CKD

Compact Flow Rate Controller

Rapiflow® FCM Series

INSTRUCTION MANUAL

SM-358642-A/7

- Read this Instruction Manual before using the product.
- Read the safety notes carefully.
- Keep this Instruction Manual in a safe and convenient place for future reference.

CKD Corporation

PREFACE

Thank you for purchasing CKD's "**Rapiflow® FCM Series" compact flow rate controller**.
This Instruction Manual contains basic matters such as installation and usage instructions in order to ensure optimal performance of the product. Please read this Instruction Manual thoroughly and use the product properly.
Keep this Instruction Manual in a safe place and be careful not to lose it.

Product specifications and appearances presented in this Instruction Manual are subject to change without notice.

- The product is intended for users who have basic knowledge about materials, piping, electricity, and mechanisms of pneumatic components. CKD shall not be responsible for accidents caused by persons who selected or used the product without knowledge or sufficient training.
- Since there are a wide variety of customer applications, it is impossible for CKD to be aware of all of them. Depending on the application or usage, the product may not be able to exercise its full performance or an accident may occur due to fluid, piping, or other conditions. It is the responsibility of the customer to check the product specifications and decide how the product shall be used in accordance with the application and usage.

SAFETY INFORMATION

When designing and manufacturing any device incorporating the product, the manufacturer has an obligation to ensure that the device is safe. To that end, make sure that the safety of the machine mechanism of the device, the pneumatic or water control circuit, and the electric system that controls such mechanism is ensured.

To ensure the safety of device design and control, observe organization standards, relevant laws and regulations, which include the following:

ISO 4414, JIS B 8370, JFPS 2008 (the latest edition of each standard), the High Pressure Gas Safety Act, the Industrial Safety and Health Act, other safety rules, organization standards, relevant laws and regulations.

In order to use our products safely, it is important to select, use, handle, and maintain the products properly.
Observe the warnings and precautions described in this Instruction Manual to ensure device safety.

Although various safety measures have been adopted in the product, customer's improper handling may lead to an accident. To avoid this:

Thoroughly read and understand this Instruction Manual before using the product.

To explicitly indicate the severity and likelihood of a potential harm or damage, precautions are classified into three categories: "DANGER", "WARNING", and "CAUTION".

⚠ **DANGER**	Indicates an imminent hazard. Improper handling will cause death or serious injury to people.
⚠ **WARNING**	Indicates a potential hazard. Improper handling may cause death or serious injury to people.
⚠ **CAUTION**	Indicates a potential hazard. Improper handling may cause injury to people or damage to property.

Precautions classified as "CAUTION" may still lead to serious results depending on the situation.
All precautions are equally important and must be observed.

Other general precautions and tips on using the product are indicated by the following icon.

Indicates general precautions and tips on using the product.

Precautions on Product Use

⚠ WARNING

The product must be handled by a qualified person who has extensive knowledge and experience.

The product is designed and manufactured as a device or part for general industrial machinery.

Use the product within the specifications.

The product must not be used beyond its specifications. Also, the product must not be modified and additional work on the product must not be performed.

The product is intended for use in devices or parts for general industrial machinery. It is not intended for use outdoors or in the conditions or environment listed below.

- In applications for nuclear power, railroad system, aviation, ship, vehicle, medical equipment, and equipment that directly touches beverage or food.
- For special applications that require safety including amusement equipment, emergency shut-off circuit, press machine, brake circuit, and safety measures.
- For applications where life or properties may be adversely affected and special safety measures are required.

(Exception is made if the customer consults with CKD prior to use and understands the specifications of the product. However, even in that case, safety measures must be taken to avoid danger in case of a possible failure.)

Do not handle the product or remove pipes and devices until confirming safety.

- Inspect and service the machine and devices after confirming the safety of the entire system. Also, turn off the energy source (air supply or water supply) and power to the relevant facility. Release compressed air from the system and use extreme care to avoid water or electric leakage.
- Since there may be hot or live parts even after operation has stopped, use extreme care when handling the product or removing pipes and devices.
- When starting or restarting a machine or device that incorporates pneumatic components, make sure that a safety measure (such as a pop-out prevention mechanism) is in place and system safety is secured.

Precautions on Working Fluid

⚠ DANGER

Do not flow gas with a concentration that falls within the explosion limits.

There is a risk of explosion.

Purge gas inside the pipes with inert gases such as nitrogen or argon before flowing a combustible gas.

There is a risk of explosion if the product is used without purging the pipes with inert gases.

Do not flow oxygen gas in models not designed for oxygen.

There is a risk of fire accident. Even if the product is an oxygen model, once the product is used with gas other than oxygen gas, do not ever use that product with oxygen gas.

⚠ WARNING

Do not use the product as a meter for commercial transactions.
The product does not comply with the Measurement Act (of Japan) or equivalent measurement acts of any country and cannot be used for commercial transactions.

Use the product within the fluid temperature range of 0°C to 50°C.
Even if the temperature is within the specified range, do not use the product in places where sudden changes in the temperature may cause condensation.

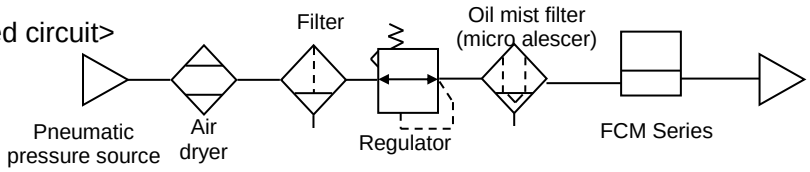
Use only applicable fluids.
The FCM Series is designed for the gas types specified in the model number. When used with fluids other than the applicable fluids, performance such as accuracy and controllability are not guaranteed. Especially, if hydrogen or helium gas flows into a product not designed for hydrogen or helium gas, the product may not operate due to the safety circuit of the sensor. (Once the safety circuit is activated, the flow rate cannot be measured or controlled until the power is turned off.)

Make sure that the cleanliness of fluid is sufficient.

- Use clean and dry gas that does not contain corrosive chemicals (such as chlorine, sulfur, or acid), dusts, and oil mists.
- If a fluid is left in the product for a long period, the fluid quality may negatively affect the product performance. Do not leave the fluid enclosed in the pipes for a long time.
- If foreign matters such as dusts, water drops, and oil mists in the pipes enter the product, the accuracy and the controllability may deteriorate or the product may fail. If there is a possibility of foreign matters entering the product, install a filter, an air dryer, or an oil mist filter (micro alescer) on the primary side (upstream) of the product.
- When using compressed air, use clean air that is in accordance with JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 1:6:2].
- Compressed air from the compressor contains drainage such as water, oxidized oil, and foreign matters. Install a filter, an air dryer, or an oil mist filter (micro alescer) on the primary side (upstream) of the product.

Note that the mesh (metal) provided in the product is used to rectify the flow in the piping. It is not a filter for removing foreign matters.

<Recommended circuit>



Use the product after checking that the fluid pressure is within the operating differential pressure range.

- If the pressure exceeds the proof pressure or is outside the operating differential pressure range, the product may fail.
- If the primary pressure is low or the secondary side pressure is high, the fluid will not flow due to insufficient differential pressure.

Check the flow characteristics of the regulator on the primary side.
Depending on the flow characteristics of the regulator, the pressure may become unstable when a certain amount of fluid flows and the output from the product may fluctuate.

Use a valve with an oil-prohibited specification and install a filter when using a valve on the primary side of the product.
The product may malfunction or fail due to the grease or oil splattering or the abrasion powder generated from the valve.

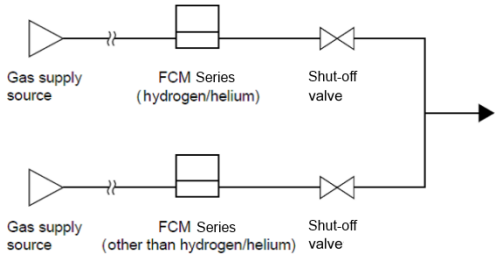
Vaporize liquefied gases such as propane gas before use.
Flowing liquefied gas into the product may cause failures.

Design the arrangement of the product and the piping so that the backfire is prevented and the product is protected from damage even if a backfire occurs when using the product for burner air-fuel ratio control.
A rise in the internal pressure in the pipes and a fire caused by a burner's backfire may cause failures.

⚠ WARNING

When using a mixture of hydrogen or helium gas and other gases, make sure not to let gases used in each FCM Series controller to flow into other FCM Series controllers.

For use in a parallel circuit as shown in the figure below, if hydrogen or helium gas flows into a product not designed for hydrogen or helium gas, the product may not operate due to the safety circuit of the sensor. Take measures to prevent this inflow. (Once the safety circuit is activated, the flow rate cannot be measured or controlled until the power is turned off.) When shutting off the gas, install a shut-off valve for each product as shown in the figure below to prevent the backflow of gas.



Precautions on Maintenance

⚠ CAUTION

Do not use materials such as solvents, alcohol, and detergents to remove dirt and stains.

The case is made of resin and resin can be damaged by these materials. Soak a waste cloth in a diluted neutral detergent and wring it out well. Use this cloth to wipe off dirt.

Check the flow rate accuracy periodically.

It is recommended to check the flow rate accuracy periodically. The accuracy may change from the initial state depending on the condition of use and the environment. Also, when the product is used for a long period, the accuracy may change due to a deterioration of the sensor chip.

The flow rate displayed on the product is the volumetric flow converted from the mass flow. The measured mass flow is converted to the volumetric flow rate at 20°C, 1 atmospheric pressure (101 kPa), and 65% RH.

CONTENTS

1. PRODUCT OVERVIEW

1.1 Model Number Indication

1.1.1 General gas model

FCM – 9500 AI – H6 0 AN R 1 B T

- FCM: Model
- 9500: (a) Flow rate range
- AI: (b) Applicable fluid
- H6: (c) Port size/body material
- 0: (d) Input signal
- AN: (e) Output specification
- R: (f) Display direction
- 1: (g) Cable
- B: (h) Bracket
- T: ((i) Traceability

■Example of model number indication

FCM-0001AI-H81ANR1BK

(a) Flow rate range : 0 L/min to 1 L/min
(b) Applicable fluid : Compressed air, nitrogen
(c) Port size/body material : Push-in (ø8), resin body
(d) Input signal : Analog 0 VDC to 5 VDC
(e) Output Specification : 1 V to 5 V analog, error (NPN)
(f) Display direction : Upside-down
(g) Cable : 1 m
(h) Bracket : With bracket
(i) Traceability : Inspection report

Option model number

FCM – AC1

Symbol	Description
AC1	Analog 9-conductor cable, 1 m
AC3	Analog 9-conductor cable, 3 m
PC1	Parallel 15-conductor cable, 1 m
PC3	Parallel 15-conductor cable, 3 m
LB1	Bracket

Symbol	Description						
(a) Flow rate range							
Applicable fluid			AI	AR	O2	LN	C1	C3
9500	Standard differential pressure type	0 L/min to 0.5 L/min	●	●	●	●	●	●
0001		0 L/min to 1 L/min	●	●	●	●	●	●
0002		0 L/min to 2 L/min	●	●	●	●	●	●
0005		0 L/min to 5 L/min	●	●	●	●	●	●
0010		0 L/min to 10 L/min	●	●	●	●	●	●
0020		0 L/min to 20 L/min	●	●				
0050		0 L/min to 50 L/min	●	●				
0100		0 L/min to 100 L/min (resin body only)	●					
L9500	Low differential pressure type (stainless steel only)	0 L/min to 0.5 L/min	●		●	●	●	●
L0001		0 L/min to 1 L/min	●		●	●	●	●
L0001		0 L/min to 2 L/min	●		●	●	●	●
L0005		0 L/min to 5 L/min	●		●	●	●	●
L0010		0 L/min to 10 L/min	●		●	●	●	●

(b) Applicable fluid	
AI	Compressed air, nitrogen
AR	Argon
O2	Oxygen (oil-prohibited specification)
LN	City gas (13A)
C1	Methane (CH4)
C3	Propane (C3H8)

(c) Port size/body material							
Port size/body material		AI	AR	O2	LN	C1	C3
H6	Push-in (ø6), resin body (excluding flow rate ranges 50 L/min and 100 L/min)	●					
H8	Push-in (ø8), resin body	●					
8A	Rc1/4, stainless steel body	●	●	●	●	●	●
UF Note 1	9/16-18UNF, stainless steel body	●	●	●	●	●	●

(d) Input signal	
0	Analog 0 VDC to 10 VDC
1	Analog 0 VDC to 5 VDC
2	Analog 4 mADC to 20 mADC
P	Parallel 10-bit

(e) Output specification	
AN	1 V to 5 V analog, error (NPN)
AP	1 V to 5 V analog, error (PNP)
SN	Switch (NPN), error (NPN)
SP	Switch (PNP), error (PNP)

(f) Display direction	
Blank	Normal direction
R	Upside-down

(g) Cable Note 2	
Blank	None
1	1 m
3	3 m

(h) Bracket Note 2	
Blank	None
B	With bracket

(i) Traceability Note 2	
Blank	None
T	Traceability certificate, system diagram, inspection report
K	Inspection report

Note 1: Refer to "1.3 Dimensions" for the 9/16-18UNF screw shape.
Note 2: Items (g), (h), and (i) are delivered with the product when selected

1.1.2 Hydrogen/helium model

FCM - 0002 H2 - 8A 0 AN R 1 B T

Model | (a) Flow rate range | (b) Applicable fluid | (c) Port size | (d) Input signal | (e) Output specification | (f) Display direction | (g) Cable | (h) Bracket | (i) Traceability

Symbol	Description
(a) Flow rate range	

Applicable fluid		H2	HE
0002	0 L/min to 2 L/min	Y	Y
0005	0 L/min to 5 L/min	Y	Y
0010	0 L/min to 10 L/min	Y	Y
0020	0 L/min to 20 L/min	Y	Y

(b) Applicable fluid	
H2	Hydrogen
HE	Helium

(c) Port size

Port size		H2	HE
8A	Rc1/4	Y	Y
UF Note 1	9/16-18UNF	Y	Y
4S	1/4-inch double bite-type fitting	Y	Y
4RM	1/4-inch JXR male fitting	Y	Y

(d) Input signal	
0	Analog 0 VDC to 10 VDC
1	Analog 0 VDC to 5 VDC
2	Analog 4 mADC to 20 mADC
P	Parallel 10-bit

(e) Output specification	
AN	1 V to 5 V analog, error (NPN)
AP	1 V to 5 V analog, error (PNP)
SN	Switch (NPN), error (NPN)
SP	Switch (PNP), error (PNP)

(f) Display direction	
Blank	Normal direction
R	Upside-down

(g) Cable Note 2	
Blank	None
1	1 m
3	3 m

(h) Bracket Note 2	
Blank	None
B	With bracket

(i) Traceability Note 2	
Blank	None
T	Traceability certificate, system diagram, inspection report
K	Inspection report

■ Example of model number indication

FCM-0002H2-8A1ANR1BK

(a) Flow rate range : 0 L/min to 2 L/min
(b) Applicable fluid : Hydrogen
(c) Port size : Rc1/4
(d) Input signal : Analog 0 VDC to 5 VDC
(e) Output specification : 1 V to 5 V analog, error (NPN)
(f) Display direction : Upside-down
(g) Cable : 1 m
(h) Bracket : With bracket
(i) Traceability : Inspection report

Option model number

FCM - AC1

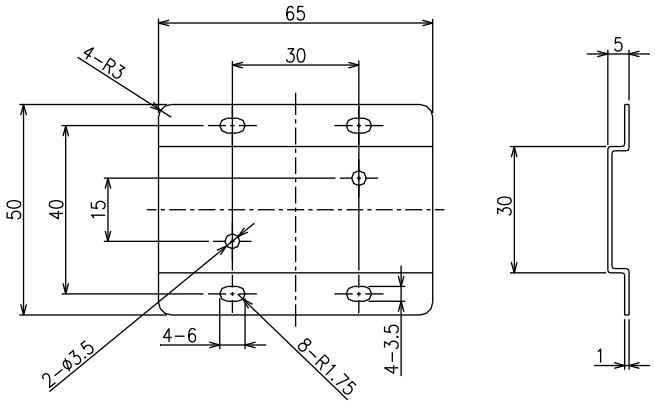
Symbol	Description
AC1	Analog 9-conductor cable, 1 m
AC3	Analog 9-conductor cable, 3 m
PC1	Parallel 15-conductor cable, 1 m
PC3	Parallel 15-conductor cable, 3 m
LB1	Bracket

Note 1: Refer to "1.3 Dimensions" for the 9/16-18UNF screw shape.
Note 2: Items (g), (h), and (i) are delivered with the product when selected.

1.1.3 Optional parts

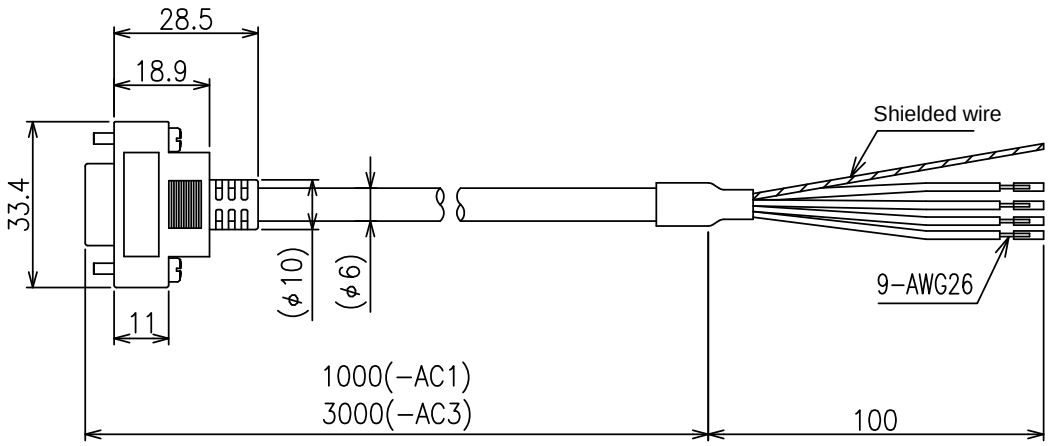
■ Dedicated bracket

Model number: FCM-LB1



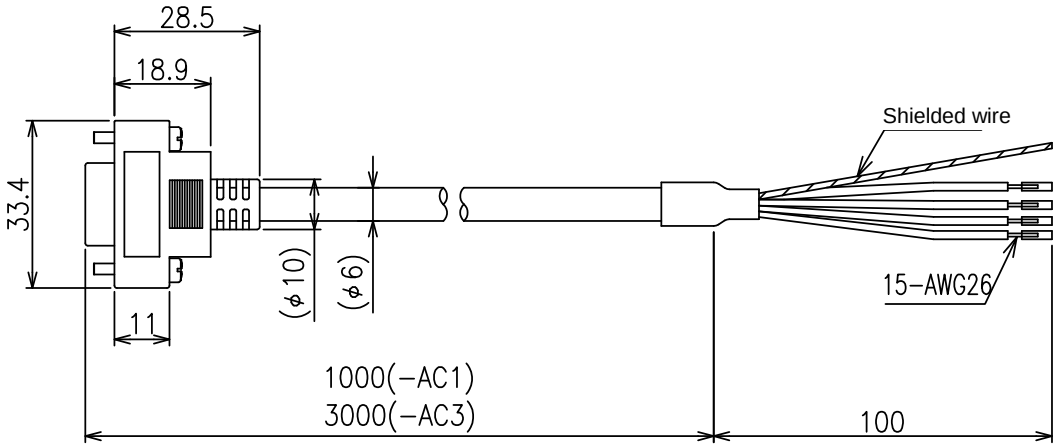
■ Optional cable (9-conductor cable for analog input type)

Model number: FCM-AC1, AC3



■ Optional cable (15-conductor cable for parallel input type)

Model number: FCM-PC1, PC3



1.2 Specifications

1.2.1 General gas model

Descriptions \ Model no.				FCM-[(a)] [(b)]-[(c)] [(d)] [(e)]						
Valve actuation				Proportional solenoid valve: Closed when not energized						
				Full-scale flow rate	AI (Air, nitrogen)	AR (Argon)	O2 (Oxygen)	LN (City gas)	C1 (Methane)	C3 (Propane)
Flow rate range Note 1	(a)	Standard differential pressure type	9500	500 mL/min	Y	Y	Y	Y	Y	Y
			0001	1 L/min	Y	Y	Y	Y	Y	Y
			0002	2 L/min	Y	Y	Y	Y	Y	Y
			0005	5 L/min	Y	Y	Y	Y	Y	Y
			0010	10 L/min	Y	Y	Y	Y	Y	Y
			0020	20 L/min	Y	Y				
			0050	50 L/min	Y	Y				
			0100	100 L/min (resin body only)	Y					
		Low differential pressure type (Stainless steel only)	L9500	500 mL/min	Y		Y	Y	Y	Y
			L0001	1 L/min	Y		Y	Y	Y	Y
			L0002	2 L/min	Y		Y	Y	Y	Y
			L0005	5 L/min	Y		Y	Y	Y	Y
			L0010	10 L/min	Y		Y	Y	Y	Y
Applicable fluid Note 2	(b)		AI	Compressed air, nitrogen	Y					
			AR	Argon		Y				
			O2	Oxygen (oil-prohibited specification)			Y			
			LN	City gas (13A) Note 3				Y		
			C1	Methane (CH4 100%)					Y	
			C3	Propane (C3H8 100%)						Y
Port size/ body material	(c)		H6	Push-in (ø6), resin body (excluding flow rate ranges 50 L/min and 100 L/min)	Y					
			H8	Push-in (ø8), resin body	Y					
			8A	RC1/4, stainless steel body	Y	Y	Y	Y	Y	Y
			UF	9/16-18UNF, stainless steel body	Y	Y	Y	Y	Y	Y
Control	Control range			3%FS to 100%FS						
	Response time	(a)	9500 to 0020	Within 0.5 sec at setting ± 5%FS (TYP)						
			0050 to 0100	Within 1 sec at setting ± 5%FS (TYP)						
	Accuracy			± 3%FS or less						
	Repeatability			± 1%FS or less						
	Temperature characteristics			± 0.2%FS/°C or less (reference temperature: 25°C)						
	Pressure characteristics			± 1%FS or less per 98 kPa (reference: standard differential pressure)						
Pressure specification	Standard differential pressure			Refer to the separate table.						
	Operating differential pressure			Refer to the separate table.						
	Max. working pressure			Refer to the separate table.						
	Proof pressure	(c)	H6/H8	490 kPa						
			8A/UF	980 kPa						
Operating ambient temperature, humidity				0°C to 50°C, 90% RH or less (no condensation)						

Note 1: Converted to volumetric flow rate at 20°C, 1 atmospheric pressure (101 kPa), and 65% RH. Full-scale is the maximum value in the flow rate range.

Note 2: Use clean and dry gas that does not contain corrosive chemicals (such as chlorine, sulfur, or acid), dusts, and oil mists. When using compressed air, use clean air that is in accordance with JIS B 8392-1:2012 (ISO 8573-1:2010) [1:1:1 to 1:6:2]. Compressed air from the compressor contains drainage such as oxidized oil and foreign matters. Install a filter, an air dryer (minimum pressure dew point 10°C or less), or an oil mist filter (maximum oil concentration 0.1 mg/m^3) on the primary side (upstream) of the product.

Note 3: City gas (13A) represents a gas that is 88% methane (CH4) generated from LNG.

Descriptions \ Model no.				FCM-[(a)] [(b)]-[(c)] [(d)] [(e)]
Input/output	Input signal(input impedance)/ preset input	(d)	0	0 VDC to 10 VDC (6.7 kΩ)/4 points (2-bit)
			1	0 VDC to 5 VDC (10 kΩ)/4 points (2-bit)
			2	4 mADC to 20 mADC (250 Ω)/4 points (2-bit)
			P	Parallel 10-bit/none
	Output specification	(e)	AN	Analog output: 1 V to 5 V (connected load impedance 500 kΩ or more) Note 4 Error output: NPN open collector output, 50 mA or less, voltage drop 2.4 V or less
			AP	Analog output: 1 V to 5 V (connected load impedance 500 kΩ or more) Note 4 Error output: PNP open collector output, 50 mA or less, voltage drop 2.4 V or less
			SN	Switch output: NPN open collector output, 50 mA or less, voltage drop 2.4 V or less Error output: NPN open collector output, 50 mA or less, voltage drop 2.4 V or less
			SP	Switch output: PNP open collector output, 50 mA or less, voltage drop 2.4 V or less Error output: PNP open collector output, 50 mA or less, voltage drop 2.4 V or less
Flow rate display	Display method			3-digit 7-segment LED, display accuracy: control accuracy ± 1 digit
	Display range and resolution			Refer to the separate table.
Integration				Refer to the separate table.
Power	Power supply voltage			24 VDC ± 10% (stabilized power supply with ripple rate 2% or less)
	Current consumption Note 5			250 mA or less
Mounting orientation				No restriction
Wetted part material		(c)	H6/H8	Polyamide resin, fluoro rubber, stainless steel, alumina, semiconductor silicon, solder
			8A/UF	Stainless steel, fluoro rubber, alumina, semiconductor silicon, solder
Weight		(c)	H6/H8	Approx. 200 g
			8A/UF	Approx. 480 g
Degree of protection				Equivalent to IP40 (IEC standard)
Protection circuit Note 6				Power reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection
EMC directive				EN 55011, EN 61000-6-2, EN 61000-4-2/3/4/6/8

Note 4: Output impedance for the analog output voltage is approximately 1 kΩ. If the impedance of the connected load is low, the margin of error with the output value will increase.
Check the margin of error with the impedance of the connected load before use.

Note 5: This is the current consumption at power supply voltage of 24 VDC with no load connected and at full-scale flow rate. The current consumption varies depending on the load connected.

Note 6: The protection circuit is only effective against the specified reverse connections and load short-circuit, and not against all incorrect connections.

■ Standard differential pressure type: Pressure specifications Note 7, Note 8

			Flow rate range (a)							
			9500	0001	0002	0005	0010	0020	0050	0100
Applicable fluid (b)	AI	Standard differential pressure (kPa)	50	100	100	100	100	150	200	300
		Operating differential pressure (kPa)	20 to 150	50 to 200	50 to 250	50 to 250	50 to 250	100 to 300	150 to 300	250 to 350
		Max. working pressure (kPa)	150	200	250	250	250	300	300	350
	AR	Standard differential pressure (kPa)	50	100	100	100	100	150	200	
		Operating differential pressure (kPa)	20 to 150	50 to 200	50 to 250	50 to 250	50 to 250	100 to 300	150 to 300	
		Max. working pressure (kPa)	150	200	250	250	250	300	300	
	O2	Standard differential pressure (kPa)	50	100	100	100	100			
		Operating differential pressure (kPa)	20 to 150	50 to 200	50 to 250	50 to 250	50 to 250			
		Max. working pressure (kPa)	150	200	250	250	250			
	LN/C1	Standard differential pressure (kPa)	50	50	50	50	50			
		Operating differential pressure (kPa)	20 to 150	20 to 150	20 to 150	20 to 150	30 to 150			
		Max. working pressure (kPa)	150	150	150	150	150			
	C3	Standard differential pressure (kPa)	50	50	50	50	50			
		Operating differential pressure (kPa)	20 to 150	20 to 150	20 to 150	20 to 150	30 to 150			
		Max. working pressure (kPa)	150	150	150	150	150			

Note 7: The standard differential pressure is the differential pressure when the product is calibrated at the factory (with the secondary side opened to the atmosphere).

Note 8: The operating differential pressure is required to operate the product normally. It varies depending on the flow rate range and the applicable fluid.
The minimum operating differential pressure is required to flow the full-scale flow rate with the secondary side opened to the atmosphere.
The maximum working pressure (the maximum value of the operating differential pressure) is the maximum value of the primary side pressure. If larger pressure is applied, the control will become unstable or the maximum flow rate will become uncontrollable.

■ Low differential pressure type: Pressure specifications

			Flow rate range (a)				
			L9500	L0001	L0002	L0005	L0010
Applicable fluid (b)	AI/O2 LN/C1 C3 Note 9	Standard differential pressure (kPa)	20	20	20	20	20
		Operating differential pressure (kPa)	5 to 50	5 to 50	5 to 50	5 to 50	10 to 50
		Max. working pressure (kPa)	50	50	50	50	50

Note 9: For the low pressure line (1 kPa to 2.5 kPa) of city gas, the operating differential pressure will be outside the range.

■ Flow rate display and integration

		Flow rate range (a)							
		9500 L9500	0001 L0001	0002 L0002	0005 L0005	0010 L0010	0020	0050	0100
Flow rate display	Display range	0 to 500 mL/min	0.00 to 1.00 L/min	0.00 to 2.00 L/min	0.00 to 5.00 L/min	0.0 to 10.0 L/min	0.0 to 20.0 L/min	0.0 to 50.0 L/min	0 to 100 L/min
	Display resolution	1 mL/min	0.01 L/min	0.01 L/min	0.01 L/min	0.1 L/min	0.1 L/min	0.1 L/min	1 L/min
Integration Note 10	Display range	999999 mL	9999.99 L	9999.99 L	9999.99 L	99999.9 L	99999.9 L	99999.9 L	999999 L
	Display resolution	1 mL	0.01 L	0.01 L	0.01 L	0.1 L	0.1 L	0.1 L	1 L
	Pulse output rate	5 mL	0.01 L	0.02 L	0.05 L	0.1 L	0.2 L	0.5 L	1 L

Note 10: The integrated flow rate is a calculated (reference) value. The value is reset when the power is turned off.

1.2.2 Hydrogen/helium model

Descriptions \ Model no.			FCM-[(a)] [(b)]-[(c)] [(d)] [(e)]		
Valve actuation			Proportional solenoid valve: Closed when not energized		
			Full-scale flow rate	Hydrogen (H2)	Helium (HE)
Flow rate range Note 1	(a)	0002	2 L/min	Y	Y
		0005	5 L/min	Y	Y
		0010	10 L/min	Y	Y
		0020	20 L/min	Y	Y
Applicable fluid Note 2	(b)	H2	Hydrogen	Y	
		HE	Helium		Y
Port size	(c)	8A	Rc1/4	Y	Y
		UF	9/16-18UNF	Y	Y
		4S	1/4-inch double bite-type fitting	Y	Y
		4RM	1/4-inch JXR male fitting	Y	Y
Control	Control range		3%FS to 100%FS		
	Response time		Within 0.5 sec at setting ± 5%FS (TYP)		
	Accuracy		± 3%FS or less		
	Repeatability		± 1%FS or less		
	Temperature characteristics		± 0.2%FS/°C or less (reference temperature: 25°C)		
	Pressure characteristics		± 1%FS or less per 98 kPa (reference: standard differential pressure)		
Pressure specification	Standard differential pressure		Refer to the separate table.		
	Operating differential pressure range		Refer to the separate table.		
	Max. working pressure		Refer to the separate table.		
	Proof pressure		980 kPa		
Operating ambient temperature, humidity			0°C to 50°C, 90% RH or less (no condensation)		
External leakage Note 3			1 x 10^{-6} Pa·m^3/s (helium leakage rate) or less		
Input/ output	Input signal(input impedance)/ preset input	(d)	0	0 VDC to 10 VDC (6.7 kΩ)/4 points (2-bit)	
			1	0 VDC to 5 VDC (10 kΩ)/4 points (2-bit)	
			2	4 mADC to 20 mADC (250 Ω)/4 points (2-bit)	
			P	Parallel 10-bit/none	
	Output specification	(e)	AN	Analog output: 1 V to 5 V (connected load impedance 500 kΩ or more) Note 4 Error output: NPN open collector output, 50 mA or less, voltage drop 2.4 V or less	
			AP	Analog output: 1 V to 5 V (connected load impedance 500 kΩ or more) Note 4 Error output: PNP open collector output, 50 mA or less, voltage drop 2.4 V or less	
			SN	Switch output: NPN open collector output, 50 mA or less, voltage drop 2.4 V or less Error output: NPN open collector output, 50 mA or less, voltage drop 2.4 V or less	
			SP	Switch output: PNP open collector output, 50 mA or less, voltage drop 2.4 V or less Error output: PNP open collector output, 50 mA or less, voltage drop 2.4 V or less	
Flow rate display	Display method		3-digit 7-segment LED, display accuracy: control accuracy ± 1 digit		
	Display range and resolution		Refer to the separate table.		
Integration			Refer to the separate table.		
Power	Power supply voltage		24 VDC ± 10% (stabilized power supply with ripple rate 2% or less)		
	Current consumption Note 5		270 mA or less		

Note 1: Converted to volumetric flow rate at 20°C, 1 atmospheric pressure (101 kPa). Full-scale is the maximum value in the flow rate range.
Note 2: Use clean and dry gas that does not contain corrosive chemicals (such as chlorine, sulfur, or acid), dusts, and oil mists.
Note 3: The internal valve of the product cannot be used as a stop valve (a valve which does not allow leakage). Leakage is allowed to some degree for the internal valve.
Note 4: Output impedance for the analog output voltage is approximately 1 kΩ. If the impedance of the connected load is low, the margin of error with the output value will increase.
Check the margin of error with the impedance of the connected load before use.
Note 5: This is the current consumption at power supply voltage of 24 VDC with no load connected and at full-scale flow rate. The current consumption varies depending on the load connected.

Descriptions \ Model no.			FCM-[(a)] [(b)]-[(c)] [(d)] [(e)]
Mounting orientation			No restriction
Wetted part material			Stainless steel, fluoro rubber, alumina, semiconductor silicon, solder
Weight	(c)	8A/UF	Approx. 480 g
		4S/4RM	Approx. 560 g
Degree of protection			Equivalent to IP40 (IEC standard)
Protection circuit Note 6			Power reverse connection protection, switch output reverse connection protection, switch output load short-circuit protection
EMC directive			EN 55011, EN 61000-6-2, EN 61000-4-2/3/4/6/8

Note 6: The protection circuit is only effective against the specified reverse connections and load short-circuit, and not against all incorrect connections.

■ Pressure specifications Note 7, Note 8

			Flow rate range (a)			
			0002	0005	0010	0020
Applicable fluid (b)	H2	Standard differential pressure (kPa)	20	50	50	50
		Operating differential pressure (kPa)	10 to 50	30 to 80	30 to 80	30 to 80
		Max. working pressure (kPa)	50	80	80	80
	HE	Standard differential pressure (kPa)	50	100	100	100
		Operating differential pressure (kPa)	20 to 100	50 to 150	50 to 150	100 to 150
		Max. working pressure (kPa)	100	150	150	150

Note 7: The standard differential pressure is the differential pressure when the product is calibrated at the factory (with the secondary side opened to the atmosphere).

Note 8: The operating differential pressure is required to operate the product normally. It varies depending on the flow rate range and the applicable fluid.
The minimum operating differential pressure is required to flow the full-scale flow rate with the secondary side opened to the atmosphere.
The maximum working pressure (the maximum value of the operating differential pressure) is the maximum value of the primary side pressure. If larger pressure is applied, the control will become unstable or the maximum flow rate will become uncontrollable.

■ Flow rate display and integration

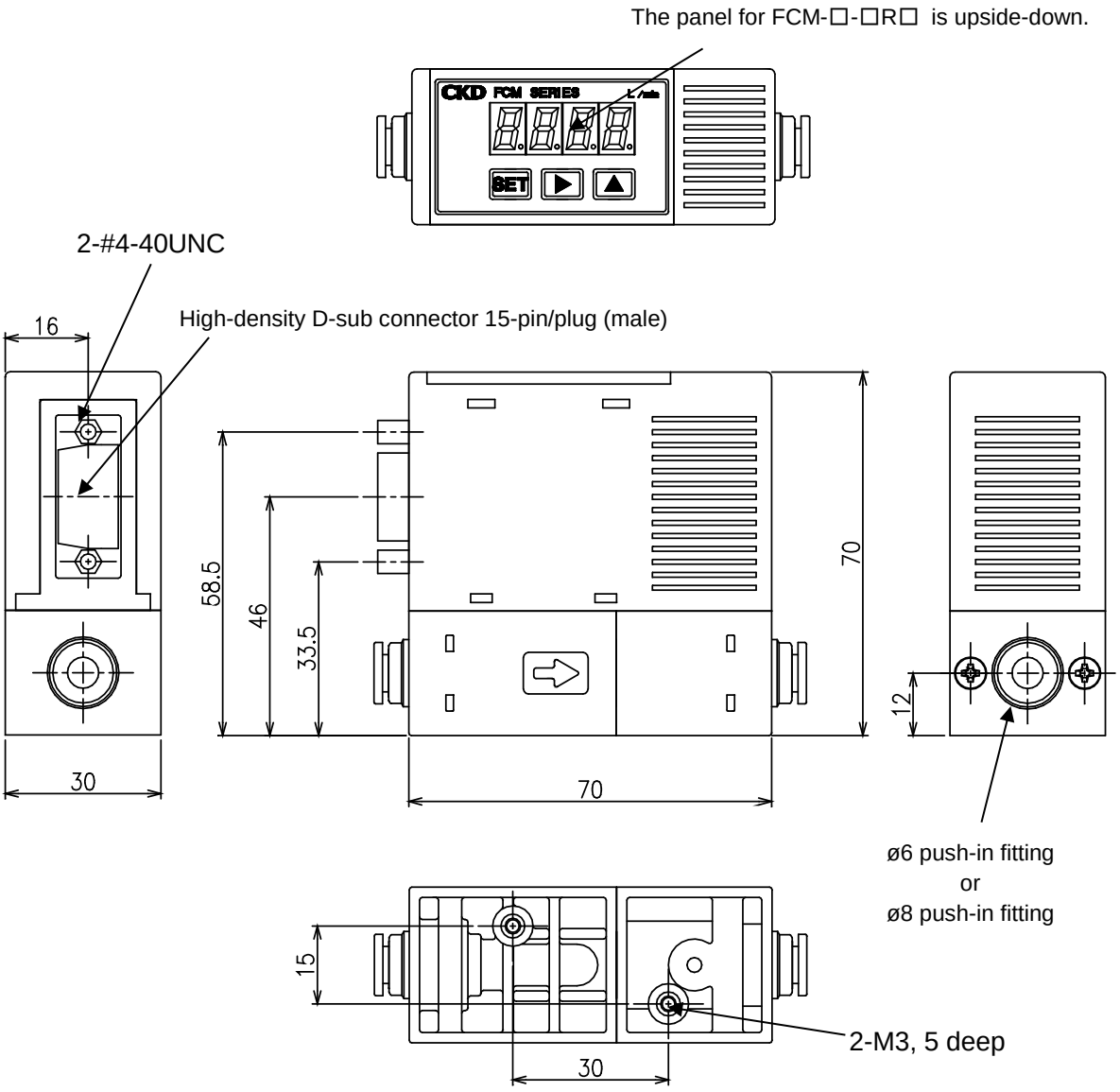
		Flow rate range (a)			
		0002	0005	0010	0020
Flow rate display	Display range	0.00 L/min to 2.00 L/min	0.00 L/min to 5.00 L/min	0.0 L/min to 10.0 L/min	0.0 L/min to 20.0 L/min
	Display resolution	0.01 L/min	0.01 L/min	0.1 L/min	0.1 L/min
Integration Note 9	Display range	9999.99 L	9999.99 L	99999.9 L	99999.9 L
	Display resolution	0.01 L	0.01 L	0.1 L	0.1 L
	Pulse output rate	0.02 L	0.05 L	0.1 L	0.2 L

Note 9: The integrated flow rate is a calculated (reference) value. The value is reset when the power is turned off.

1.3 Dimensions

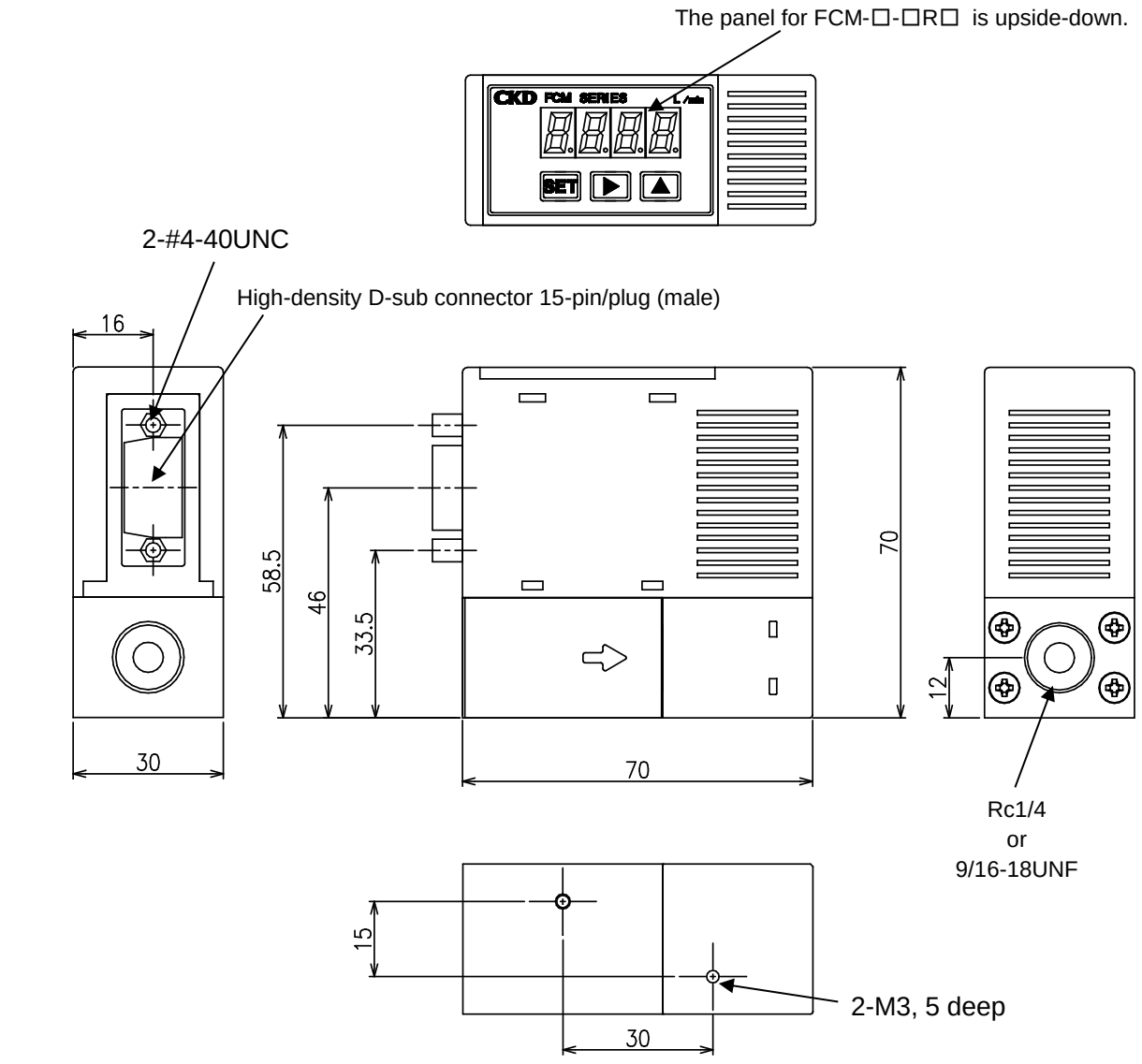
1.3.1 Resin body

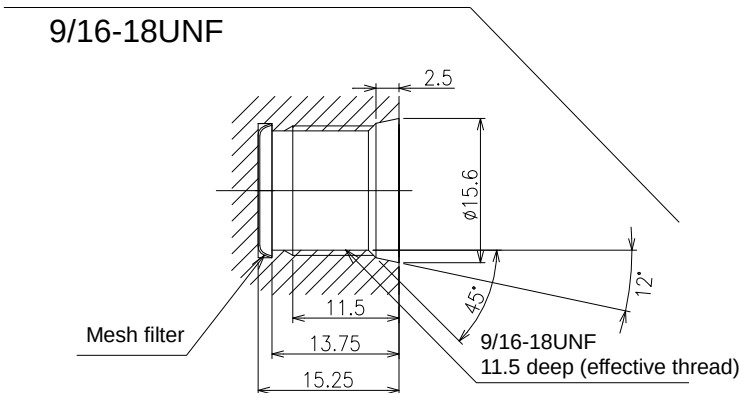
Model number: FCM-☐-H8/H6☐
Port size: Push-in (ø8) or (ø6)



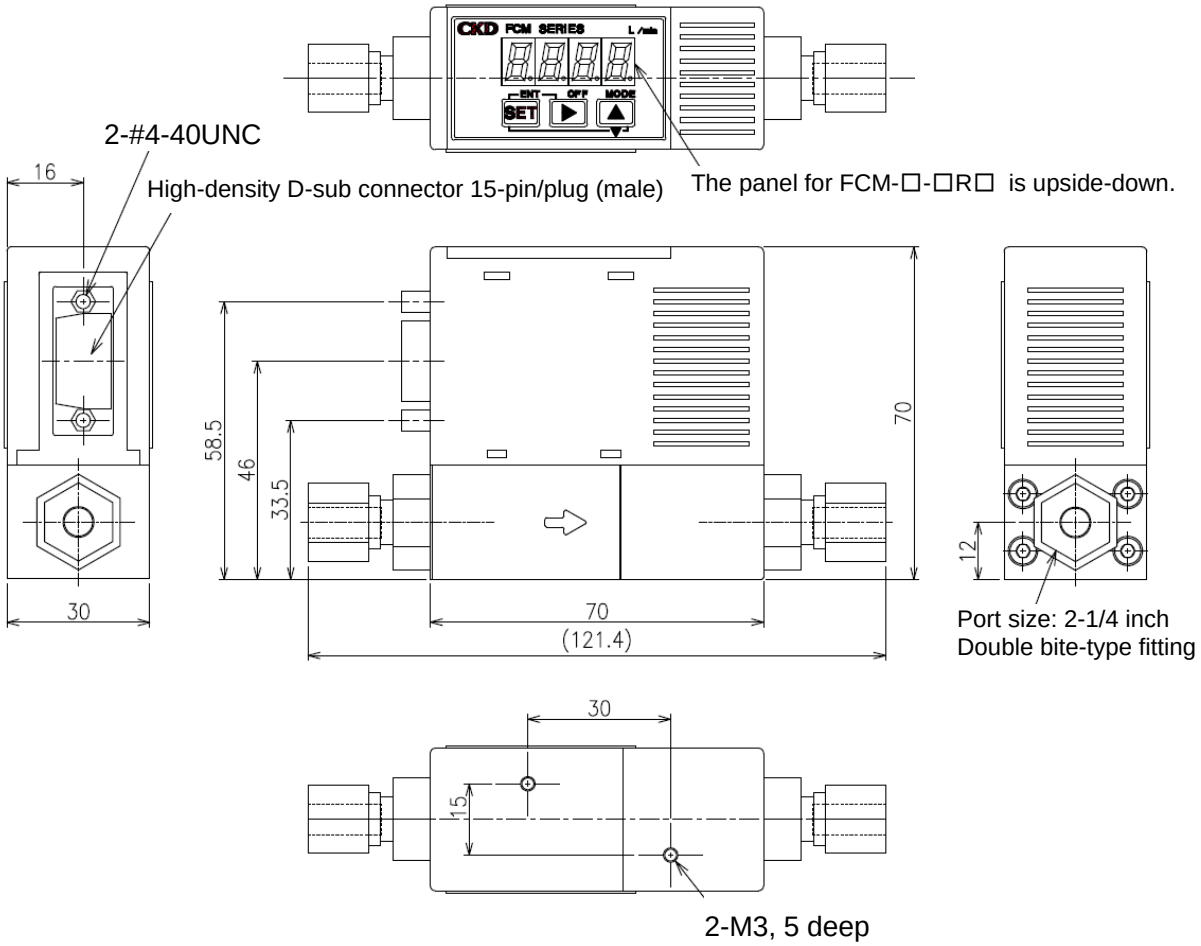
1.3.2 Stainless steel body

Model number: FCM-☐-8A/UF☐
Port size: Rc1/4 or 9/16-18UNF

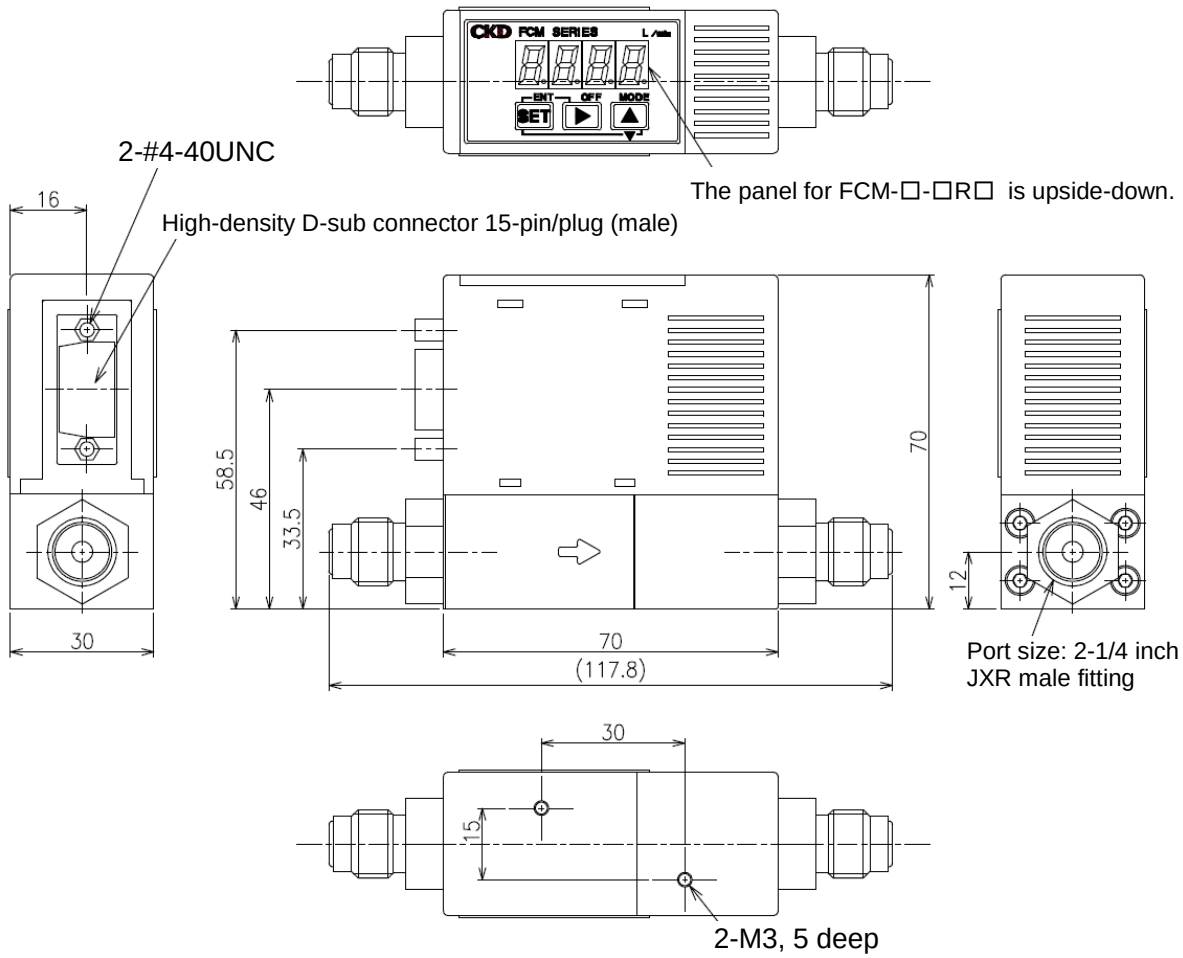




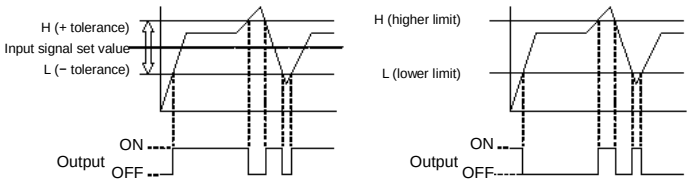
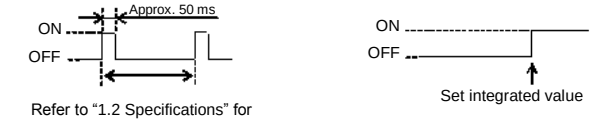
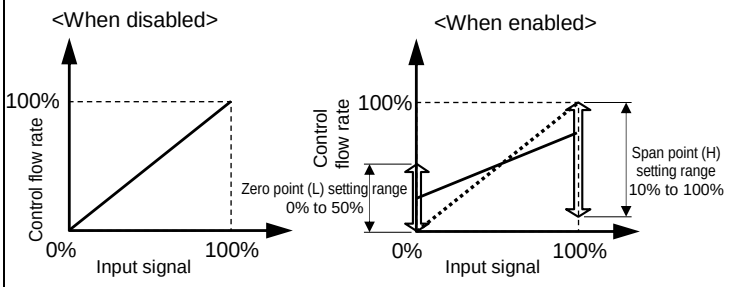
Model number: FCM-☐-4S
Port size: 1/4-inch double bite-type fitting



Model number: FCM-☐-4RM
Port size: 1/4-inch JXR male fitting

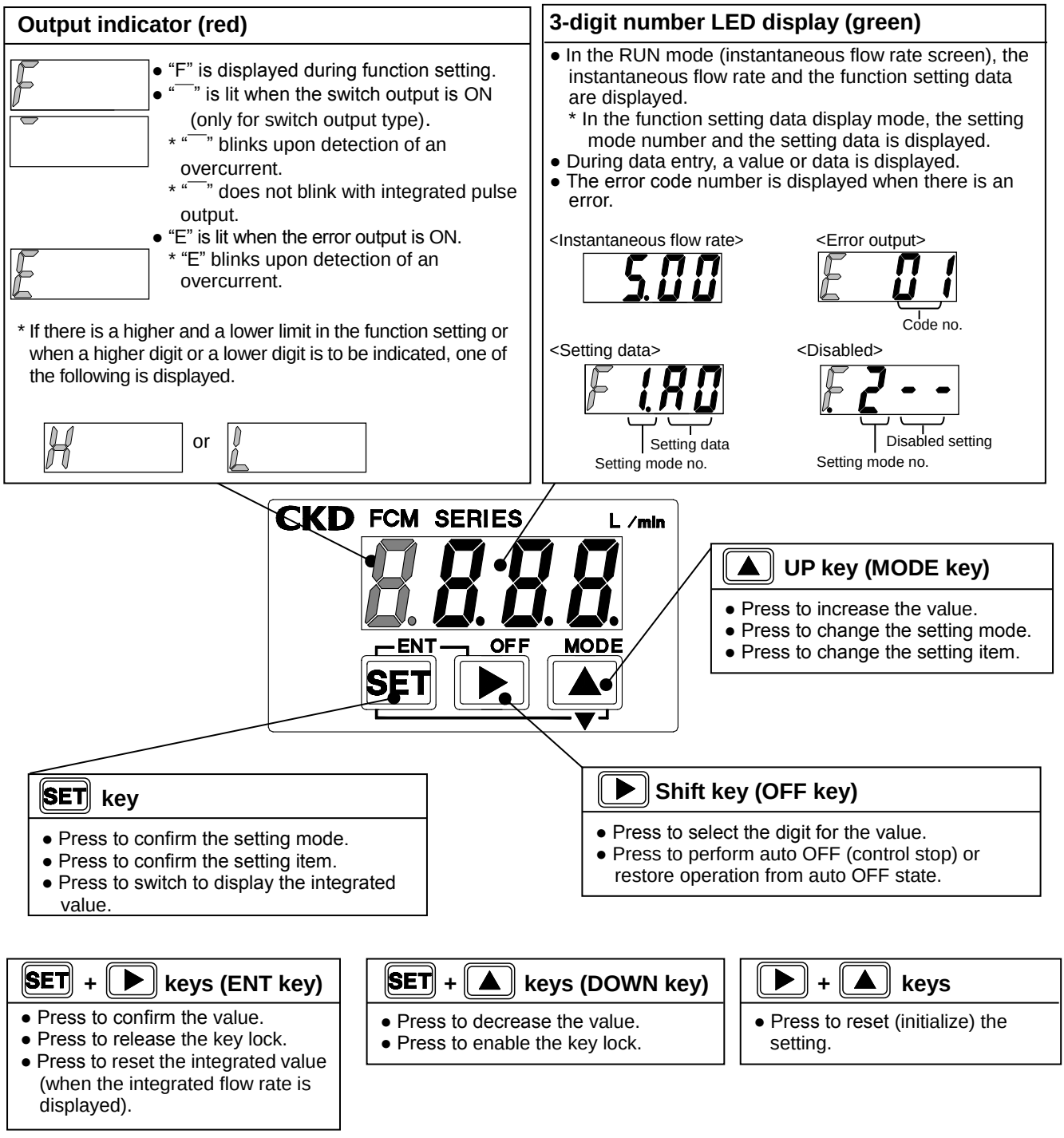


1.4 Functions

Function	Description	Compatible model				Usage
		Analog input		Parallel input		
		Analog output	Switch output	Analog output	Switch output	
Direct memory	Target value can be input with keys. Even without external input signals, control flow rate can be freely adjusted with operation keys.	Y	Y	Y	Y	P.31 P.32 P.44
Preset input	Flow rate can be switched by setting four flow rates and inputting a 2-bit signal from an external source (signal from PLC, etc.).	Y	Y			P.33 P.44
Analog input	Flow rate can be controlled by inputting analog input signals from an external source.	Y	Y			P.35 P.44
Parallel input	Flow rate can be controlled by inputting a 10-bit parallel signal from an external source (signals from PLC, etc.). An expensive I/O device, such as a D/A converter, is not required.			Y	Y	P.36 P.44
Integration	Functions are as follows: 1. Integrates and displays the flow rate. 2. Closes the proportional solenoid valve at the set integrated flow rate. 3. Outputs an integrated pulse signal (voltage) for each prescribed integrated value. 4. Outputs a switch output signal when the flow rate reaches the set integrated flow rate. 5. Resets the integrated flow rate. Note 1 Note 1: For analog input type, use external input or key input to reset the integrated flow rate. For parallel input type, use key input to reset the integrated flow rate.	1. 2. 5.	1. 2. 3. 4. 5.	1. 2. 5.	1. 2. 3. 4. 5.	P.38 P.39 P.40 P.41 P.44 P.45 P.46
Switch output	Following switch functions can be selected. - Tolerance mode: Turns the switch ON when the actual flow rate is within the tolerance (any value) of input signal set value. - Designated range mode: Turns the switch ON when the flow rate is outside the specified flow rate range. - Integrated pulse: Outputs integrated pulse during integration. - ON at set integration or higher: Turns the switch ON at the set integrated flow rate. [Mode 1: Tolerance mode] [Mode 2: Designated range mode]  [Mode 3: Integrated pulse] [Mode 4: ON at set integration or higher]  Refer to “1.2 Specifications” for the pulse output rate.	Y			Y	P.40 P.41 P.42 P.43
Input signal zero/span adjustment	Input signal zero point and span point can be changed. 	Y	Y			P.45
Zero point adjustment	Flow rate output zero point can be adjusted.	Y	Y	Y	Y	P.46

Function	Description	Compatible model				Usage
		Analog input		Parallel input		
		Analog output	Switch output	Analog output	Switch output	
Automatic power off	Flow rate display is turned off if there are no operations for approximately one minute. (Control is not stopped by automatic power off.) Power is saved since the display is turned off when not needed.	Y	Y	Y	Y	P.45
Error display	Error status is displayed. Following functions are also available. - Turns ON error output when an error occurs. - Automatically stops control when an error occurs.	Y	Y	Y	Y	P.15 P.46 P.50
Error automatic shut-off	Control is automatically stopped, valve is fully opened or closed, and error output is turned ON when an error occurs.	Y	Y	Y	Y	P.46
Key lock	Setting change is disabled to prevent incorrect operations.	Y	Y	Y	Y	P.44
Setting reset	Factory setting is restored (initialization).	Y	Y	Y	Y	P.44

1.4.1 Names and Functions of Display and Operation Panel



2. INSTALLATION

2.1 Environment

⚠ WARNING

Do not use the product in an atmosphere that contains corrosive gas such as sulfur dioxide gas.

Use the product within the ambient temperature range of 0°C to 50°C.
Even if the temperature is within the specified range, do not use the product in places where sudden changes in the temperature may cause condensation.

Do not install the product in places where moisture, saline matters, dusts, or cutting chips are present and pressure is applied or reduced.
The degree of protection of the product is equivalent to IP40. The product cannot be used where the temperature changes sharply or humidity is high as condensation may develop in the product and cause damage.

Do not install the product to a movable section or in places subject to vibrations.
Vibrations and shocks may cause a malfunction.

⚠ CAUTION

Check for leakage currents from the external control devices to prevent a malfunction.
Leakage current from equipment such as PLC may cause the product to malfunction.

Consult the manufacturer of the output device when driving multiple units of this model with a single output device.
Due to wiring reasons, the power ground and the output device must share a common connection. When driving multiple units of this model with one output device, correct signals may not be input to the product depending on the circuit type of the output device. Consult the manufacturer of the output device before use.

For the current input type, use a signal generator appropriate for the input impedance.
The current input type can be usually used with the input signal of 1 V to 5 V. Since the input impedance of the product is 250 Ω, which is smaller than other voltage input type products, use a signal generator appropriate for the impedance.

Consider the pressure loss in the pipes and adjust the differential pressure between the upstream and the downstream of the product so that it falls within the operating differential pressure range.
The product may not operate properly if used outside the operating differential pressure range. The differential pressure increases especially when there is an orifice plate or objects regulating the flow on the secondary side (downstream side) of the product. Also, the flow rate control may become unstable due to frequent pressure fluctuation on the primary or secondary side or from not being able to follow the control of the product.

Blow air into the pipes to clean and remove cutting chips and foreign matters before piping.
The rectifying unit and the platinum sensor may become damaged if cutting chips or foreign matters enter into the pipes.

Connect a fitting when using a stainless steel body model with the OUT side opened to the atmosphere.
There is a risk of the port filter coming off.

Do not bend the tube near the push-in fitting when using a resin body model.
If there is a possibility for the tube near the push-in fitting to be subjected to stress, insert an insert ring into the tube and then insert the tube to the push-in fitting.

Insert the tube securely and then pull the tube to check that it does not come off when using a resin body model.
Use a tube cutter to cut the tube at a right angle.

Check that there is no gas leakage after piping.

Observe the following when using the product with oxygen gas.

- Piping must be performed by a qualified person who has extensive knowledge and techniques for handling oxygen gas.
- Use pipes that are free of oil.
- Remove foreign matters such as dirt and burrs from the pipes before mounting the product.
- Install a filter on the primary side of the product.

Do not install a pressure reducing valve (regulator) or a solenoid valve immediately before the product.
These valves may cause a drift and result in an error. Install a straight piping before the product as necessary.

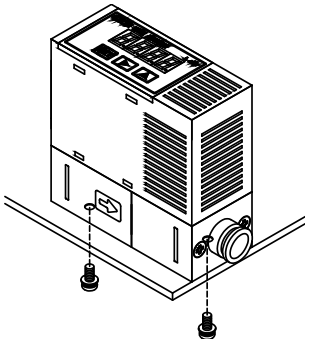
Note that the change in the flow rate depends on the mounting orientation of the product.
Although the mounting orientation is specified as “no restriction”, the flow rate may change depending on the mounting orientation or the piping conditions.

Do not install two or more products in close contact with each other.
The temperature of the products can rise due to the heat generated from the operation of each product. This may promote changes in characteristics or deterioration of resin materials. If using the products side by side, keep at least 10 mm between each product.

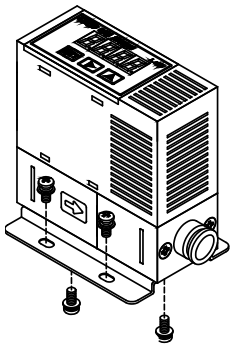
2.2 Mounting

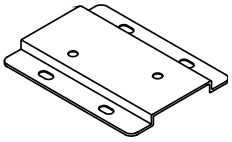
■ Mounting directly

Secure with the screws.



■ Mounting with dedicated bracket





Dedicated bracket
model number: FCM-LB1

2.3 Piping

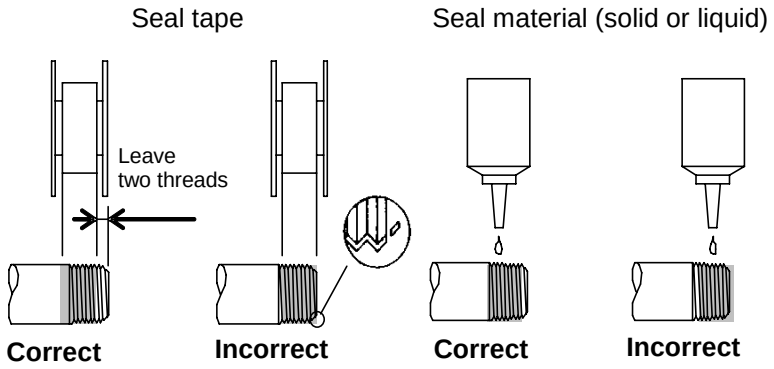
2.3.1 Pipe cleaning

Before piping, blow air into the pipes to clean and remove cutting chips and foreign matters. The rectifying unit and the platinum sensor may become damaged if cutting chips or foreign matters enter into the pipes.

2.3.2 Seal material

Apply a seal tape or seal material to the screw threads leaving two or more threads at the pipe end uncovered or uncoated. If the pipe end is fully covered or coated, a shred of seal tape or residue of seal material may enter inside of the pipes or device and cause a failure.

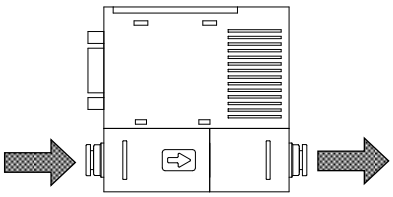
When using a seal tape, wind it around the screw threads in the direction opposite from the screw threads and press it down with your fingers to attach it firmly.
When using a liquid seal material, be careful not to apply it to resin parts. The resin parts can become damaged and this may lead to a failure or malfunction.
Also, do not apply seal material to the internal threads.



Remove any remaining seal material from the threads after removing the pipes if the pipes are to be reused.

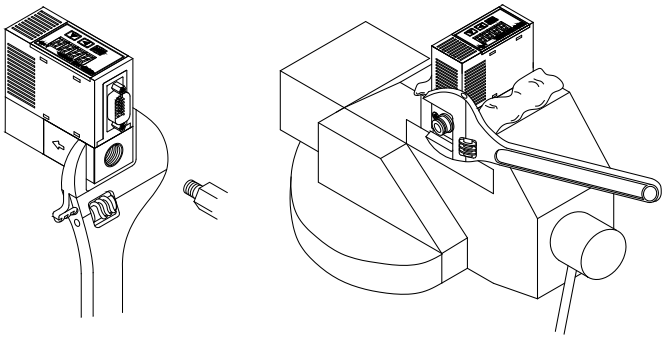
2.3.3 Piping direction

Pipe so that the fluid flows in the direction indicated on the body.



2.3.4 Tightening

- When piping, place the wrench on the stainless steel part of the body and do not apply force to the resin part.



- Following table shows the tightening torque for each fitting.

Port size	Tightening torque (N·m)
Rc1/4	6 to 8
9/16-18UNF	6 to 8

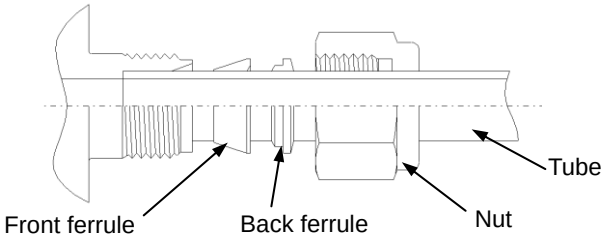
■ Tightening the fitting with port size of 4S/4RM (hydrogen/helium model)

<4S (double bite-type fitting)>

1 Check that the front ferrule, the back ferrule, and the nut are assembled correctly.

2 Insert the tube all the way into the body and tighten the nut with fingers as much as possible. (This position is called the finger-tight position.)

3 Tighten the nut 1 and 1/4 turns from the finger-tight position with a tool.

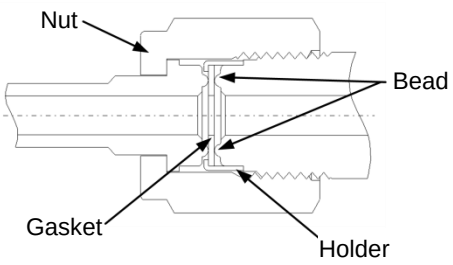


<4RM (1/4-inch JXR male fitting)>

1 Insert the gasket with a holder to the gland.
This will place and hold the gasket correctly on the bead.
(For a gasket without a holder, insert the gasket to the female nut.)

2 Assemble each part and tighten the nut with fingers as much as possible.
(This position is called the finger-tight position.)

3 Hold the body securely and tighten the female nut a 1/8 turn (when the gasket material is nickel or SUS316) from the finger-tight position.
For other gasket materials, contact your nearest CKD sales office or distributor.



2.4 Wiring

⚠ DANGER

Use the product within the specified power supply voltage range.
Applying voltage beyond the specified range may cause a malfunction, damage to the product, electric shock, or fire.

Do not connect a load exceeding the rated output.
The output circuit may become damaged or a fire may occur.

⚠ WARNING

Check the connector pins and the cable conductor colors before wiring.
Incorrect wiring may cause damage, failure, and malfunctions of the product. Check the wire color described in the Instruction Manual before wiring.

Check the wiring insulation.
Make sure that the wires do not contact other circuits and there is no ground fault and insulation failure between terminals. Otherwise, an overcurrent may flow into the product and cause damage.

For the product, use a DC stabilized power supply that is within the rating and isolated from the AC power.
If the power supply is not isolated, an electric shock may occur. If the power supply is not stabilized, the peak value may exceed the rating. This may damage the product or lead to poor accuracy.

Stop the control device and the machinery and turn off the power before wiring.
Operating the product suddenly may cause an unexpected behavior and a dangerous situation. Perform an electrical current test with the control device and the machinery stopped and set the required data. Discharge static electricity from your body, tools, and devices before and during work. For movable sections, use wiring material with the same level of bending resistance as a robot wire.

Install the product and its wiring away from sources of noise such as high-voltage lines as much as possible.
Take measures against surges on the power cable, separately.

Do not apply AC power.
Applying AC power (100 VAC) may cause damage to the product, electric shock, or fire.

Do not short-circuit the load.
The product may burst or burn.

For the power supply of the stainless steel body model, use a DC stabilized power supply completely isolated from the AC primary side and connect either the positive side or the negative side of the power supply to the F.G.
A varistor (limiting voltage of approximately 40 VDC) is connected between the stainless steel body and the internal power circuit to prevent a dielectric breakdown of the product. Do not conduct a withstand voltage test and an insulation resistance test between the stainless steel body and the internal power circuit. If these tests are required, disconnect the wiring before carrying them out. An excessive potential difference between the power supply and the stainless steel body will cause the internal parts to burn out. If the devices or the frames are electrically welded or a short-circuit accident occurs after installing, connecting, and wiring the stainless steel body model, a welding current, a transient high voltage during welding, or a surge voltage may run through the wires, the ground wires, and the fluid passage connected between the components described above. This may cause damage to the wires and the components. Disconnect all F.G. connections from the product and the electrical wiring before electric welding.

Do not incorrectly wire the polarity of the power.
The product may burst or burn.

⚠ CAUTION

Use a cable that is 3 m or shorter.
If a cable that is longer than 3 m is used, the errors of analog I/O signals may become larger or the control may become unstable due to wiring resistance. Using a cable that is shorter than 3 m is recommended.

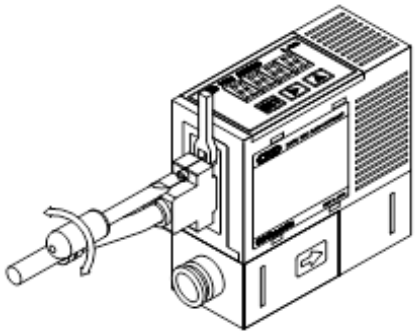
Insulate unused wires to avoid contact with other wires (including the shielded wires).
Connecting unused wires accidentally to the ground may cause the product to malfunction or become damaged.

2.4.1 D-sub connector

⚠ CAUTION

Lock the D-sub connector to prevent it from falling off.

Check the direction of the connector, insert it all the way in, and lock it so that it does not come off.
When loosening the lock, secure the fixing base with a tool.



2.4.2 Cable connection

■ Analog input type

Model number: FCM-□-□0/1/2□

D-sub socket pin no.	1	2	3	4	5	6 to 9	10	11			12	13		14	15
Optional cable insulator color	Brown	Orange	Yellow	-	Red	-	Gray	White			-	Green		Blue	Black
Item	Preset input signal		Integration reset signal	Not used	Power+	Not used	Common	Input signal			Not used	Analog output	Switch output	Error output	Power – (0 V)
Input type	Bit 1	Bit 2			+24 VDC			0 VDC to 10 VDC	0 VDC to 5 VDC	4 mADC to 20 mADC		Output 1 VDC to 5 VDC	NPN or PNP output	NPN or PNP output	

* Pin number 10 is the common terminal for the preset input and the integration reset signals (pin numbers 1 to 3).

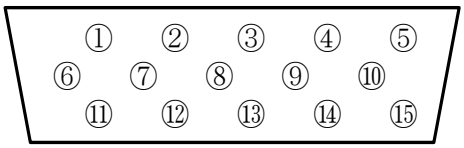
■ Parallel input type

Model number: FCM-□-□P□

D-sub socket pin no.	1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
Optional cable insulator color	Brown	Orange	Yellow	Purple	Red	Light blue	Pink	White (with black line)	Red (with black line)	Gray	White	Green (with black line)	Green		Blue	Black
Item	Parallel input signal				Power+	Parallel input signal				Common	Parallel input signal		Analog output	Switch output	Error output	Power – (0 V)
Input type	Bit 1	Bit 2	Bit 3	Bit 4	+24 VDC	Bit 5	Bit 6	Bit 7	Bit 8		Bit 9	Bit 10	Output 1 VDC to 5 VDC	NPN or PNP output	NPN or PNP output	

* Pin number 10 is the common terminal for the parallel input signals (pin numbers 1 to 4, 6 to 9, 11, and 12).

<Connector pin layout> (product body side)

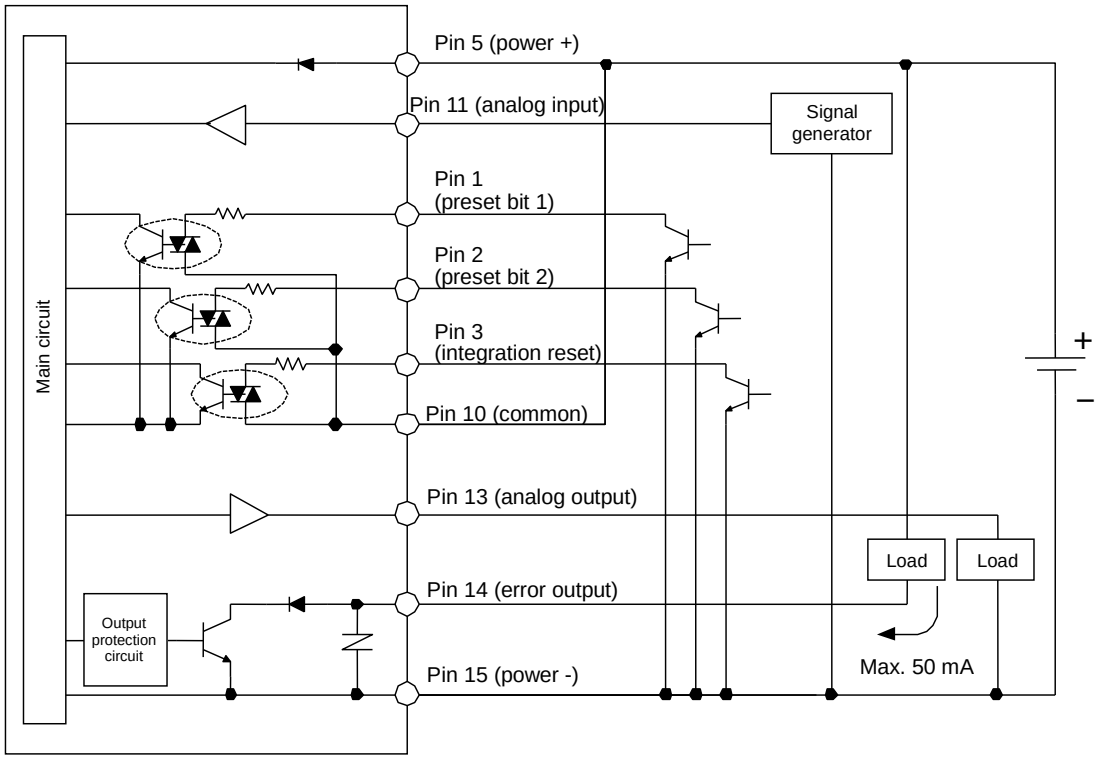


* The analog input type does not have 4, 6, 7, 8, 9 and 12 pins.

2.4.3 Example of internal circuit and load connection

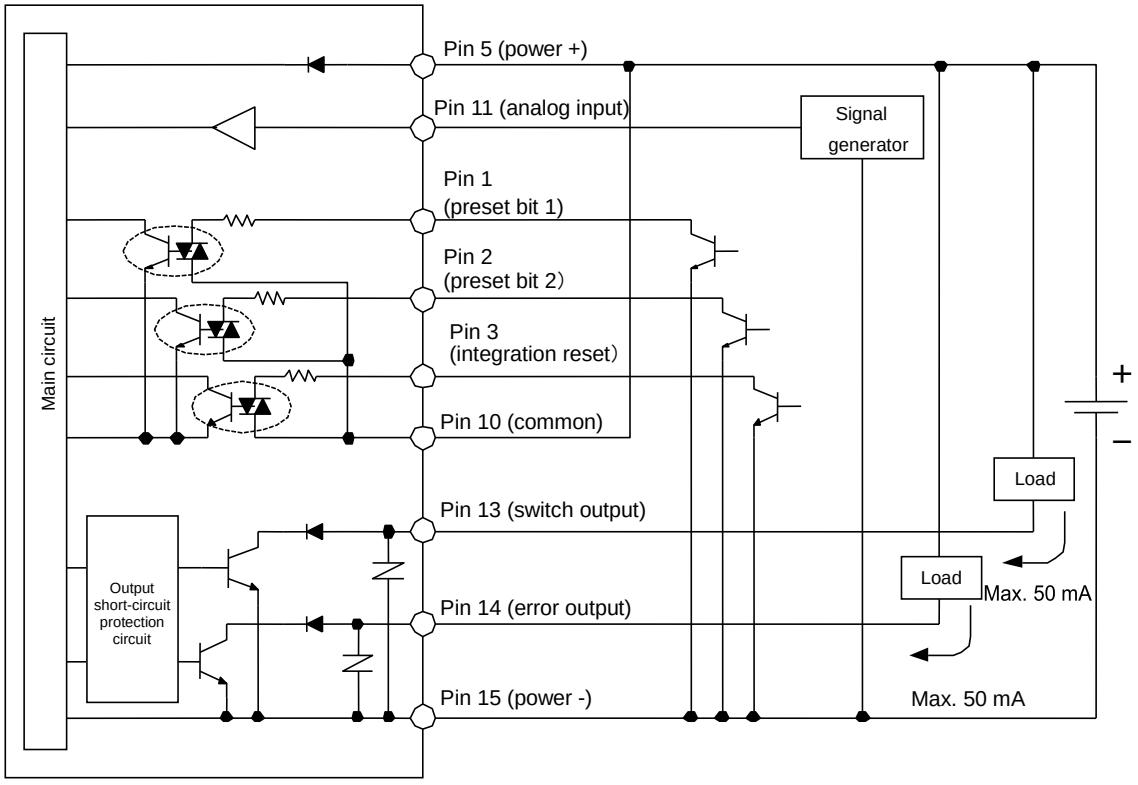
■ Input Type: Analog, Output Type: Analog + error (NPN)

Model number: FCM-☐-☐0/1/2AN☐



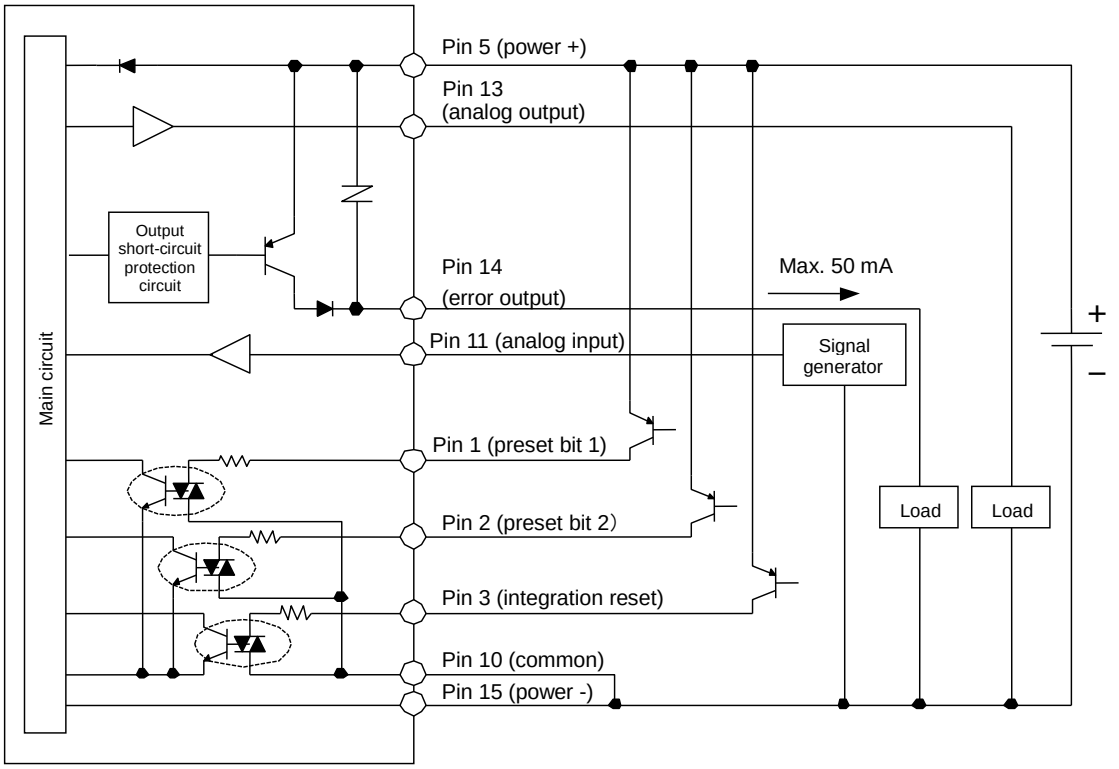
■ Input Type: Analog, Output Type: Switch (NPN) + error (NPN)

Model number: FCM-☐-☐0/1/2SN☐



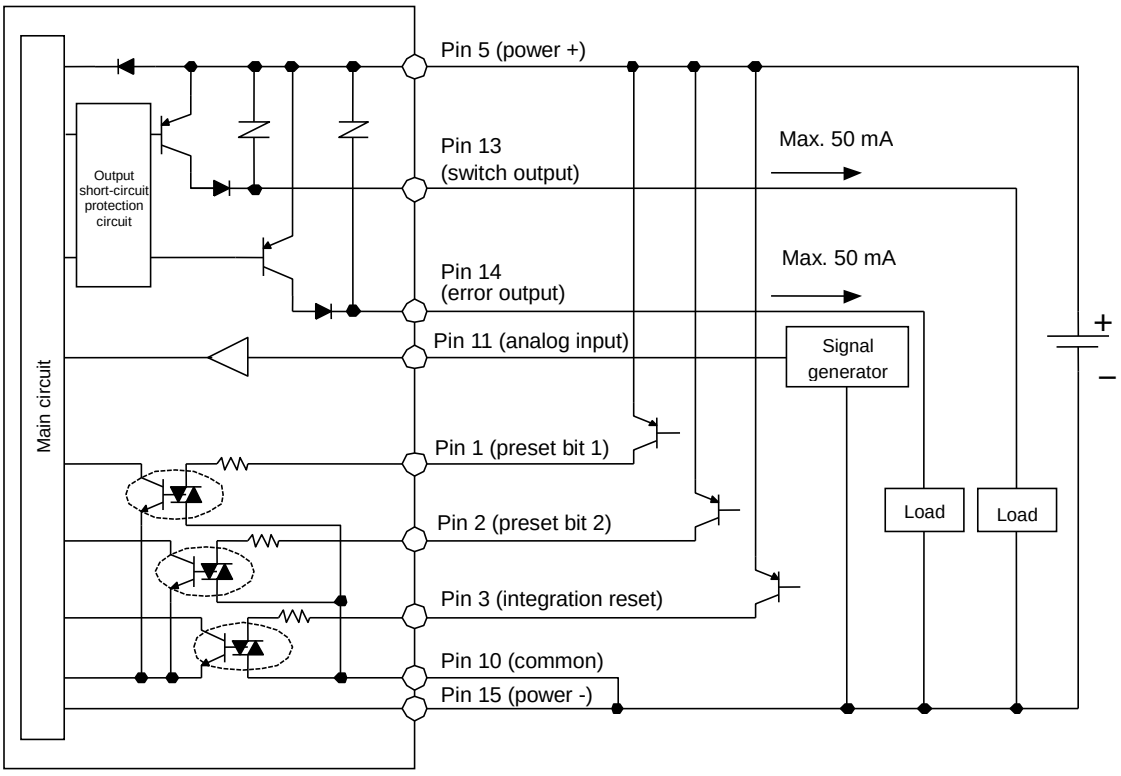
■ Input Type: Analog, Output Type: Analog + error (PNP)

Model number: FCM-☐-☐0/1/2AP☐



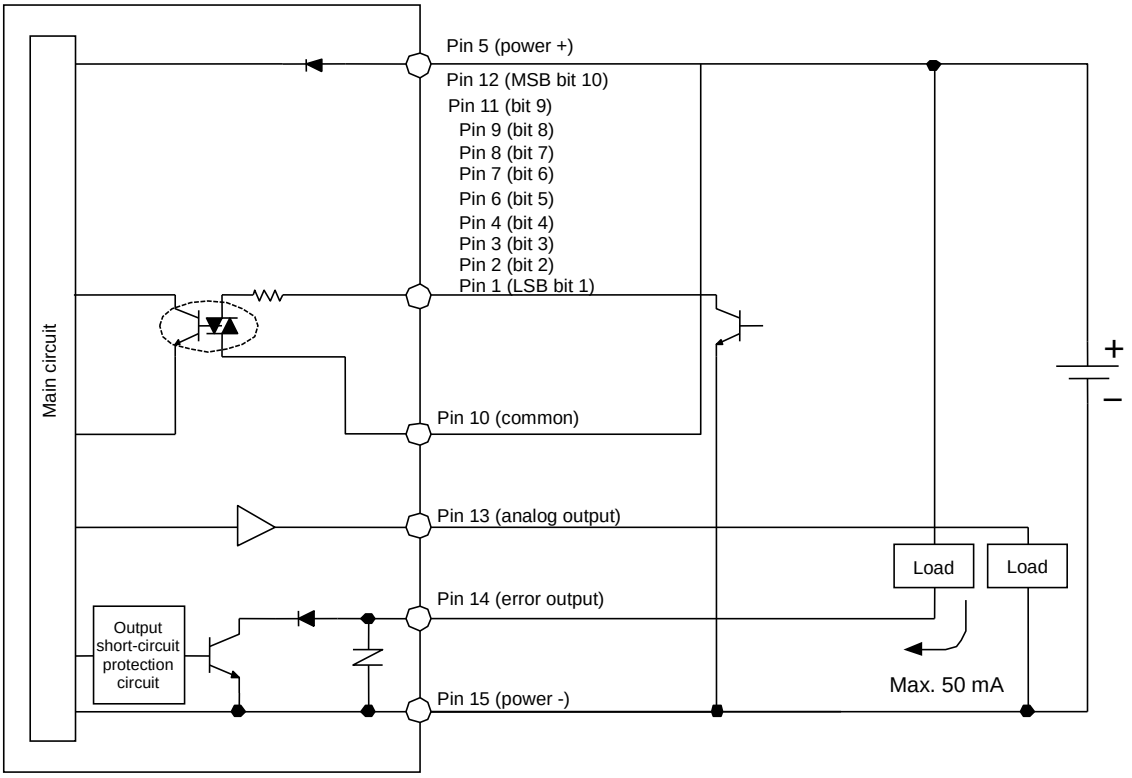
■ Input Type: Analog, Output Type: Switch (PNP) + error (PNP)

Model number: FCM-☐-☐0/1/2SP☐



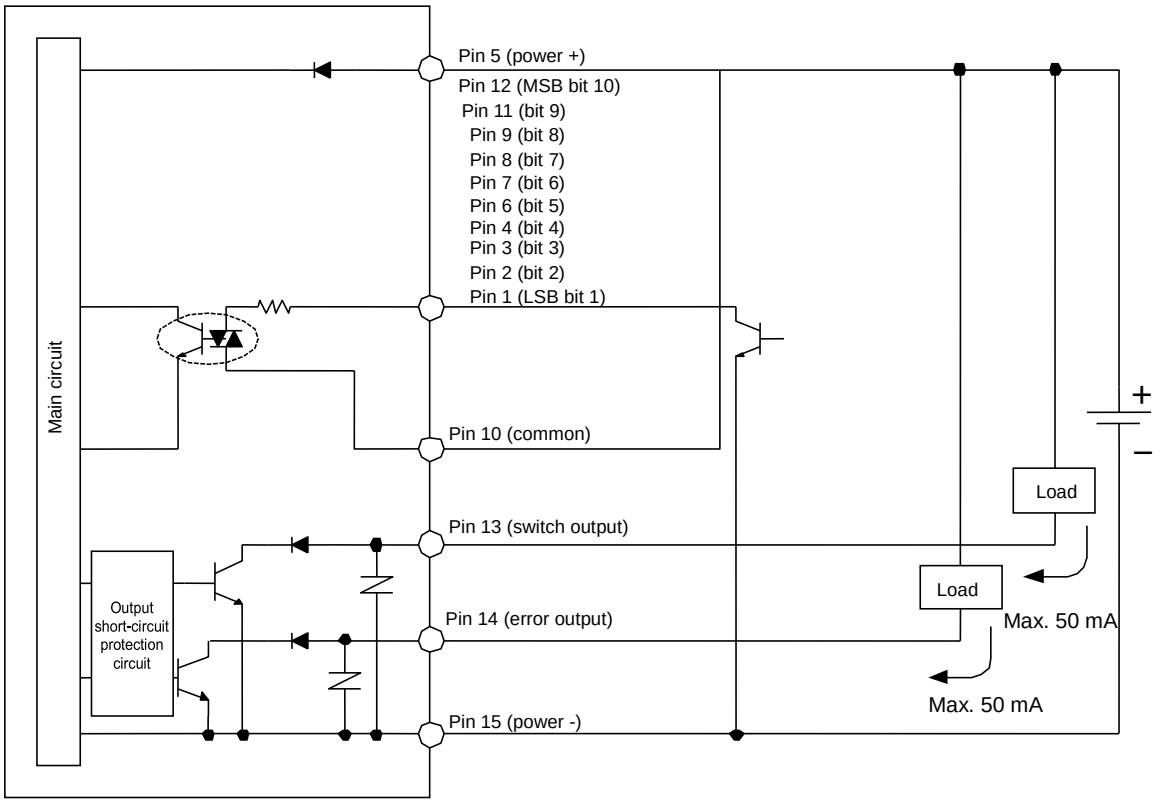
■ Input Type: Parallel, Output Type: Analog + error (NPN)

Model number: FCM-☐-☐PAN☐



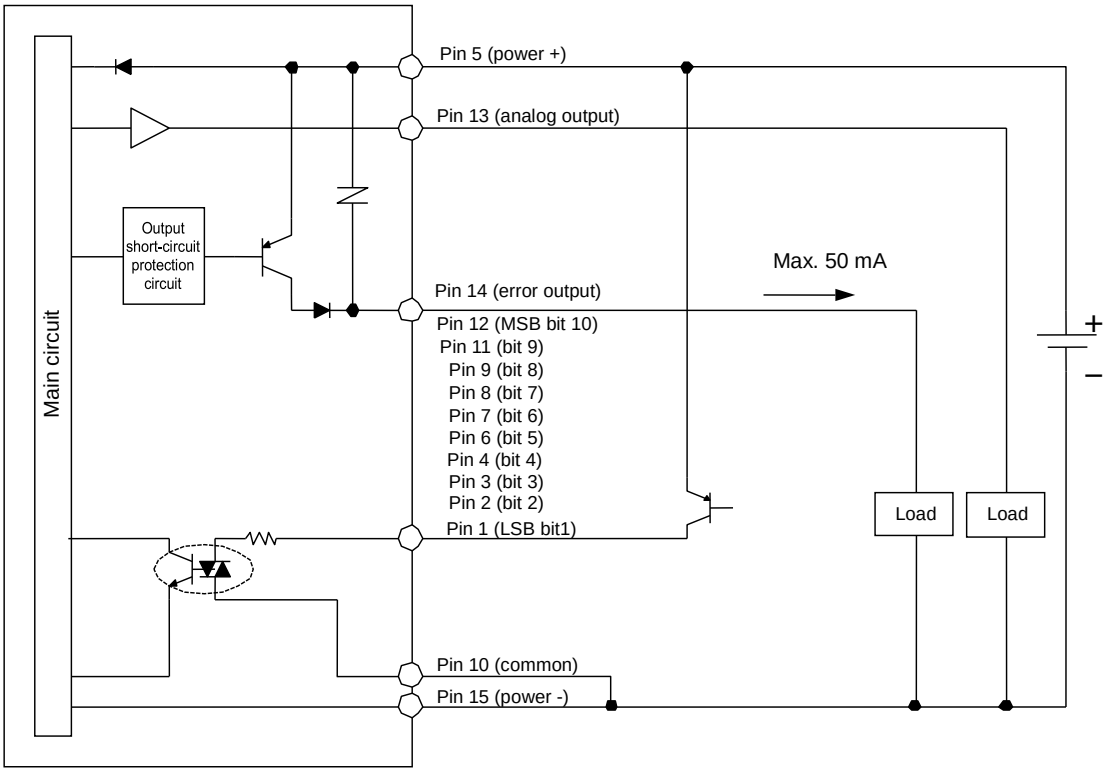
■ Input Type: Parallel, Output Type: Switch (NPN) + error (NPN)

Model number: FCM-☐-☐PSN☐



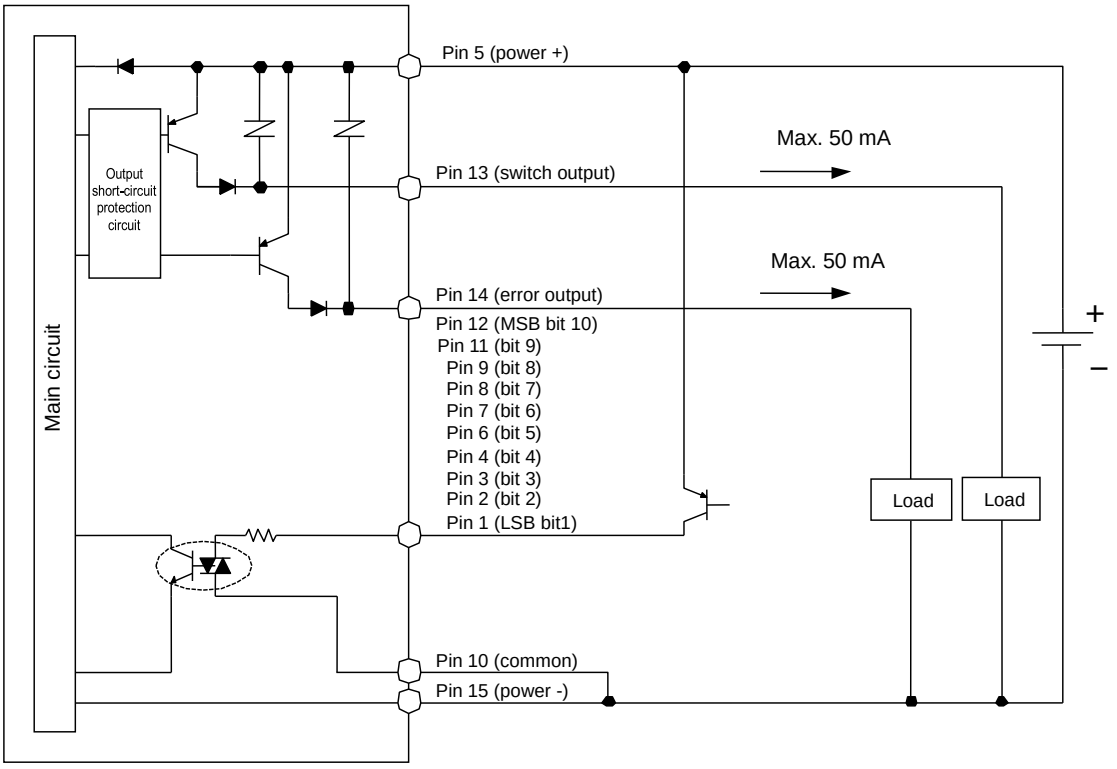
■ Input Type: Parallel, Output Type: Analog + error (PNP)

Model number: FCM-☐-☐PAP☐



■ Input Type: Parallel, Output Type: Switch (PNP) + error (PNP)

Model number: FCM-☐-☐PSP☐



3. USAGE

⚠ WARNING

Warm up the product (at least 10 minutes) before use.
Output accuracy is affected not only by the temperature characteristics but also by the heat generated from energization.

Stop the device before changing the settings of the product.
The control system devices may operate unintentionally.

Do not disassemble or modify the product.
This may lead to a failure.

Install an external shut-off valve if the proportional solenoid valve must fully close.
The proportional solenoid valve in the product does not fully close. When the external shut-off valve is closed, keep the proportional valve fully closed (set flow rate is zero). If the product is controlling normally while the external shut-off valve is closed, excessive fluid will flow instantaneously when the external shut-off valve is opened.
Also, the heat generated from the proportional valve may affect the characteristics. Frequent on/off operation may shorten the service life of the proportional valve depending on the condition of use.

⚠ CAUTION

Observe the conditions of use for conforming to the CE standard.
The product complies with the CE marking requirements of the EMC directive.
Following items are essential for the product to be in conformity to the harmonized standard EN 61000-6-2 related to immunity.

- Cable in which the power line and the signal line are paired and that is evaluated as a signal line.
- Measures against lightning surges on the device side.

⚠ CAUTION

Use the product in places where it is not subject to impacts from falling objects and vibrations since a micro sensor chip is incorporated.

Handle the product as a precision component during installation and transportation.

If an abnormality occurs during operation, immediately stop using the product, turn off the power and contact your dealer.

Create a program and a control circuit that ignores signals for approximately two seconds after energization.

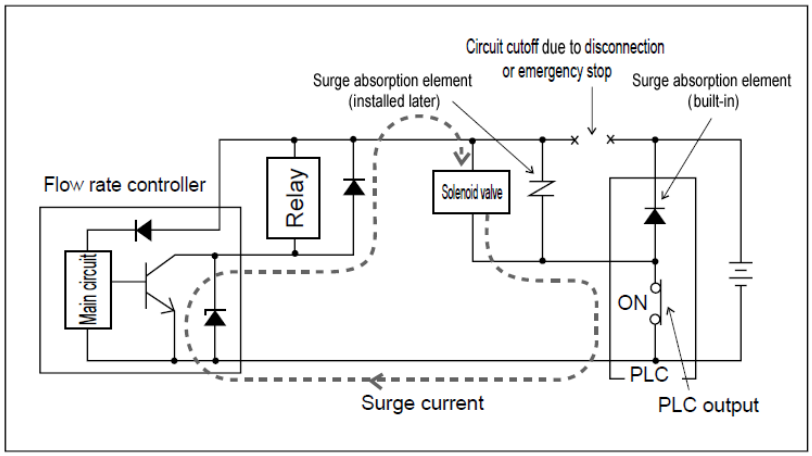
This product will not control the flow rate for approximately two seconds after energization in order to perform a self-diagnosis.

Use the product within the rated flow rate range.

Use the product within the operating differential pressure range.

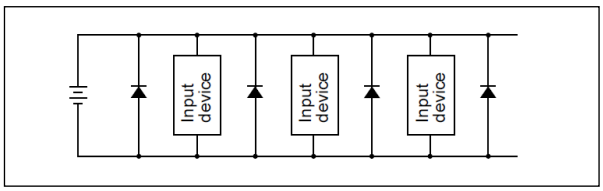
Take measures against loop surge currents if the power supply is shared with an inductive load that generates surge currents.

If the power supply is shared between the product and the inductive load that generates a surge current (such as a solenoid valve or a relay) and the circuit is cut off while the inductive load is functioning, the surge current may enter into the switch output circuit and cause damage depending on where the surge absorption element is installed.



Take the following measures to prevent damage from loop surge currents.

- Separate the power supply for the output systems that act as inductive loads (such as a solenoid valve and a relay) from that for the input systems (such as the flow rate controller).
- If the power supply cannot be separated, directly install a surge absorption element for each inductive load. The surge absorption element connected to a PLC or other devices only protects the individual device that the element is connected.
- Connect a surge absorption element to places on the power wiring shown in the figure below to protect the devices from disconnections at any place.



When the devices are connected to a connector, turn off the power before disconnecting or connecting the connector. If the connector is disconnected while the product is energized, the output circuit may become damaged due to loop surge currents.

3.1 Flow Rate Control

3.1.1 Controlling the flow rate with the direct memory function

The target value can be input with the keys. Even without external input signals, the control flow rate can be freely adjusted with the operation keys. The direct memory function has two action modes.

Direct memory (1): Settings are applied when the value is changed (the flow rate can be changed without confirming the value). This is useful for fine adjustment of the flow rate. Determine the flow rate and then confirm the set value.

Direct memory (2): Settings are applied when the value is confirmed (the flow rate will not change unless the value is confirmed).

■ Operating the direct memory (1)

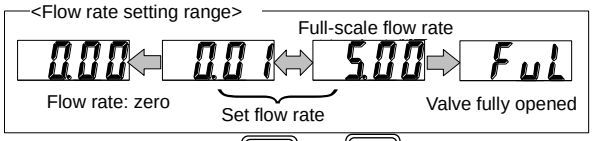
1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key.
The F1: Input signal confirmation screen is displayed and the present input signal type and the input value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

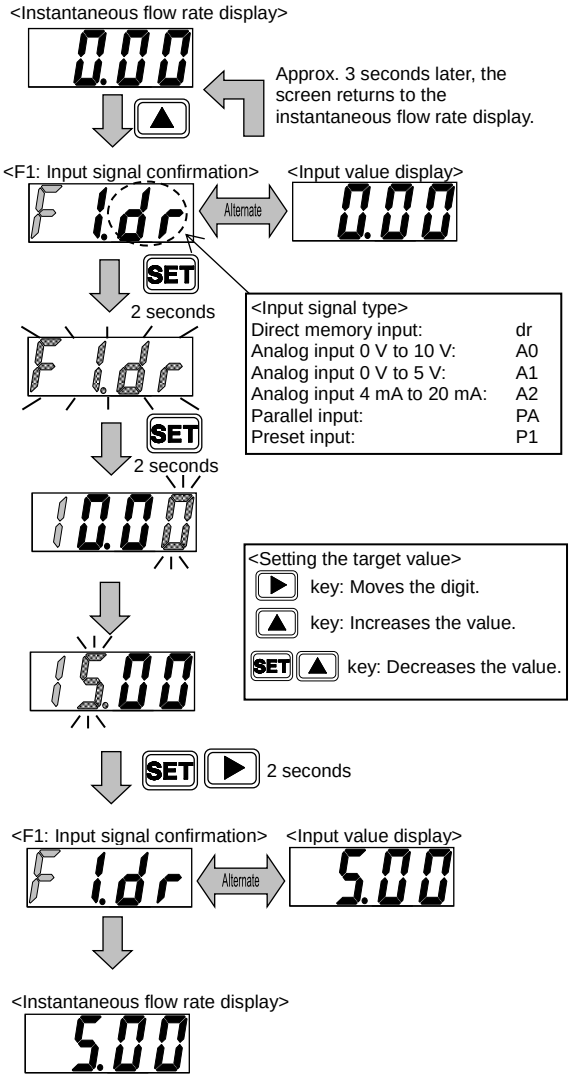
3 Press and hold the SET key for approximately two seconds.
"F1.dr" blinks.

4 Press and hold the SET key for approximately two seconds.
The direct memory (1) setting screen is displayed.

5 Change the value.
The flow rate is changed.
The flow rate can be changed without confirming the value.



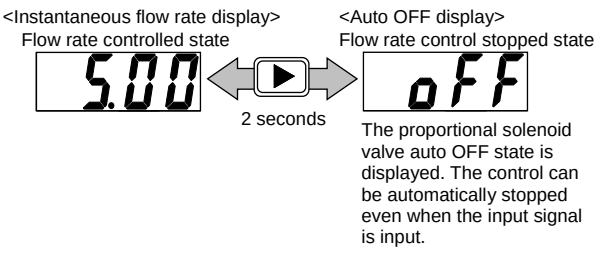
6 Press and hold the SET + ▶ keys for approximately two seconds.
The value is confirmed and the screen returns to the F1: Input signal confirmation screen.
Approximately three seconds later, the screen automatically returns to the instantaneous flow rate display.



■ Operating the auto OFF (flow rate zero)

1 Press and hold the ▶ key for approximately two seconds in the flow rate controlled state (instantaneous flow rate screen).
The control can be automatically stopped (flow rate zero).

2 Press and hold the ▶ key for approximately two seconds in the flow rate control stopped state (auto OFF).
It is possible to return to the flow rate controlled state.



■ Operating the direct memory (2)

1 Turn on the power.
The instantaneous flow rate is displayed.

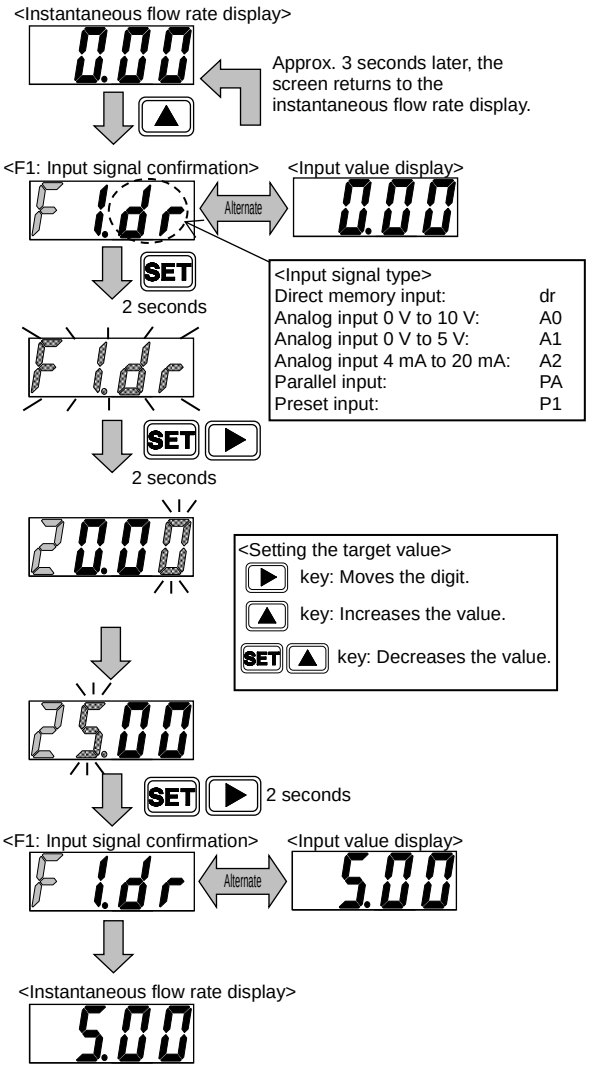
2 Press the ▲ key.
The F1: Input signal confirmation screen is displayed and the present input signal type and the input value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

3 Press and hold the SET key for approximately two seconds.
"F1.dr" blinks.

4 Press and hold the SET + ▶ keys for approximately two seconds.
The direct memory (2) setting screen is displayed.

5 Change the value.
The flow rate will not change unless the value is confirmed.

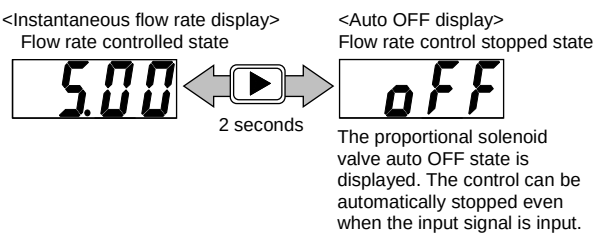
6 Press and hold the SET + ▶ keys for approximately two seconds.
The value is confirmed and the screen returns to the F1: Input signal confirmation screen.
Approximately three seconds later, the screen automatically returns to the instantaneous flow rate display.



■ Operating the auto OFF (flow rate zero)

1 Press and hold the ▶ key for approximately two seconds in the flow rate controlled state (instantaneous flow rate screen).
The control can be automatically stopped (flow rate zero).

2 Press and hold the ▶ key for approximately two seconds in the flow rate control stopped state (auto OFF).
It is possible to return to the flow rate controlled state.



- The control does not stop while setting the direct memory. In situations where safety must be considered, stop the control (auto OFF) before setting the direct memory.
- The flow rate control/auto OFF states (the set values) are maintained even if the power is turned off.

3.1.2 Controlling the flow rate with the preset input function (analog input type only)

The flow rate can be switched by setting four flow rates and inputting a 2-bit signal from an external source.

Example: To control 0, 1, 2, and 5 L/min with preset input, select preset input in the input setting mode, and set the following:
P1: 0 L/min P2: 1 L/min
P3: 2 L/min P4: 5 L/min
When signals are input from a PLC or other controllers according to the table on the right, the flow rate is switched to the flow rate in the memory.

D-sub socket pin no.	2	1	Preset memory no.
Optional cable insulator color	Orange	Brown	
Input type	Bit 2	Bit 1	
Input signal	OFF	OFF	P1
	OFF	ON	P2
	ON	OFF	P3
	ON	ON	P4

■ Controlling with the preset input signal

1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key.
The F1: Input signal confirmation screen is displayed and the present input signal type and the input value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

3 Press and hold the SET key for approximately two seconds.
"F1.dr" blinks.

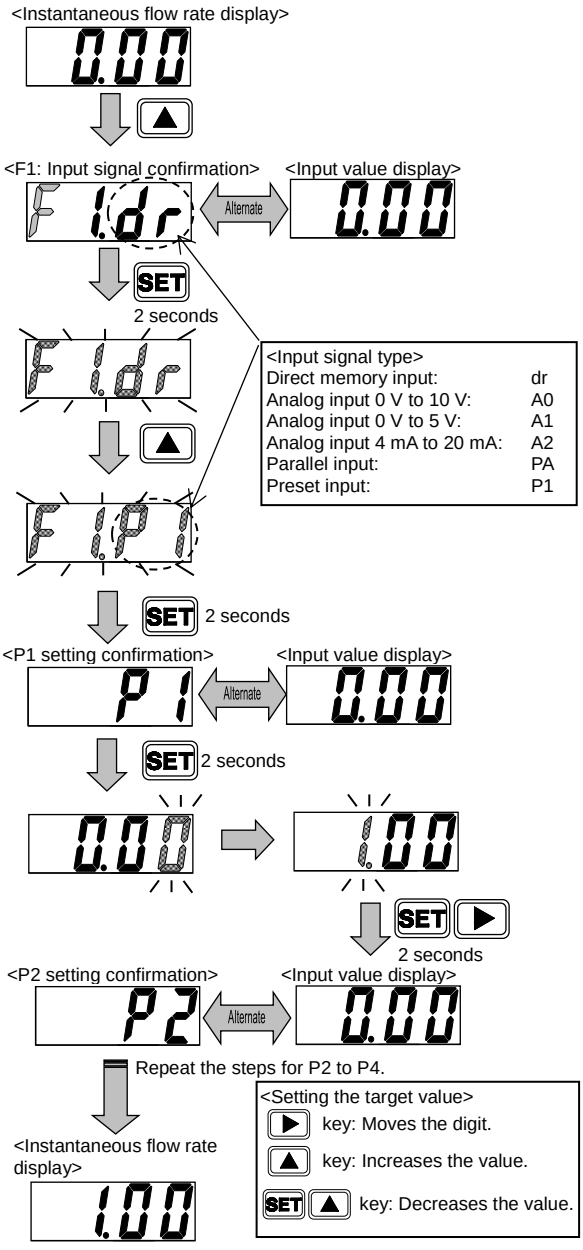
4 Press the ▲ key twice.
"F1.P1" blinks.

5 Press and hold the SET key for approximately two seconds.
The P1 setting confirmation screen is displayed.

6 Press and hold the SET key for approximately two seconds.
The target input screen is displayed. Input the target value.

7 Press and hold the SET + ▶ keys for approximately two seconds.
The target value is set in memory and the P2 setting confirmation screen is displayed.

8 Repeat the same steps to set the target values for P2 to P4.
Approximately three seconds later, the screen automatically returns to the instantaneous flow rate display. The flow rate can be controlled with the preset input.



When switching Bit 1 and Bit 2 at the same time, switch them within 15 msec.
For example, when switching preset memory from P2 to P3, if there is a time lag, an incorrect preset memory number may be set.

3.1.3 Changing the settings with the shortcut keys (only when using the direct memory or preset input functions)

When controlling the flow rate with the direct memory or the preset input, the setting change screen can be displayed with a single key operation using a shortcut key.

- Pressing the shortcut key will display the setting change screen for the input signal that is currently used.
  (Example: The P2 setting change screen is displayed if the flow rate is controlled with the preset input for P2.)
- This cannot be used if the flow rate is controlled with the analog input or the parallel input.

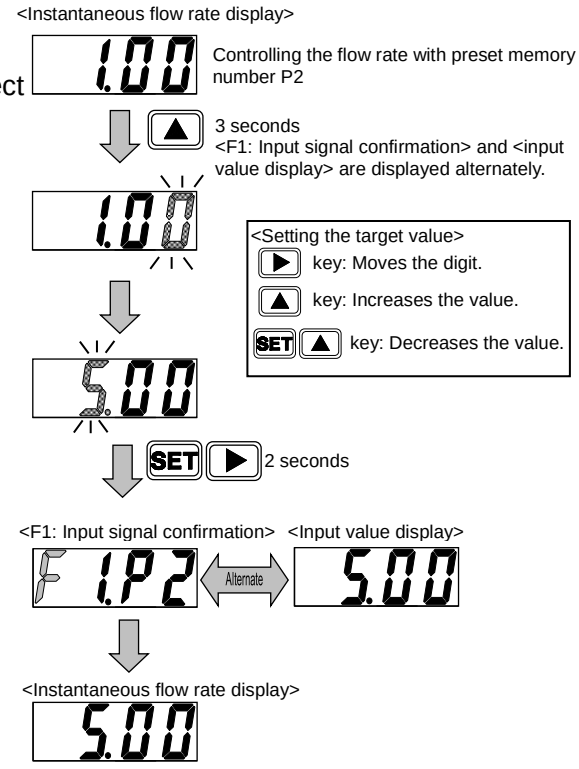
■ Changing the settings with the shortcut keys

1 Turn on the power.
The instantaneous flow rate is displayed.
(This can be used only when controlling with the direct memory or the preset input.)

2 Press and hold the ▲ key for approximately three seconds.
Pressing the ▲ key will display the setting change screen for the input signal that is currently used.

3 Change the value.
The flow rate is changed.
The flow rate can be changed without confirming the value.

4 Press and hold the SET + ▶ keys for approximately two seconds.
The value is confirmed and the screen returns to the F1: Input signal confirmation screen.
Approximately three seconds later, the screen automatically returns to the instantaneous flow rate display.



- Do not change the external preset input while changing the settings with a shortcut key. The setting value may be set in an incorrect preset memory number.
- Data is not saved in the memory if the power is turned off before confirming the value. Make sure to confirm the value before turning the power off.

3.1.4 Controlling the flow rate with the analog input function (analog input type only)

The flow rate can be controlled with analog input signals.

■ Controlling with analog input signals

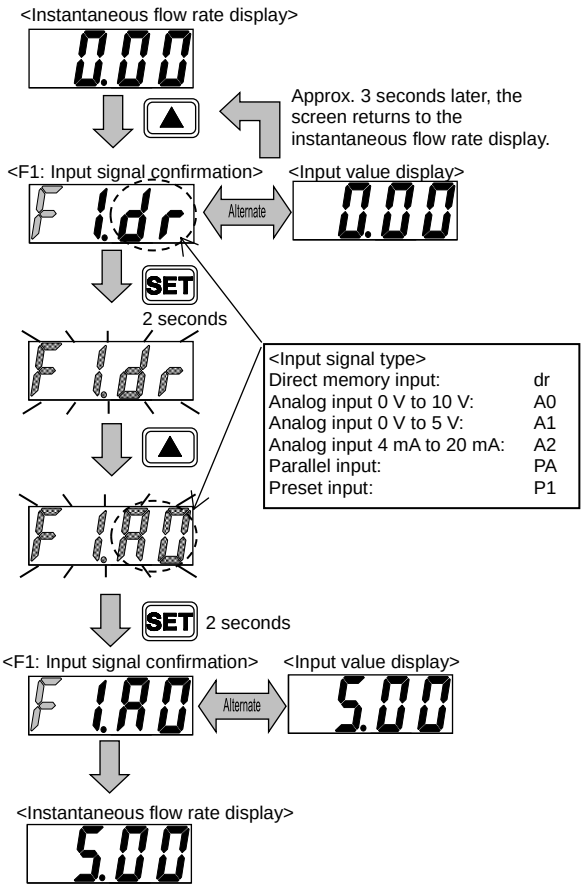
1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key.
The F1: Input signal confirmation screen is displayed and the present input signal type and the input value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

3 Press and hold the SET key for approximately two seconds.
"F1.dr" blinks.

4 Press the ▲ key.
"F1.A0" blinks.
(The value in "□" varies depending on the model number.)

5 Press and hold the SET key for approximately two seconds.
The value is confirmed and the screen returns to the F1: Input signal confirmation screen.
Approximately three seconds later, the screen automatically returns to the instantaneous flow rate display.
The flow rate can be controlled with the analog input.



Fully open (FuL) cannot be set with the analog input.

3.1.5 Controlling the flow rate with the parallel input function (parallel input type only)

The flow rate can be controlled with a parallel 10-bit signal (signal from PLC or other controllers). An expensive I/O device, such as a D/A converter, is not required. The parallel input signal is 10-bit and ranges from 0 to 1023 when converted to a decimal number. The resolution is approximately 0.1%.

Following formula shows the relationship between the parallel input signal and the control flow rate.

Input signal = set flow rate/full-scale flow rate x 1023

Example: Input signal for setting 300 mL/min when the full-scale flow rate is 500 mL/min
300 (mL/min)/500 (mL/min) x 1023 = 613.8 --> 614

When 614 (a decimal number) is converted to a binary number, it becomes 1001100110. "1" sets the input signal to ON and "0" sets the input signal to OFF (refer to the following table).

D-sub socket pin no.	12	11	9	8	7	6	4	3	2	1
Optional cable insula tor color	Green (with black line)	White	Red (with black line)	White (with black line)	Pink	Light blue	Purple	Yellow	Orange	Brown
Input type	Bit10 MSB	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1 LSB
Binary [For 614 (decimal)]	1	0	0	1	1	0	0	1	1	0
Input signal	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF

■ Controlling with parallel input signals

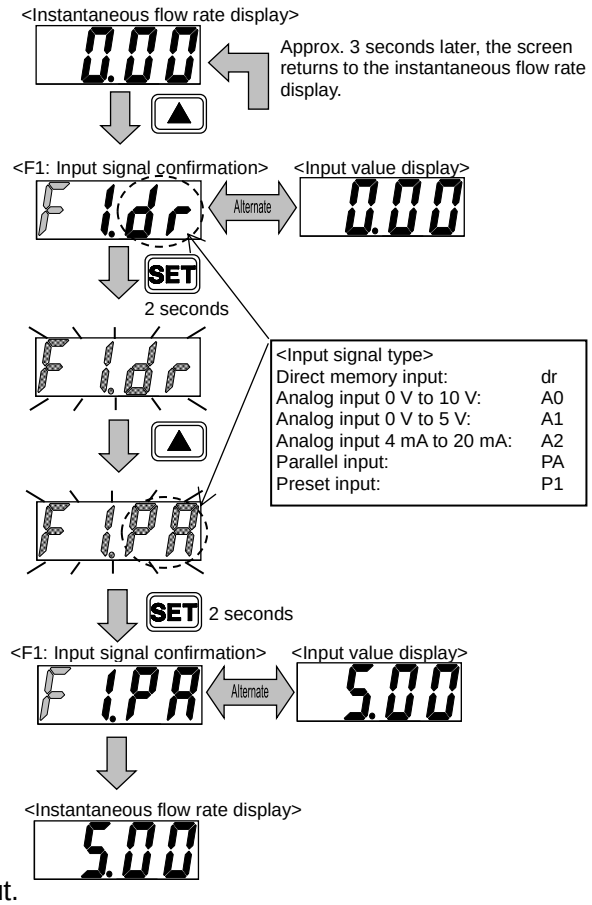
1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key.
The F1: Input signal confirmation screen is displayed and the present input signal type and the input value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

3 Press and hold the SET key for approximately two seconds.
"F1.dr" blinks.

4 Press the ▲ key.
"F1.PA" blinks.

5 Press and hold the SET key for approximately two seconds.
The setting is confirmed and the screen returns to the F1: Input signal confirmation.
Approximately three seconds later, the screen automatically returns to the instantaneous flow rate display.
The flow rate can be controlled with the parallel input.



- Fully open (FuL) cannot be set with the parallel input.
- If a high resolution is not required, the number of input points can be decreased.
  Example: If a resolution of approximately 2% is acceptable, the control can be made by inputting only six points (0 to 63 when converted to a decimal number).
  In this case, by short-circuiting the Bit 5 to Bit 1 in the table above as one bit (LSB) and turning the input signal ON/OFF, the flow rate can be controlled with six points.

3.2 Flow Rate Integration

3.2.1 Displaying the integrated flow rate

The integrated flow rate can be displayed. The display range is as shown in the following table.

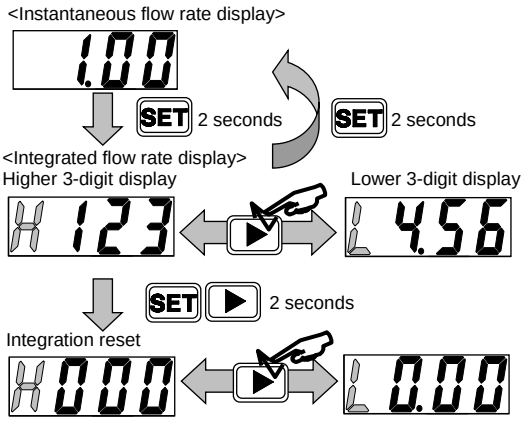
Model: FCM-		9500 L9500	0001 L0001	0002 L0002	0005 L0005	0010 L0010	0020	0050	0100
Flow rate display	Display range	0 to 500 mL/min	0.00 to 1.00 L/min	0.00 to 2.00 L/min	0.00 to 5.00 L/min	0.0 to 10.0 L/min	0.0 to 20.0 L/min	0.0 to 50.0 L/min	0 to 100 L/min
Integration	Display range	999999 mL	9999.99 L	9999.99 L	9999.99 L	99999.9 L	99999.9 L	99999.9 L	999999 L
	Display resolution	1 mL	0.01 L	0.01 L	0.01 L	0.1 L	0.1 L	0.1 L	1 L
	Pulse output rate	5 mL	0.01 L	0.02 L	0.05 L	0.1 L	0.2 L	0.5 L	1 L

■ Displaying the integrated flow rate

1 Turn on the power.
Integration in the instantaneous flow rate display starts. (The integrated value is reset when the power is turned off.)

2 Press and hold the SET key for approximately two seconds.
The integrated flow rate screen is displayed.
To return to the instantaneous flow rate display, press and hold the SET key for approximately two seconds.
Move the digit by pressing the ▶ key.

3 Press and hold the SET + ▶ keys for approximately two seconds.
The integration is reset. For analog input type, the integration can be reset with the external input (pin number 3). Integrated value is also reset when the power is turned off.



3.2.2 Closing the proportional solenoid valve at the set integrated flow rate

The proportional solenoid valve is closed when the flow rate reaches the set integrated flow rate. This is suitable for a process where filling with a certain amount of flow rate is necessary.

■ Operation

1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key five times.
The F5: Integration automatic shut-off setting screen is displayed. If the integration automatic shut-off is enabled, "F5.on" and the present set value are displayed alternately. (After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

3 Press and hold the SET key for approximately two seconds.
"F5.--" blinks.

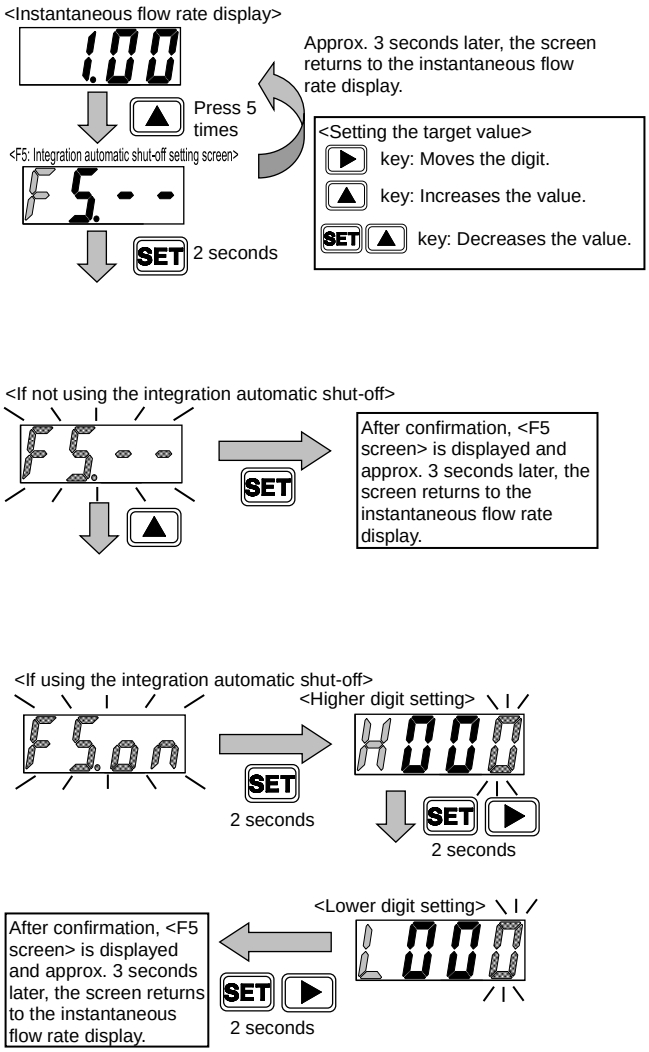
4 If not using the integration automatic shut-off, press and hold the SET key for approximately two seconds.
The F5 screen is displayed and approximately three seconds later, the screen returns to the instantaneous flow rate screen.

5 To use the integration automatic shut-off, press the ▲ key.
"F5.on" blinks.

6 Press and hold the SET key for approximately two seconds to set the higher digit.

7 Press and hold the SET + ▶ keys for approximately two seconds to set the lower digit.

8 Press and hold the SET + ▶ keys for approximately two seconds.
The F5 screen is displayed and approximately three seconds later, the screen returns to the instantaneous flow rate screen.



- Only in this mode, the integrated value is reset when the input signal becomes zero (enabled only after automatic shut-off).
- When the flow rate reaches the set integrated flow rate, the proportional solenoid valve is automatically shut off and the switch operates.
- If the display for automatic shut-off is "OFF", the switch output indicator does not turn on. The screen returns to the flow rate screen when the integrated value is reset (key input or external input).
- The automatic shut-off function cannot be disabled during automatic shut-off unless the integrated value is reset.
- The integrated value is reset when the automatic shut-off is set to "on" and a value is set.
- After changing the settings, reset the integrated flow rate value.

3.2.3 Outputting the integrated pulse (switch output type only)

The integrated pulse is output. For the pulse rate, refer to "1.2 Specifications". For the switch output cable connection, refer to "2.4.2 Cable connection" and "2.4.3 Example of internal circuit and load connection".

■ Operation

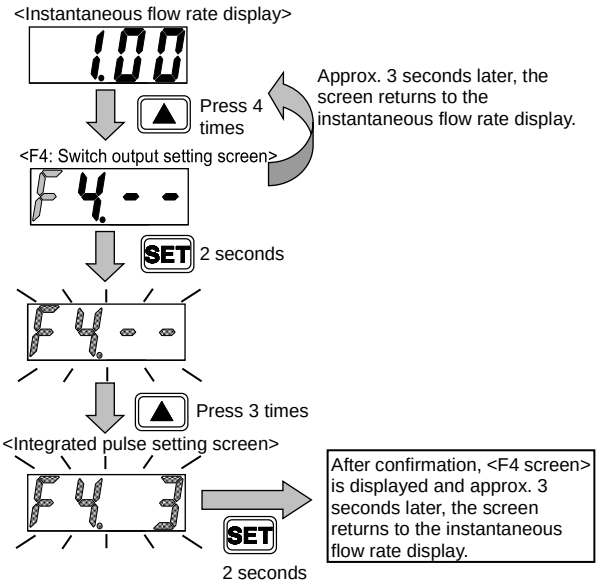
1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key four times.
The F4: Switch output setting screen is displayed.
If the switch output setting is enabled, "F4.□" and the present set value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

3 Press and hold the SET key for approximately two seconds.
The switch output setting mode is displayed.

4 Press the ▲ key three times.
"F4. 3" blinks.

5 Press and hold the SET key for approximately two seconds.
The integrated pulse output is confirmed and the screen returns to the F4 screen.
Approximately three seconds later, the screen returns to the instantaneous flow rate screen.



3.2.4 Turning the switch ON with the set integrated flow rate (switch output type only)

The switch output is turned ON at the set integrated flow rate.
For the switch output cable connection, refer to "2.4.2 Cable connection" and "2.4.3 Example of internal circuit and load connection".

■ Operation

1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key four times.
The F4: Switch output setting screen is displayed.
If the switch output setting is enabled, "F4.□" and the present set value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

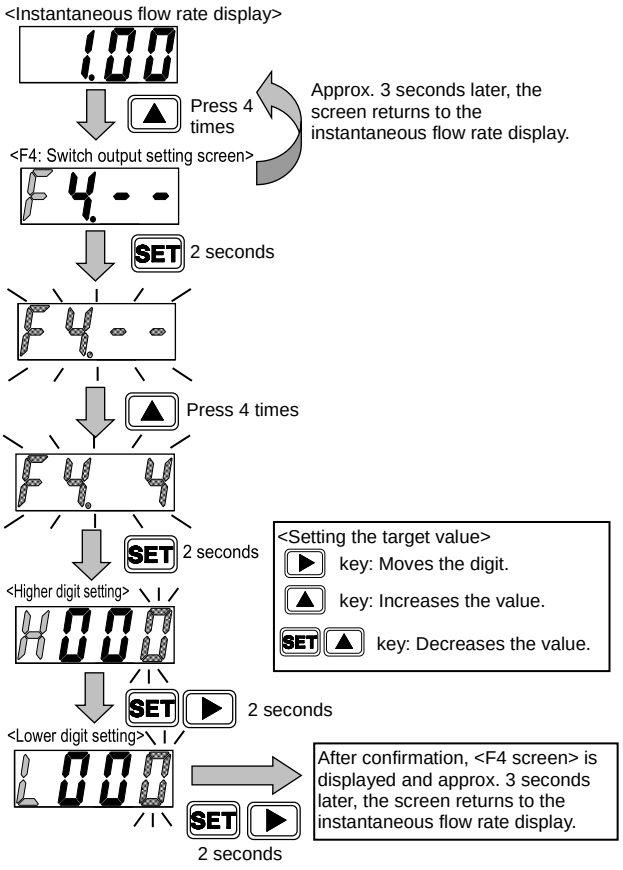
3 Press and hold the SET key for approximately two seconds.
The switch output setting mode is displayed.

4 Press the ▲ key four times.
"F4. 4" blinks.

5 Press and hold the SET key for approximately two seconds.
The target setting screen is displayed.

6 Set the higher three digits of the target value and press and hold the SET + ▶ keys for approximately two seconds.

7 Set the lower three digits of the target value and press and hold the SET + ▶ keys for approximately two seconds.
The integrated value is reset after the target value is confirmed.
The F4 screen is displayed and approximately three seconds later, the screen returns to the instantaneous flow rate screen.



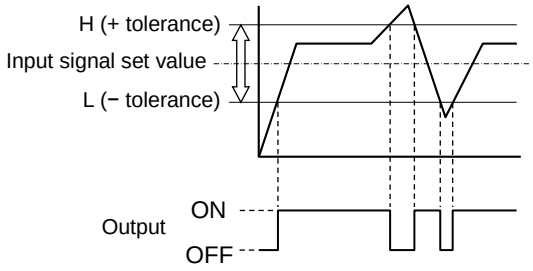
After changing the settings, reset the integrated flow rate value.

3.3 Switch Output (Switch Output Type Only)

3.3.1 Using the tolerance mode

The switch output turns ON when the actual flow rate is within the tolerance of the input signal set value.

Both the plus side and the minus side of the tolerance can be set and are set as %FS (full-scale).
For the switch output cable connection, refer to "2.4.2 Cable connection" and "2.4.3 Example of internal circuit and load connection".



■ Operation

1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key four times.
The F4: Switch output setting screen is displayed.
If the switch output setting is enabled, "F4.☐" and the present set value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

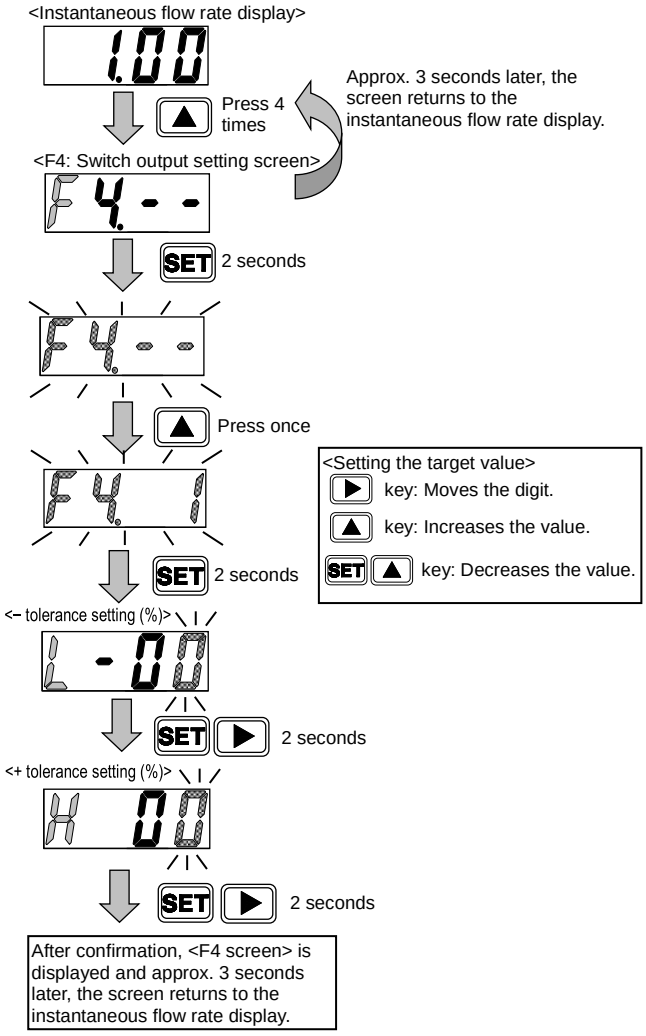
3 Press and hold the SET key for approximately two seconds.
The switch output setting mode is displayed.

4 Press the ▲ key.
"F4. 1" blinks.

5 Press and hold the SET key for approximately two seconds.
The target setting screen is displayed.

6 Set the tolerance value (minus side) and press and hold the SET + ▶ keys for approximately two seconds.
Minus side setting range: −50%FS to 0%FS

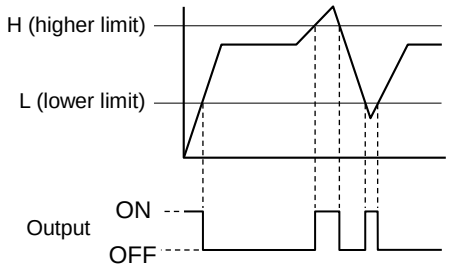
7 Set the tolerance value (plus side) and press and hold the SET + ▶ keys for approximately two seconds.
Plus side set range: 0%FS to 50%FS
The F4 screen is displayed and approximately three seconds later, the screen returns to the instantaneous flow rate screen.



No tolerance is set for "FuL" (fully open).
Note that if the input signal is changed to "FuL" (fully open) while using the switch output in the tolerance mode, the switch output settings will maintain the tolerance of the previously input tolerance values.

3.3.2 Using the designated range mode

The switch output turns ON when the actual flow rate is outside the specified range. Higher and lower limit values are set regardless of the input signal set value (control target value).
Both the higher and lower limits can be set and are set as %FS (full-scale).
For the switch output cable connection, refer to "2.4.2 Cable connection" and "2.4.3 Example of internal circuit and load connection".



■ Operation

1 Turn on the power.
The instantaneous flow rate is displayed.

2 Press the ▲ key four times.
The F4: Switch output setting screen is displayed.
If the switch output setting is enabled, "F4.□" and the present set value are displayed alternately.
(After approximately three seconds without pressing any key, the screen returns to the instantaneous flow rate display.)

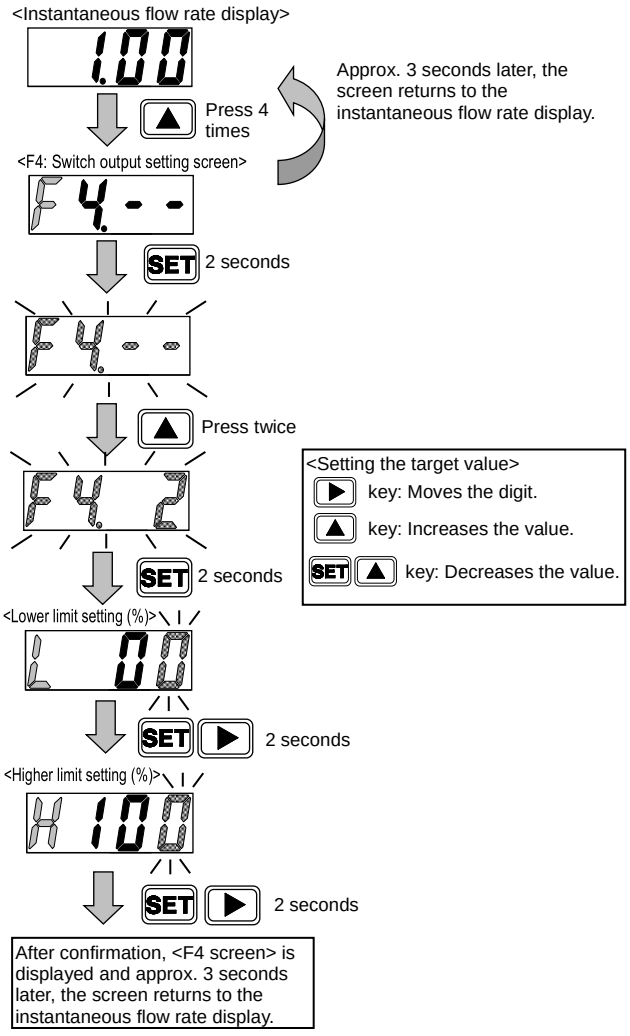
3 Press and hold the SET key for approximately two seconds.
The switch output setting mode is displayed.

4 Press the ▲ key twice.
"F4. 2" blinks.

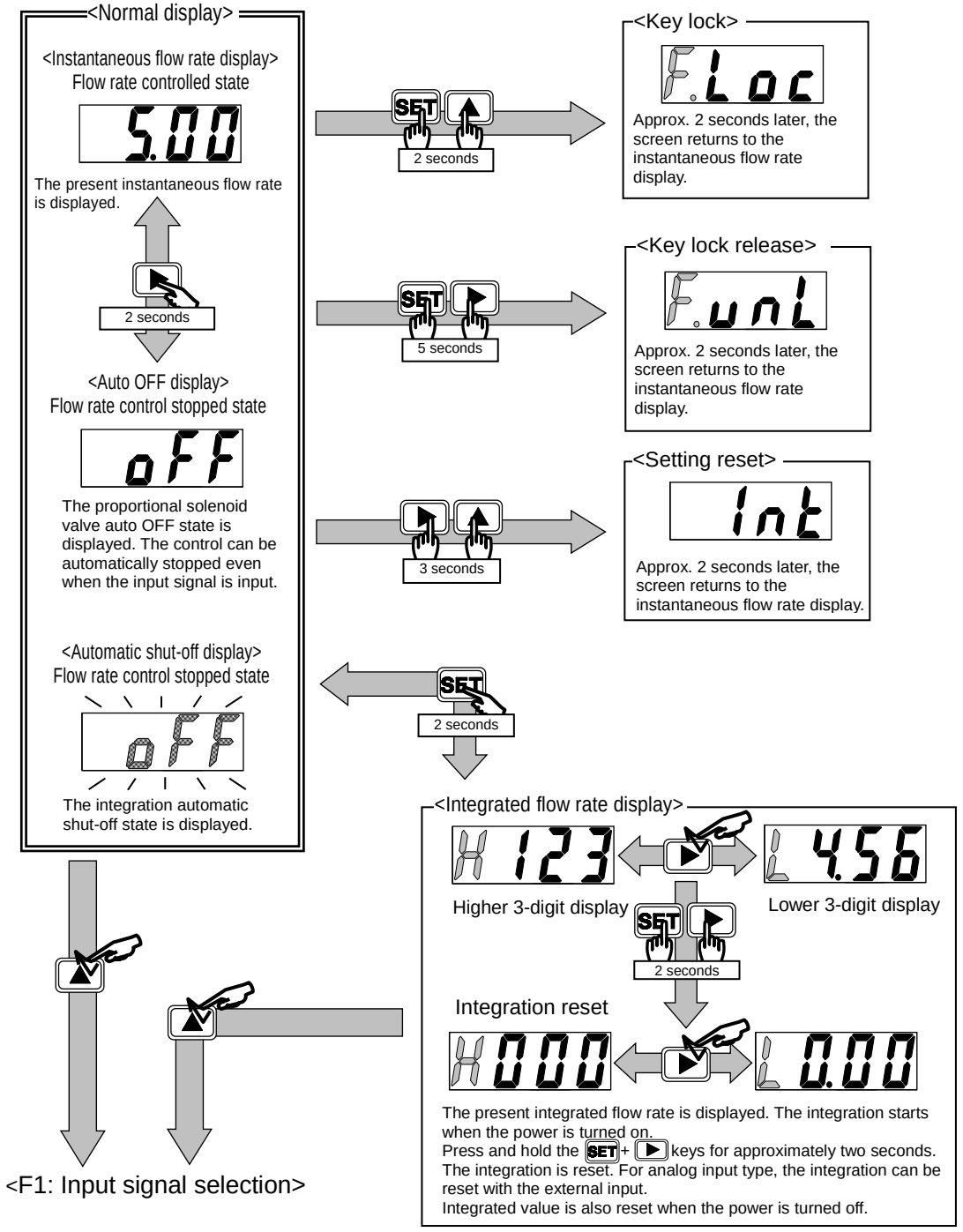
5 Press and hold the SET key for approximately two seconds.
The target setting screen is displayed.

6 Set the lower limit value and press and hold the SET + ▶ keys for approximately two seconds.
Lower limit setting range: 0%FS to 90%FS

7 Set the higher limit value and press and hold the SET + ▶ keys for approximately two seconds.
Higher limit setting range: 10%FS to 100%FS
Note that the difference between the higher and lower limits must be 10%FS or more.
The F4 screen is displayed and approximately three seconds later, the screen returns to the instantaneous flow rate screen.

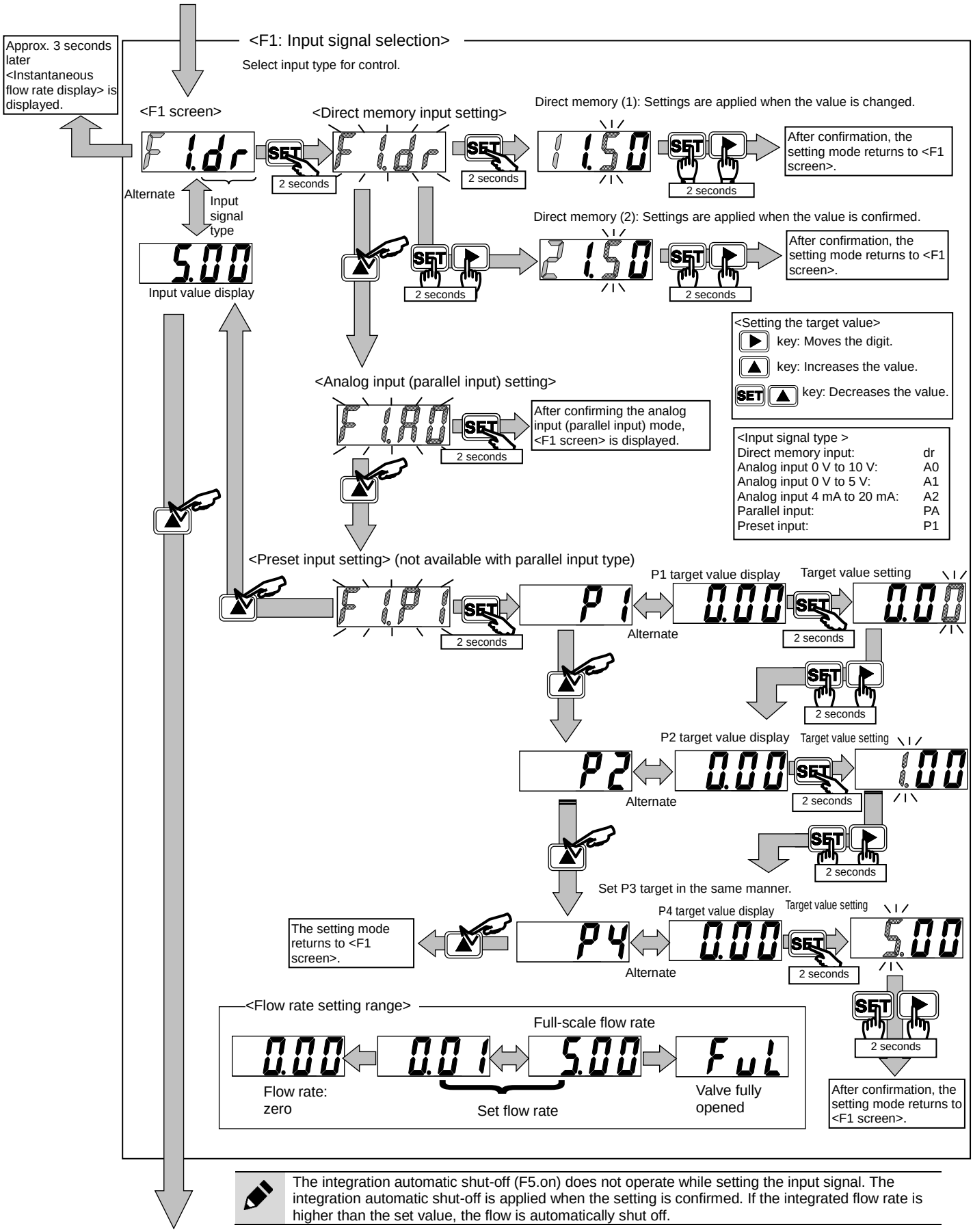


3.4 Operation Flow



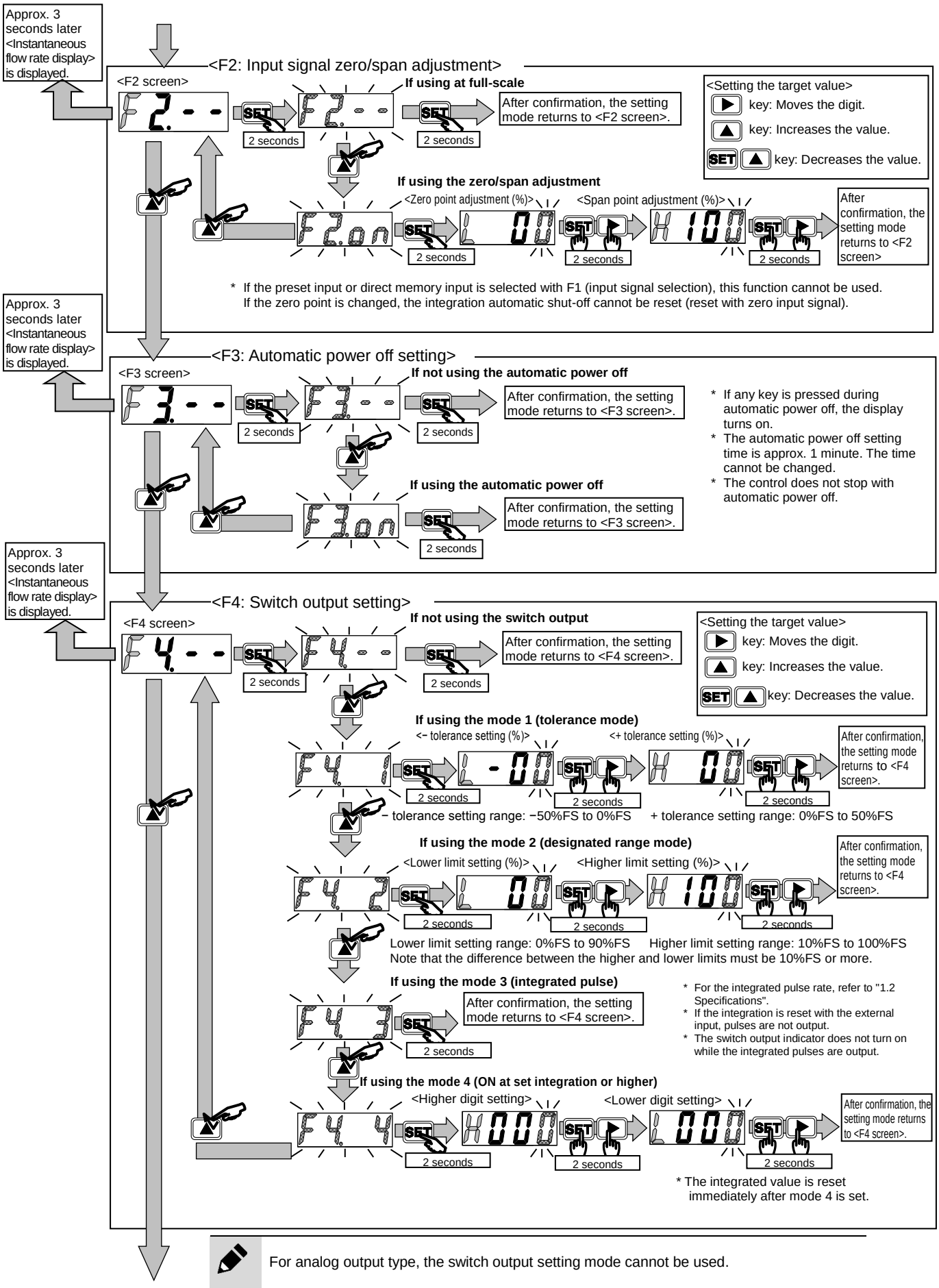
The key lock is disabled before shipping from the factory. Lock the key as necessary.
The key lock state (enabled/disabled) is maintained even if the power is turned off.

- When the key lock is enabled, only auto OFF operation is allowed.
- To disable the key lock, press SET + ▶ keys for approximately five seconds.
- The control does not stop while setting the F1: Input signal selection or the F2: Input signal zero/span adjustment. In situations where safety must be considered, stop the control (auto OFF) before making these settings.
- The settings/auto OFF state are maintained even if the power is turned off.



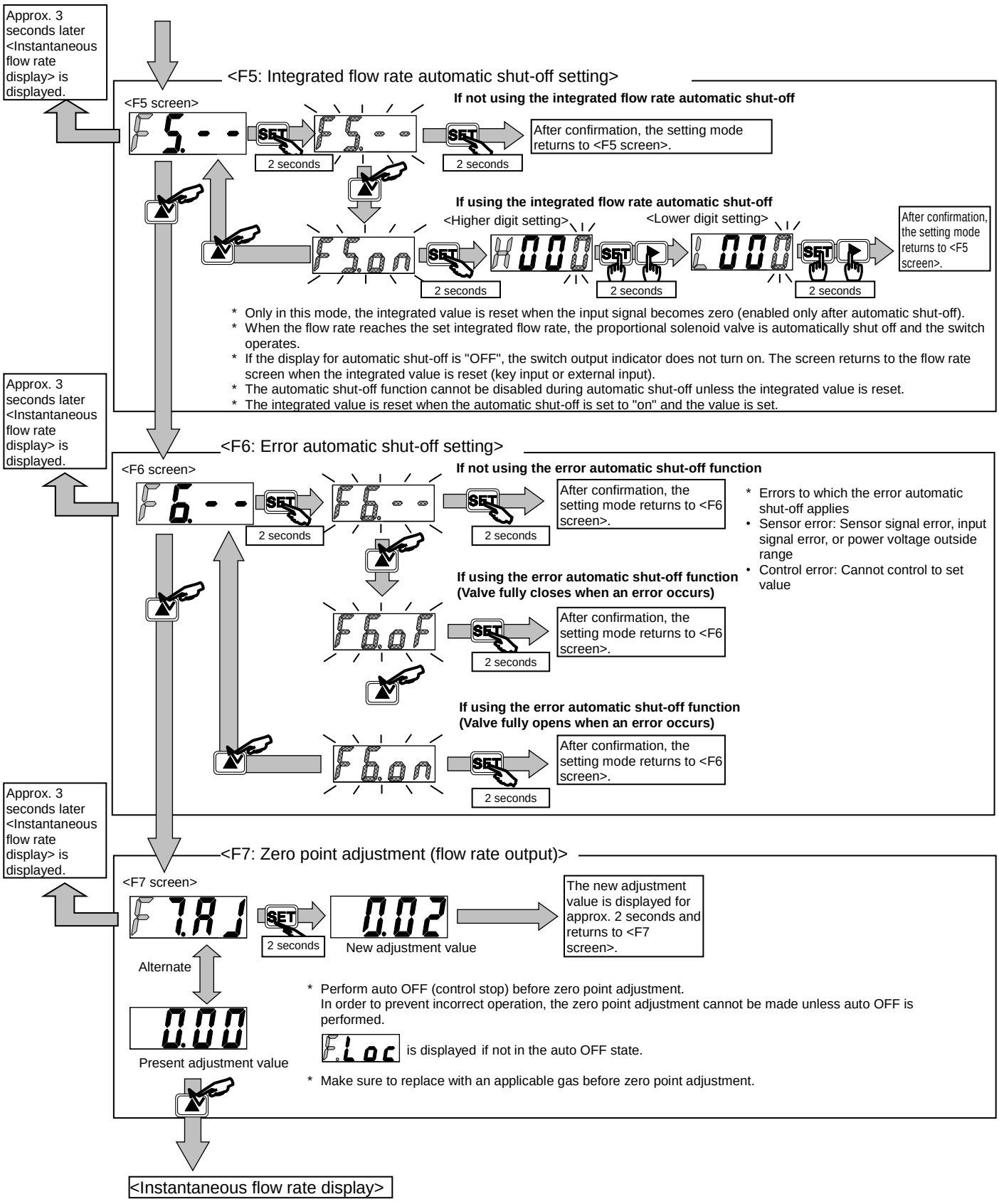
The integration automatic shut-off (F5.on) does not operate while setting the input signal. The integration automatic shut-off is applied when the setting is confirmed. If the integrated flow rate is higher than the set value, the flow is automatically shut off.

<F2: Input signal zero/span adjustment>



For analog output type, the switch output setting mode cannot be used.

<F5: Integrated flow rate automatic shut-off setting>


Approx. 3 seconds later <Instantaneous flow rate display> is displayed.
<F5: Integrated flow rate automatic shut-off setting>
<F5 screen>
SET
2 seconds
If not using the integrated flow rate automatic shut-off
After confirmation, the setting mode returns to <F5 screen>.
If using the integrated flow rate automatic shut-off
<Higher digit setting>
<Lower digit setting>
After confirmation, the setting mode returns to <F5 screen>.
* Only in this mode, the integrated value is reset when the input signal becomes zero (enabled only after automatic shut-off).
* When the flow rate reaches the set integrated flow rate, the proportional solenoid valve is automatically shut off and the switch operates.
* If the display for automatic shut-off is "OFF", the switch output indicator does not turn on. The screen returns to the flow rate screen when the integrated value is reset (key input or external input).
* The automatic shut-off function cannot be disabled during automatic shut-off unless the integrated value is reset.
* The integrated value is reset when the automatic shut-off is set to "on" and the value is set.
Approx. 3 seconds later <Instantaneous flow rate display> is displayed.
<F6: Error automatic shut-off setting>
<F6 screen>
If not using the error automatic shut-off function
After confirmation, the setting mode returns to <F6 screen>.
* Errors to which the error automatic shut-off applies
• Sensor error: Sensor signal error, input signal error, or power voltage outside range
• Control error: Cannot control to set value
If using the error automatic shut-off function (Valve fully closes when an error occurs)
After confirmation, the setting mode returns to <F6 screen>.
If using the error automatic shut-off function (Valve fully opens when an error occurs)
After confirmation, the setting mode returns to <F6 screen>.
Approx. 3 seconds later <Instantaneous flow rate display> is displayed.
<F7: Zero point adjustment (flow rate output)>
<F7 screen>
New adjustment value
The new adjustment value is displayed for approx. 2 seconds and returns to <F7 screen>.
Alternate
Present adjustment value
* Perform auto OFF (control stop) before zero point adjustment.
In order to prevent incorrect operation, the zero point adjustment cannot be made unless auto OFF is performed.
is displayed if not in the auto OFF state.
* Make sure to replace with an applicable gas before zero point adjustment.
<Instantaneous flow rate display>

4. TROUBLESHOOTING

4.1 Problems, Causes, and Solutions

If the product does not operate as intended, check the table below for a possible solution.

Problem	Cause	Solution
Setting cannot be changed.	Key is locked.	Release the key lock according to "3.4 Operation Flow" and then change the settings.
	Operation keys do not work.	Replace the product.
Flow rate does not display.	Automatic power off function is enabled.	Press any operation key. * If the display turns on and then off after one minute, the automatic power off function is enabled. * Refer to "3.4 Operation Flow" to disable the automatic power off.
	Power supply is not connected correctly.	Connect the rated power correctly.
	There is disconnection inside FCM.	Replace the product.
	Connector is not connected correctly due to deformed connector pin.	Replace the product.
	Cable is disconnected.	Replace the cable.
Switch output does not turn ON.	Switch output is disabled.	Refer to "3.3 Switch Output (Switch Output Type Only)".
	There is a failure in FCM.	Replace the product.
	Connector is not connected correctly due to deformed connector pin.	Replace the product.
	Cable is disconnected.	Replace the cable.
	Cable for switch output is not wired.	Refer to "2.4 Wiring".
	Wiring is not correct. Note 1	Refer to "2.4 Wiring".
	Input specification of control device and switch output specification of FCM do not match (e.g. PLC with NPN connected to FCM with PNP).	Refer to "2.4 Wiring".
	Analog output type is used. Note 2	Replace with the switch output type.
	Switch output action mode is incorrect. Note 3	Refer to "1.4 Functions ".
Switch output does not turn OFF.	Switch output is enabled.	Refer to "3.3 Switch Output (Switch Output Type Only)".
	There is a failure in FCM.	Replace the product.
	Wiring is not correct. Note 1	Refer to "2.4 Wiring".
	Input specification of control device and switch output specification of FCM do not match (e.g. PLC with NPN connected to FCM with PNP).	Refer to "2.4 Wiring".
	Switch output action mode is incorrect. Note 3	Refer to "1.4 Functions".
Flow rate is unstable.	Differential pressure is above operating differential pressure range.	Decrease the primary side pressure.
	Fluctuation of primary side pressure is large.	Install a regulator on the primary side.
	There is an interference with regulator.	Change the set pressure of the regulator.
	There is a large pressure loss between regulator and FCM. (Fluctuation of primary side pressure is large due to changing flow rate.)	Shorten and widen the pipe.
	There is a failure in FCM.	Replace the product.
	Flow rate on secondary side is restricted.	Do not restrict the flow rate with flow rate adjustment valve, or widen the pipe.
	Flow rate from primary side is insufficient.	Check the primary pressure or piping condition.

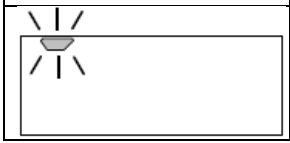
Problem	Cause	Solution
Flow rate display does not become zero.	Zero point of sensor is not aligned correctly.	Perform zero point adjustment of the sensor. Refer to "3.4 Operation Flow".
	There is a failure in FCM.	Replace the product.
	Warm-up time is insufficient.	Since the product is affected by heat generated from energization, warm up the product (energize at least 10 minutes before use).
	Fluid in product has not been replaced with applicable fluid.	Replace with an applicable fluid before use.
	Sensor display is incorrect due to foreign matters inside.	Replace the product and install a filter on the primary side of the product to prevent foreign matters from entering inside.
Fluid does not flow.	Differential pressure is below operating differential pressure range.	Increase the primary side pressure.
	Differential pressure is above operating differential pressure range.	Decrease the primary side pressure.
	Ambient temperature is high.	Lower the ambient temperature.
	Integration automatic shut-off function is enabled.	Reset the integration automatic shut-off. Refer to "3.2 Flow Rate".
	Error automatic shut-off function is enabled.	Check "4.2 Error Code" and eliminate the cause of the error.
	Input signal and action mode do not match.	Check the input signal.
	There is a failure in FCM.	Replace the product.
	Proportional solenoid valve is fully closed due to auto OFF.	Turn off the auto OFF function.
Excessive fluid flows.	Input signal is input with no primary side pressure supplied.	Supply the primary side pressure and then input the input signal.
	Input signal is input with secondary side valve of FCM closed.	Open the secondary side valve of FCM and then input the input signal.
	Differential pressure is above operating differential pressure range.	Decrease the primary side pressure.
	There is a failure in FCM.	Replace the product.
	"FuL" (fully open) is set in preset or direct memory mode.	Refer to "3.1 Flow Rate".
Accuracy is poor.	Regulator is vibrating to some degree.	Change the set pressure of the regulator.
	Foreign matter is adhering to sensor.	Replace the product.
	Non-applicable gas is used.	Use an applicable gas.
Integrated flow rate is zero and does not change.	Integrated value reset signal (external input) is ON.	Set the integrated value reset signal (external input) to OFF. Refer to "2.4 Wiring".
	Integration reset is enabled due to incorrect wiring.	Refer to "2.4 Wiring".

Note 1: There are two output types, NPN and PNP, and each type needs different wiring.
Note 2: The analog output type does not have a switch output function.
Note 3: The operation pattern differs in the tolerance mode and the designated range mode.

If you have any other questions or concerns, contact your nearest CKD sales office or distributor.

4.2 Error Code

Basically, errors are reset automatically. If an error is not reset automatically, perform auto OFF or turn off the power, confirm the cause and correct the errors according to the table below. Then, turn off the auto OFF function or turn on the power again.

Display	Cause	Solution
	Supplied power voltage is outside the rated range. (Detected at 19.5 VDC or less. Detection accuracy is ± 10%FS.)	● Check the product power specifications and adjust the power voltage so that it is within the rated range.
	Input signal exceeds the rated range. (Detected at input of 110%FS or more. Detection accuracy is ± 1%FS.)	● Check the product input signal type and adjust the input signal so that it is within the rated range.
	Error occurred during EEPROM reading or writing.	● Contact your nearest CKD sales office or distributor.
	Error occurred during memory reading or writing.	● Contact your nearest CKD sales office or distributor.
	Flow rate does not maintain the set value for five or more consecutive seconds. (Detected when difference between set value and control value is ± 20%FS or more. Detection accuracy is ± 6%FS. No error is detected when set flow rate is 20%FS or less.)	● Check the primary side pressure and supply pressure that is within the rated operating differential pressure range; or, perform auto OFF (control stop) to reset the error. ● Check that there is no leakage from the pipes, fittings, or other components and correct the connections. ● Contact your nearest CKD sales office or distributor.
	Output error occurs in sensor.	● Stop supplying fluid to the product and set the flow rate to zero. If this error occurs again, contact your nearest CKD sales office or distributor.
	Switch output overcurrent protection circuit is activated.	● Check that the load current does not exceed the rated range and correct the connections.

5. WARRANTY PROVISIONS

5.1 Warranty Conditions

■ Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified below, 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:

- 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 this Instruction Manual.
- Failure caused by incorrect use such as careless handling or improper management.
- Failure not caused by the product.
- Failure caused by use not intended for the product.
- Failure caused by modifications/alterations or repairs not carried out by CKD.
- Failure that could have been avoided if the customer's machinery or device, into which the product is incorporated, had functions and structures generally provided in the industry.
- Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
- 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.

■ Confirmation of product compatibility

It is the responsibility of the customer to confirm compatibility of the product with any system, machinery, or device used by the customer.

■ Others

The terms and conditions of this warranty stipulate basic matters.
When the terms and conditions of the warranty described in individual specification drawings or the Specifications are different from those of this warranty, the specification drawings or the Specifications shall have a higher priority.

5.2 Warranty Period

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