CKD

Compact Flow Rate Controller

Rapiflow® FCM Series
RS-485 type

INSTRUCTION MANUAL

SM-A49916-A

- 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 RS-485 Type" 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.
(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.)

- 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.

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.

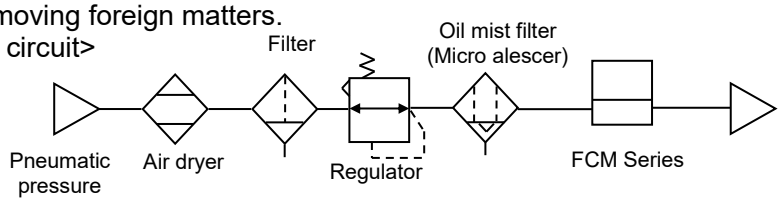
Use the product within the fluid temperature range of 0°C to 50°C.
Even if the temperature is within the specified range, do not use the product in places where sudden changes in the temperature may cause condensation.

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 rate characteristics of the regulator on the primary side.
Depending on the flow rate 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.

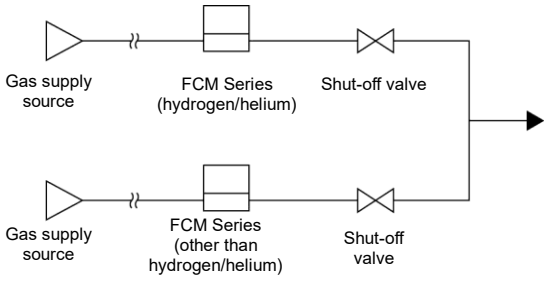
Vaporize liquefied gases such as propane gas before use.
Flowing liquefied gas into the product may cause failures.

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. The resin may 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.

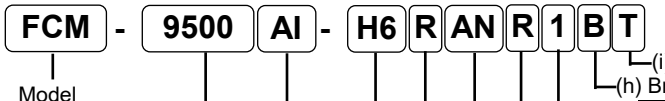
The flow rate displayed on the product is the volumetric flow rate converted from the mass flow rate.
The measured mass flow rate is converted to the volumetric flow rate at 20°C, 1 atmospheric pressure (101 kPa), and 65% RH.

CONTENTS

1. PRODUCT OVERVIEW

1.1 Model Number Indication

1.1.1 General gas model



Symbol		Description
(a) Flow rate range		
Applicable fluid		
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

Applicable fluid	AI	AR	O2	LN	C1	C3
9500	●	●	●	●	●	●
0001	●	●	●	●	●	●
0002	●	●	●	●	●	●
0005	●	●	●	●	●	●
0010	●	●	●	●	●	●
0020	●	●				
0050	●	●				
0100	●					
L9500	●		●	●	●	●
L0001	●		●	●	●	●
L0001	●		●	●	●	●
L0005	●		●	●	●	●
L0010	●		●	●	●	●

(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	
R	RS-485

(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	Parallel 15-conductor cable, 1 m
3	Parallel 15-conductor cable, 3 m

(h) Bracket Note 2	
Blank	None
B	Bracket

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

■Example of model number indication

FCM-0001AI-H8RANR1BK

(a) Flow rate range : 0 L/min to 1 L/min
(b) Applicable fluid : Compressed air, nitrogen
(c) Port size/body material : Push-in φ8, resin body only
(d) Input signal : RS-485
(e) Output specification : 1 V to 5 V, analog, error (NPN)
(f) Display direction : Upside-down
(g) Cable : Parallel 15-conductor cable, 1 m
(h) Bracket : Bracket
(i) Traceability : Inspection report

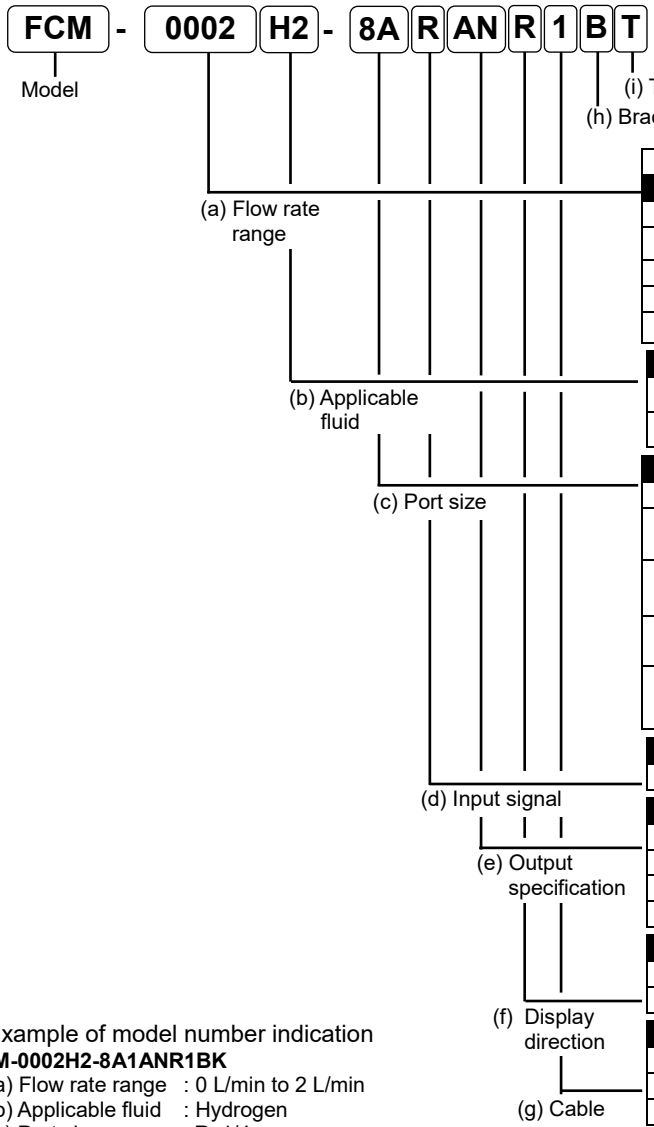
Option model number

	Symbol	Description
*	**RC1**	Parallel 15-conductor cable, 1 m
*	**RC3**	Parallel 15-conductor cable, 3 m
	LB1	Bracket

*The cable body is the same as FCM-PC1 and PC3.

Note 1: Refer to “1.4 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



Symbol	Description		
(a) Flow rate range			
Applicable fluid		**H2**	**HE**
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	●	●

(b) Applicable fluid	
H2	Hydrogen
HE	Helium

(c) Port size			
Port size		**H2**	**HE**
8A	Rc1/4	●	●
UF Note 1	9/16-18UNF	●	●
4S	1/4-inch Double bite-type fitting	●	●
4RM	1/4-inch JXR male fitting	●	●

(d) Input signal	
R	RS-485

(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	Parallel 15-conductor cable, 1 m
3	Parallel 15-conductor cable, 3 m

(h) Bracket Note 2	
Blank	None
B	Bracket

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

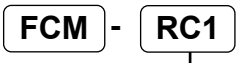
Note 1: Refer to “1.4 Dimensions” for the 9/16-18UNF screw shape.
Note 2: Items (g), (h), and (i) are delivered with the product when selected.

■ 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 : RS-485
(e) Output specification : 1 V to 5 V analog, error (NPN)
(f) Display direction : Upside-down
(g) Cable : Parallel 15-conductor cable, 1 m
(h) Bracket : Bracket
(i) Traceability : Inspection report

Option model number



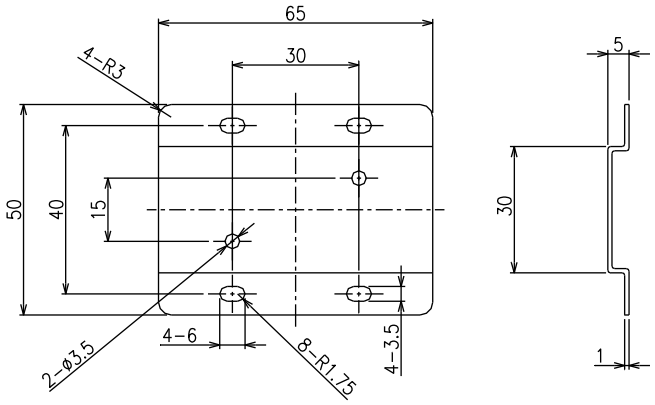
	Symbol	Description
*	**RC1**	Parallel 15-conductor cable, 1 m
*	**RC3**	Parallel 15-conductor cable, 3 m
	LB1	Bracket

*The cable body is the same as FCM-PC1 and PC3.

1.1.3 Optional parts

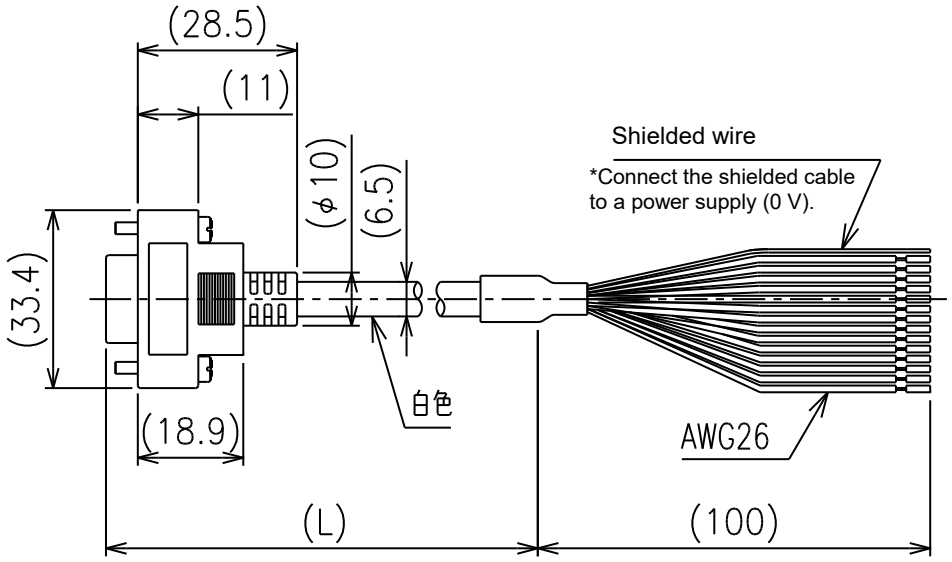
■ Dedicated bracket

Model number: FCM-LB1



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

Model Number: FCM-RC1 and RC3



Model number	Length	Number of cores
FCM-RC1	1000	15
FCM-RC3	3000	15

1.2 Specifications

1.2.1 General gas model

Item \ Model no.				FCM-[(a)] [(b)]-[(c)] R [(d)] [(e)][(f)][(g)] (Input signal)						
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	●	●	●	●	●	●
			0001	1 L/min	●	●	●	●	●	●
			0002	2 L/min	●	●	●	●	●	●
			0005	5 L/min	●	●	●	●	●	●
			0010	10 L/min	●	●	●	●	●	●
			0020	20 L/min	●	●				
			0050	50 L/min	●	●				
			0100	100 L/min (resin body only)	●					
		Low differential pressure type (stainless steel only)	L9500	500 mL/min	●		●	●	●	●
			L0001	1 L/min	●		●	●	●	●
			L0002	2 L/min	●		●	●	●	●
			L0005	5 L/min	●		●	●	●	●
			L0010	10 L/min	●		●	●	●	●
Applicable fluid Note 2	(b)		AI	Compressed air, nitrogen	●					
			AR	Argon		●				
			O2	Oxygen (oil-prohibited specification)			●			
			LN	City gas (13A) Note 3				●		
			C1	Methane (CH4 100%)					●	
			C3	Propane (C3H8 100%)						●
Port size/body material	(c)		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	9/16-18UNF, stainless steel body	●	●	●	●	●	●
Control	Control range			3%F.S. to 100%F.S.						
	Response time	(a)	9500 to 0020	Within 0.5 sec at setting ± 5%F.S. (TYP)						
			0050 to 0100	Within 1 sec at setting ± 5%F.S. (TYP)						
	Accuracy			± 3%F.S. or less						
	Repeatability			± 1%F.S. 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.

Item \ Model no.				FCM-[(a)] [(b)]-[(c)] R [(d)] [(e)][(f)][(g)] (Input signal)
Input/ output	Input signal Note 4	-	R	RS-485 Communication (Modbus RTU)/0 -10 VDC (6.7 kΩ)/0 -5 VDC (10 kΩ)/ 4 -20 mA DC (250 Ω)/4 preset inputs (2 bits) (Changeable by setting) Note 5
	Output specification Note 6	(d)	AN	Analog output: 1 V to 5 V (connected load impedance 500 kΩ or more) 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) 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.
Integrating functions				Refer to the separate table.
Power	Power supply voltage			24 VDC ± 10% (stabilized power supply with ripple rate 2% or less)
	Current consumption Note 7			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	Approximately 200 g
			8A/UF	Approximately 480 g
Degree of protection				Equivalent to IP40 (IEC standard)
Protection circuit Note 8				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: The default setting is RS-485. You can change it to analog input or preset input as required.
(Cannot be used with RS-485 at the same time.)
Do not apply an analog signal that differs from the set analog input type.
Do not apply an excessive voltage that exceeds the analog input specifications. Also, do not turn the power on / off with the input signal applied. Overvoltage may be applied, causing malfunction or damage to the product. Be especially careful when the current input is DC4-20mA.

Note 5: Please use a current input signal that does not apply an overvoltage of 10V or higher.

Note 6: 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 7: 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 8: 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 Notes 9 and 10

			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 9: 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 10: 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 11	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 11: 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
Integrating functions Note 12	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 12: 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

Item \ Model no.				FCM-[(a)] [(b)]-[(c)] R [(d)] [(e)][(f)][(g)] (Input signal)		
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	●	●
			0005	5 L/min	●	●
			0010	10 L/min	●	●
			0020	20 L/min	●	●
Applicable fluid Note 2		(b)	H2	Hydrogen	●	
			HE	Helium		●
Port size		(c)	8A	Rc1/4	●	●
			UF	9/16-18UNF	●	●
			4S	1/4-inch double bite-type fitting	●	●
			4RM	1/4-inch JXR male fitting	●	●
Control	Control range			3%FS to 100%F.S.		
	Response time			Within 0.5 sec at setting ± 5%FS (TYP)		
	Accuracy			± 3%F.S. or less		
	Repeatability			± 1%F.S. or less		
	Temperature characteristics			± 0.2%F.S./°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			980 kPa		
Operating ambient temperature, humidity				0°C to 50°C, 90% RH or less (no condensation)		
Leak to outside Note 3				1 x 10^{-6} Pa · m^3/s (helium leakage) or less		
Input/ output	Input signal Note 4	-	R	RS-485 Communication (Modbus RTU)/0 -10 VDC (6.7 kΩ)/0 -5 VDC (10 kΩ)/ 4 -20 mA DC (250 Ω)/4 preset inputs (2 bits) (Changeable by setting) Note 5		
	Output specification Note 6	(d)	AN	Analog output: 1 V to 5 V (connected load impedance 500 kΩ or more) 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) 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.		
Integrating functions				Refer to the separate table.		
Power	Power supply voltage			24 VDC ± 10% (stabilized power supply with ripple rate 2% or less)		
	Current consumption Note 7			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: The default setting is RS-485. You can change it to analog input or preset input as required.
(Cannot be used with RS-485 at the same time.)
Do not apply an analog signal that differs from the set analog input type.
Do not apply an excessive voltage that exceeds the analog input specifications. Also, do not turn the power on / off with the input signal applied. Overvoltage may be applied, causing malfunction or damage to the product. Be especially careful when the current input is DC4-20mA.
Note 5: Please use a current input signal that does not apply an overvoltage of 10V or higher.
Note 6: 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 7: 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.

Item \ Model no.			FCM-[(a)] [(b)]-[(c)] R [(d)] [(e)][(f)][(g)] (Input signal)
Mounting orientation			No restriction
Wetted part material			Stainless steel, fluoro rubber, alumina, semiconductor silicon, solder
Weight	(c)	8A/UF	Approximately 480 g
		4S/4RM	Approximately 560 g
Degree of protection			Equivalent to IP40 (IEC standard)
Protection circuit Note 8			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 8: The protection circuit is only effective against the specified reverse connections and load short-circuit, and not against all incorrect connections.

■ Pressure specification Notes 9 and 10

			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 9: 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 10: 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 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
	Display resolution	0.01 L/min	0.01 L/min	0.1 L/min	0.1 L/min
Integrating functions Note 11	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 11: The integrated flow rate is a calculated (reference) value. The value is reset when the power is turned off.

1.3 Communication Specifications

1.3.1 General

Item	Details
Communication standard	RS-485 compliant
Communication system	Half-duplex
Synchronization system	Asynchronous system
Communication protocol	Modbus RTU compliant
Transmission rate	9.6/19.2/38.4 kbps
Data bit	8 bits
Parity bit	None/Odd/Even
Stop bit	1 bit/2 bits
Transmission distance	Up to 20 m
Device address	1 to 247
Connection system	1: N (up to 31 units)
Wiring connection	D-SUB 15 pin connector

■ Unicast mode

The master sends a query (inquiry) to one (1) slave.
The slave executes a process and sends back a response.

■ Broadcast mode

If you specify slave address 0 for the master, you can send queries to all slaves.
The slave executes the process but does not respond.

■ Modbus function format

Classification	Item	Description	Support
Address	Data/address	Address used to reference or change data	—
Data	Coil	Binary data that can be referenced or changed	×
	Input status	Binary data that cannot be changed: for reference only	×
	Input register	16-bit data that cannot be changed: for reference only	×
	Holding register	16-bit data that can be referenced and changed	○

■ Function code

The supported function codes are as follows:

Function code	Item	Function	Broadcast
0x03	Reading holding register “Read Holding Register”	Read register (16 bit). You can specify the start address and the number of holding registers to read consecutive registers. Used to read setting and instantaneous flow rate.	None
0x06	Writing to holding register “Preset Single Register”	Write data to the specified register. In the broadcast mode, the contents of the register of the same addresses of all slaves will be changed. Press to write the setting.	Yes
0x10	Writing to multiple holding registers “Preset Multiple Register”	Write data to multiple consecutive registers. Specify the starting address, the number of registers, and the data to be changed. In the broadcast mode, the contents of the register of the same addresses of all slaves will be changed. Used to set up all at once.	Yes
0x08	Diagnostics “Diagnostics”	Diagnose communication between master and slave. Send data specified by the user and determine whether the communication is normal based on the result of the returned data. Only the sub-function 0x0000 (response to a query) is supported.	None

1.3.2 Message format

Examples of response messages to query (inquiry) in function codes are shown below.

■ Read the 0x03 holding register

- Query (inquiry)

A query message specifies the start address of the holding register and the number of holding registers.

Example 1: Read instantaneous flow rate (0x0022)

Field name	Example (HEX)
Slave address	0x01
Function code	0x03
Start address (higher)	0x00
Start address (lower)	0x22
Number of register (higher)	0x00
Number of register (lower)	0x01
Error checking	CRC (16-bit)
Total bytes	8 bytes

- Response

The response message is 16-bit data per 1 held address.

Response message from slave to example 1

When instantaneous flow rate is 35 L/min (0x0DAC)

Field name	Example (HEX)
Slave address	0x01
Function code	0x03
Number of data bytes	0x02
Data 1 (higher)	0x0D
Data 1 (lower)	0xAC
Error checking	CRC (16-bit)
Total bytes	7 bytes

■ 0x06 Writing to holding register (Preset Single Register)

- Query (inquiry)

The query message specifies the address of the holding register and the data to be changed.
Example 2) When setting 0x0033 RS-485 Input flow rate to “0x0DAC: 3500 (35 L/min)”

Field name	Example (HEX)
Slave address	0x01
Function code	0x06
Start address (higher)	0x00
Start address (lower)	0x33
Change data (higher)	0x0D
Change data (lower)	0xAC
Error checking	CRC (16-bit)
Total bytes	8 bytes

- Response

If the change is made successfully, the response message will be the same as the query.
Response message from slave to example 2

Field name	Example (HEX)
Slave address	0x01
Function code	0x06
Start address (higher)	0x00
Start address (lower)	0x33
Change data (higher)	0x0D
Change data (lower)	0xAC
Error checking	CRC (16-bit)
Total bytes	8 bytes

■ 0x10 Writing to multiple holding registers (Preset Multiple Registers)

- Query (inquiry)

The query message specifies the start address of the holding register, the number of holding registers, the number of bytes of data, and the data to be changed.

Example 3) Change set flow rate-related data all at once (when the number of re is 12)

Field name	Example (HEX)
Slave address	0x01
Function code	0x10
Start address (higher)	0x00
Start address (lower)	0x32
Number of register (higher)	0x00
Number of register (lower)	0x0C
Number of data bytes	0x18
Data 1 to be changed (higher)	0x00
Data 1 to be changed (lower)	0x02
Data 2 to be changed (higher)	0x00
Data 2 to be changed (lower)	0x00
to	to
Change data 12 (higher)	0x00
Change data 12 (lower)	0x01
Error checking	CRC (16-bit)
Total bytes	33 bytes

- Response

The response message, if successfully changed, will respond with a copy of the query excluding the number of bytes of the data and the changed data.

Response message from slave to example 3

Field name	Example (HEX)
Slave address	0x01
Function code	0x10
Start address (higher)	0x00
Start address (lower)	0x32
Number of register (higher)	0x00
Number of register (lower)	0x0C
Error checking	CRC (16-bit)
Total bytes	8 bytes

■ 0x08 Diagnostics

The diagnostic sub-function of “0x0000 Reply to query” is only supported.

“0x0000: Response to query (Return Query Data)” diagnoses the communication between master and slave.

The device sends any data specified by the user, and if the returned data is the same as the query message, the communication is determined to be normal.

- Query (inquiry)

Query messages specify diagnostic sub-functions and data.

Example 4) Specify any data (0x1234)

Field name	Example (HEX)
Slave address	0x01
Function code	0x08
Diagnostic sub-functions (higher)	0x00
Diagnostic sub-functions (lower)	0x00
Data (higher)	0x12
Data (lower)	0x34
Error checking	CRC (16-bit)
Total bytes	8 bytes

- Response

The response message is the same as the query.

Response message from slave to example 4

Field name	Example (HEX)
Slave address	0x01
Function code	0x08
Diagnostic sub-functions (higher)	0x00
Diagnostic sub-functions (lower)	0x00
Data (higher)	0x12
Data (lower)	0x34
Error checking	CRC (16-bit)
Total bytes	8 bytes

1.3.3 Exceptional response

The supported exceptional codes are as follows:

Exception code	Name	Meaning
0x01	Illegal function “Illegal Function”	The slave does not support this function.
0x02	Illegal data address “Illegal Data Address”	The specified data address does not exist on the slave.
0x03	Illegal data “Illegal Data Value”	The specified data is not the slave’s tolerance.
0x05	Acknowledgement *1 “Acknowledge”	The slave accepted and is processing the request, but it takes time to process; therefore, so the slave returns the request in order to prevent a timeout error on the master.

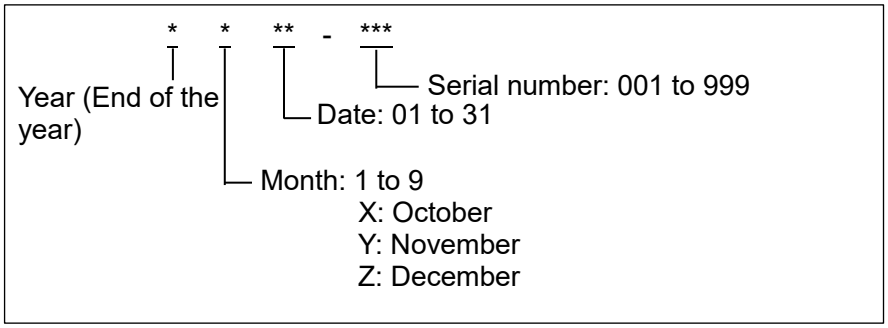
*1 It occurs when the number of registers in function code “0x10 Write to multiple holding registers” is 15 or more. It will be processed internally, but if a normal response is required, send the same command again.

1.3.4 Parameter

■ Model-related data

Address	Item	Content (decimal notation)	Value range (hexadecimal notation)	Access	ROM	Format
0x0000 up to 0x0013	Model no.	FCM-0050*-*R* *1	—	R	—	String (40 bytes)
0x0014 up to 0x0017	Serial No.	****-*** *2	—	R	—	String (8 bytes)
0x0018	Version No.	*** *3	—	R	—	Unsigned short
0x0019	Applicable fluid	0: AIR 1: AR 2: O2 3: LN 4: CH4 5: C3H8 6: H2 7: He	0x0000 to 0x0007	R	—	Unsigned short
0x001A	The position of decimal point of instantaneous flow rate	0: XXX.X 1: XX.XX 2: X.XXX	0x0000 to 0x0002	R	—	Unsigned short
0x001B	The position of decimal point of integrated flow rate	0: No decimal point 1: XXXXX.X 2: XXXX.XX	0x0000 to 0x0002	R	—	Unsigned short

* R: Read out, W: Writing, R/W: Read out/Writing
*1 As an example, 50 L/min is used for reference.
*2 About serial No.



*3 The version number of software (3 digits).

■ Operating status-related data

Address	Item	Content (decimal notation)	Value range (hexadecimal notation)	Access	ROM	Format
0x001E	Control ON/Auto OFF	0: Auto OFF 1: Control ON	0x0000 to 0x0001	R/W	○	Unsigned short
0x001F	Status (Normal/Error)	0: Normal 1: Error	0x0000 to 0x0001	R	—	Unsigned short
0x0020	warning	0: Normal 1: Warning	0x0000 to 0x0001	R	—	Unsigned short
0x0021	Error Code	Refer to “Table 2: Error codes”	0x0000 to 0x000A	R	—	Unsigned short
0x0022	Flow rate display range	Refer to “Table 1: Flow rate range for each model.”	According to Table 1.	R	—	Signed short
0x0023	Set flowrate	Refer to “Table 1: Flow rate range for each model.”	According to Table 1.	R	—	Unsigned short
0x0024	Higher thee digits of integrated flow rate	0 to 999	0x0000 to 0x03E7	R	—	Unsigned short
0x0025	Lower thee digits of integrated flow rate	0 to 999	0x0000 to 0x03E7	R	—	Unsigned short
0x0026	Integration reset	1: Reset integrated value	0x0001	W	—	Unsigned short
0x0027	Integration stop	0: Integrated flow operation 1: Stop operating integrated flow rate	0x0000 to 0x0001	R/W	○	Unsigned short
0x0028	Integration automatic shut-off status	0: not shut off 1: Integration automatic shut-off status	0x0000 to 0x0001	R	—	Unsigned short
0x0029	Switch output status	0: Output OFF 1: Output ON	0x0000 to 0x0001	R	—	Unsigned short

* R: Read out, W: Writing, R/W: Read out/Writing
* part: default values

■ Set flow rate-related data

Address	Item	Content (decimal notation)	Value range (hexadecimal notation)	Access	ROM	Format
0x0032	Input Select	0: RS-485 input mode 1: Analog input mode 2: Preset mode 3: Direct mode	0x0000 to 0x0003	R/W	○	Unsigned short
0x0033	RS-485 input flow	0 L/min *1 Setting range: Refer to Table 1	According to Table 1.	R/W	—	Unsigned short
0x0034	Analog input specification selection *2	0: 0-10 V 1: 0-5 V 2: 4-20 mA	0x0000 to 0x0002	R/W	○	Unsigned short
0x0035	Analog input signal zero span adjustment	0: Used in full scale 1: Use after zero span adjustment	0x0000 to 0x0001	R/W	○	Unsigned short
0x0036	Analog input signal zero point adjustment value	0%F.S. Setting range: 0 to 50%F.S. Only applicable when analogue input is set	0x0000 to 0x0032	R/W	○	Unsigned short
0x0037	Analog input signal span point adjustment value	100%F.S. (−10%F.S. to 100%F.S.) Only applicable when analogue input is set	0x000A to 0x0064	R/W	○	Unsigned short
0x0038	Select preset memory number	1 Setting range: 1 to 4	0x0001 to 0x0004	R/W	○	Unsigned short
0x0039	Preset memory 1	0 L/min *1 Setting range: Refer to Table 1	According to Table 1	R/W	○	Unsigned short
0x003A	Preset memory 2	0 L/min *1 Setting range: Refer to Table 1	According to Table 1	R/W	○	Unsigned short
0x003B	Preset memory 3	0 L/min *1 Setting range: Refer to Table 1	According to Table 1	R/W	○	Unsigned short
0x003C	Preset memory 4	0 L/min *1 Setting range: Refer to Table 1	According to Table 1	R/W	○	Unsigned short
0x003D	Preset input specification setting	0: External input 1: RS-485	0x0000 to 0x0001	R/W	○	Unsigned short

* R: Read out, W: Writing, R/W: Read out/Writing
* part: default values
*1 If “9999” is set, “Valve fully opens”.
*2 Do not apply an analog signal that differs from the set analog input type. do not apply an excessive voltage that exceeds the analog input specifications. Also, do not turn the power on / off with the input signal applied. Overvoltage may be applied, causing malfunction or damage to the product. be especially careful when the current input is DC4-20mA.

Table 1: Flow rate range for each model

Model no.	Flow rate display range			Integrated flow	
	Display range	Display value	RS-485 Input/output value *1	Integrated flow display range	Display value
FCM-9500*-*R	0.0 to 500.0 mL/min	0 to 500	0 to 5000 (0x1388)	0 to 999999 mL	0 to 999999
FCM-0001*-*R	0.000 to 1.000 L/min	0 to 1.00	0 to 1000 (0x03E8)	0 to 9999.99 L	
FCM-0002*-*R	0.000 to 2.000 L/min	0 to 2.00	0 to 2000 (0x07D0)		
FCM-0005*-*R	0.000 to 5.000 L/min	0 to 5.00	0 to 5000 (0x1388)		
FCM-0010*-*R	0.00 to 10.00 L/min	0 to 10.0	0 to 1000 (0x03E8)	0 to 99999.9 L	
FCM-0020*-*R	0.00 to 20.00 L/min	0 to 20.0	0 to 2000 (0x07D0)		
FCM-0050*-*R	0.00 to 50.00 L/min	0 to 50.0	0 to 5000 (0x1388)		
FCM-0100*-*R	0.0 to 100.0 L/min	0 to 100	0 to 1000 (0x03E8)	0 to 999999 L	

*1 The values of instantaneous flow rate and set flow rate handled in RS-485 communication have one more decimal place than the displayed value.
The displayed value will be rounded to the second least significant digit. The position of the decimal point can be checked by “0x001A: Position of decimal point in instantaneous flow rate”.
Example) RS-485 input/output value: 1234 (0x04D2)
The position of decimal point of instantaneous flow rate: XX.XX (0x01) → Display: 12.3 L/min

■ Function setting-related data

Address	Item	Content (decimal notation)	Value range (hexadecimal notation)	Access	ROM	Format
0x0046	Reset to factory setting	1: Reset to factory default	0x0001	W	—	Unsigned short
0x0047	Key lock setting	0: Unlock 1: Lock	0x0000 to 0 x0001	R/W	○	Unsigned short
0x0048	Integration reset input specification setting	0: External input 1: RS-485	0x0000 to 0x0001	R/W	○	Unsigned short
0x0049	Auto power off setting	0: OFF 1: ON	0x0000 to 0x0001	R/W	○	Unsigned short
0x004A	Select a switch output mode	0: Not used 1: Tolerance mode 2: Designated range mode 3: Integrated pulse *1 4: ON at set integrated value or more	0x0000 to 0x0004	R/W	○	Unsigned short
0x004B	Lower limit in tolerance mode	0%F.S. Setting range:-50 to 0%F.S. *2	From 0x0000 0x0032	R/W	○	Unsigned short
0x004C	Upper limit in tolerance mode	0%F.S. Setting range: 0 to 50%F.S.	0x0000 to 0x0032	R/W	○	Unsigned short
0x004D	Reference setting in the tolerance mode when valve fully open	0: OFF 1: ON	0x0000 to 0x0001	R/W	○	Unsigned short
0x004E	Reference value in the tolerance mode when valve fully open	100%F.S. Setting range: 0 to 100%F.S.	0x0000 to 0x0064	R/W	○	Unsigned short
0x004F	Lower limit in designated range mode	0%F.S. Setting range: 0 to 90%F.S. *3	0x0000 to 0x005A	R/W	○	Unsigned short
0x0050	Upper limit in designated range mode	100%F.S. Setting range: 10 to 100%F.S *3	0x000A to 0x0064	R/W	○	Unsigned short
0x0051	Not less than set value Higher 3 digits of set value for ON	0 Setting range: 0 to 999.	0x0000 to 0x03E7	R/W	○	Unsigned short
0x0052	Not less than set value Lower 3 digits of set value for OFF	0 Setting range: 0 to 999.	0x0000 to 0x03E7	R/W	○	Unsigned short
0x0053	Switch output inversion setting	0: Normal 1: Inversion	0x0000 to 0x0001	R/W	○	Unsigned short
0x0054	Integration auto shutoff function	0: OFF 1: ON	0x0000 to 0x0001	R/W	○	Unsigned short
0x0055	Integration automatic shut-off Higher 3 digits of set value	0 Setting range: 0 to 999.	0x0000 to 0x03E7	R/W	○	Unsigned short
0x0056	Integration automatic shut-off Lower 3 digits of set value	0 Setting range: 0 to 999.	0x0000 to 0x03E7	R/W	○	Unsigned short
0x0057	Error automatic shut-off function	0: OFF 1: Valve fully closes 2: Valve fully opens	0x0000 to 0x0002	R/W	○	Unsigned short
0x0058	Control error threshold value setting	Control value ±20 %F.S. Setting range: 5 to 100%F.S.	0x0005 to 0x0064	R/W	○	Unsigned short
0x0059	Error output inversion setting	0: Output when an error occurs 1: Output during normal status	0x0000 to 0x0001	R/W	○	Unsigned short
0x005A	Zero adjustment	1: Perform zero adjustment	0x0001	W	—	Unsigned short
0x005B	Zero-adjusted point	−10%F.S. to 10%F.S.	0xFFF6 to 0x000A	R	—	Signed short
0x005C	Zero adjustment reset	1: Reset zero-adjusted value	0x0001	W	—	Unsigned short

* R: Read out, W: Writing, R/W: Read out/Writing
* part: default values
*1 No integrated pulse is output to “0x0029: Switch output status.”
*2 Note that although the setting range is “-50% F.S. to 0% F.S.”, the valid input range is "0 to 50".
*3 Set an interval of 10% F.S. or more between the upper limit and lower limit.
If the difference is under 10%F.S., the upper limit value is set to “lower limit value + 10%F.S.”.

■ Communication setting-related data

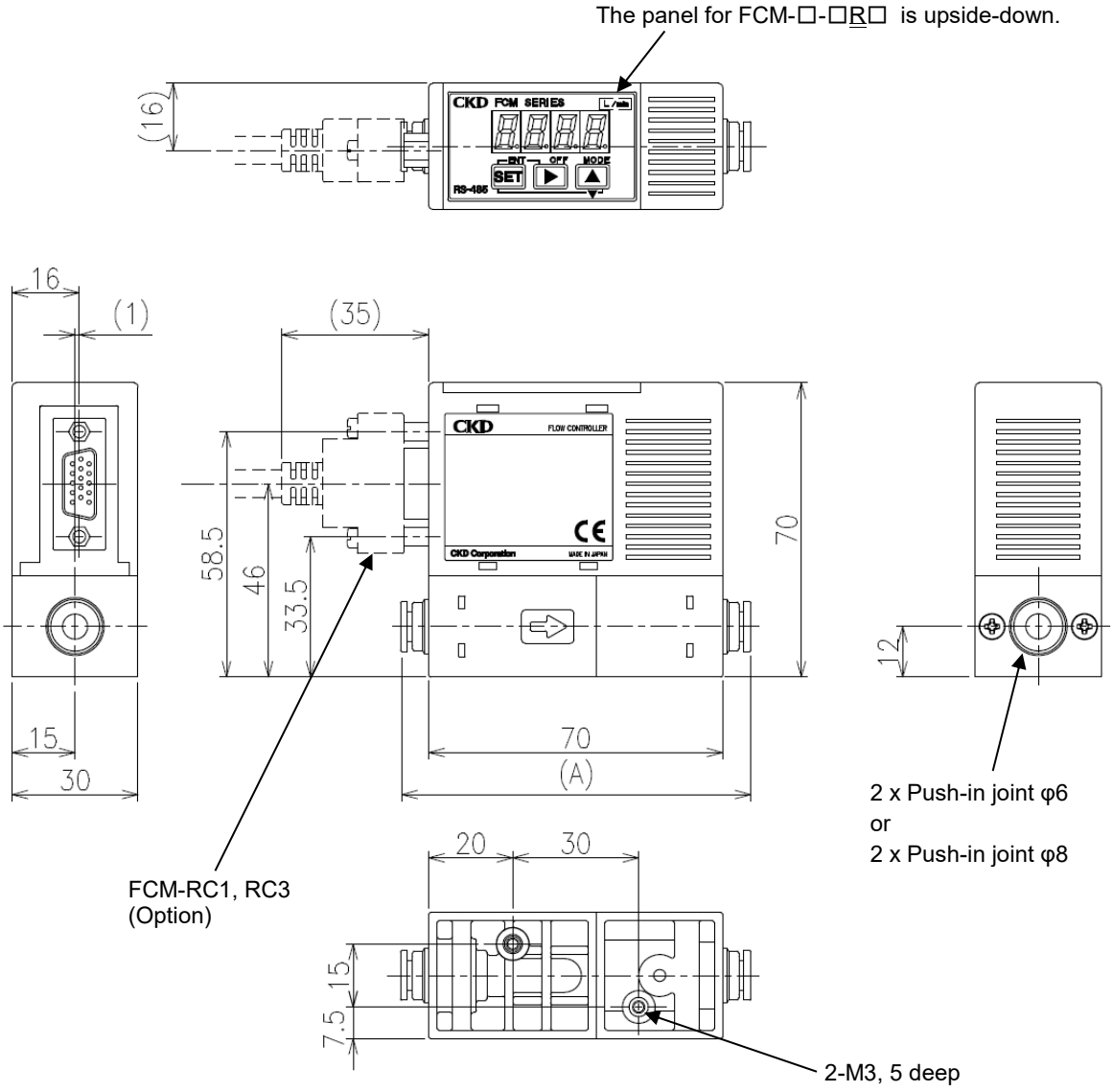
Address	Item	Content (decimal notation)	Value range (hexadecimal notation)	Access	ROM	Format
0x0064	Communication lock	0: Unlock 1: Lock The written data will be applied by turning the power on.	0x0000 to 0x0001	R/W	○	Unsigned short
0x0065	Device address setting	1 Setting range: 1 to 247 The written data will be applied by turning the power on.	0x0001 to 0x00F7	R/W	○	Unsigned short
0x0066	Transmission rate setting	0: 9600 bps 1: 19200 bps 2: 38400 bps The written data will be applied by turning the power on.	0x0000 to 0x0002	R/W	○	Unsigned short
0x0067	Communication parity setting	0: No parity 1: Odd parity 2: Even parity The written data will be applied by turning the power on.	0x0000 to 0x0002	R/W	○	Unsigned short
0x0068	Stop bit setting	0: 1 bit 1: 2 bits The written data will be applied by turning the power on.	0x0000 to 0x0001	R/W	○	Unsigned short

* R: Read out, W: Writing, R/W: Read out/Writing
* part: default values

1.4 Dimensions

1.4.1 Resin body

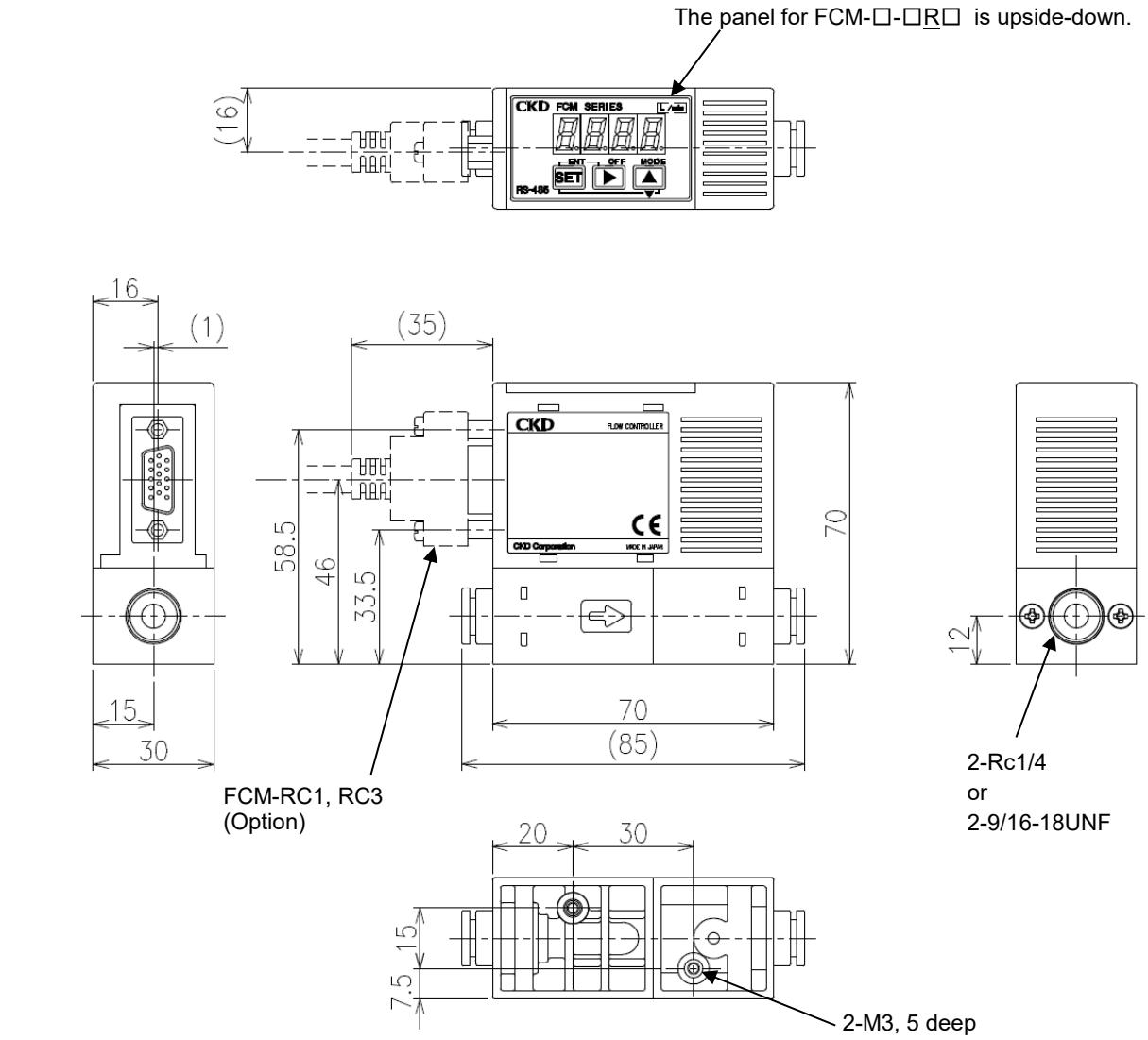
Model no.: FCM-☐-H6R/H8R☐
Port size: Push-in (φ6) or (φ8)

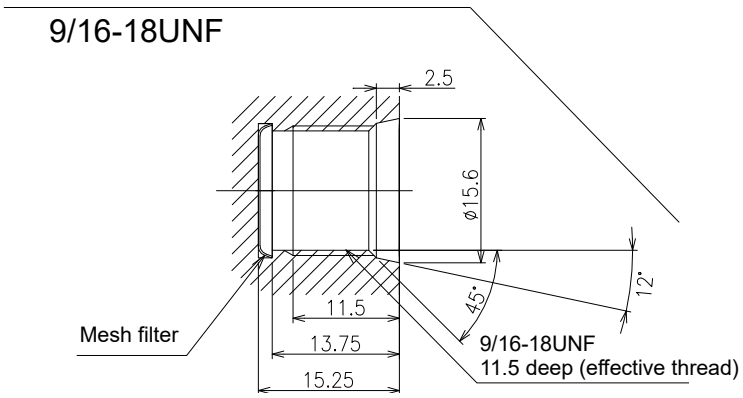


Model no.	Fitting	(A) size
FCM-□-H6R□	Push-in φ6	84
FCM-□-H8R□	Push-in φ8	85

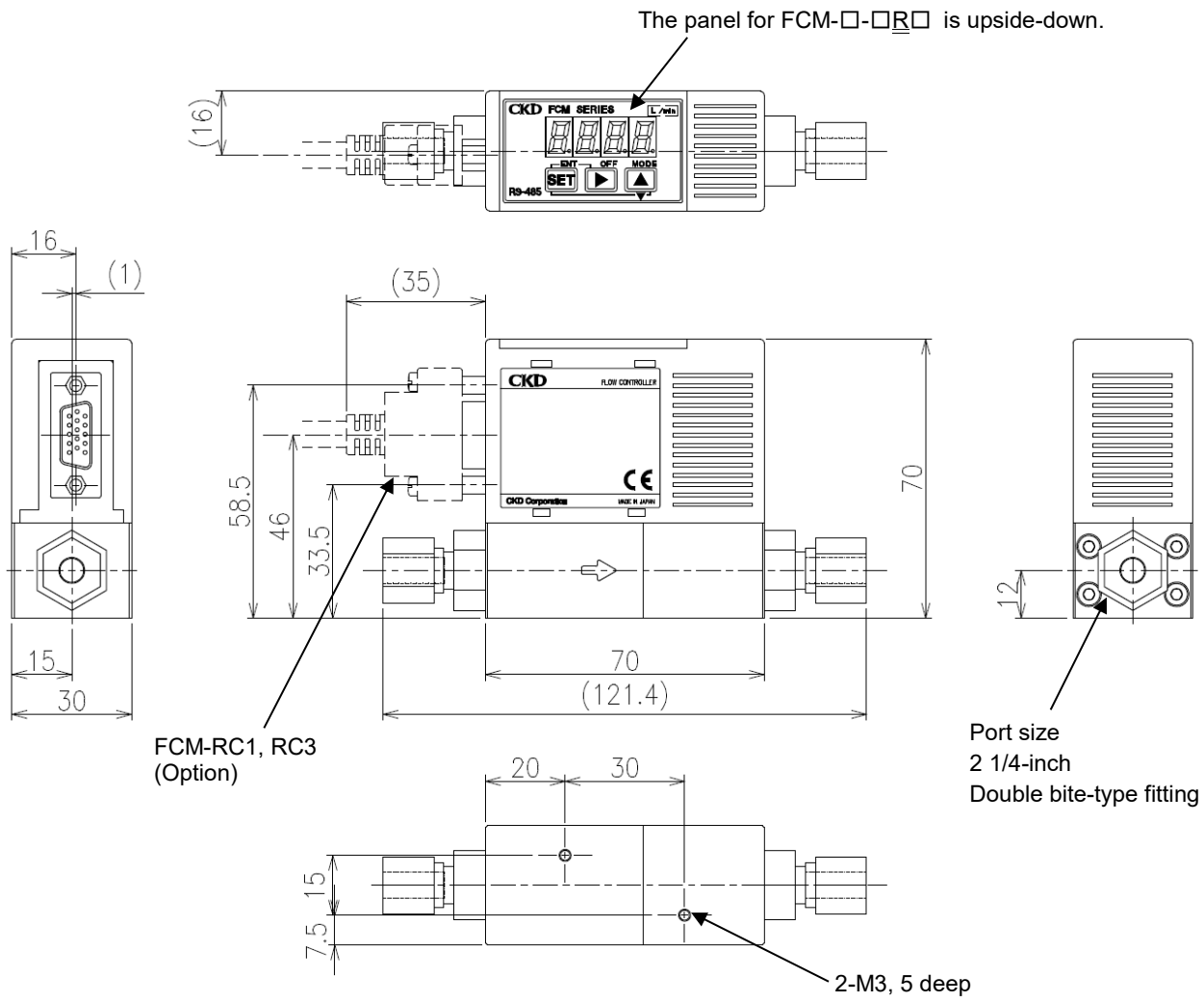
1.4.2 Stainless steel body

Model no.: FCM-☐-8AR/UFR☐
Port size: Rc1/4 or 9/16-18UNF

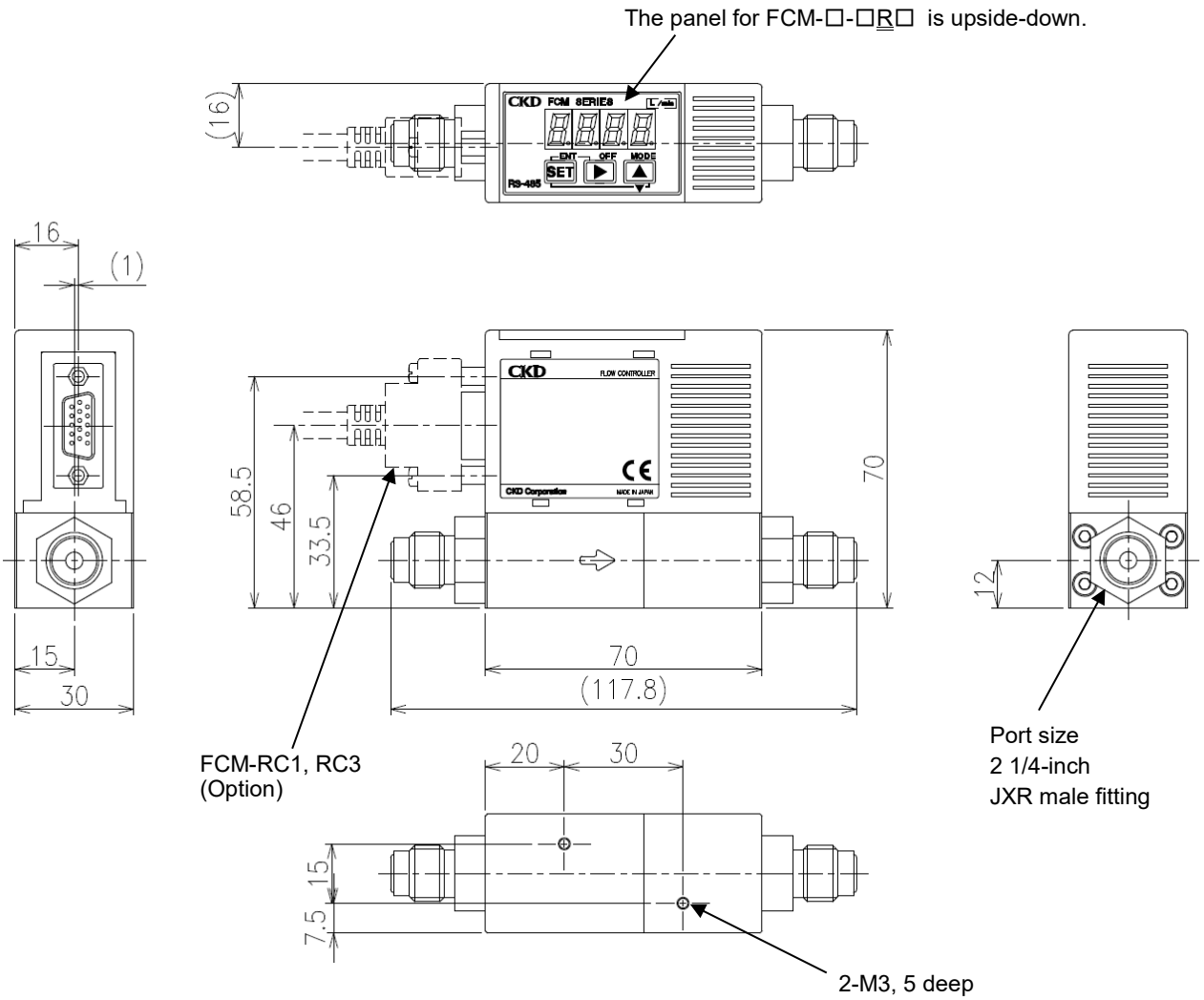




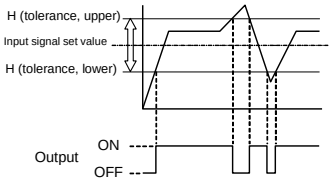
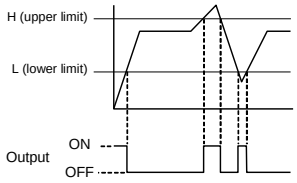
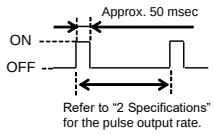
Model no.: FCM-☐-4SR
Port size: 1/4-inch double bite-type fitting

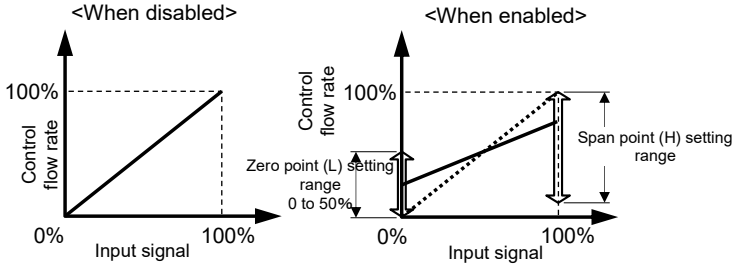


Model no.: FCM-□-4RMR
Port size: 1/4-inch JXR male fitting

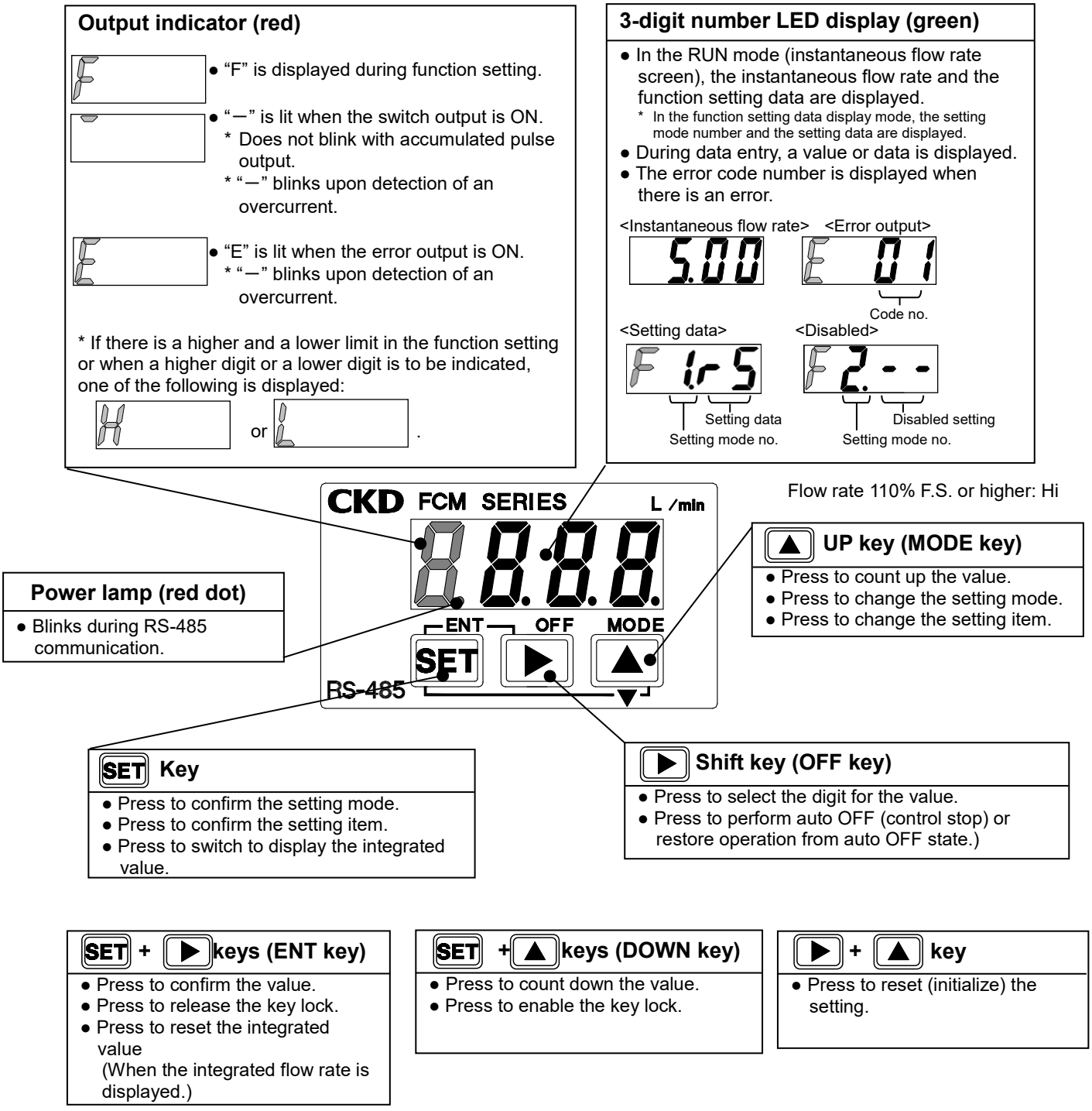


1.5 Functions

Function	Description	Compatible model		Usage
		Analog output	Switch output	
RS-485 setting function	Slave address, communication speed, parity and stop bit can be set.	○	○	P.18 P.41 P.42 P.65
RS-485 input function	Any flow rate can be set to the target value in RS-485 communication.	○	○	P.16 P.49 P.50 P.66
Direct memory	Target value can be entered using keys. Control flow rate can be controlled freely using the operation keys on the product even if there is no external input signal.	○	○	P.43 P.44 P.45 P.66
Preset input	The flow rate can be controlled by setting four flow rates and inputting a 2-bit signal from an external source (e.g., PLC) or using “Address: 0x0038 Select preset number” of RS-485 communication.	○	○	P.16 P.46 P.47 P.66
Analog input	Flow rate can be controlled using analog input. The input signal can be selected/switched from 0 to 10 V, 0 to 5 V, and 4 to 20 mA.	○	○	P.18 P.51 P.52 P.66
Integrating functions	This section describes how to integrate flow rate. Besides the function of displaying integrated flow rate, the following are also available. - Control start/stop, reset of integration function in RS-485 communication. - Closing solenoid valve when the value reaches the set integrated flow rate. - Read integrated flow rate value by RS-485 communication. - Turn the switch ON when the value reaches the set integrated flow rate How to reset the integrated value. - External input, operation by keys, RS-485 communication	○	○	P.15 P.17 P.53 P.54 P.55 P.56 P.57 P.58 P.59 P.64 P.68
Switch output function	Following switch functions can be selected. - (1) Tolerance mode: Turns the switch on when the value is within the tolerance value (arbitrary setting) against the controlled target value. - (2) Designated range mode: Turns the switch ON when the flow rate is outside the specified flow rate range. - (3) Integrated pulse: Outputs integrated pulse during integration. - (4) Set integration or more ON: Turns the switch ON when the flow rate reaches the set rate. [Mode 1: Tolerance mode]  [Mode 2: Designated range mode]  [Mode 3: Integrated pulse]  [Mode 4: ON at set integrated value or more] 	-	○	P.15 P.17 P.57 P.58 P.59 P.60 P.61 P.62 P.63 P.67

Function	Description	Compatible model		Usage
		Analog output	Switch output	
Input analog signal zero/span adjustment	The zero point and span point of analog input signal can be changed. <When disabled> <When enabled>  	○	○	P.16 P.67
Zero point adjustment	Flow rate output zero point can be adjusted.	○	○	P.17 P.68
Automatic power off	Turn off the flow rate display if no operation is performed for about 1 minute. (The control does not stop with automatic power off). Power is saved since the display is turned off when not needed.	○	○	P.17 P.67
Error display function	The status of the error will be displayed. Besides error display, the following functions are also available. - Turns ON error output when an error occurs. - Auto off controlling when the error occurs. - Check error status and error code in RS-485 communication.	○	○	P.14 P.71
Error automatic shut-off	Control is automatically stopped, valve is fully opened or closed, and error output is turned ON when an error occurs.	○	○	P.17 P.68 P.71
Control error threshold setting	Threshold value for judging control error (E 05) can be set with RS-485 parameter. (Default: ±20%F.S.)	○	○	P.17 P.71
Key lock	Disable the operation keys and setting change to prevent incorrect operations.	○	○	P.17 P.64
Setting reset	Factory setting is restored (initialization).	○	○	P.17 P.64

1.5.1 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

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.

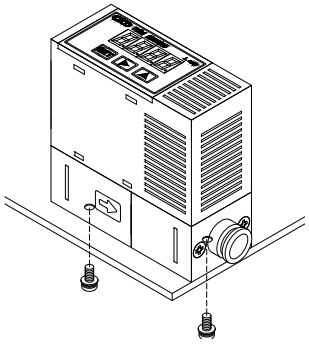
Do not install two or more products in close contact with each other.

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.

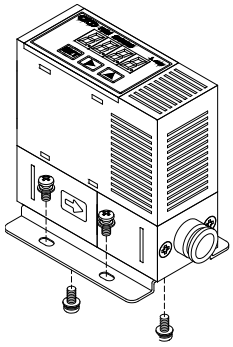
2.2 Mounting

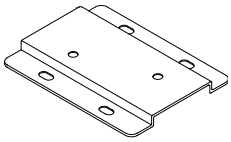
■ Mounting directly

Secure with the screws.



■ Mounting with dedicated bracket





Dedicated bracket
Model number: FCM-LB1

2.3 Piping

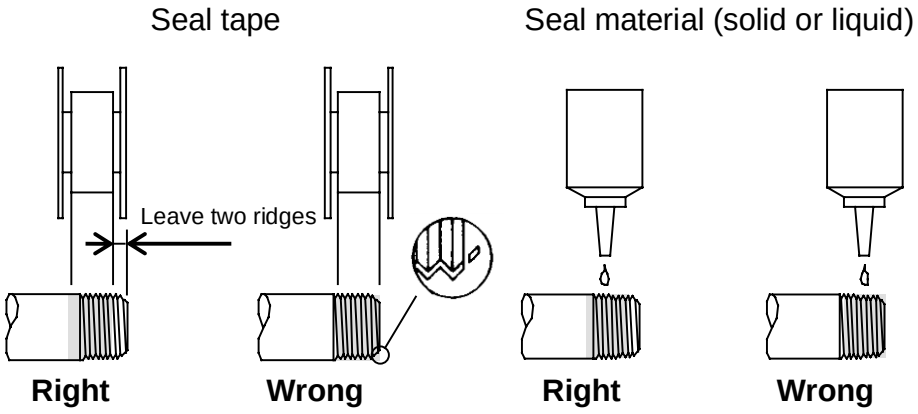
2.3.1 Pipe cleaning

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 ridges 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.

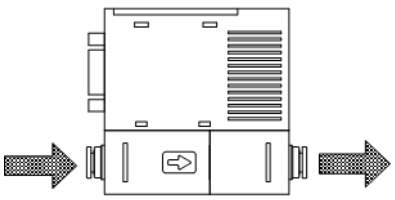
When using a seal tape, wind it around the screw threads in the direction opposite from the screw threads and press it down with your fingers to attach it firmly.
When using a liquid seal material, be careful not to apply it to resin parts. The resin parts can become damaged and this may lead to a failure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

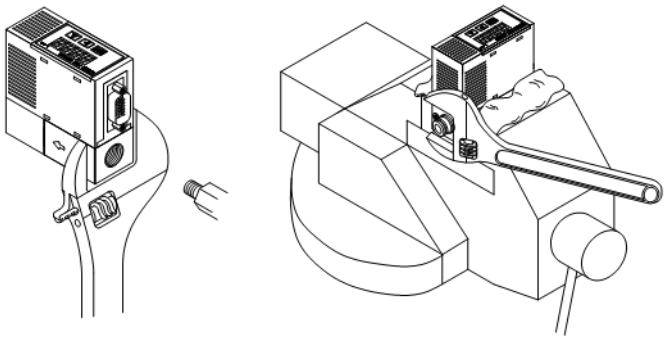
2.3.3 Piping direction

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

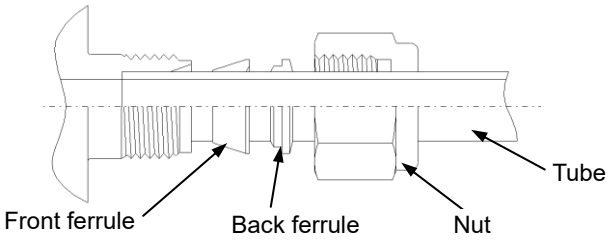
■ Tightening the fitting with port size of 4S/4RM (hydrogen/helium model)

<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.

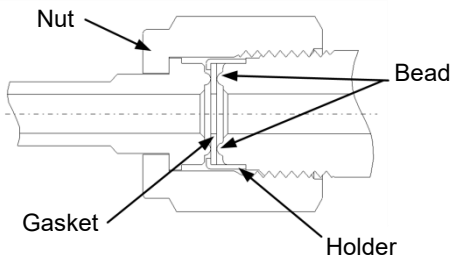


<4RM (1/4-inch JXR male fitting)>

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.

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. For analog mode, 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.

For RS-485 communication, use a cable that is 20 m or shorter.
Ensure that the total distance of the RS-485 communication cable does not exceed 20 m. If it is longer than 20 m, communication may become unstable.

To extend the communication cable, use a twisted pair wire.
RS-485 communication employs a transmission method using differential signals. Using twisted pair wire paring A-IN and B-IN; and A-OUT and B-OUT reduces the impact by noise.

Do not connect more than 31 units simultaneously.
Connecting more than 31 units may result in unstable communication.

Attach termination resistor to both ends of the communication path.
The product has a built-in termination resistor (120 Ω).

Ensure to connect the digital signal ground.
If not connected, the communication may not remain stable.

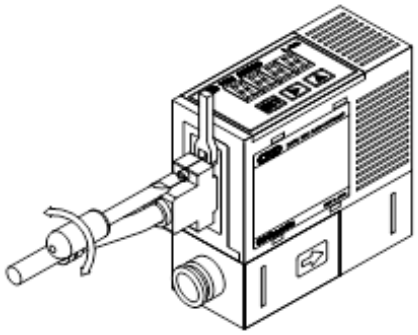
2.4.1 D-sub connector

⚠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

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
Name	Preset input signal		Integration reset signal	Digital signal ground	Power +	RS-485 Communication line				Common	Analog input	Terminal resistor	Analog output	Switch output	Error output	Power – (0 V)
Input type	Bit 1	Bit 2			+24 VDC	A–IN (+)	B–IN (–)	A– OUT (+)	B– OUT (–)				Output: 1 to 5 VDC	NPN or PNP output	NPN or PNP output	

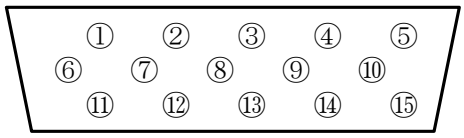
Note: Pin 4 is the signal ground for RS-485 communication.

Note: Pin 8 (A-OUT) and Pin 9 (B-OUT) are used for crossover wiring. Use it when connecting multiple devices.
Pin 6 (A-IN) and Pin 8 (A-OUT), Pin 7 (B-IN) and Pin 9 (B-OUT) are connected internally. If a crossover wire is not used, insulate Pin 8 (A-OUT) and Pin 9 (B-OUT) so that they do not come into contact with other pins (other lead wire when option cable is used).

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

Note: It can be used as a termination resistor by connecting the termination resistor pin of Pin 12 to Pin 7 or Pin 9.

- <Connector pin layout> (product body side)

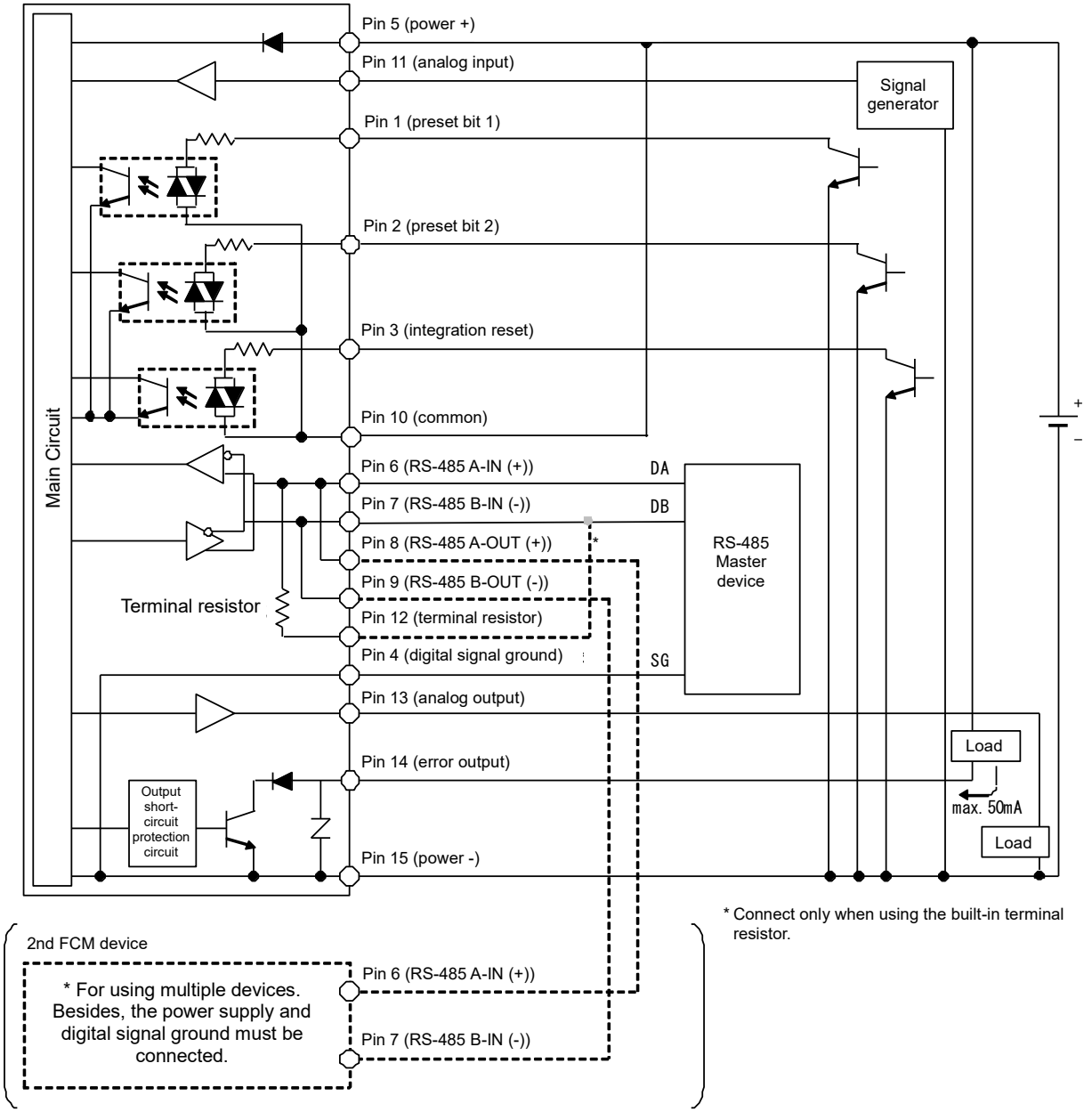


Please note the following when using RS-485 communication.

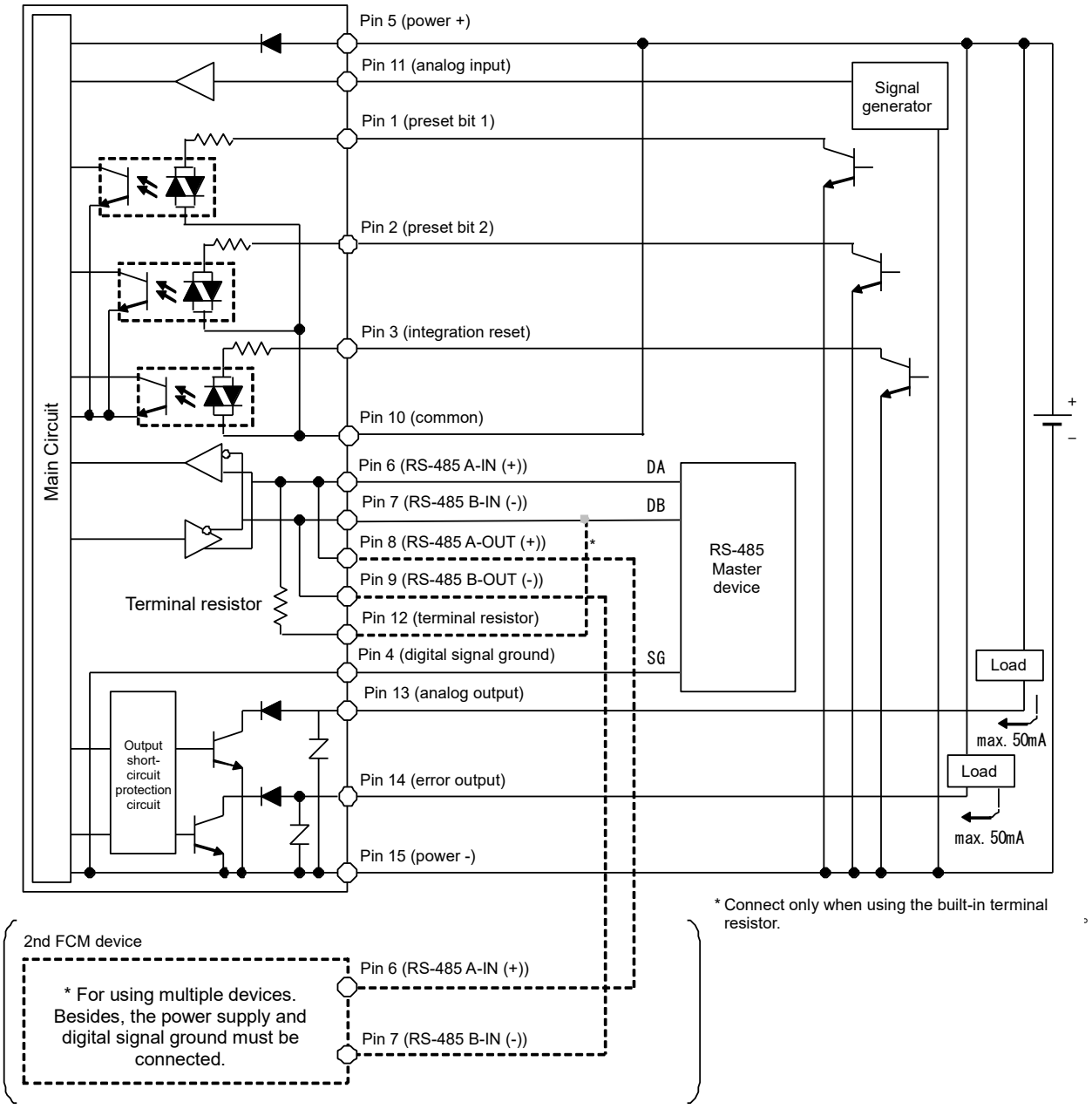
- Install terminating resistors at both ends of the communication line.
  The product has a built-in terminating resistor (120 Ω). It can be used as a terminating resistor by connecting the terminating resistor pin of pin 12 to pin 7 or pin 9.
- Be sure to connect the digital signal ground. If it is not connected, stable communication may not be possible.

2.4.3 Example of internal circuit and load connection

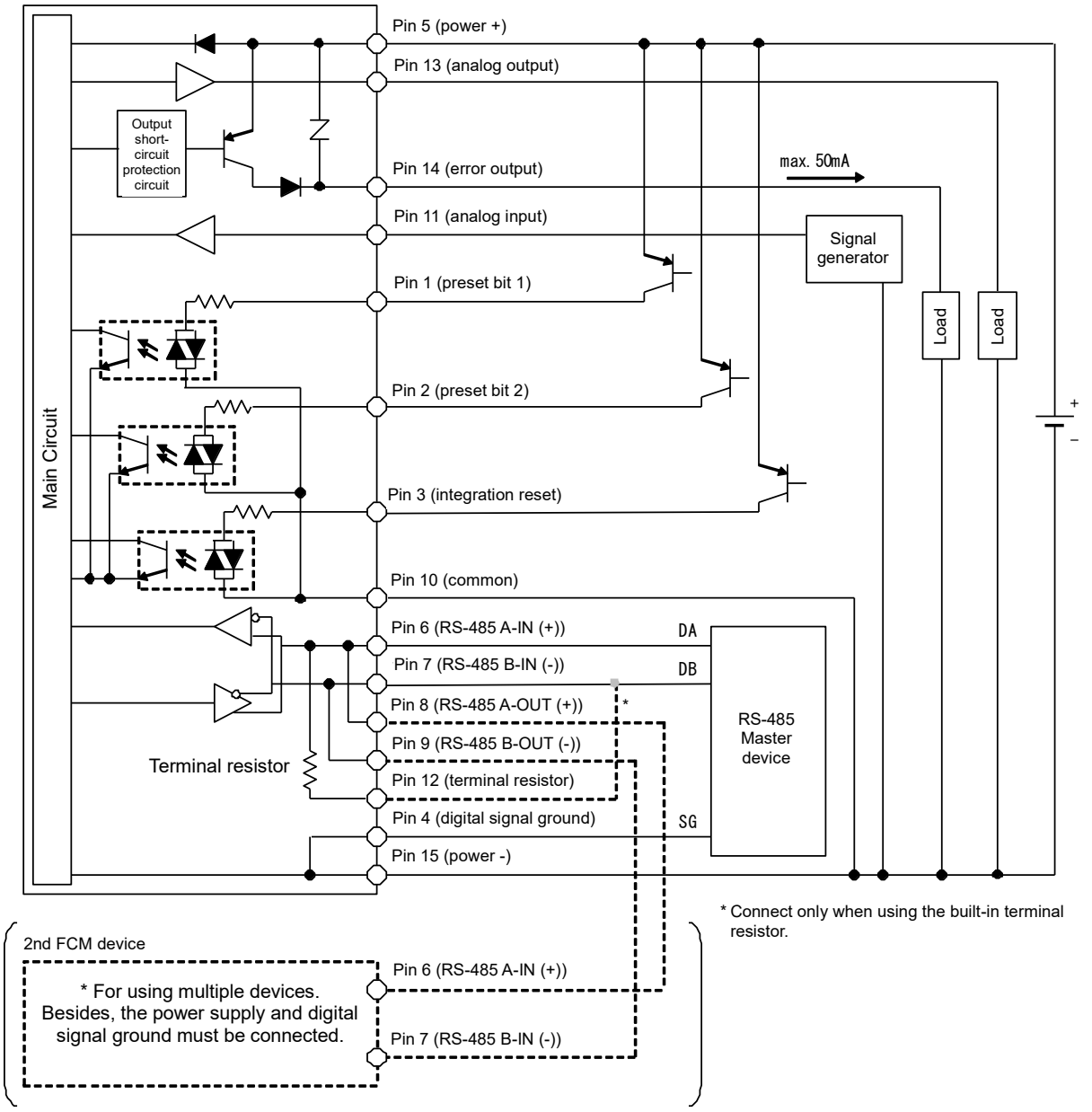
■ Output Type: Analog + Error Output (NPN)



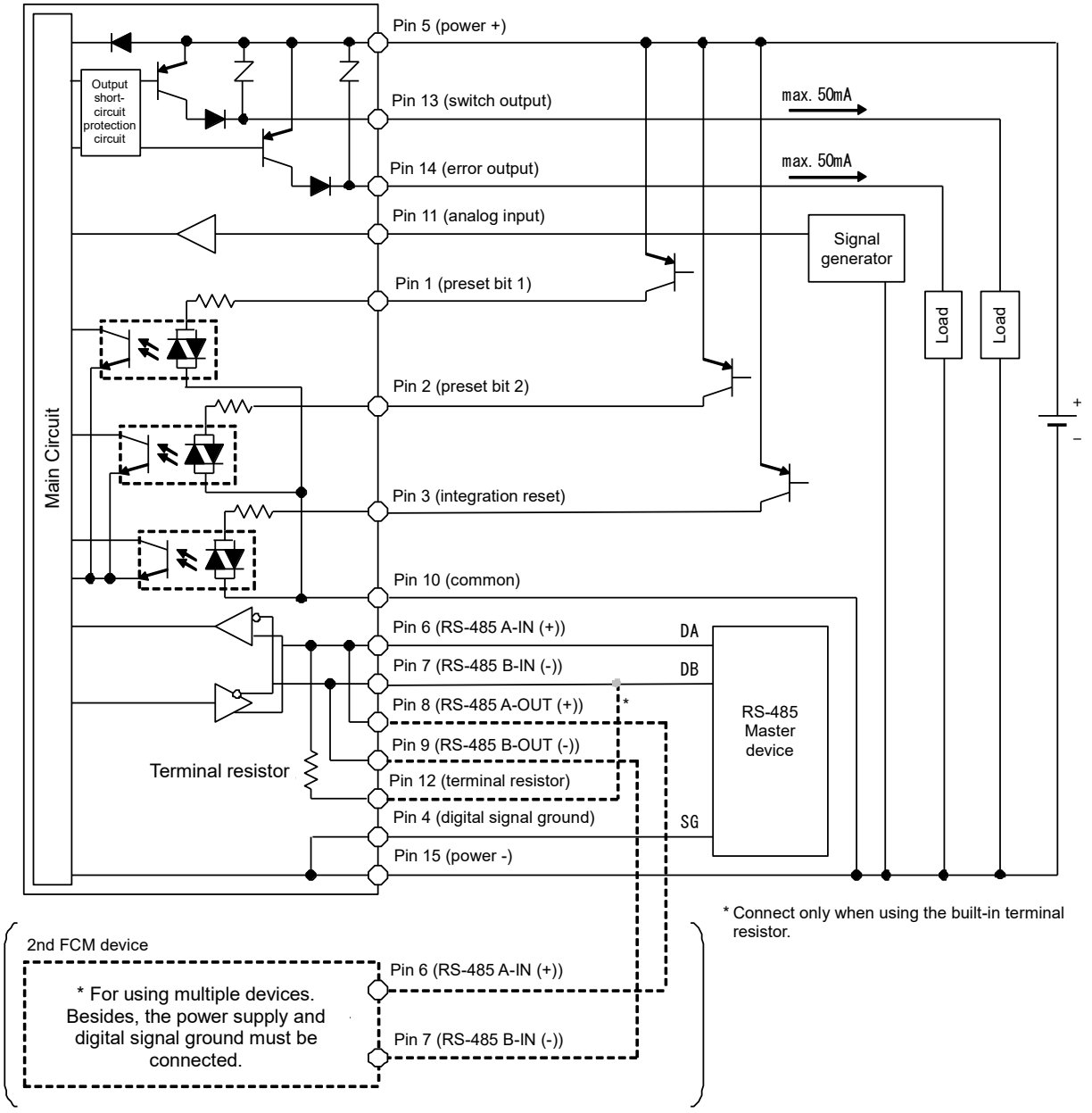
■ Output Type: Switch (NPN) + Error Output (NPN)



■ Output Type: Analog + Error Output (PNP)



■ Output Type: Switch (PNP) + Error Output (PNP)



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.

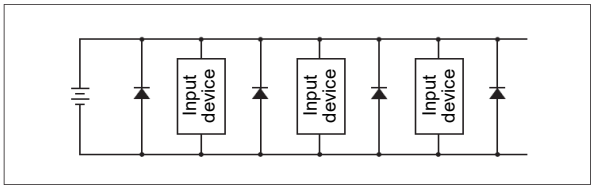
Use the product within the rated flow rate range.

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.

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 RS-485 Setting

RS-485 communication setting can be changed by operation using keys or via communication.

■ How to perform RS-485 communication setting (operation by keys)

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press [▲] key.
F0: Communication function check screen, communication function ON/OFF and device address value are displayed alternately.
(After approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

3 Hold down the [SET] key for approx. 2 seconds.
“F0.on” blinks.

4 Hold down the [SET] key for approx. 2 seconds.
When the device address setting screen appears, input the device address.

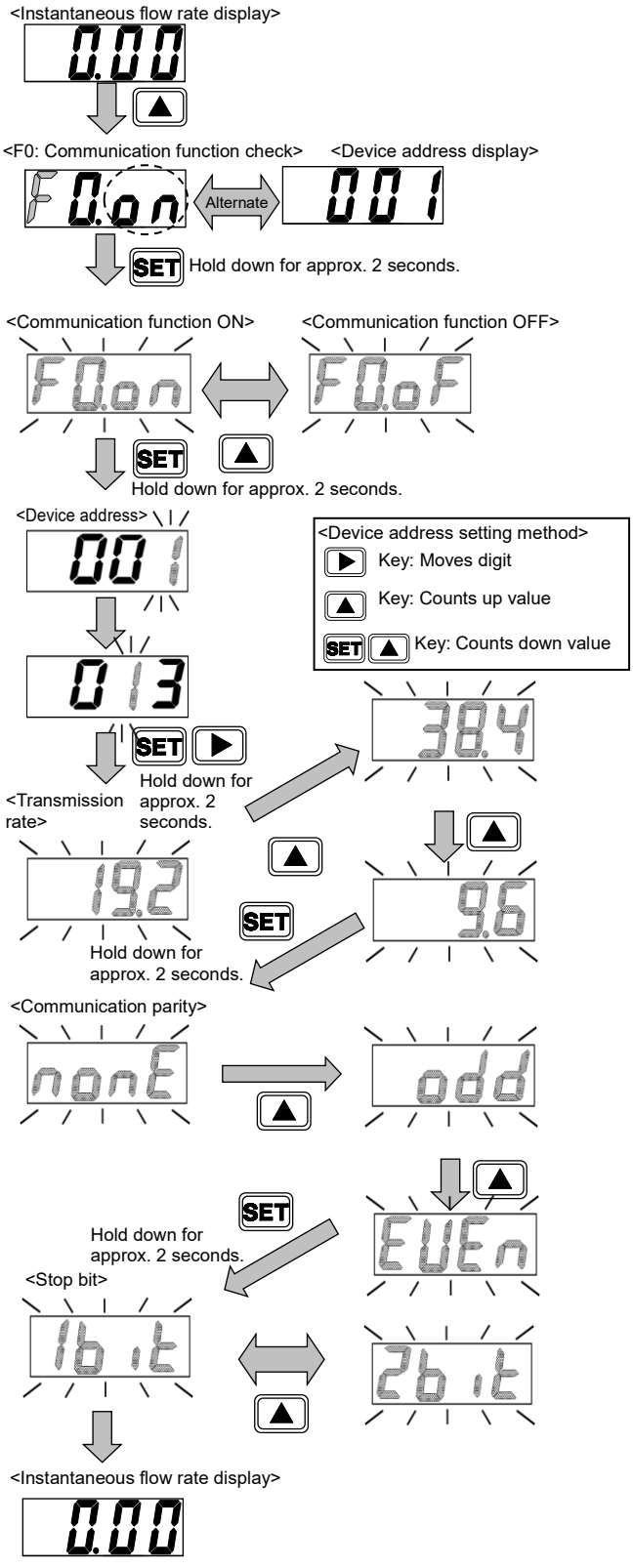
5 Hold down [SET] + [▶] key for approx. 2 seconds.
The device address value is stored in memory, and the screen enters the transmission rate setting screen.

6 Hold down [SET] key for approx. 2 seconds.

7 The transmission rate setting is stored in memory, and the screen enters the communication parity setting screen.

8 Hold down the [SET] key for approx. 2 seconds.
The communication parity setting is stored in memory, and the screen enters the stop bit setting screen.

9 Hold down [SET] key for approx. 2 seconds.
The stop bit setting is confirmed and the screen returns to the F0: Communication function check screen.
Returns to the instantaneous flow rate display automatically after approx. 3 seconds.



Communication setting is changed by operation using keys, the setting will be applied to the communication setting when the stop bit setting is confirmed.

■ How to perform RS-485 communication setting (RS-485 communication)

[Parameter setting]

- Setting communication function ON/OFF
Write “0: Unlock” to “Address: 0x0064 Communication lock”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Device address setting
Write the device address to “Address: 0x0065 Device address setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Transmission rate setting
Select and write the transmission speed to “Address: 0x0066 Transmission rate setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x0064	Communication lock	0: Unlock 1: Lock	0x0000
0x0065	Device address setting	13	0x000D
0x0066	Transmission rate setting	0: 9600 bps 1: 19200 bps 2: 38400 bps	0x0000
0x0067	Communication parity setting	0: No parity 1: Odd parity 2: Even parity	0x0002
0x0068	Stop bit setting	0: 1 bit 1: 2 bits	0x0000

- Communication parity setting
Select the communication parity and write it to “Address: 0x0067 Communication parity setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Stop bit setting
Select a stop bit and write it to “Address: 0c0068 Stop bit setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

[Operation]

- Turn on the power again.
Turn on the power again to apply the changed communication setting.

If communication setting is changed by operation using keys, the setting will be applied to the communication setting when the stop bit setting is confirmed. However, if a change is made via RS-485 communication (address: 0x 0064 to 0 x0068), the communication setting will not be applied until the power is turned on again.

[Confirmation]

Use “0x08 Diagnostics” and check whether the communication settings are correct by checking whether the response is returned correctly.

3.2 Flow Rate Controlled

3.2.1 Controlling the flow rate using the direct memory function

Target value can be entered using keys. Control flow rate can be adjusted freely using the operation keys on the product even if there is no external input signal. Direct memory function has two operation modes.

Direct memory (1): Settings are applied by changing the value. (Even if the value is not confirmed, the flow rate can be varied by changing the value). This function is convenient for fine adjustment of the flow rate. Confirm the set value after determining the flow rate.

Direct memory (2): Applied after the value is confirmed. (When not confirming the value, the flow rate is not changed).

■ How to operate direct memory (1) (operation by keys)

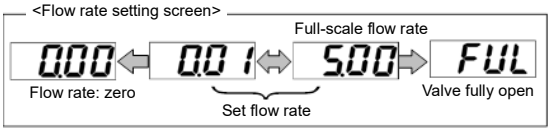
1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press ▲ key 2 times.
The screen switches to the F1: Input signal confirmation screen, and the present input signal and input value are alternately displayed.
(After approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

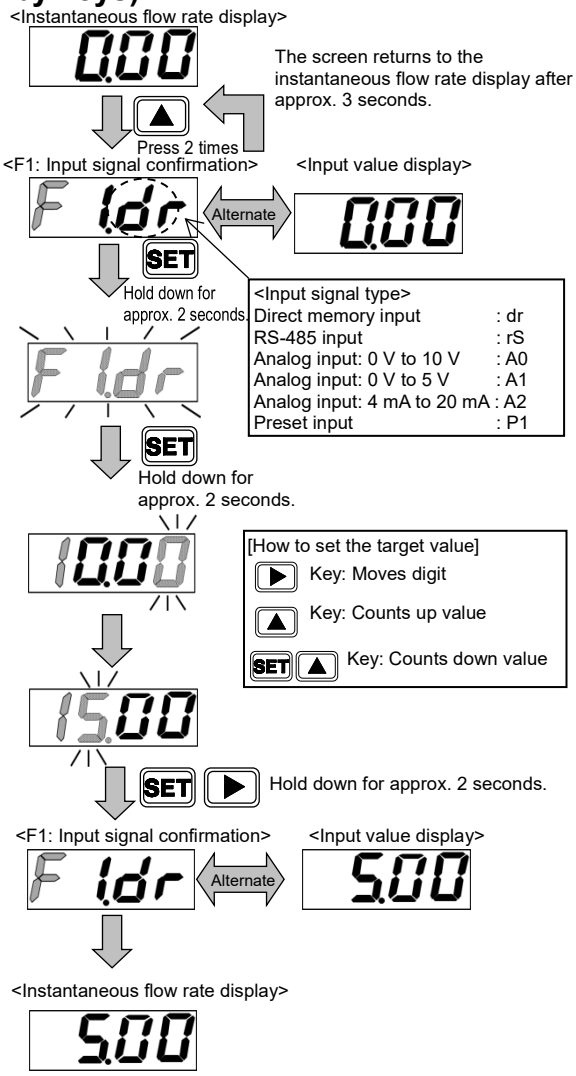
3 Hold down SET key for approx. 2 seconds.
"F1.dr" blinks.

4 Hold down SET key for approx. 2 seconds.
The screen enters the direct memory (1) setting screen.

5 Change the value.
The flow rate changes.
Even if the value is not confirmed, the flow rate can be changed by changing the value.



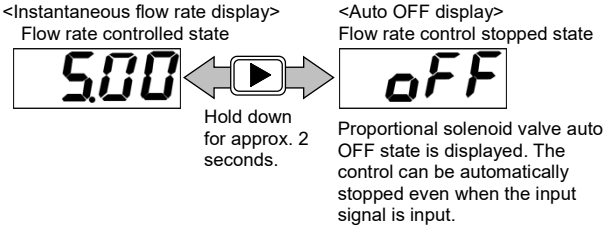
6 Hold down SET + ▶ key for approx. 2 seconds.
The value is confirmed, and the screen returns to F1: Input signal confirmation screen.
Returns to the instantaneous flow rate display automatically after approx. 3 seconds.



■ Auto OFF (flow rate zero) method

1 With the flow rate controlled (instantaneous flow rate displayed), hold down the ▶ key for approx. 2 seconds.
Control can be forced to stop (flow rate zero).

2 With flow rate control stopped (auto OFF), hold down the ▶ key for approx. 2 seconds.
It can be returned to the flow rate controlled state.



■ How to operate direct memory (2) (operation by keys)

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

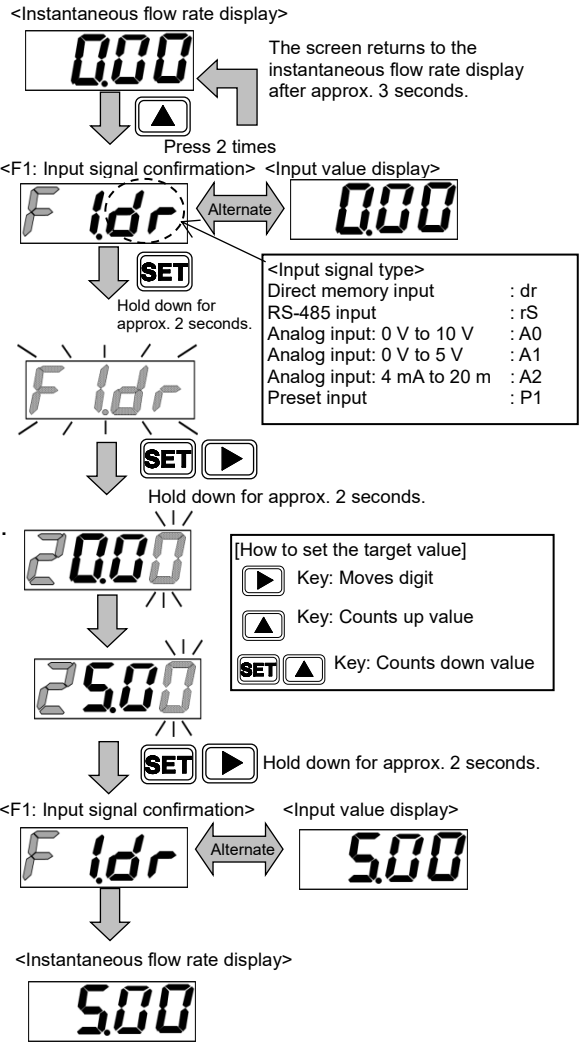
2 Press the ▲ key 2 times.
The screen switches to the F1: Input signal confirmation screen, and the present input signal and input value are alternately displayed.
(After approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

3 Hold down SET key for approx. 2 seconds.
"F1.dr" blinks.

4 Hold down the SET + ▶ key for approx. 2 seconds.
The screen enters the direct memory (2) setting screen.

5 Change the value.
When not confirming the value, the flow rate is not changed.

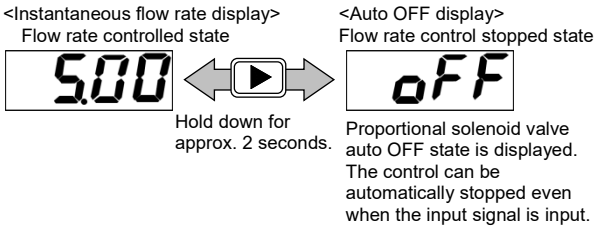
6 Hold down the SET + ▶ key for approx. 2 seconds.
The value is confirmed, and the screen returns to F1: Input signal confirmation screen.
Returns to the instantaneous flow rate display automatically after approx. 3 seconds.



■ Auto OFF (flow rate zero) method

1 With the flow rate controlled (instantaneous flow rate displayed), hold down the ▶ key for approx. 2 seconds.
Control can be forced to stop (flow rate zero).

2 With the flow control rate stopped (auto OFF), hold down the ▶ key for approx. 2 seconds.
It can be returned to the flow rate controlled state.



- Control is not stopped when setting direct memory. In situations where safety must be considered, stop the control (auto OFF) before making these setting.
- The flow rate control /auto OFF state is controlled by the power is turned off and the power is turned on again.

■ Direct memory control method (RS-485 communication)

Although the input setting can be changed to direct memory over RS-485 communication, the direct memory value cannot be set. Operate the keys to set the value.
The direct memory value will not be cleared even if the input setting is changed.
To change the flow rate set via RS-485 communication, use the RS-485 input mode.

[Parameter setting]

- Input signal setting

Write “3: Direct mode” to “Address: 0x0032 Input setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x0032	Input Select	0: RS-485 input mode 1: Analog input mode 2: Preset mode 3: Direct mode	0x0003

[Operation]

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x001E	Control ON/Auto OFF	0: Auto OFF 1: Control ON	0x0001

- Set to start state (flow rate control state)

Write “1: Control ON” to “Address: 0x001E Control ON/auto OFF” to put it to the controllable state. It will be controlled at the direct memory flow rate value that was set via operation by keys.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

[Confirmation]

Parameter

Address	Item	Description
0x0023	Set flowrate	Value set in the direct memory

The set flow rate can be confirmed by using “Address: 0x0023 Set flow rate”.
(Refer to “Read the 0x03 holding register”.)

If “Address: 0x001E Control ON/Auto OFF” is set to “0: Auto OFF” or “Addresses: 0x0032 Input setting” is not set to “3: Direct mode”, control by direct memory settings cannot be performed.

3.2.2 Controlling the flow rate using the preset input function

The flow rate can be switched by setting four flow rates and inputting a 2-bit signal from an external source or using “Address: 0x0038 Select preset number”.

Example) To control 0, 1, 2, or 5 L/min using preset input, select preset input for the input setting mode, and then set as follows:
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. 21	2	1	Preset memory number
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

■ Control method using preset input signal (operation by keys)

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press the ▲ key 2 times.
The screen switches to the F1: Input signal confirmation screen, and the present input signal and input value are alternately displayed.
(After approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

3 Hold down SET key for approx. 2 seconds.
“F1.dr” blinks.

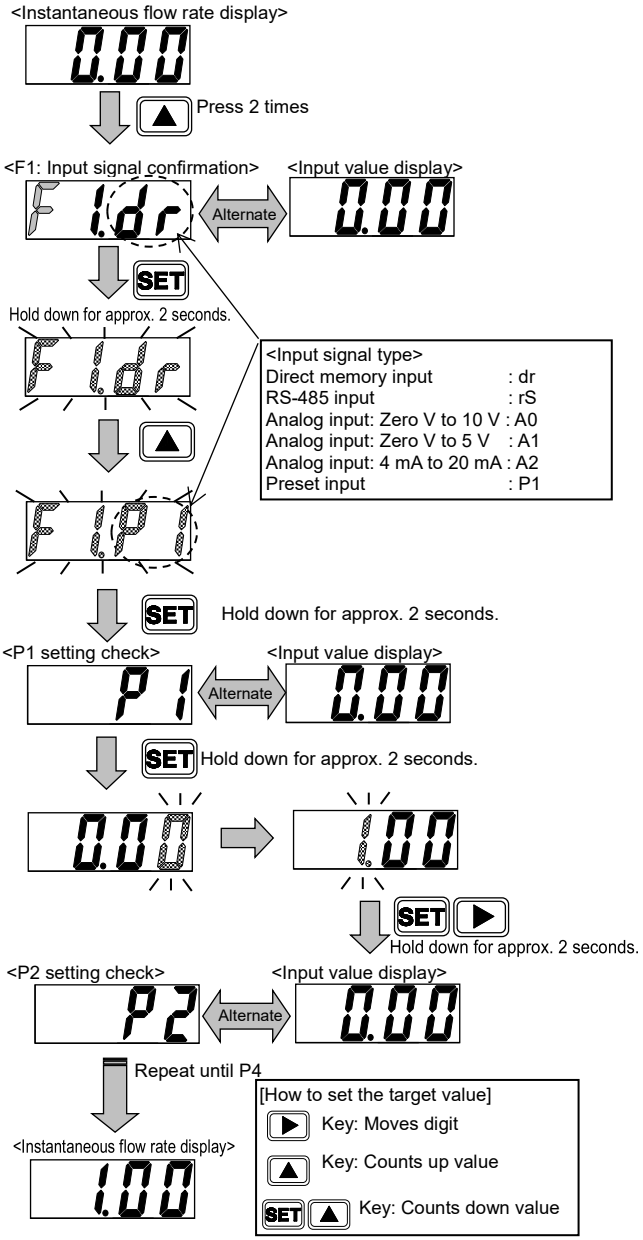
4 Press ▲ key 3 times.
“F1.P1” blinks.

5 Hold down SET key for approx. 2 seconds.
The screen enters the P1 setting confirmation screen.

6 Hold down SET key for approx. 2 seconds.
Enter the target value when the screen enters the target value input screen.

7 Hold down the SET + ▶ key for approx. 2 seconds.
The target value is stored in memory, and the screen enters the P2 setting confirmation screen.

8 Repeat the same procedure, and determine the target of P2 to P4.
Returns to the instantaneous flow rate display automatically after approx. 3 seconds. The flow rate can be controlled with the preset input.



If switching external input bit 1 and bit 2 at the same time, switch within 15 msec.
As an example, note that preset memory may be wrongly set if there is a large time difference, such as when switching the preset memory no. from P2 → P3.

■ Control method using preset input signal (RS-485 communication)

[Parameter setting]

- Input signal setting

Write “2: Preset Mode” to “Address: 0x0032 Input setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Preset memory 1 to 4 setting

Write the set flow rate to “Address: 0x0039 to 3C (preset memory 1 to 4)”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Preset input setting

Write “1: RS-485” to “Address: 0x003D Preset memory input specification setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x0032	Input Select	0: RS-485 input mode 1: Analog input mode 2: Preset mode 3: Direct mode	0x0002
0x0039	Preset memory 1	0.00 L/min	0x0000
0x003A	Preset memory 2	1.00 L/min	0x03E8
0x003B	Preset memory 3	2.00 L/min	0x07D0
0x003C	Preset memory 4	5.00 L/min	0x1388
0x003D	Preset memory input specification setting	0: External input 1: RS-485	0x0001

- The flow rate is expressed in 4 digits, having one digit more than the displayed value (5.00 L/min -> 5000(0x1388). No decimal point is required.
- Entering “9999(0x270F)” will set this to fully open (FUL).
- To perform preset input of the RS-485 function, ensure to set the preset input specification to RS-485.

[Operation]

- Set to start state (flow rate control state)

Set “Address: 0x001E Control ON/auto OFF” to “1: Control ON” to activate it. It will be controlled by each flow rate stored in memory, based on the preset memory no.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x001E	Control ON/Auto OFF	0: Auto OFF 1: Control ON	0x0001
0x0038	Select preset memory number	1	0x0001

- Preset memory switching

Use “Address: 0x0038 Preset number selection” to select the preset number directly and switch it.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

[Confirmation]

Address	Item	Description
0x0023	Set flowrate	Flow rate set to preset memory number

The set flow rate can be confirmed by using “Address: 0x0023 Set flow rate”.
(Refer to “Read the 0x03 holding register”.)

If “Address: 0x001E Control ON/auto OFF” is set to “0: Auto OFF” or “Address: 0x0032 Input setting” is not set to “2: Preset mode”, “Address: 0x0023 Set flow rate” does not change even if the preset number is switched by using external input or “Address: 0x0038 Preset number selection”.

3.2.3 Setting change using shortcut keys (only when using direct memory and preset input functions)

When using the direct memory function and the preset input function to control the flow rate, the screen can enter the set value change screen with a single operation by keys using the shortcut keys.

- The screen enters the screen for changing the set value of the input signal when the shortcut key is pressed.
  (Example: When controlling the flow rate with the preset input P2, the screen enters the P2 set value change screen.)
- This does not apply when controlling the flow rate using RS-485 input.

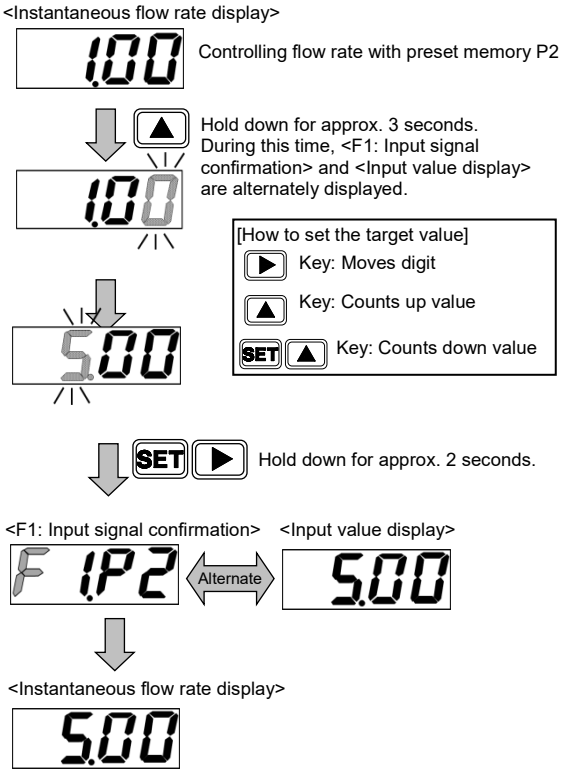
■ Set value change method using shortcut keys

1 Turn the power supply ON.
The instantaneous flow rate is displayed.
(Applicable only when controlling with direct memory function or preset input function.)

2 Hold down the ▲ key for approx. 3 seconds.
It will enter the screen for changing the set value of the input signal when the ▲ key is pressed.

3 Change the value.
The flow rate changes.
Even if the value is not confirmed, the flow rate can be changed by changing the value.

4 Hold down the SET + ▶ key for approx. 2 seconds.
The value is confirmed, and the screen returns to F1: Input signal confirmation screen.
Returns to the instantaneous flow rate display automatically after approx. 3 seconds.



- When changing settings using shortcut keys, do not switch the preset no. The setting value may be stored at an incorrect preset number.
- Because the data is not stored in memory after turning OFF the power supply without confirming the value, make sure to confirm the value before turning OFF the power supply.

3.2.4 Controlling the flow rate using the RS-485 input function (RS-485 communication only)

The flow rate can be controlled by using “Address: 0x0033 RS-485 input flow rate”.
Set values cannot be changed using operation by keys.

■ Control method using RS-485 communication (operation by keys)

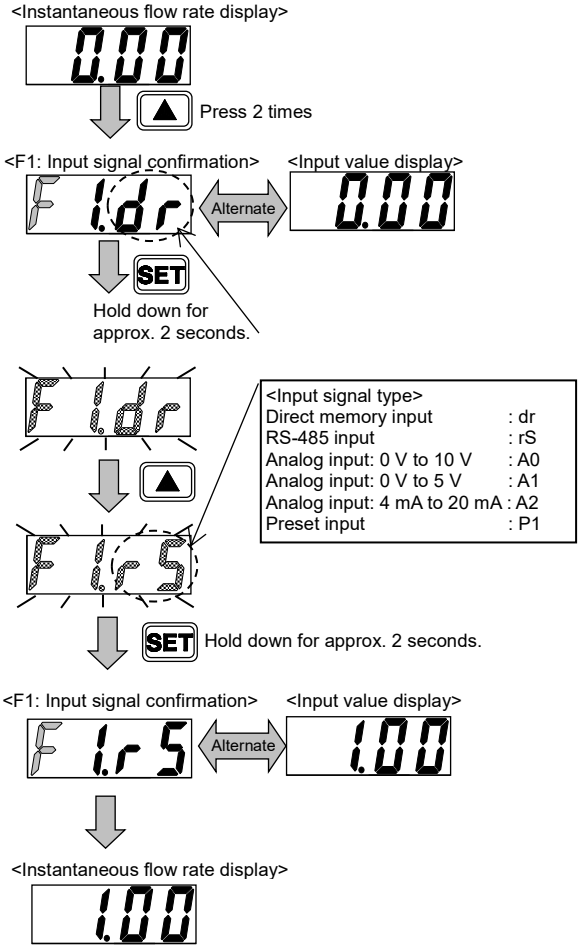
5 Turn the power supply ON.
The instantaneous flow rate is displayed.

6 Press the ▲ key 2 times.
The screen switches to the F1: Input signal confirmation screen, and the present input signal and input value are alternately displayed.
(After approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

7 Hold down the SET key for approx. 2 seconds.
“F1.dr” blinks.

8 Press the ▲ key 1 time.
“F1.rS” blinks.

9 Hold down the SET + key for approx. 2 seconds.
The value is confirmed, and the screen returns to F1: Input signal confirmation screen.
Returns to the instantaneous flow rate display automatically after approx. 3 seconds.



- By operation using keys, you can only switch input setting only. Change the input value using RS-485 communication.

■ Control method using RS-485 communication (RS-485 communication)

[Parameter setting]

- Input signal setting

Write “0: RS-485 input mode” to “Address: 0x0032 Input setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x0032	Input Select	0: RS-485 input mode 1: Analog input mode 2: Preset mode 3: Direct mode	0x0000

[Operation]

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x001E	Control ON/Auto OFF	0: Auto OFF 1: Control ON	0x0001
0x0033	RS-485 input flow	1.00 L/min	0x03E8

- Set to start state (flow rate control state)

Set “Address: 0x001E Control ON/auto OFF” to “1: Control ON” to activate it.
The flow rate can be controlled using “Address: 0x0033 RS-485 input flow rate”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Flow rate setting range for each model

Model no.	0x0033 RS-485 input flow rate	Set flowrate
FCM-9500*-*R	0 to 5000 (0x1388)	0.0 to 500.0 mL/min
FCM-0001*-*R	0 to 1000 (0x03E8)	0.000 to 1.000 L/min
FCM-0002*-*R	0 to 2000 (0x07D0)	0.000 to 2.000 L/min
FCM-0005*-*R	0 to 5000 (0x1388)	0.000 to 5.000 L/min
FCM-0010*-*R	0 to 1000 (0x03E8)	0.00 to 10.00 L/min
FCM-0020*-*R	0 to 2000 (0x07D0)	0.00 to 20.00 L/min
FCM-0050*-*R	0 to 5000 (0x1388)	0.00 to 50.00 L/min
FCM-0100*-*R	0 to 1000 (0x03E8)	0.0 to 100.0 L/min

- Input 4 digits value for flow rate (1.00 L/min => 1000 (0x03E8)). No decimal point is required.
- Do not enter a value outside of the setting range. Ensure the value set to “Address: 0x0033 RS-485 Input flow rate” is within the valid range by using user programs.
- As the only exception to this rule, entering “9999 (0x270F)” will set this to fully open (FUL).

[Confirmation]

Address	Item	Description
0x0023	Set flowrate	Value set to “RS-485 Input flow rate”

The set flow rate can be confirmed by using “Address: 0x0023 Set flow rate”.
(Refer to “Read the 0x03 holding register”.)

If “Address: 0x001E Control ON/auto OFF” is set to “0: Auto OFF” or “Address: 0x0032 Input setting” is not set to “0: RS-485 input mode”, “Address: 0x0023 Set flow rate” does not change even if the value in “Address: 0x0033 RS-485 input flow rate” is changed.

3.2.5 Controlling the flow rate using the analog input function

The flow rate can be controlled with analog input signals.

■ Control method using analog input signal (operation by keys)

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

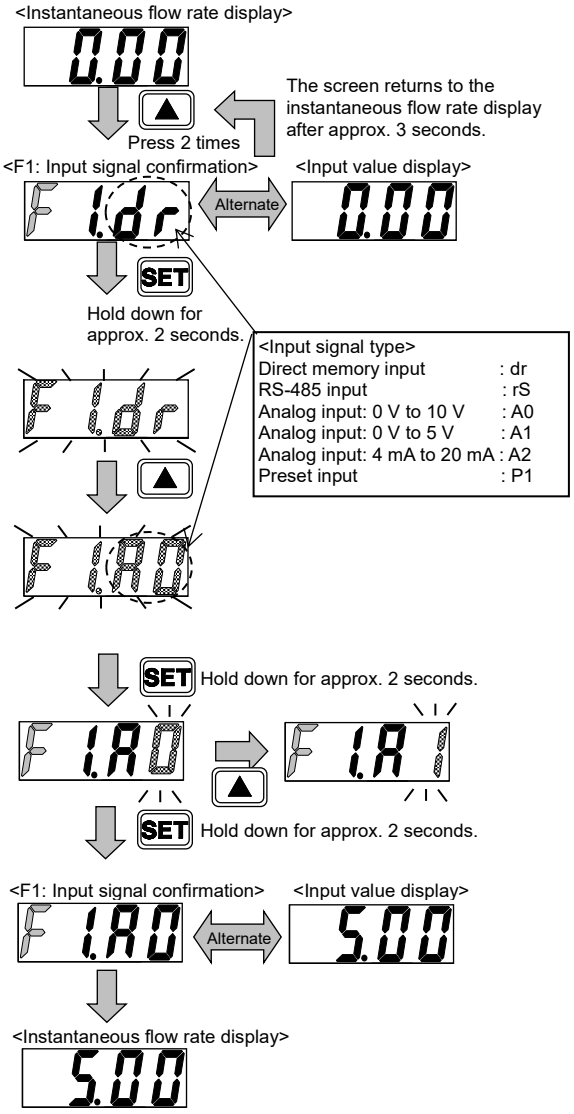
2 Press the ▲ key 2 times.
The screen switches to the F1: Input signal confirmation screen, and the present input signal and input value are alternately displayed.
(After approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

3 Hold down the SET key for approx. 2 seconds.
"F1.dr" blinks.

4 Press the ▲ key 2 times.
"F1.A0" blinks.
(The value in "□" varies depending on the setting.))

5 Hold down the SET key for approx. 2 seconds.
Select analog input specification.

6 Hold down the SET key for approx. 2 seconds.
The value is confirmed and the screen returns to the F1: Input signal confirmation screen.
Returns to the instantaneous flow rate display automatically after approx. 3 seconds.
The flow rate can be controlled with the analog input.



- Fully open (FUL) cannot be set with the analog input.
- Do not input an analog signal that is not compatible with the set specifications.
  Do not apply an excessive voltage that exceeds the analog input specifications. Also, do not turn the power on / off with the input signal applied. Overvoltage may be applied, causing malfunction or damage to the product. Be especially careful when the current input is DC4-20mA.
  If an overvoltage is applied to the analog input signal, it may cause malfunction or damage. Especially when the current input is 4-20mA, an unexpected voltage may be applied, so check the specifications of the equipment used and be careful not to overvoltage.
  When connecting an analog input signal, be sure to turn off the connection state if the analog input signal is not used in RS-485 input mode.

■ Control method using analog signal (RS-485 communication)

[Parameter setting]

- Input signal setting

Write “1: Analog input mode” to “Address: 0x0032 Input setting”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Setting analog input specifications

Write analog specification for use to “Address: 0x0034 Analog input specification selection”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x0032	Input Select	0: RS-485 input mode 1: Analog input mode 2: Preset mode 3: Direct mode	0x0001
0x0034	Analog input Communication selection	0: 0-10 V 1: 0-5 V 2: 4-20 mA	0x0000

- Input values cannot be changed in RS-485 communication.
- Do not input an analog signal that is not compatible with the set specifications.

[Operation]

- Set to start state (flow rate control state)

Set “Address: 0x001E Control ON/auto OFF” to “1: Control ON” to activate it. Control flow rate according to the analog input.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Values	Set value (hexadecimal notation)
0x001E	Control ON/ Auto OFF	0: Auto OFF 1: Control ON	0x0001

[Confirmation]

Address	Item	Description
0x0023	Set flowrate	Flow according to the analog input

The set flow rate can be confirmed by using “Address: 0x0023 Set flow rate”.
(Refer to “Read the 0x03 holding register”.)

If “Address: 0x001E Control ON/auto OFF” is set to “0: Auto OFF” or “Address: 0x0032 Input setting” is not set to “1: Analog input”, “Address: 0x0023 Set flow rate” does not change even if the analog input value is changed.

3.3 Flow Rate Integration

3.3.1 How to display integrated flow

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

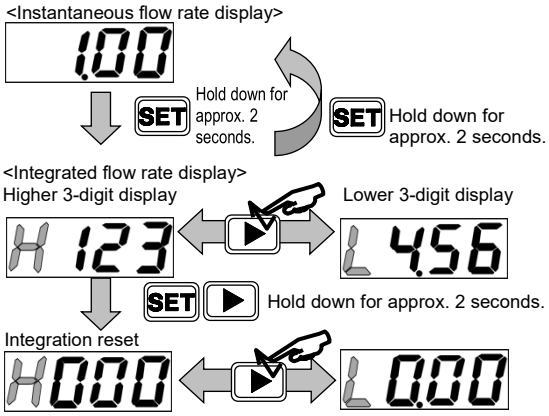
Model: FCM-		9500 L9500	0001 L0001	0002 L0002	0005 L0005	0010 L0010	0020	0050	0100
Flow rate display	Display range	0 to 500 mL/min	0.00 to 1.00 L/min	0.00 to 2.00 L/min	0.00 to 5.00 L/min	0.0 to 10.0 L/min	0.0 to 20.0 L/min	0.0 to 50.0 L/min	0 to 100 L/min
Integrating functions	Display range	999999 mL	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

■ How to display integration (operation by keys)

1 Turn the power supply ON.
Instantaneous flow rate display integration begins. (The integrated value is reset when the power supply is turned OFF.)

2 Hold down SET key for approx. 2 seconds.
The screen enters the integration display screen.
To return to the instantaneous flow rate display, hold down the SET key for approx. 2 seconds.
Pressing the ▶ key switches the display digit.

3 Hold down SET + ▶ key for approx. 2 seconds.
Integration reset is performed. The integration can be reset with the external input (Pin 3) or using 0x0026 Integration reset. The integrated value is also reset when the power supply is turned OFF.



■ How to display integration (RS-485 communication)

Combine the values of “Address: 0x0024 Higher 3 digits of integrated flow rate” and “Address: 0x0025 Lower 3 digits of integrated flow rate” to display the integrated flow rate.
(Refer to “Read the 0x03 holding register”.)

Accumulated flow calculation example

Parameter

Address	Item	Description
0x0024	Higher thee digits of integrated flow rate	123 (0x007B)
0x0025	Lower thee digits of integrated flow rate	456 (0x01C8)

007B 01C8(hex) => 123456(dec)
For FCM-0005* - *R, the integrated flow will be 1234.56 L.

- Integration reset

Setting the external input (Pin 3) to “ON” or “Address: 0x0026 Integration reset” to “1: Reset integrated value” resets the integration.
Use “Address: 0x0048 Integration reset input specification setting” to set input specifications for resetting integration.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Integration stop

Integration stop can be performed by setting “Address: 0x0027 Stop integration” to “1: Stop operating integrated flow rate”.
While the “Address: 0x0027 Integration stop” bit is “1”, flow rate integration will be continuously stopped. To restart flow rate integration, set the “Address: 0x0027 Integration stop” bit to “0”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x0026	Integration reset	1: Reset integrated value	0x0001
0x0027	Integration stop	0: Operate integrated flow rate 1: Stop operating integrated flow rate	0x0001
0x0048	Integration reset input specification setting	0: External input 1: RS-485	0x0001

The integrated value is reset when the power supply is turned OFF.

3.3.2 Closing solenoid valve when the value reaches the set integrated flow rate.

When the value reaches the set integrated flow rate, the proportional solenoid valve is closed. Ideal for filling processes with a constant flow rate, etc.

■ How to operate (operation by keys)

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press [▲] key 6 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 approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

3 Hold down [SET] key for approx. 2 seconds.
“F5.--” blinks.

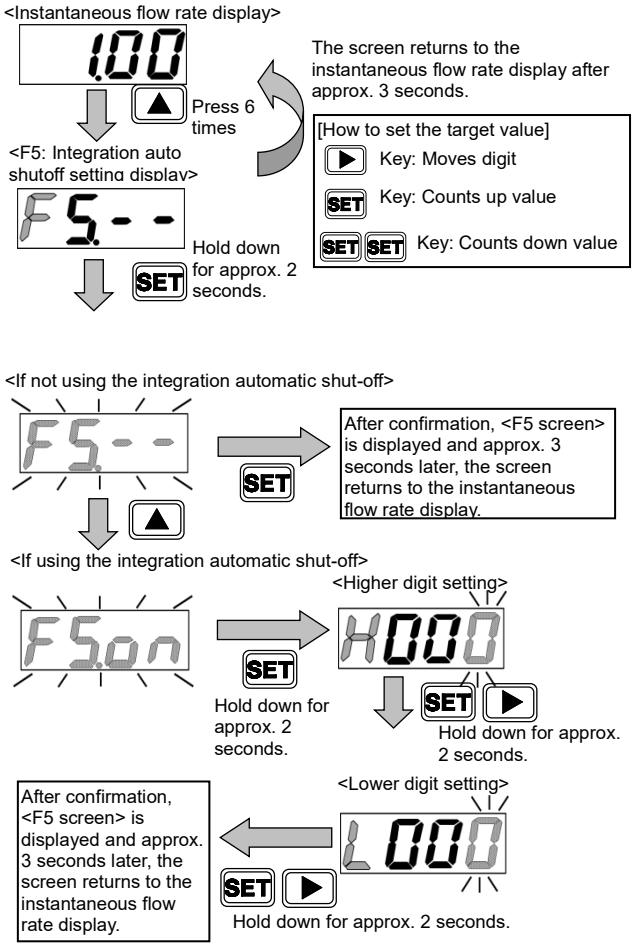
4 To disable integration auto shutoff, hold down [SET] key for approx. 2 seconds.
The display returns to F5 screen, and after approx. 3 seconds, it returns to the instantaneous flow rate display.

5 To use integration auto shutoff, press [▲] key.
“F5.on” blinks.

6 Hold down [SET] key for approx. 2 seconds, and then set the higher digits.

7 Hold down [SET] + [▶] key for approx. 2 seconds, and then set the lower digits.

8 Hold down [SET] + [▶] key for approx. 2 seconds.
The display returns to F5 screen, and after approx. 3 seconds, it returns to the instantaneous flow rate display.



- Only in this mode, the integrated value is reset when the input signal becomes zero. (enabled after automatic shut-off only)
- The proportional solenoid valve is shutoff automatically when the value matches the integrated flow rate.
- When the display is set to “OFF” by automatic shut-off, reset the integrated flow rate (by inputting using keys, performing external input, or using “Address: 0x0026 Reset integration”) to display flow rate again.
- Even if the auto shutoff function is disabled at the time of auto shutoff, operation cannot be performed unless the integrated value is reset.
- The integrated value is reset at the point when the auto shutoff is turned “ON” and the value is set.
- After changing the setting, reset the integrated flow rate.

■ How to operate (RS-485 communication)

[Parameter setting]

- Integration auto shutoff function enable/disable setting

Write “1: ON” to “Address: 0x0054 (integration auto shutoff function)” to enable it.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x0054	Integration auto shutoff function	0: OFF 1: ON	0x0001
0x0055	Integration automatic shut-off Higher 3 digits of set value	123	0x007B
0x0056	Integration automatic shut-off Lower 3 digits of set value	456	0x01C8

- Integration auto shutoff value setting

Write the desired integrated flow rate to “Address: 0x0055 Higher 3 digits of the value set for automatic integration shut-off” or “Address: 0x0056 Lower 3 digits of the value set for automatic integration shut-off”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- After auto shutoff only, the integrated value is reset once the input signal drops to zero.
- The proportional solenoid valve is shutoff automatically when the value matches the integrated flow rate.
- When the display is set to “OFF” by automatic shut-off, reset the integrated flow rate (by inputting using keys or using “Address: 0x0026 Reset integration”) to display flow rate again.
- Even if the auto shutoff function is disabled at the time of auto shutoff, operation cannot be performed unless the integrated value is reset.
- The integrated value is reset at the point when the auto shutoff is turned “ON” and the value is set.
- After changing the setting for each function, reset the integrated flow rate.
- Input integrated flow rates in 6 digits (1234.56 L => Higher 3 digits: 123 (0x007B) and lower 3 digits: 456 (0x01C8)). No decimal point is required.

3.3.3 Outputting the integrated pulse (switch output type only)

This section describes how to output integrated pulse. For the pulse rate, refer to “1.2 Specifications”. For the switch output cable connection, see “2.4.2 Cable connection” and “2.4.33 Example of internal circuit and load connection”.

■ How to operate (operation by keys)

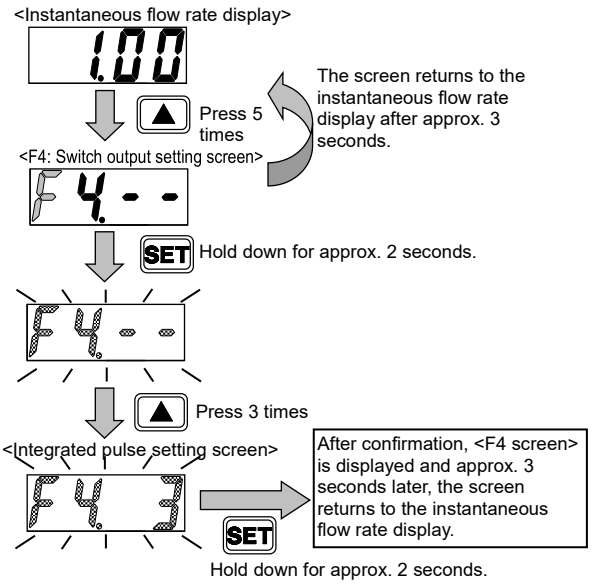
1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press ▲ key 5 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 approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

3 Hold down SET key for approx. 2 seconds.
The switch output setting mode is displayed.

4 Press ▲ key 3 times.
“F4. 3” blinks.

5 Hold down SET key for approx. 2 seconds.
The integrated pulse output is confirmed, and the screen returns to the F4 screen.
The screen returns to the instantaneous flow rate display after approx. 3 seconds.



■ How to operate (RS-485 communication)

[Parameter setting]

- Select a switch output mode
  Write “3: Integrated pulse” to “Address: 0x004A Switch output mode selection”.
  (Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x004A	Switch output Mode selection	0: Not used 1: Tolerance mode 2: Designated range mode 3: Integrated pulse 4: ON at set integrated value or more	0x0003

The integrated pulse will be output only to the external switch output, and cannot be checked by using “Address: 0x0029 Switch output status” or by checking the screen display.

3.3.4 Turning the switch ON with the set integrated flow rate

The switch output is turned ON when the value reaches the set integrated flow rate.
For the switch output cable connection, see “2.4.2 Cable connection” and “2.4.33 Example of internal circuit and load connection”.

■ How to operate

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press ▲ key 5 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 approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

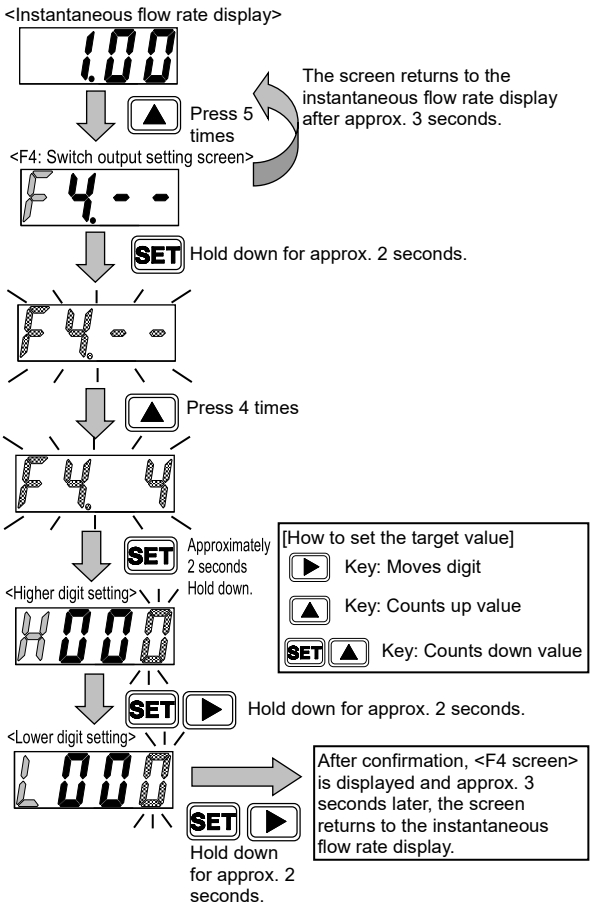
3 Hold down SET key for approx. 2 seconds.
The switch output setting mode is displayed.

4 Press ▲ key 4 times.
“F4. 4” blinks.

5 Hold down SET key for approx. 2 seconds.
The screen enters the target value setting screen.

6 After setting the higher 3 digits of the target value, hold down SET + ▶ keys for approx. 2 seconds.

7 After setting the lower 3 digits of the target value, hold down SET and ▶ keys for approx. 2 seconds.
The integrated value is reset immediately after confirmation.
The display returns to F4 screen, and after approx. 3 seconds, it returns to the instantaneous flow rate display.



After changing the setting, reset the integrated flow rate.

■ How to operate (RS-485 communication)

[Parameter setting]

- Select switch output mode
  Write “4: ON at set integrated value or more” to “Address: 0x004A Switch output mode selection”.

(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Input a value for turning ON when an integrated flow rate is the set value or more
  Write the desired integrated flow rate to “Address: 0x0051 Higher 3 digits of the value set for turning ON at set value or more” or “Address: 0x0052 Lower 3 digits of the value set for turning ON at set value or more”.

(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x004A	Select a switch output mode	0: Not used 1: Tolerance mode 2: Designated range mode 3: Integrated pulse 4: ON at set integrated value or more	0x0004
0x0051	Not less than set value Higher 3 digits of set value for ON	123	0x007B
0x0052	Not less than set value Lower 3 digits of set value for OFF	456	0x01C7

- After changing the setting, reset the integrated flow value.
- Input integrated flow rates in 6 digits (1234.56 L => Higher 3 digits: 123 (0x007B) and lower 3 digits: 456 (0x01C8)).
  No decimal point is required.

[Confirmation]

Parameter

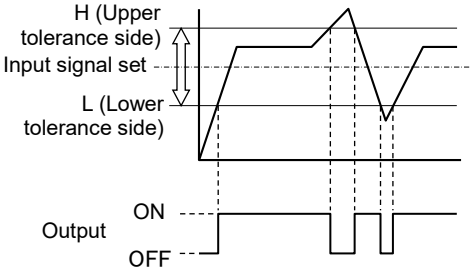
Address	Item	Description
0x0029	Switch output status	0: Output OFF 1: Output ON

Confirm output values by “Address: 0x0029 Switch output status”.
(Refer to “Read the 0x03 holding register”.)

3.4 Switch Output Function

3.4.1 Using tolerance mode

Turns the switch output ON when the value is within tolerance against the input signal set value.
The tolerance value can be set on both positive and negative sides, with % F.S. (full scale).
For the switch output cable connection, see “2.4.2 Cable connection” and “2.4.33 Example of internal circuit and load connection”.



■ How to operate (operation by keys)

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press ▲ key 5 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 approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

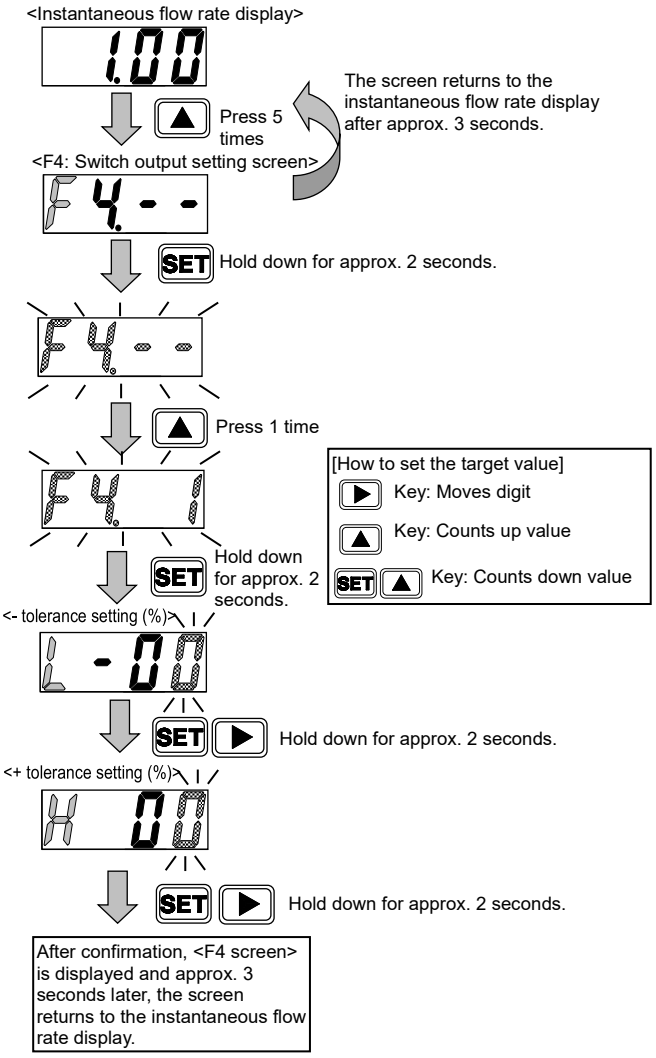
3 Hold down SET key for approx. 2 seconds.
The switch output setting mode is displayed.

4 Press ▲ key.
“F4. 1” blinks.

5 Hold down SET key for approx. 2 seconds.
The screen enters the target value setting screen.

6 After setting the tolerance value (negative side), hold down SET + ▶ keys for approx. 2 seconds.
Negative side setting range: -50 to 0% F.S.

7 After setting the tolerance value (positive side), hold down SET + ▶ keys for approx. 2 seconds.
Positive side setting range: 0 to 50% F.S.
The display returns to F4 screen, and after approx. 3 seconds, it returns to the instantaneous flow rate display.



The tolerance is not set in “FUL” (valve fully open).
When using switch output in tolerance mode, note that the switch output setting will use the same tolerance for the input value prior to changing it if the input signal is changed to “FUL” (valve fully open).

■ How to operate (RS-485 communication)

[Parameter setting]

- Select a switch output mode

Write “1: Tolerance mode” to “Address: 0x004A Switch output mode selection”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Input the lower limit in the tolerance mode

Write the tolerance value (negative side) to “Address: 0x004B Lower limit in the tolerance mode”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Values	Set value (hexadecimal notation)
0x004A	Select a switch output mode	0: Not used 1: Tolerance mode 2: Designated range mode 3: Integrated pulse 4: ON at set integrated value or more	0x0001
0x004B	Lower limit in tolerance mode	-10 %F.S.	0x000A
0x004C	Upper limit in tolerance mode	5 %F.S.	0x0005

- Input upper limit in the tolerance mode

Write the tolerance value (positive side) to “Address: 0x004C Upper limit in the tolerance mode”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

The setting range of “Address: 0x004B Lower limit in the tolerance mode is “-50% F.S. to 0% F.S.”, but the valid input range is “0 to 50 (0x0032).”

[Confirmation]

Parameter

Address	Item	Description
0x0029	Switch output status	0: Output OFF 1: Output ON

Confirm output values by using “Address: 0x0029 Switch output status.”
(Refer to “Read the 0x03 holding register”.)

- Reference value setting when valve fully open

The tolerance is not set in “FUL” (valve fully open). Set the behavior to use when the input signal is changed to “FUL” (valve fully open).

- Reference value setting ON/OFF selection when valve fully open

If “Address: 0x004D Reference setting in the tolerance mode when valve is fully open” is set to “1: ON”, switch output will be determined using the same tolerance for the value set to “Address: 0x004E Reference value in the tolerance mode when valve fully open”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

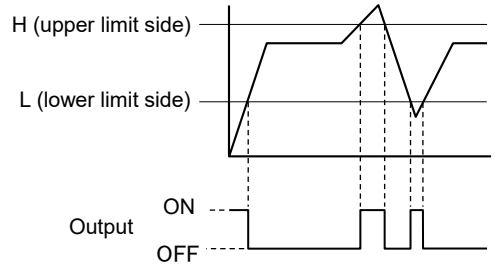
If “Address: 0x004D Reference setting in the tolerance mode when valve is fully open” is set to “0: OFF”, switch output will be determined using the same tolerance for the input value prior to changing it to “FUL” (valve fully open).
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x011F	Reference value setting when valve fully open	0: OFF 1: ON	0x0001
0x0120	When valve fully open Reference value	50 %F.S.	0x0032

3.4.2 Using the designated range mode

The switch output turns ON when the value is outside the designated flow rate range. The upper/lower limits are set regardless of input signal set value (control target value).
Both upper and lower limits can be set, with % F.S. (full scale).
For the switch output cable connection, see “2.4.2 Cable connection” and “2.4.33 Example of internal circuit and load connection”.



■ How to operate (operation by keys)

1 Turn the power supply ON.
The instantaneous flow rate is displayed.

2 Press ▲ key 5 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 approx. 3 seconds have elapsed without pressing a key, the display returns to the instantaneous flow rate display.)

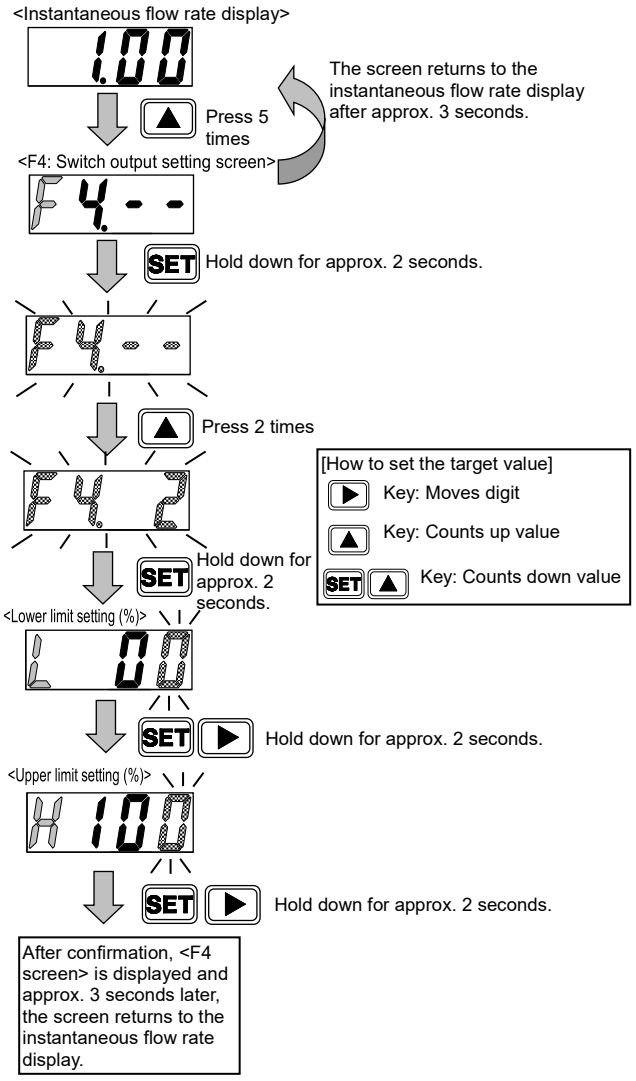
3 Hold down SET key for approx. 2 seconds.
The switch output setting mode is displayed.

4 Press the ▲ key 2 times.
“F4. 2” blinks.

5 Hold down SET key for approx. 2 seconds.
The screen enters the target value setting screen.

6 Hold down the SET + ▶ key for approx. 2 seconds.
Lower limit setting range: 0 to 90% F.S.

7 Set the upper limit and hold down the SET + ▶ key for approx. 2 seconds.
Upper limit setting range: 10 to 100% F.S.
With interval of 10% F.S. or more between the upper limit and lower limit.
The display returns to F4 screen, and after approx. 3 seconds, it returns to the instantaneous flow rate display.



■ How to operate (RS-485 communication)

[Parameter setting]

- Select a switch output mode

Write “2: Designated range mode” to “Address: 0x004A Select switch output mode”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

- Input the lower limit in designated range mode

Write the lower limit value (0 to 90% F.S). to “Address: 0x004F Lower limit in the designated range mode”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Parameter

Address	Item	Description	Set value (hexadecimal notation)
0x004A	Select a switch output mode	0: Not used 1: Tolerance mode 2: Designated range mode 3: Integrated pulse 4: ON at set integrated value or more	0x0002
0x004F	Lower limit in designated range mode	30 %F.S.	0x001E
0x0050	Upper limit in designated range mode	70 %F.S.	0x0046

- Input the upper limit in designated range mode

Write the upper limit value (10 to 100% F.S). to “Address: 0x0050 Upper limit in the designated range mode”.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

Set an interval of 10% F.S. or more between the upper limit and lower limit.
If this is less than 10% F.S., the upper limit value will be set to “lower limit value +10% F.S.”.

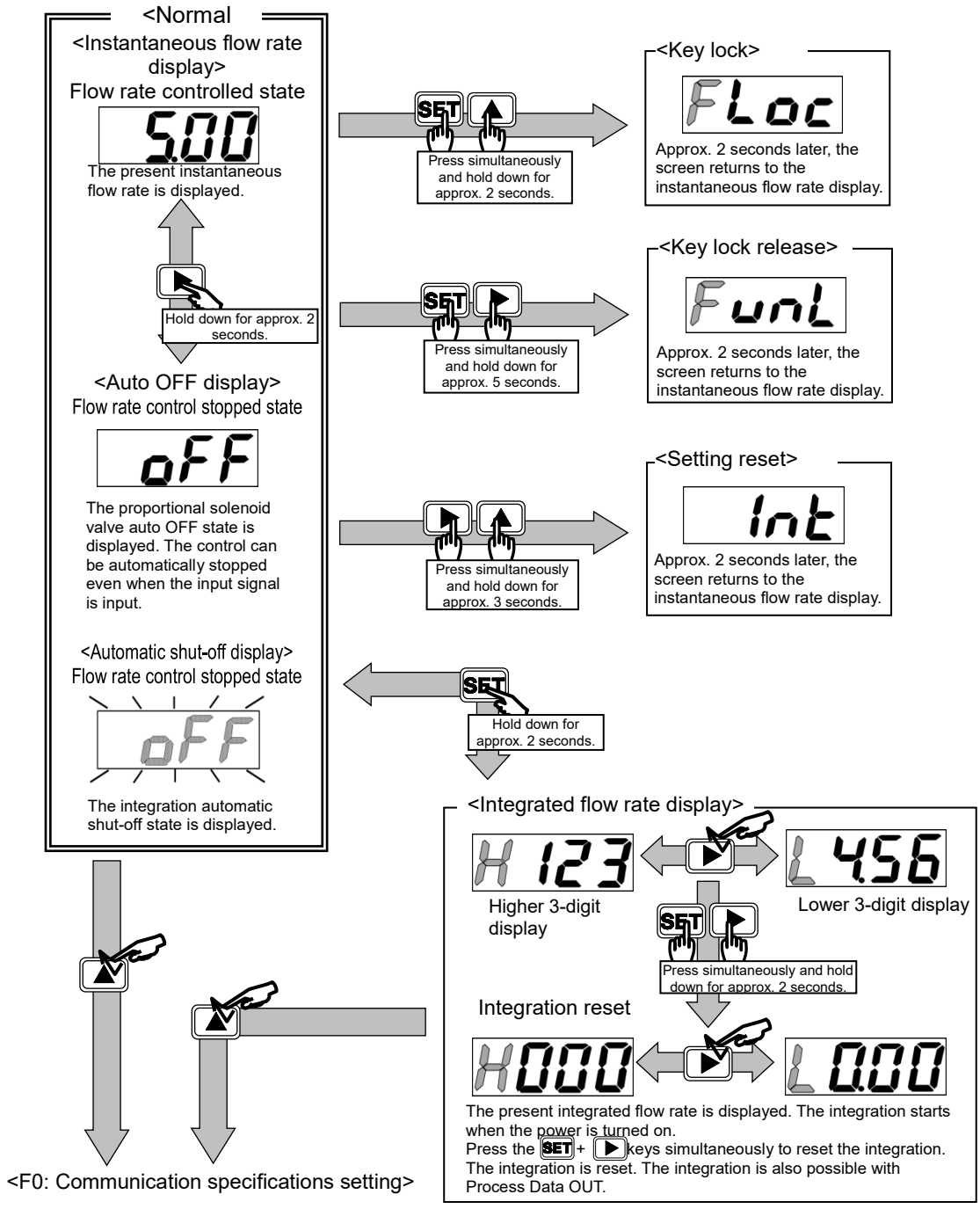
[Confirmation]

Parameter

Address	Item	Description
0x0029	Switch output status	0: Output OFF 1: Output ON

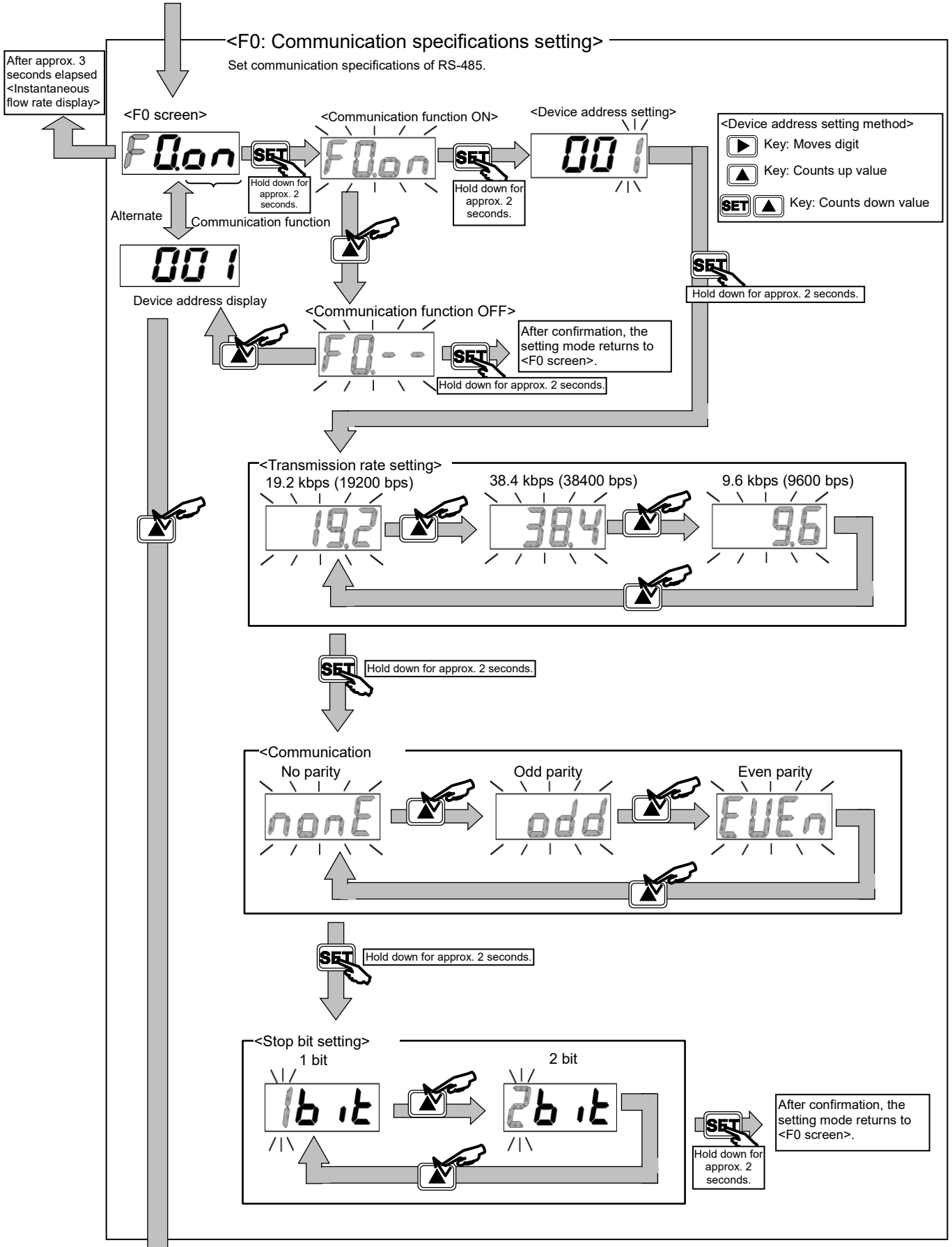
Confirm output values by using “Address: 0x0029 Switch output status.”
(Refer to “Read the 0x03 holding register”.)

3.5 Operation Flow



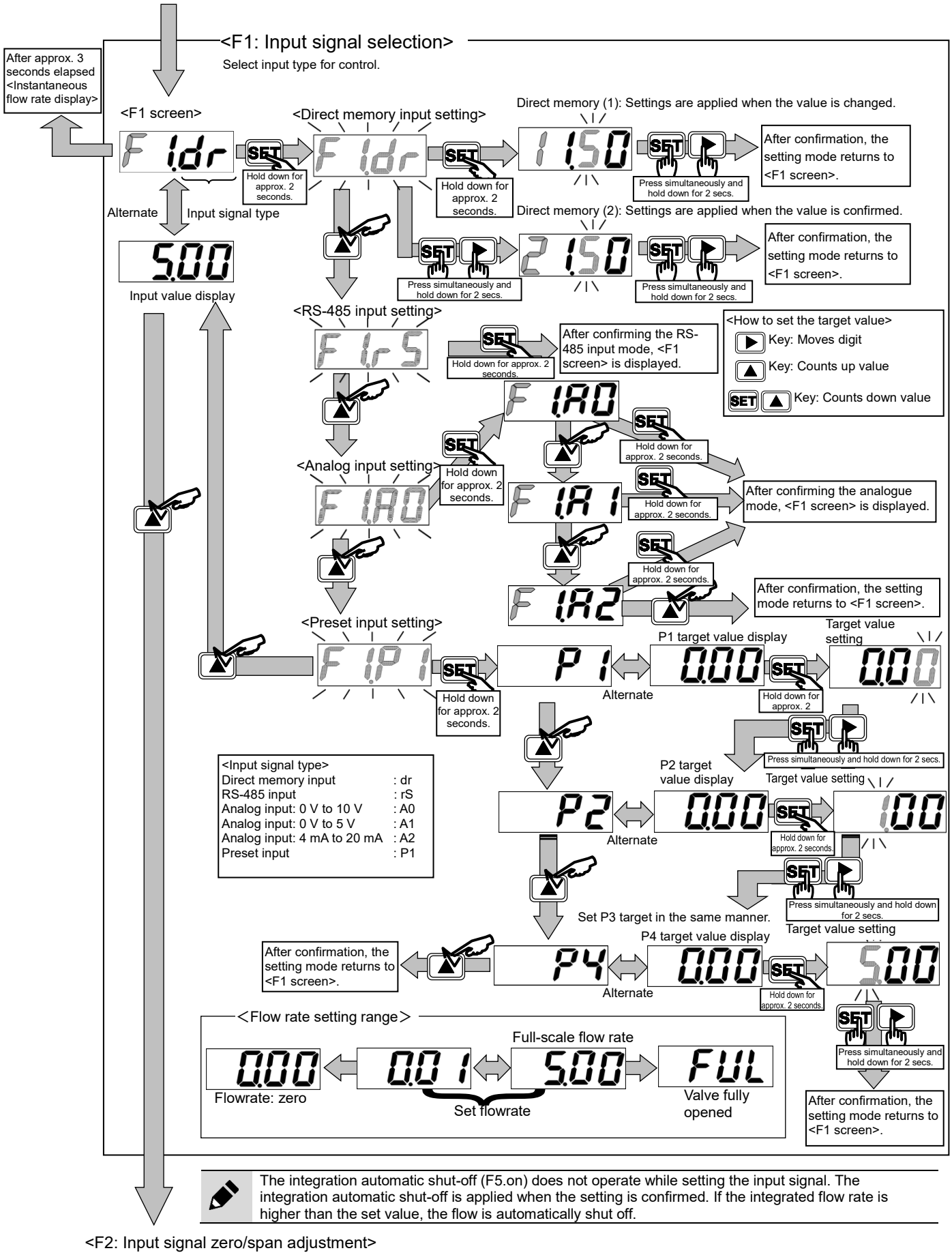
The key lock is disabled before shipping from the factory. Lock the key as necessary.
The key lock state (enabled/disabled) is maintained even if the power is turned off.

- 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 setting.
- The control ON/auto OFF status is held even when the power is turned off.



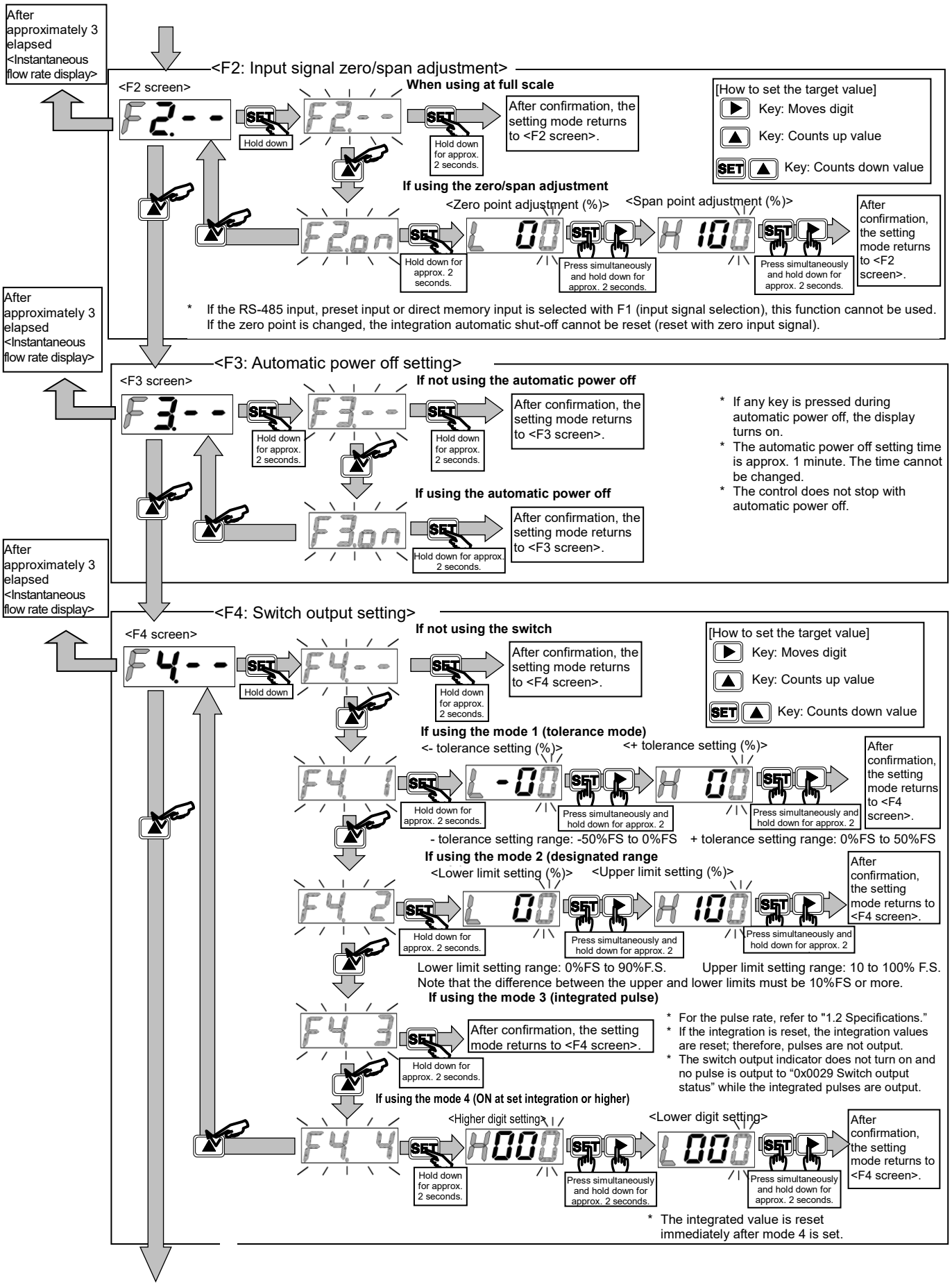
If communication setting is changed by operation using keys, the setting will be applied to the communication setting when the stop bit setting is confirmed, but a change is made via RS-485 communication (address: 0x 0064 to 0 x0068), the communication setting is not applied until the power is turned on again.

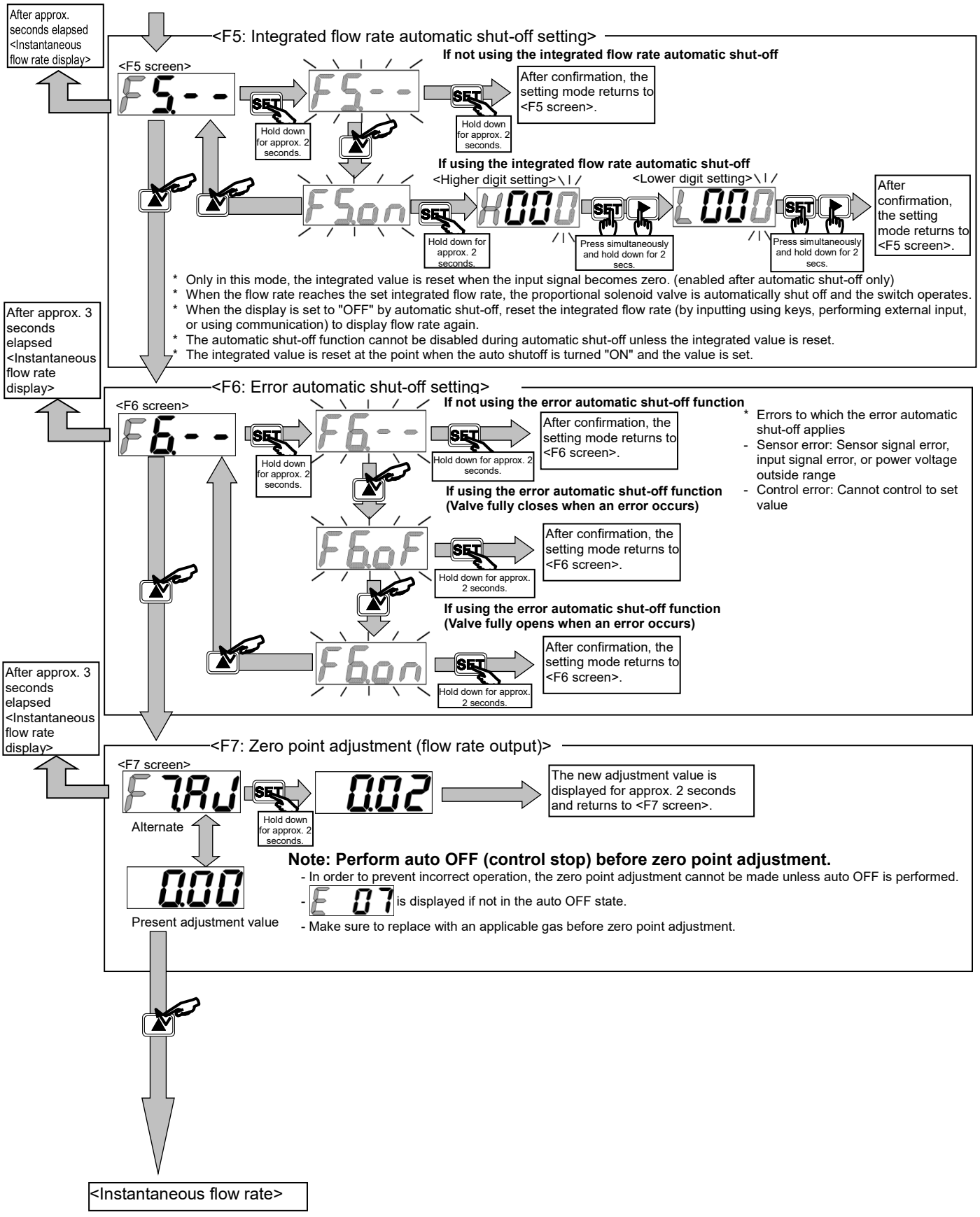
<F1: Input signal selection>



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>


After approximately 3 elapsed <Instantaneous flow rate display>
<F2: Input signal zero/span adjustment>
<F2 screen>
When using at full scale
Hold down
Hold down for approx. 2 seconds.
After confirmation, the setting mode returns to <F2 screen>.
[How to set the target value]
Key: Moves digit
Key: Counts up value
Key: Counts down value
If using the zero/span adjustment
<Zero point adjustment (%)>
<Span point adjustment (%)>
Hold down for approx. 2 seconds.
Press simultaneously and hold down for approx. 2 seconds.
After confirmation, the setting mode returns to <F2 screen>.
* If the RS-485 input, preset input or direct memory input is selected with F1 (input signal selection), this function cannot be used.
If the zero point is changed, the integration automatic shut-off cannot be reset (reset with zero input signal).
After approximately 3 elapsed <Instantaneous flow rate display>
<F3: Automatic power off setting>
<F3 screen>
If not using the automatic power off
Hold down for approx. 2 seconds.
After confirmation, the setting mode returns to <F3 screen>.
If using the automatic power off
* If any key is pressed during automatic power off, the display turns on.
* The automatic power off setting time is approx. 1 minute. The time cannot be changed.
* The control does not stop with automatic power off.
After approximately 3 elapsed <Instantaneous flow rate display>
<F4: Switch output setting>
<F4 screen>
If not using the switch
Hold down
Hold down for approx. 2 seconds.
After confirmation, the setting mode returns to <F4 screen>.
[How to set the target value]
Key: Moves digit
Key: Counts up value
Key: Counts down value
If using the mode 1 (tolerance mode)
<- tolerance setting (%)>
<+ tolerance setting (%)>
Hold down for approx. 2 seconds.
Press simultaneously and hold down for approx. 2
After confirmation, the setting mode returns to <F4 screen>.
- tolerance setting range: -50%FS to 0%FS
+ tolerance setting range: 0%FS to 50%FS
If using the mode 2 (designated range
<Lower limit setting (%)>
<Upper limit setting (%)>
Hold down for approx. 2 seconds.
Press simultaneously and hold down for approx. 2
After confirmation, the setting mode returns to <F4 screen>.
Lower limit setting range: 0%FS to 90%F.S.
Upper limit setting range: 10 to 100% F.S.
Note that the difference between the upper and lower limits must be 10%FS or more.
If using the mode 3 (integrated pulse)
Hold down for approx. 2 seconds.
After confirmation, the setting mode returns to <F4 screen>.
* For the pulse rate, refer to "1.2 Specifications."
* If the integration is reset, the integration values are reset; therefore, pulses are not output.
* The switch output indicator does not turn on and no pulse is output to “0x0029 Switch output status” while the integrated pulses are output.
If using the mode 4 (ON at set integration or higher)
<Higher digit setting>
<Lower digit setting>
Hold down for approx. 2 seconds.
Press simultaneously and hold down for approx. 2 seconds.
After confirmation, the setting mode returns to <F4 screen>.
* The integrated value is reset immediately after mode 4 is set.
<F5: Integrated flow rate automatic shut-off setting>


After approx. seconds elapsed <Instantaneous flow rate display>
<F5: Integrated flow rate automatic shut-off setting>
<F5 screen>
SET
Hold down for approx. 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>
Press simultaneously and hold down for 2 secs.
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 after automatic shut-off only)
* When the flow rate reaches the set integrated flow rate, the proportional solenoid valve is automatically shut off and the switch operates.
* When the display is set to "OFF" by automatic shut-off, reset the integrated flow rate (by inputting using keys, performing external input, or using communication) to display flow rate again.
* The automatic shut-off function cannot be disabled during automatic shut-off unless the integrated value is reset.
* The integrated value is reset at the point when the auto shutoff is turned "ON" and the value is set.
After approx. 3 seconds elapsed <Instantaneous flow rate display>
<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>.
If using the error automatic shut-off function (Valve fully closes when an error occurs)
If using the error automatic shut-off function (Valve fully opens when an error occurs)
* 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
After approx. 3 seconds elapsed <Instantaneous flow rate display>
<F7: Zero point adjustment (flow rate output)>
<F7 screen>
Alternate
Present adjustment value
The new adjustment value is displayed for approx. 2 seconds and returns to <F7 screen>.
Note: 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.
- E 07 is displayed if not in the auto OFF state.
- Make sure to replace with an applicable gas before zero point adjustment.
<Instantaneous flow rate>

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
RS-485 communication does not work.	Communication setting is not correct.	Check the communication settings of this product and the master to match both settings before performing communication.
	Wiring is not correct.	Refer to “2.4 Wiring”.
The settings cannot be changed by operation using keys.	Key is locked.	Release the key lock according to “3.5 Operation Flow” and then change the settings. Or change “0x0047 Key lock setting” to “0: Unlock” to release the key lock.
	Operation keys do not work.	Replace the product.
Flow rate is not displayed.	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 “3.5 Operation Flow” to disable the automatic power off. Or change “0x0049 Auto power off setting” to “0: 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 “3.4 Switch Output.”
	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 “1.5 Functions.”
Switch output does not turn OFF.	Switch output is disabled.	Refer to “3.4 Switch Output.”
	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 “1.5 Functions.”

Problem	Cause	Solution
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.
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.
	Pressure greatly drops 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.
Flow rate display does not become zero.	Zero point of sensor is not aligned correctly.	Perform zero point adjustment of the sensor. Refer to “3.5 Operation Flow.” Alternatively, write “1: Perform zero adjustment” to “0x005A Zero adjustment” to adjust the zero point.
	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 “3.3 Flow Rate Integration.”
	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.	Press keys or set “0x001E Control ON/Auto OFF” to “1: Control ON” to cancel the Auto OFF.
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 “3.2 Flow Rate Controlled.”

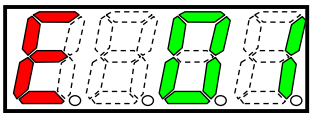
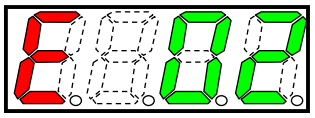
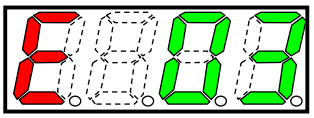
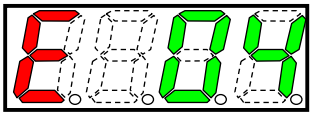
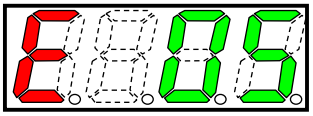
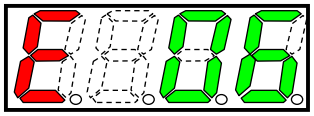
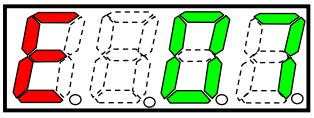
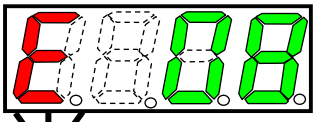
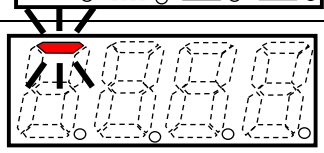
Problem	Cause	Solution
Integrated flow rate is zero and does not change.	Integration reset pin (Pin 3) of external input is ON.	Turn the integration reset pin (Pin 3) to OFF. Refer to “3.3 Flow Rate Integration.”
	“0x0027 Integration stop” is set to “1: ON”.	Set “0x0027 Integration stop” to “0: OFF”. Refer to “3.3 Flow Rate Integration.”
Integrated value cannot be reset by “0x0026 Integration reset”.	0x0048 Integration reset input specification setting is set to “0: external input”.	Set “0x0048 Integration reset input specification setting” to “1: RS-485”.
Integrated value cannot be reset by external input.	0x0048 Integration reset input specification setting is set to “1: RS-485”.	Set “0x0048 Integration reset input specification setting” to “0: External input”. If RS-485 communication is not available, reset the setting by following “3.5 Operation Flow”.
Preset input cannot be performed.	“0x0038 Select preset number” is changed when “0x003D Preset input specification setting” is set to “0: External input”.	Set “0x003D Preset input specification setting” to “1: RS-485”.
	The number is switched using external input (Pin 1/Pin 2) when “0x003D Preset input specification setting” is set to “1: RS-485”.	Set “0x003D Preset input specification setting” to “0: External input”. If RS-485 communication is not available, reset the setting by following “3.5 Operation Flow”.

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.

Type	Explanation	Display	Control processing (Solenoid valve operates)	Treatment
Error	Supplied power voltage is outside the rated range. Detected at 19.5 VDC or less.		Depends on F6 Setting. (Note 2)	- Turn on the power again after adjusting the power voltage so that it is within the rated range.
Error	Input signal exceeds the rated range. Detected at input of 110%F.S. or more.		Depends on F6 Setting. (Note 2)	- Adjust the input signal so that it is within the rated range.
Error	Error occurred during EEPROM reading or writing.		Flow rate control stopped.	- Turn on the power again. - Replace the main body of this product.
Error	Error occurred during memory reading or writing.		Flow rate control stopped.	- Turn on the power again. - Replace the main body of this product.
Error	Flow rate does not maintain the set value for five or more consecutive seconds. When the difference between set value and control value is 20%FS or more. (Note 1)		Depends on F6 Setting. (Note 2)	- Check the primary side pressure and supply pressure that is within the rated operating differential pressure range. After that, turn on the power again. - Check that there is no leakage from the pipes, fittings, or other components and correct the connections. After that, turn on the power again.
Error	Output error occurs in sensor.		Flow rate control stopped. Valve closed.	- Stop supplying fluid to the product and set the flow rate to zero. After that, turn on the power again. - Replace the main body of this product.
Error	The value is not in the Auto OFF state during zero adjustment.		Flow rate control does not stop.	- Forcibly turn off the valve. After that, operate again.
Error	The flow rate exceeds the range where zero adjustment is possible. (Flow rate ≧ ±10%F.S.)		Flow rate control does not stop.	- Check the primary side pressure and supply pressure that is within the rated operating differential pressure range. After that, turn on the power again.
Error	Switch output overcurrent protection circuit is activated.		Flow rate control does not stop.	- Check that the load current does not exceed the rated range and correct the connections.
Warning	The Proportional solenoid valve has been used at the limit value continuously for more than 10 seconds.	(No 7 segment display) Error code is “E10”.	Flow rate control does not stop.	- Check the primary side pressure and supply pressure that is within the rated operating differential pressure range. After that, turn on the power again. - Check clogging of the pipes, fittings, or other components. After that, supply pressure that is within the rated operating differential pressure range and turn on the power again.

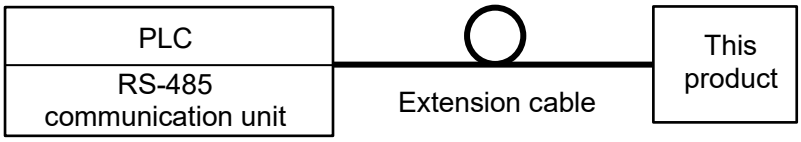
Note 1: Threshold value can be changed by “0x0058 Control error threshold setting”.
Note 2: The operation changes depending on the setting of “F6 Error automatic shutoff setting”.

5. REFERENCE

5.1 System Example of RS-485 Communication

This product has been verified for RS-485 communication using the following system.
The following system shows a connection example and does not guarantee the operation.

(1) When using a PLC



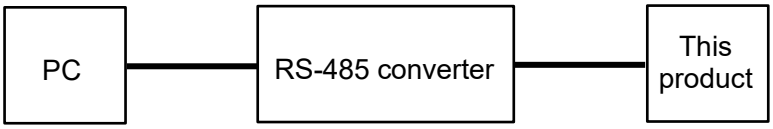
Master List

Manufacturer	PLC	RS-485 communication unit
OMRON Corporation	NX1P2-9024DT	NX1W-CIF11 (non-insulated type)
		NX1W-CIF12 (insulated type)
Mitsubishi Electric Corporation	FX5UC-32MT/D	RS-485 port with built-in CPU
Keyence Corporation	KV-N24AT	KV-N 11 L (non-insulated)
Contec Ltd.	(PC connection)	COM-1PD(USB)H

Extension cable

Manufacturer	Model	Conductor resistance
Tatsuta Tachii Electric Cable Co., Ltd.	U-TKVV (BS) 2P-AWG24	88.3 Ω/km

(2) When using a PC and an RS-485 communication converter



Master List

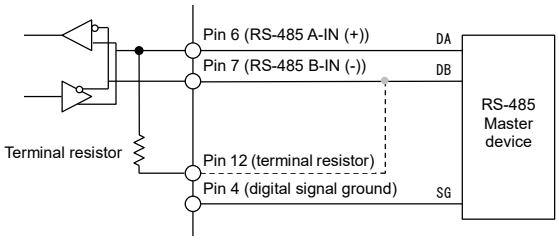
Manufacturer	RS-485 converter
Contec Ltd.	COM-1PD(USB)H

*Communication problems may occur depending on the PC used.
Please check the communication operation on your PC in advance.

5.2 Example of Using an RS-485 Input Function

The following is an example of the procedure from wiring to control using the RS-485 input function. As below, the function codes 0x06 (Writing to holding register) and 0x03 (Reading holding register) are used to set the control flow rate and read the instantaneous flow rate from the internal sensor.

1 Connect the power supply and communication line referring to “2.4.2 Cable connection” and “2.4.3 Example of internal circuit and load connection”.



- In this product, line A is expressed as “+” and line B is expressed as “-”.
  In some RS-485 master device, the position of “+” and “-” may be reversed: check them and ensure to connect “+” to “+” and “-” to “-”.

2 Refer to “3.5 Operation Flow”, and set “device address”, “transmission rate”, “communication parity”, and “stop bit”. Change the settings to match the master setting.

3 Referring to “3.2.4 Controlling the flow rate using the RS-485 input function (RS-485 communication only)”, using RS-485 communication, write the desired flow rate to “Address: 0x0032 input settings” in the 0: RS-485 input mode and “Address: 0x0033 RS-485 Input flow rate” to start the flow rate control.
(Refer to “0x06 Writing to holding register (Preset Single Register)”.)

4 The instantaneous flow rate can be checked on the screen or by “Address: 0x0022 Instantaneous flow rate”.
(Refer to “Read the 0x03 holding register”.)

6. WARRANTY PROVISIONS

6.1 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.

6.2 Warranty Period

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