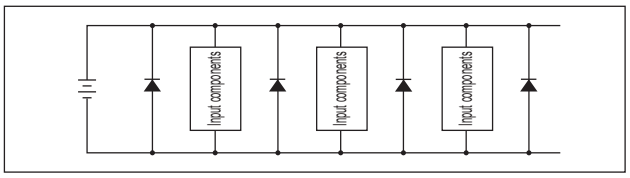


Take the measures below to prevent damage from sneak surge current.

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

②If 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.

③Connect 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.

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

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

■ The explosion-proof and protective structures function with the protective cover (transparent cover) correctly attached. Regularly confirm that the cover bolt (M3) for fixing the protective cover is tightened to the following torque. Also, when opening and closing the protective cover, make sure that there is no floating or displacement of the protective cover and that there is no adhered foreign matter, etc., on the seal surface. Tighten and fix with the following torque.
Cover bolt tightening torque: 0.6N·m ±10%

ATEX Compliance

■ The following are supported.
II3 G Ex ec II C T6 Gc 0°C ≦ Ta ≦ 50°C

■ Working conditions
1) There is a risk of static discharge. Attach to grounded metal and wipe with a wet cloth.
2) Use in a clean environment with a contamination level of 2 or more.
3) The cable retaining parts of this product do not have sufficient retaining functions. When using this product, be sure to provide the cable with an additional retainer function in order to ensure that tension is not transmitted to the end.
4) The protective cover of this product can be opened and closed, but it has explosion-proof construction only when the protective cover is closed and the cover bolts are tightened with the specified torque. Cover bolt tightening torque: 0.6N·m±10%

■ Fluid temperature rating
The temperature of the fluid measured for explosion-proof specifications is 50°C.

■ ATEX Directive 2014/34/EU
EN standards for explosive atomosheres
EN IEC 60079-0:2018
EN IEC 60079-7:2015/A1:2018

⚠WARNING

■ Do not remove or insert cables while energized in an explosive atmosphere.
■ Do not loosen the cover bolt while the unit is energized in an explosive atmosphere. Do not open the protective cover.
■ Do not disassemble or modify the product.

⚠CAUTION

■ The separated display (FSM2-D) does not conform to the ATEX standard.
When using the separated display (FSM2-D) in combination, install outside the explosive atmosphere.

MEMO

Related products

Compact flow rate sensor (RAPIFLOW) separated display FSM2-D Series

- High-speed response
- Wide flow rate range 0.5 to 1000L/min
- When connecting FSM3 bar display, the flow rate range, flow direction and gas type are automatically recognized
- Switch output (2-point output)
- Integrating functions
- Auto reference function

Note: IP40 or equivalent. Not compliant with ATEX standards.

Catalog No. CB-024SA

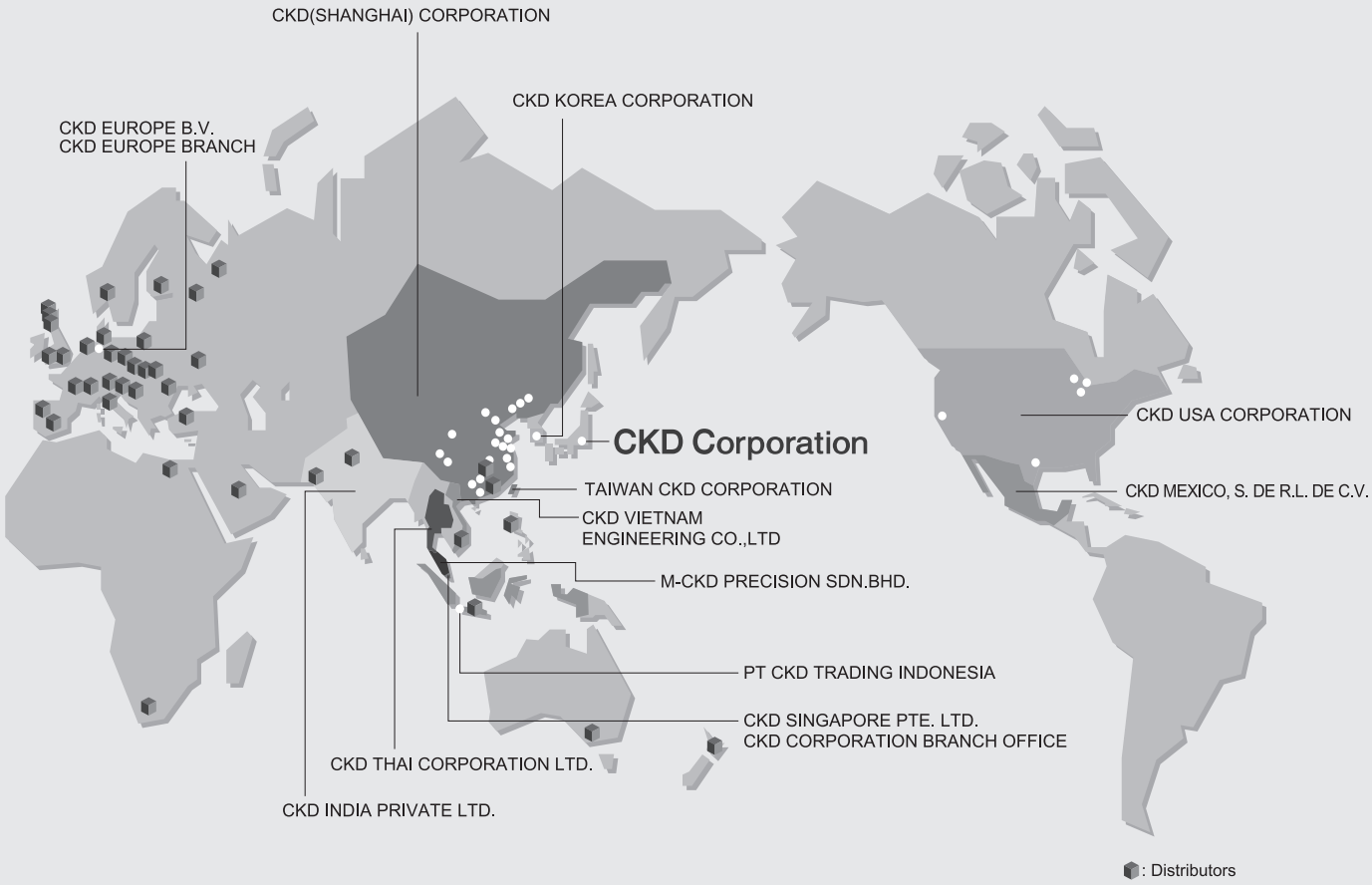
ATEX related products

Karman Vortex Flow Sensor WFK2 Series

- IO-Link compatible
- Compatible with a wide range of flow rates (0.4 to 250 L/min)
- All models equipped as standard with fluid temperature measuring function
- Option with manual valve (needle/cock) for easy flow rate adjustment available
- Handles water up to 95 °C
- The LCD display can be rotated 90° in each direction without moving the body
- Displays the setting value or temperature, etc., simultaneously with an easy-to-read 2-screen color liquid crystal
- Compatible with fluorine liquids

Catalog No. CC-1342A

WORLD-NETWORK



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