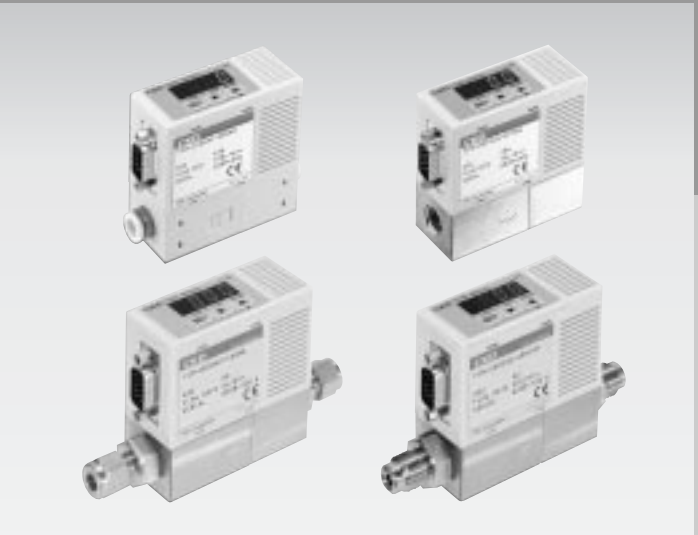
Small size flow controller
FCM

■ Sensors / flow controller



CONTENTS

Product introduction	1366
Applications	1368
Series variation	1369
⚠ Safety precautions	1370
● FCM	1376
Technical data	1385
Functional explanation, operation	1387
Custom	1403

Compact, high-speed, multifunction solution

High-speed response micro machined sensor chip incorporated

Microcomputer attains high accuracies and multi-functions

Stainless steel body

■ Applicable fluids/Flow rates

AIR N2
0.015 to 50 ℓ/min.

Ar
0.015 to 50 ℓ/min.

O2 13A CH4 C3H8
0.015 to 10 ℓ/min.

H2 He
0.06 to 20 ℓ/min.

■ Weight/approx. 480g

Rectifier mechanism improves low pressure loss and repeatability

Resin body

■ Applicable fluids/Flow rates

AIR N2
0.015 to 100 ℓ/min.

■ Weight/approx. 200g

Ultimate ideal multi-functions flow controller

Small size flow controller

FCM Series

Merging the small size flow sensor FSM and small solenoid valve technologies. The small size flow controller FCM Series is equipped with sensor functions, proportional control functions and valve functions, all which have a high performance and cost feasibility. This series supports various applications.

CKD Green Technology

New Compatible with various fluid types

This series supports various gases including air, nitrogen, argon, oxygen, methane and propane. The new series is compatible with hydrogen and helium, allowing use with a variety of applications.

New low differential pressure model

The flow of combustion gas with low supply pressure, such as burner thermal power control, can now be controlled.

Compact and light weight

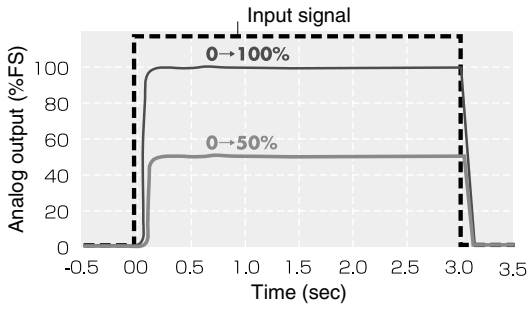
The size is just 70H×70D ×30W.
Install in a confined place or on a moving space to downsize and lighten a system.

Volume Compared to conventional approx. **30**%

Weight Compared to conventional approx. **20**%

0.5 second high-speed control

The platinum sensor chip using silicone micro machining achieves 0.5 second high-speed control, enabling use in various applications.



Dedicated power supply not required

A 24VDC power voltage allows operation with general-purpose single supplies.

Highly reliable flow control

CKD's original rectifier control enhances the repeatability affecting flow controllability.

Repeatability	±1% FS
Precision	±3% FS

RoHS Directive compliant

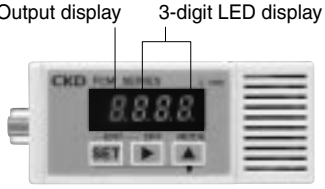
All substances, such as lead and hexavalent chrome, which could adversely affect the global environment, have been completely eliminated from the materials used in this controller.

Digital display shows the control state at a glance

- The flow value is displayed digitally with three digits.
- The output state (switch output ON-OFF) is displayed in addition to the error display.

Output display 3-digit LED display

A top/bottom reversed display can be selected according to the installation direction (option)



Parallel input type available as a standard

Control with parallel input (PLC, etc., ON/OFF signal, 10-bit resolution 1024) is possible. An analog input/output device, such as a D/A converter, is no longer needed.

Realize multi functions with microcomputer

● **Error display function**
Errors are displayed and notified with electrical signals.

● **Zero/span adjustment function**
Zero and span can be adjusted according to the usage methods.

● **Preset input function**
Set up to four random flow rate points, and control the flow with 2-bit signal inputs from an external source (signals from PLC, etc.).

● **Direct memory function**
Freely adjust the control flow with the production's operation keys even without input signals from an external source.

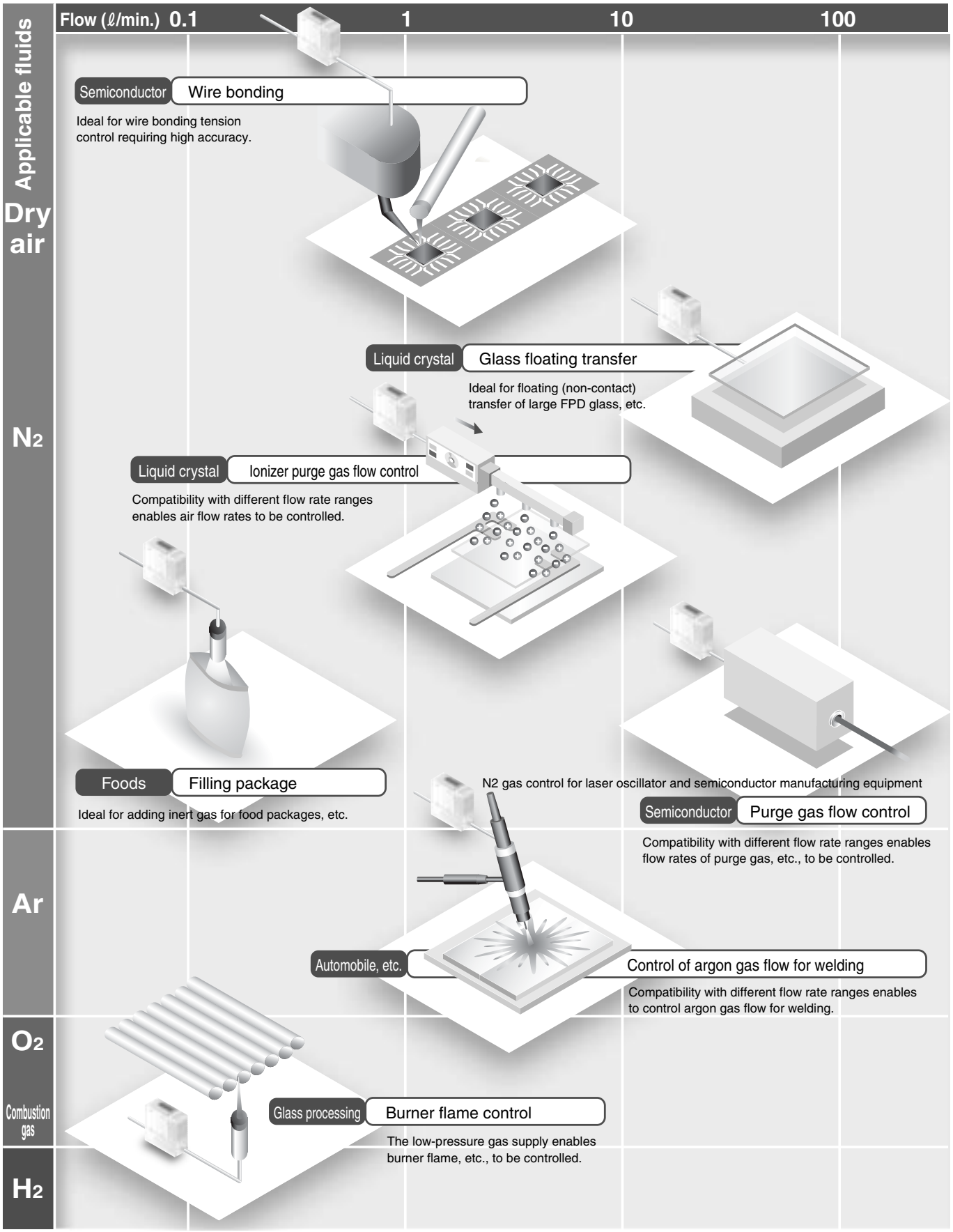
● **Switch output function**
A switch output function using the flow rate's upper/lower limit settings is incorporated. (Built-in overcurrent protection)

● **Flow rate integrating function**
Integral display of the flow rate (max. 6 digits) and pulse outputs for integration are possible.

● **Automatic shutoff function**
The valves are automatically shutoff in an emergency, such as when an error occurs.

Useful in different fields

This small size flow controller is used for different applications including machinery, automobile, precision device fields, and advanced fields such as semiconductors and biotechnology, medicine and food.



Applicable fluids / flow control ranges

	Model no.	Applicable fluids	Flow control range (ℓ/min.) 0.01 0.1 1 10 100	Body material	Port size
Air type	FCM-9500 AI	AIR Air, N_2 Nitrogen	0.015 to 0.5	Resin / SUS	Resin: ø6 push-in, ø8 push-in; SUS: Rc1/4, 9/16-18 UNF
	FCM-0001 AI		0.03 to 1		
	FCM-0002 AI		0.06 to 2		
	FCM-0005 AI		0.15 to 5		
	FCM-0010 AI		0.3 to 10		
	FCM-0020 AI		0.6 to 20		
	FCM-0050 AI		1.5 to 50		
	FCM-0100 AI (only resin)		3 to 100		
Gas type	FCM-9500 AR	Ar Argon	0.015 to 0.5	SUS	Rc1/4, 9/16-18 UNF
	FCM-0001 AR		0.03 to 1		
	FCM-0002 AR		0.06 to 2		
	FCM-0005 AR		0.15 to 5		
	FCM-0010 AR		0.3 to 10		
	FCM-0020 AR		0.6 to 20		
	FCM-0050 AR		1.5 to 50		
Gas type	FCM-9500 O2/LN/C1/C3	O_2 Oxygen, 13A City gas, CH_4 Methane, C_3H_8 Propane	0.015 to 0.5	SUS	Rc1/4, 9/16-18 UNF
	FCM-0001 O2/LN/C1/C3		0.03 to 1		
	FCM-0002 O2/LN/C1/C3		0.06 to 2		
	FCM-0005 O2/LN/C1/C3		0.15 to 5		
	FCM-0010 O2/LN/C1/C3		0.3 to 10		
Gas type	FCM-0002 H2/HE	H_2 Hydrogen, He Helium	0.06 to 2	SUS	Rc1/4, 9/16-18 UNF, 1/4 inch Double barbed joint, 1/4 inch JXR male joint
	FCM-0005 H2/HE		0.15 to 5		
	FCM-0010 H2/HE		0.3 to 10		
	FCM-0020 H2/HE		0.6 to 20		

I/O specifications

Input	Model no.	Output		
Input signal: specifications		Output method	Specifications	Error output
Analog: 0-10V / Preset: 4 points (2 bit) (Note)	FCM-*-*0AN	Analog	1-5V	NPN
	FCM-*-*0AP			PNP
	FCM-*-*0SN	NPN PNP Switch	NPN	NPN
	FCM-*-*0SP		PNP	PNP
Analog: 0-5V / Preset: 4 points (2 bit) (Note)	FCM-*-*1AN	Analog	1-5V	NPN
	FCM-*-*1AP			PNP
	FCM-*-*1SN	NPN PNP Switch	NPN	NPN
	FCM-*-*1SP		PNP	PNP
Analog: 4-20mA / Preset: 4 points (2 bit) (Note)	FCM-*-*2AN	Analog	1-5V	NPN
	FCM-*-*2AP			PNP
	FCM-*-*2SN	NPN PNP Switch	NPN	NPN
	FCM-*-*2SP		PNP	PNP
Parallel: 10bit	FCM-*-*PAN	Analog	1-5V	NPN
	FCM-*-*PAP			PNP
	FCM-*-*PSN	NPN PNP Switch	NPN	NPN
	FCM-*-*PSP		PNP	PNP

(Note) Preset 8-point (3-bit) input is used customized. (The external integration reset signal input cannot be used.) Contact our CKD Sales Office for details.

Flow controller

Safety precautions

Always read this section before starting use.
Refer to Intro 67 for general precautions.

Small size flow controller FCM Series

Design & Selection

1. Working fluid

⚠ DANGER

■ Do not feed gas at the explosion limit. There is a risk of explosion.

■ Before using hydrogen, be sure to purge piping with inert gas such as nitrogen or argon. Otherwise explosions could occur.

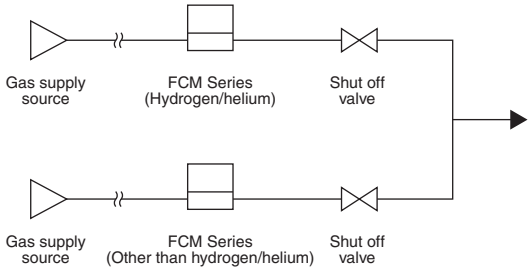
■ Do not feed oxygen gas to wetted sections that are not oil-treated. There is a risk of fire. Even if the product has oil treatment, if gas other than oxygen gas has passed even once, do not use the product for oxygen gas.

⚠ WARNING

■ This product cannot be used as a business meter. This product does not comply with Measurement Laws, and cannot be used for commercial business.

■ This product is for use with gases indicated on the model. Use of noncompatible fluids lowers product accuracy and controllability. If hydrogen or helium gas is passed to a series not designated for these, the sensor safety circuit may prevent operation. (If the safety circuit operates, the flow cannot be measured or controlled until power is turned off.)

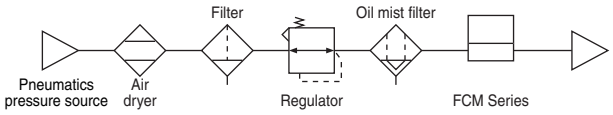
■ When mixing hydrogen or helium with another gas, be sure to note reverse gas flow. If hydrogen or helium is passed to a series not designated for these, the sensor safety circuit may prevent operation. (If the safety circuit operates, the flow cannot be measured or controlled until power is turned off.) When shutting off gas, provide shutoff valves and shut off each gas separately as shown below to prevent gas from flowing in reverse.



■ Prevent entry of foreign matter into this product.
If foreign matter gets into this product (dirt, water, or oil mist into pipes), accuracy and controllability could drop or the product could fail.
If foreign matter could enter the product, install a filter, dryer, or oil mist filter upstream from the product.

- The mesh provided in this product is used to rectify the flow in pipes. It is not a filter for removing foreign matter.
- Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.), so install a filter, air dryer, and oil mist filter (microalescer) upstream from the product.
- When using compressed air, use clean air that complies to JIS B 8392-1:2003 Class 1.1.1 to 1.6.2.

<Recommended circuit>



- When using a valve on the primary side of this product, only use an oil-prohibit specification valve. This controller could malfunction or fail if subject to splattering grease or oil, etc.
- Use dry gas which does not contain corrosive elements such as chlorine, sulfur or acids, and which is clean and does not contain dust or oil mist.
- Depending on the fluid, retaining the fluid for a long time could adversely affect the performance. Do not seal the fluid in the pipe for long periods of time.

■ When using this controller for liquefied gas such as propane gas, evaporate the gas. This controller could fail if liquefied gas is fed.

■ When using this product to control burner air-fuel ratio, take measures in the design stages to prevent backfire, and to prevent adverse effect to this product even if a backfire should occur. A rise in the pipe's internal pressure and flame caused by a burner's backfire could damage this product.

■ Confirm that the fluid supply line's pressure is within the working differential pressure range before starting use.
If the main pressure is low, or the secondary pressure is high, the differential pressure will be lost and the fluid will not flow.

Design & Selection

2. Working environment

⚠ WARNING

■ Corrosive environment
Do not use this product in an environment containing corrosive gases such as sulfurous acid.

■ Ambient temperature, fluid temperature
Keep the ambient temperature and fluid temperature within 0 to 50˚C. Even if the temperature is within the specified range, do not use this product if the ambient temperature and fluid temperature could suddenly change and cause dew to condense.

■ Guaranteed withstanding pressure and operating pressure difference range
Using this product at a level exceeding the guaranteed withstanding pressure and operating pressure difference could cause damage. Follow the specified range.
The differential pressure will be lost and the fluid will not flow if the main pressure is low or if the secondary pressure is high.

■ Drip-proof environment
This product's protective structure is IP40 or equivalent. Do not install it where it could be subject to water, salt, dust, or cutting chips, or a compressed or decompressed environment. This product cannot be used where the temperature changes sharply or in a highly humid environment as dew condensation in the product could cause damage.

■ This product's solenoid proportional valve does not have a complete close-stop.
If a complete close-stop is required, provide a separate external shutoff valve.
When the external shutoff valve is closed, wait with this product's valve fully closed (set flow rate: zero).
If this product is left in normal control while this external shutoff valve is closed, an instant overflow could occur when the external shutoff valve is opened. When using for applications that turn ON/OFF at a high frequency, the life of the proportional valve may be shortened depending on use. Contact CKD when using for applications that turn ON/OFF at a high frequency.

■ Do not install this product at a place that moves or vibrates. Vibration or impact could cause this controller to malfunction.

⚠ CAUTION

■ Check the leakage current to prevent malfunction caused by current leaking from other controllers.
When using a PLC, etc., this product could malfunction because of leakage currents.

■ Due to wiring, the current input power ground and signal common are the same.
When driving several of these products with one PLC and D/A unit, depending on the D/A unit's circuit, the correct signal may not be input because of wiring problems. Consult with the PLC maker before using.

■ Current input is used with input signal 1-5 V, but unlike other voltage input, the input impedance is small at 250Ω, so a signal generator that matches this impedance must be used.

■ Monitor the pipe's pressure loss
When piping this product, check that the differential pressure between the upstream side and downstream side is within the operating pressure difference range (refer to pages 1377, 1379). Controller may not operate properly if used outside of the operating pressure difference range. Operation may not be as expected if there is an orifice or restriction on the secondary side (downstream) of the product. Care must be taken.
If the primary or secondary pressure of this product repeatedly fluctuates, the ability to track the product's control may be lost, and the flow control may become unstable.

3. Flow unit

⚠ CAUTION

■ This controller's flow rate is measured with mass flow not affected by pressure. The unit is ℓ/min., that is the mass flow converted to volumetric flow at 20˚C 1 barometric pressure (101 kPa).

Installation & Adjustment

1. Wiring

⚠ DANGER

■ Use power voltage and output within the specified voltage. If voltage exceeding the specified voltage is applied, the sensor could malfunction or be damaged, or electrical shock or fire could occur. Do not use a load exceeding the output rating. Failure to observe this could result in output damage or fire.

⚠ WARNING

■ Check the connector pin and cable conductor wire color when wiring. Incorrect connections could result in sensor damage, problems, and malfunctions, so check the wire color against the instruction manual before wiring.

■ Check wiring insulation.
Check that wires do not contact other circuits, that there is no ground fault, and that the insulator between terminals is not defective. An overload could flow to the product, and result in damage.

■ Use a DC stabilized power supply, within the specified rating, insulated from the AC power supply. Failure to insulate the power supply could result in electric shock. If power is not stabilized, the peak could be exceeded during the summer. This could damage this product or cause accuracy to drop.

■ Stop controller and devices, and turn power OFF before wiring. Starting operation suddenly could result in unpredictable operation and hazards. Conduct an energized test with controllers and devices stopped, and set target switch data. Discharge any static electricity accumulated by personnel or tools before and during work. Connect and wire bending resistant material, such as robot wire material, for movable sections.

■ Do not use this controller at levels exceeding the power voltage range. If voltage exceeding the specified range is applied, or if an AC power (100 VAC) is applied, the controller could break or burn.

■ Separate this product and its wiring as far away from sources of noise such as power distribution wires. Provide separate measures for surge applied to the power cable.

■ Do not short-circuit the load. This product could break or burn.

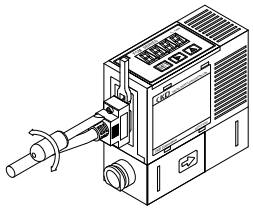
■ Use stabilized DC power completely separated from the AC primary side for stainless steel construction. Connect either the plus or minus side of the power supply to the FG. A varistor (limit voltage. 40 V) is connected between the stainless steel internal power circuit and stainless steel device to prevent dielectric breakdown of the sensor. Do not conduct a withstand voltage test or insulation resistance test between the internal power circuit and stainless steel device. Disconnect wiring if this testing is required. An excessive potential difference between the power and stainless steel device will cause the internal parts to burn.
After installing, connecting, and wiring the stainless steel device, electrical welding of the device or frame or short-circuit accidents, etc., could cause the welding current, the excessive high voltage caused by welding, or a surge voltage, etc., to run through wiring or ground wire connected between the above devices. This could result in damage to wires or devices. Conduct any work such as electrical welding after removing this device and disconnecting all electric wires connected to the FG.

⚠ CAUTION

■ The option shield cable connector is a shielded wire. Insulate wires that are not being used so that they do not contact other wires, including shielded wires. If inadvertently connected to the ground, etc., the controller could malfunction or break.

■ Check the direction and fit the D-sub connector into the back.

■ Lock the D-sub connector so that it does not dislocate. Before loosening the lock, fix the fixing block with a tool, etc.



■ Extending the cable
When extending the cable longer than 3m, the wiring resistance could cause the analog output and analog input signal error to increase and the control to become unstable. Using with a length within 3m is recommended.

Installation & Adjustment

2. Piping

⚠ CAUTION

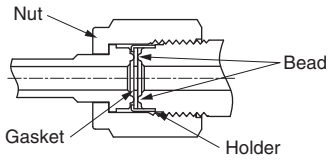
■ Pipe based on the fluid direction and the direction indicated on the device.

■ Tightening the 4S or 4RM port size (hydrogen, helium model) joint

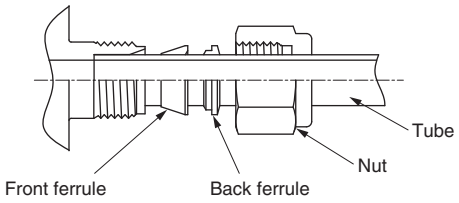
(1) Tightening the joint

4RM (1/4 inch JXR male joint) — When gasket material is nickel or SUS316

Tighten the nut by hand until the gasket contacts the bead, then tighten 1/8 of a turn using a tool.



4S (double-barbed joint) — Confirm that the front ferrule, back ferrule, and nut are correctly attached, and insert tubing until it contacts the back of the main body. Tighten the nut by hand as far as possible, then tighten 1 1/4 of a turn using a tool.

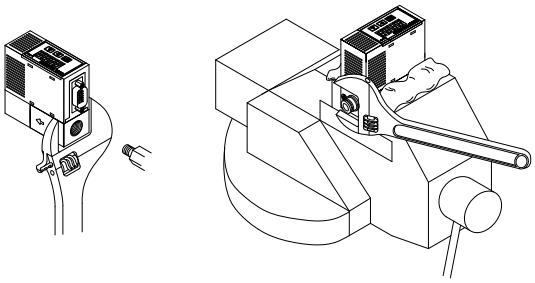


■ Before piping, clean pipes with compressed air to remove any foreign matter of cutting chips, etc. The rectifying unit or platinum sensor could be damaged if foreign matter or cutting chips get in.

■ When attaching piping to this product, use the following torques as reference so that excessive screwing torque or load torque is not applied to the connection port.

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

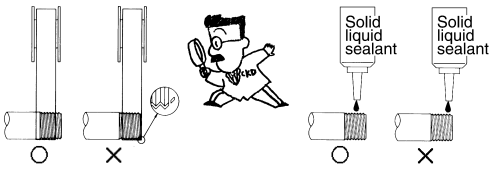
■ When piping, put a wrench, etc., on the stainless steel device so that force is not applied to the resin section.



■ Check that sealing tape or adhesive does not get inside when piping.

■ When connecting pipes, wrap sealing tape in the opposite direction from threads starting 2 mm inside from the end of piping threads.

- If sealing tape protrudes from pipe threads, it could be cut when screwed in. This could cause the tape to enter the solenoid valve and lead to faults.



When using a liquid sealing agent, check that it does not get on resin parts. Otherwise resin could be damaged. Otherwise resin could be damaged.

■ Sealant may stick to threads when piping is removed. Be sure to remove sealant before repiping.

■ Connect a joint even when using the stainless steel device with the OUT side opened. The port filter could come off.

■ When using resin construction, do not bend the tube near the push-in joint. If strain could be applied to the tube near the push-in joint, attach an insert ring onto the tube and insert into the push-in joint.

■ When using resin construction, accurately insert the tube and confirm that it does not dislocate even when pulled. Cut the tube at a right angle with a dedicated cutter before using.

■ After piping, confirm that no gas is leaking.

■ When using this product for oxygen gas, monitor the following points.

- Piping work must be completed by personnel with expertise on handling oxygen gas.
- Use oil-treated pipes.
- Remove any dirt or burrs from piping before attaching to this product.
- Attach a filter to the primary side of this product.

During Use & Maintenance

⚠ WARNING

■ Output accuracy is affected by the temperature characteristics and heat self-generated when energized. Provide a standby time (10 minutes or more after turning power ON) when using.

⚠ CAUTION

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

■ If a failure occurs during operation, turn power OFF immediately and stop use. Contact your dealer.

■ This product does not control the flow for two seconds after power is turned ON so it completes self-diagnosis. Provide a control circuit and program that ignore signals for two seconds after power is turned ON.

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

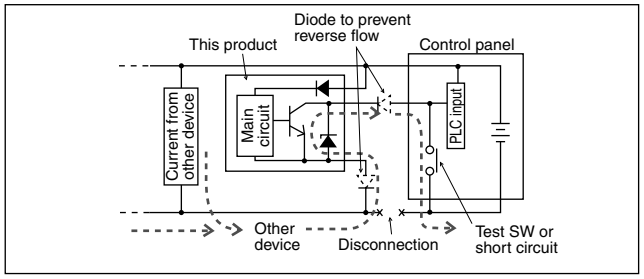
■ Use this product within the operating differential pressure range.

■ When the setting is changed, control devices could operate unintentionally. Stop devices before changing settings.

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

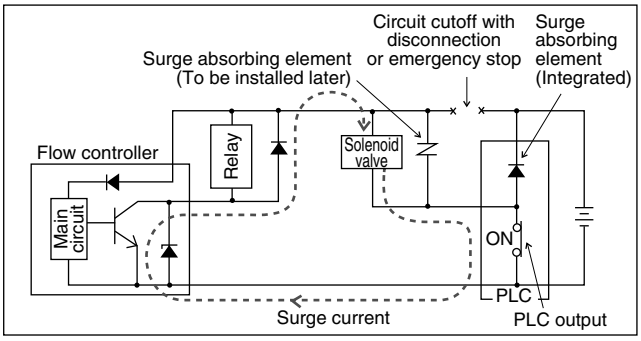
■ This case is made of resin. Do not use solvent, alcohol or any other cleaning agent to remove contamination, etc., or the resin case could be corroded or damaged. Wipe off any dirt with a rag soaked in a diluted neutral detergent solution and wrung out well.

■ Monitor leading of the surge current
When controller power is shared with an inductive load that generates a surge, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, the surge current could enter the output circuit and cause damage depending on where the surge absorption element is installed.

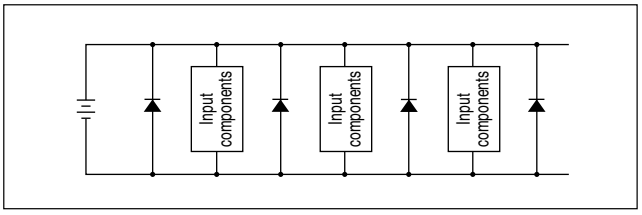


■ Take countermeasures as followings to prevent damages caused by reverse current.
(1) Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick cable as possible.
(2) Limit the number of devices connected to the same power as this product.
(3) Insert a diode in serial with the flow sensor's output cable to prevent reversal of current.
(4) Insert a diode in serially with this product's power cable to prevent reverse flow of the current.

■ Monitor leading of the surge current
When controller power is shared with an inductive load that generates a surge, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, the surge current could enter the output circuit and cause damage depending on where the surge absorption element is installed.



Take countermeasures as followings to prevent damage caused by surge current leading.
(1) Separate the power supply for output comprising the inductive load, such as the solenoid valve and relay, and input, such as the flow controller.
(2) If separate power supplies cannot be used, directly install a surge absorption element for all inductive loads. Remember that the surge absorption element connected to the PLC, etc., protects only that device.
(3) Connect a surge absorption element to the following places on the power wiring as shown below as a measure against disconnections in unspecific areas:

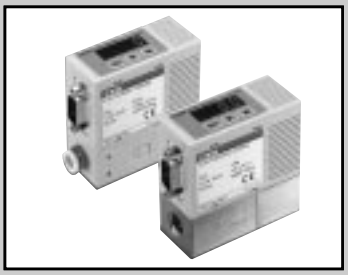


When components are connected with connectors, if a connector is dislocated during energizing, the output device could be damaged because of the reason above. Turn off the power before dislocating a connector.

■ Inspect the sensor at least once a year and confirm that it operates correctly.

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

MEMO



Small size flow controller

FCM Series

- Air, nitrogen, argon, oxygen, city gas, methane, propane (flow rate range: 0.5 to 100 ℓ/min.)
- Hydrogen, helium (flow rate range: 0 to 20 ℓ/min.)

RoHS

■ FCM Series for air, nitrogen, argon, oxygen, city gas, methane, propane

Specifications

Descriptions				FCM- (*1) (*2) - (*3) (*4) (*5)						
Valve drive method				Proportional solenoid valve When not energized: Closed						
				Flow range	AI (air, nitrogen)	AR (argon)	O2 (oxygen)	LN (city gas)	C1 (methane)	C3 (propane)
Full scale flow Note 1	*1	Standard model	9500	0 to 500m ℓ/min.	●	●	●	●	●	●
			0001	0 to 1 ℓ/min.	●	●	●	●	●	●
			0002	0 to 2 ℓ/min.	●	●	●	●	●	●
			0005	0 to 5 ℓ/min.	●	●	●	●	●	●
			0010	0 to 10 ℓ/min.	●	●	●	●	●	●
			0020	0 to 20 ℓ/min.	●	●				
			0050	0 to 50 ℓ/min.	●	●				
			0100	0 to 100 ℓ/min. (only resin)	●					
		Low pressure differential model (Only stainless steel)	L9500	0 to 500m ℓ/min.	●		●	●	●	●
			L0001	0 to 1 ℓ/min.	●		●	●	●	●
			L0002	0 to 2 ℓ/min.	●		●	●	●	●
			L0005	0 to 5 ℓ/min.	●		●	●	●	●
			L0010	0 to 10 ℓ/min.	●		●	●	●	●
Applicable fluids Note 2	*2		AI	Compressed air, nitrogen	●					
			AR	Argon		●				
			O2	Oxygen (oil-prohibited specifications)			●			
			LN	City gas (13A) Note 3				●		
			C1	Methane (CH4 100%)					●	
			C3	Propane (C3H8 100%)						●
Port size/ Body material	*3		H6	ø6 push-in, resin (excluding 50, 100 ℓ/min.)	●					
			H8	ø8 push-in, resin	●					
			8A	Rc1/4, stainless steel	●	●	●	●	●	●
			UF	9/16-18UNF, stainless steel	●	●	●	●	●	●
Control	Control range				3 to 100%F.S.					
	Responsiveness	*1	9500 to 0020, L9500 to L0010		Within 0.5sec. at setting ±5%F.S. (TYP)					
			0050 to 0100		Within 1sec. at setting ±5%F.S. (TYP)					
	Precision				±3%F.S. or less					
	Repeatability				±1%F.S. or less					
	Temperature characteristics				±0.1%F.S./˚C or less (25˚C reference)					
	Pressure characteristics				±1%F.S. or less per 98kPa (standard differential pressure reference)					
Pressure	Standard differential pressure Note 4				Refer to the separate table					
	Operating differential pressure range Note 5				Refer to the separate table					
	Withstanding pressure	*3	H6/H8 (resin body)		490kPa					
			8A/UF (SUS body)		980kPa					
Ambient temperature/humidity					0 to 50˚C, 90%RH or less (no dew)					
I/O	Input signal/ pre-set input	*4	0		0 to 10 VDC (6.7kΩ) / 4 points (2 bit)					
			1		0 to 5 VDC (10kΩ) / 4 points (2 bit)					
			2		4 to 20 mADC (250Ω) / 4 points (2 bit)					
			P		Parallel 10bit / None					
	Output signal	*5	AN		Analog output: 1-5V (connected load impedance 500kΩ and over) Error output: NPN open collector output, 50mA or less, voltage drop 2.4V or less					
			AP		Analog output: 1-5V (connected load impedance 500kΩ and over) Error output: PNP open collector output, 50mA or less, voltage drop 2.4V or less					
			SN		Switch output: NPN open collector output, 50mA or less, voltage drop 2.4V or less Error output: NPN open collector output, 50mA or less, voltage drop 2.4V or less					
			SP		Switch output: PNP open collector output, 50mA or less, voltage drop 2.4V or less Error output: PNP open collector output, 50mA or less, voltage drop 2.4V or less					
Flow display	Display method				3-digit 7-segment LED, Display precision: control precision 1 digit					
	Display range, display resolution				Refer to the separate table					
Integrating functions					Refer to the separate table					
Power supply	Power voltage				24 VDC ±10% (safety power supply with ripple ratio 2% or less)					
	Current consumption				250mA or less					
Installation attitude					Free					
Wet area material		*3	H6/H8 (resin body)		Polyamide resin, fluoro rubber, stainless steel, alumina, semiconductor silicone, solder					
			8A/UF (SUS body)		Stainless steel, fluoro rubber, alumin.a, semiconductor silicone, solder					
Weight		*3	H6/H8 (resin body)		Approx. 200g					
			8A/UF (SUS body)		Approx. 480g					
Protective structure					IEC standards IP40					
Protective circuit Note 6					Power supply reverse connection prevention, switch output reverse connection prevention, switch output load short-circuit protection					
EMC directive					EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8					

Pressure

Standard differential pressure / operating differential pressure Note 4, 5

(Standard model)

Applicable fluids *2			Flow rate range *1							
			9500	0001	0002	0005	0010	0020	0050	0100
	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
	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	
	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			
	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			
	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			

(Low pressure differential model)

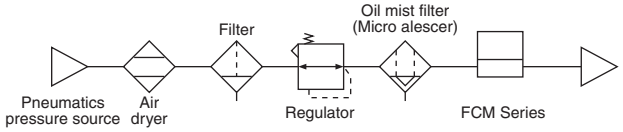
Applicable fluids *2			Flow rate range *1				
			L9500	L0001	L0002	L0005	L0010
	AI/O2 LN/C1 C3 Note 7	Standard differential pressure (kPa)	20	20	20	20	20
		Operating differential pressure (kPa)	5 to 50	5 to 50	5 to 50	5 to 50	10 to 50

Display / integration

		Flow rate range *1							
		9500 L9500	0001 L0001	0002 L0002	0005 L0005	0010 L0010	0020	0050	0100
Flow display	Display range	0 to 500m ℓ/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	1m ℓ/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	Display range	999999mℓ	9999.99ℓ	9999.99ℓ	9999.99ℓ	99999.9ℓ	99999.9ℓ	99999.9ℓ	999999 ℓ
	Display resolution	1mℓ	0.01 ℓ	0.01 ℓ	0.01 ℓ	0.1 ℓ	0.1 ℓ	0.1 ℓ	1 ℓ
	Pulse output rate	5mℓ	0.01 ℓ	0.02 ℓ	0.05 ℓ	0.1 ℓ	0.2 ℓ	0.5 ℓ	1 ℓ

Note 1: Converted to volumetric flow at 20˚C 1 barometric pressure (101kPa)
Note 2: Use dry gas that does not contain corrosive elements such as chlorine, sulfur, or acids, and clean gas that does not contain dust or oil mist. When using compressed air, use clean air that complies to JIS B 8392-1:2003 Class 1.1.1 to 1.6.2. Compressed air from the compressor contains drainage (water, oxidized oil, foreign matter, etc.). Install a filter, air dryer (minimum pressure dew point: 10˚C or less), and oil mist filter (maximum oil concentration: 0.1 mg/m^3) on the primary side of this product to maintain product functions.

<Recommended circuit>



<Recommended component>
Air filter: F Series
Oil mist filter: M Series

Note 3: City gas 13 A is for methane (CH_4) 88% gas generated from LNG.
Note 4: The standard differential pressure is the differential pressure when this product is calibrated.
Note 5: The operating differential pressure is the differential pressure required to operate this product normally. Note that this will differ according to the flow range and applicable fluid.
Note 6: This product's protective circuit is effective only for specific incorrect connections and load short-circuits. It does not necessarily provide protection for all incorrect connections.
Note 7: For the city gas low pressure line (1 to 2.5kPa), this is outside of the working differential pressure range.
Note 8: This product cannot be used as a stop value which requires the internal valve leakage to be zero. Slight leakage is permitted for the specifications.
Note 9: The analog output voltage's output impedance is approx. 1KΩ. The error with the output value will increase when the connected load's impedance is low.
Check the error with the connected load's impedance before starting use.

■ FCM Series for hydrogen, helium
Specifications

Descriptions				FCM- (*1) (*2) - (*3) (*4) (*5)		
Valve drive method				Proportional solenoid valve When not energized: Closed		
				Flow range	H2 (hydrogen)	HE (helium)
Full scale flow Note 1	*1		0002	0 to 2 ℓ/min.	●	●
			0005	0 to 5 ℓ/min.	●	●
			0010	0 to 10 ℓ/min.	●	●
			0020	0 to 20 ℓ/min.	●	●
Applicable fluids Note 2	*2		H2	Hydrogen	●	
			HE	Helium		●
Port size	*3		8A	Rc1/4	●	●
			UF	9/16-18UNF	●	●
			4S	1/4 inch double barbed joint	●	●
			4RM	1/4 inch JXR male joint	●	●
Control	Control range				3 to 100%F.S.	
	Responsiveness			*1	Within 0.5sec. at setting ±5%F.S. (TYP)	
	Precision				±3%F.S. or less	
	Repeatability				±1%F.S. or less	
	Temperature characteristics				±0.2%F.S./˚C or less (25˚C reference)	
	Pressure characteristics				±1%F.S. or less per 98kPa (standard differential pressure reference)	
Pressure	Standard differential pressure			Note 3	Refer to the separate table	
	Operating differential pressure range			Note 4	Refer to the separate table	
	Withstanding pressure				980kPa	
Ambient temperature / humidity					0 to 50˚C, 90%RH or less (no dew)	
External leakage					1×10^{-6} Pa/m³/s or less (helium leak rate)	
I/O	Input signal/ pre-set input	*4	0		0 to 10 VDC (6.7kΩ) / 4 points (2 bit)	
			1		0 to 5 VDC (10kΩ) / 4 points (2 bit)	
			2		4 to 20 VDC (250Ω) / 4 points (2 bit)	
			P		Parallel 10bit / None	
	Output signal	*5	AN		Analog output: 1-5V (connected load impedance 500kΩ and over) Error output: NPN open collector output, 50mA or less, voltage drop 2.4V or less	
			AP		Analog output: 1-5V (connected load impedance 500kΩ and over) Error output: PNP open collector output, 50mA or less, voltage drop 2.4V or less	
			SN		Switch output: NPN open collector output, 50mA or less, voltage drop 2.4V or less Error output: PNP open collector output, 50mA or less voltage drop 2.4V or less	
			SP		Switch output: PNP open collector output, 50mA or less, voltage drop 2.4V or less Error output: PNP open collector output, 50mA or less, voltage drop 2.4V or less	
Flow display	Display method				3-digit 7-segment LED, display system: control precision ±1 digit	
	Display range, display resolution				Refer to the separate table	
Integrating functions					Refer to the separate table	
Power supply	Power voltage				24 VDC ±10% (safety power supply with ripple ratio 1% or less)	
	Current consumption				270mA or less	
Installation attitude					Free	
Wet area material					Stainless steel, fluoro rubber, alumin.a, silicone, solder	
Weight		*3	8A/UF		Approx. 480g	
			4S/4RM		Approx. 560g	
Protective structure					IEC standards IP40	
Protective circuit				Note 5	Power supply reverse connection prevention, switch output reverse connection prevention, switch output load short-circuit protection	
EMC directive					EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8	

Pressure

Standard differential pressure / operating differential pressure

			Flow rate range *1			
			0002	0005	0010	0020
Applicable fluids *2	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
	HE	Standard differential pressure (kPa)	50	100	100	100
		Operating differential pressure (kPa)	20 to 100	50 to 150	50 to 150	50 to 150

Display / integration

		Flow rate range *1			
		0002	0005	0010	0020
Flow 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	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 1: Converted to volumetric flow at 20˚C 1 barometric pressure (101kPa)
Note 2: Use dry gas that does not contain corrosive elements such as chlorine, sulfur, or acids, and clean gas that does not contain dust or oil mist.
Note 3: The standard differential pressure is the differential pressure when this product is calibrated.
Note 4: The operating differential pressure is the differential pressure required to operate this product normally. Note that this will differ according to the flow range and applicable fluid.
Note 5: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.
Note 6: This product cannot be used as a stop value which requires the internal valve leakage to be zero. Slight leakage is permitted for the specifications.
Note 7: The analog output voltage's output impedance is approx. 1KΩ. The error with the output value will increase when the connected load's impedance is low.
Check the error with the connected load's impedance before starting use.

■ FCM Series for air, nitrogen, argon, oxygen, city gas, methane, propane

How to order

FCM - 9500 AI - H6 0 AN R 1 B T

- FCM: Model no.
- 9500: Ⓐ Flow rate range
- AI: Ⓑ Working fluid
- H6: Ⓒ Port, body material
- 0: Ⓓ Input specifications
- AN: Ⓔ Output specifications
- R: Ⓕ Display direction
- 1: Ⓖ Cable
- B: Ⓗ Bracket
- T: Ⓘ Traceability

Symbol		Descriptions	AI	AR	O2	LN	C1	C3
Ⓐ Flow rate range								
Working fluid								
9500	Standard model	0 to 0.5 ℓ/min.	●	●	●	●	●	●
0001		0 to 1 ℓ/min.	●	●	●	●	●	●
0002		0 to 2 ℓ/min.	●	●	●	●	●	●
0005		0 to 5 ℓ/min.	●	●	●	●	●	●
0010		0 to 10 ℓ/min.	●	●	●	●	●	●
0020		0 to 20 ℓ/min.	●	●				
0050		0 to 50 ℓ/min.	●	●				
0100		0 to 100 ℓ/min. (only resin body)	●					
L9500	Low pressure differential model (Only stainless steel)	0 to 0.5 ℓ/min.	●		●	●	●	●
L0001		0 to 1 ℓ/min.	●		●	●	●	●
L0002		0 to 2 ℓ/min.	●		●	●	●	●
L0005		0 to 5 ℓ/min.	●		●	●	●	●
L0010		0 to 10 ℓ/min.	●		●	●	●	●

Ⓑ Working fluid	
AI	Compressed air, nitrogen gas
AR	Argon
O2	Oxygen (oil-prohibited specifications)
LN	City gas (13A)
C1	Methane (CH_4)
C3	Propane (C_3H_8)

Ⓒ Port, body material							
Working fluid		AI	AR	O2	LN	C1	C3
H6	Push-in (ø6), resin body (Excluding flow rate range; 0050, 0100)	●					
H8	Push-in (ø8), resin body	●					
8A	Rc1/4, stainless steel body	●	●	●	●	●	●
UF Note 1	9/16-18 UNF, stainless steel body	●	●	●	●	●	●

Ⓓ Input specifications	
0	Analog 0-10 VDC
1	Analog 0-5 VDC
2	Analog 4-20mA DC
P	Parallel 10bit

Ⓔ Output specifications	
AN	1-5V analog error (NPN)
AP	1-5V analog error (PNP)
SN	Switch (NPN), error (NPN)
SP	Switch (PNP), error (PNP)

Ⓕ Display direction	
Blank	Positive direction
R	Reverse direction

Ⓖ Cable	
Blank	None
1	1m
3	3m

Ⓗ Bracket	
Blank	None
B	With bracket

Ⓘ Traceability	
Blank	None
T	Traceability Certificate, system diagram, inspection results included
K	Inspection results included

<Example of model number>

FCM-0001AI-H81ANR1BK

Model: Small size flow controller FCM

- Ⓐ Flow rate range : 0 to 1 ℓ/min.
- Ⓑ Working fluid : Compressed air, nitrogen
- Ⓒ Port/body material : Push-in (ø8), resin body
- Ⓓ Input specifications : Analog 0-5 VDC
- Ⓔ Output specifications : 1-5V analog, error (NPN)
- Ⓕ Display direction : Reverse direction
- Ⓖ Cable : 1m
- Ⓗ Bracket : With bracket
- Ⓘ Traceability : With inspection results

⚠ Note on model no. selection

Note 1: Refer to the dimensions on page 1382 for the 9/16-18UNF screw shape.

Discrete option model no.

FCM - AC1

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

■ For hydrogen, helium

How to order

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

Model no.

Ⓐ Flow rate range
Ⓑ Working fluid
Ⓒ Port
Ⓓ Input specifications
Ⓔ Output specifications
Ⓕ Display direction
Ⓖ Cable
Ⓗ Bracket
Ⓘ Traceability

Symbol	Descriptions		
Ⓐ Flow rate range			
Working fluid		H2	HE
0002	0 to 2 ℓ/min.	●	●
0005	0 to 5 ℓ/min.	●	●
0010	0 to 10 ℓ/min.	●	●
0020	0 to 20 ℓ/min.	●	●

Ⓑ Working fluid	
H2	Hydrogen
HE	Helium

Ⓒ Port			
Working fluid		H2	HE
8A	Rc1/4	●	●
UF	9/16-18UNF	●	●
4S	1/4 inch double barbed joint	●	●
4RM	1/4 inch JXR male joint	●	●

Ⓓ Input specifications	
0	Analog 0-10 VDC
1	Analog 0-5 VDC
2	Analog 4-20mA DC
P	Parallel 10bit

Ⓔ Output specifications	
AN	1-5V analog error (NPN)
AP	1-5V analog error (PNP)
SN	Switch (NPN), error (NPN)
SP	Switch (PNP), error (PNP)

Ⓕ Display direction	
Blank	Positive direction
R	Reverse direction

Ⓖ Cable	
Blank	None
1	1m
3	3m

Ⓗ Bracket	
Blank	None
B	With bracket

Ⓘ Traceability	
Blank	None
T	Traceability Certificate, system diagram, inspection results included
K	Inspection results included

<Example of model number>

FCM-0002H2-8A1ANR1BK

Ⓐ Flow rate range : 0 to 2 ℓ/min.
Ⓑ Working fluid : Hydrogen
Ⓒ Port : Rc1/4
Ⓓ Input specifications : Analog 0-5 VDC
Ⓔ Output specifications : 1-5V analog, error (NPN)
Ⓕ Display direction : Reverse direction
Ⓖ Cable : 1m
Ⓗ Bracket : With bracket
Ⓘ Traceability : With inspection results

Discrete option model no.

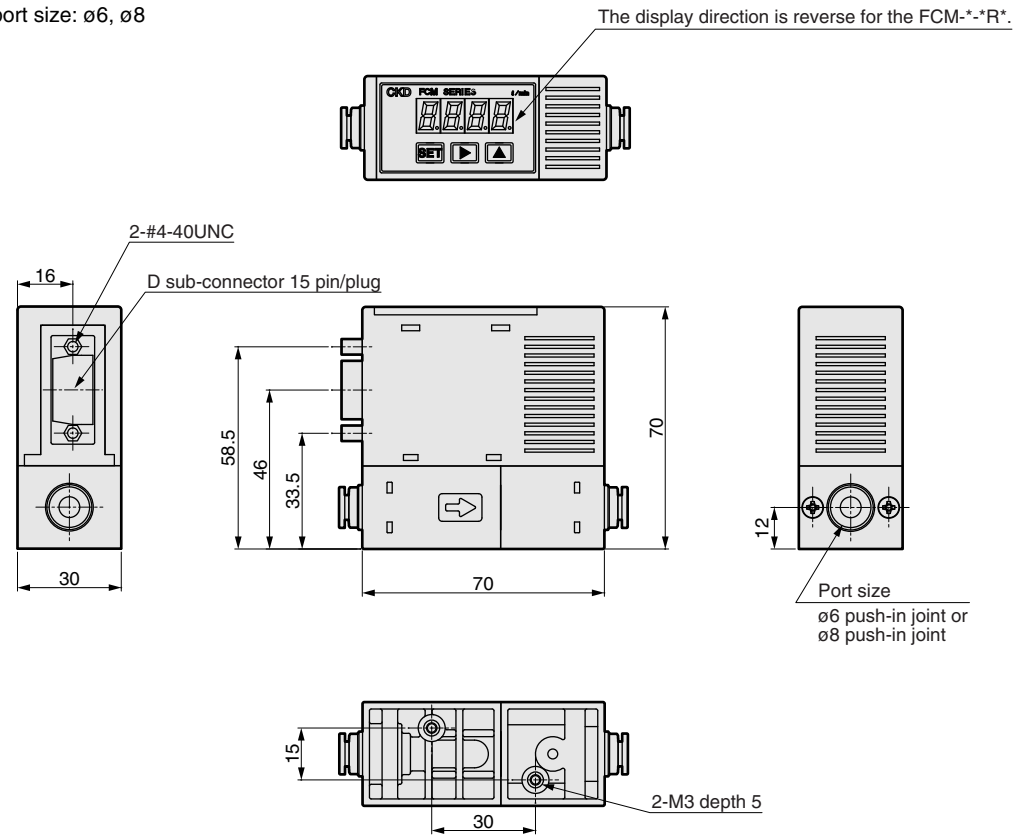
FCM - AC1

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

Dimensions

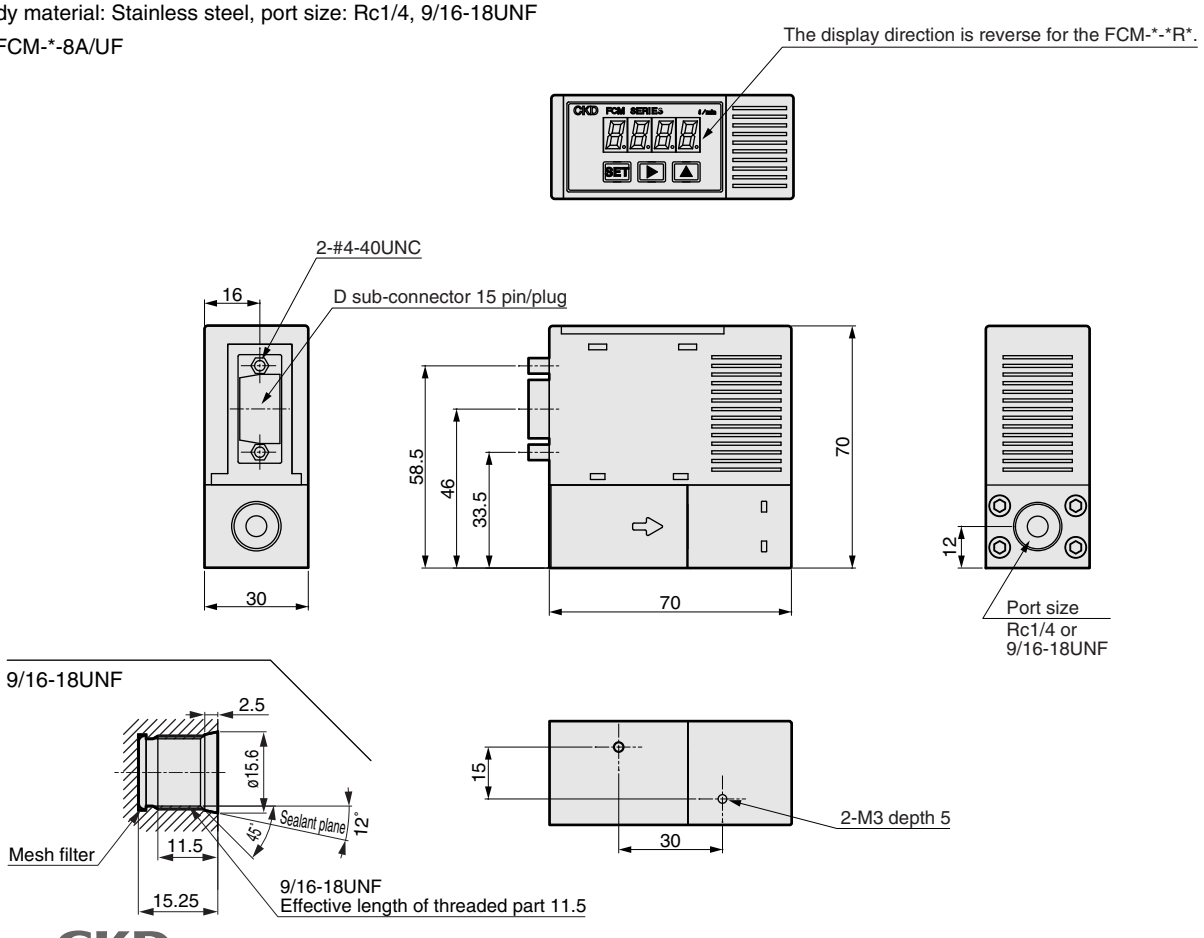
Body material: Resin, port size: ø6, ø8

● FCM-*-H8/H6*



Body material: Stainless steel, port size: Rc1/4, 9/16-18UNF

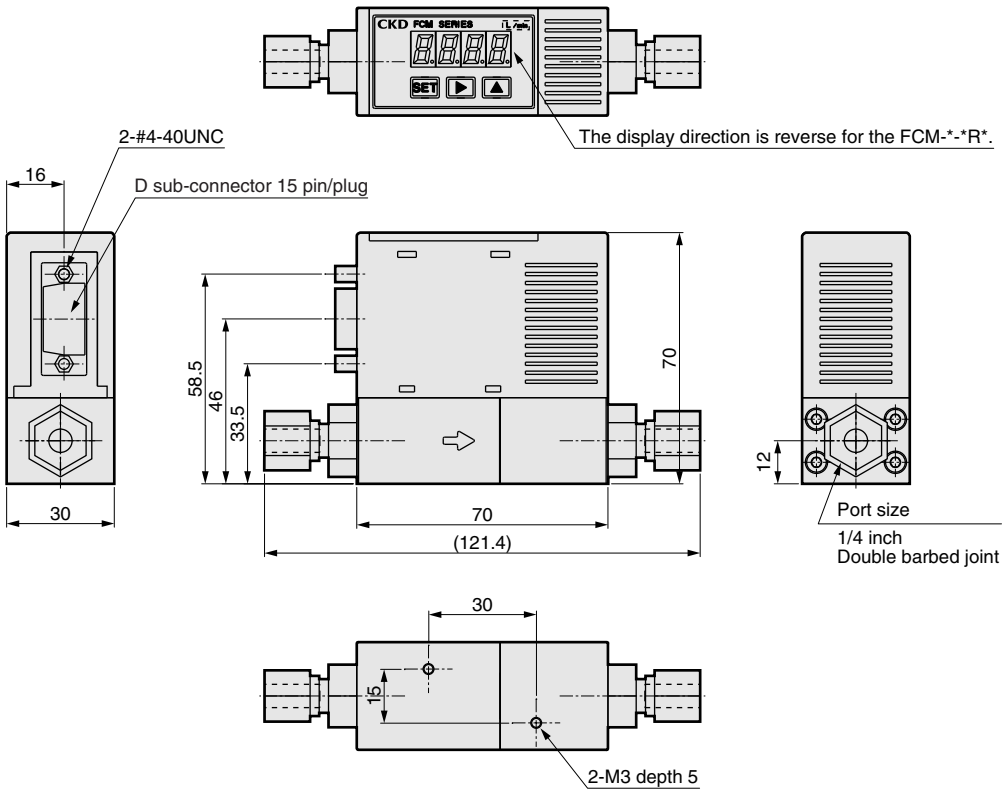
● FCM-*-8A/UF



Dimensions

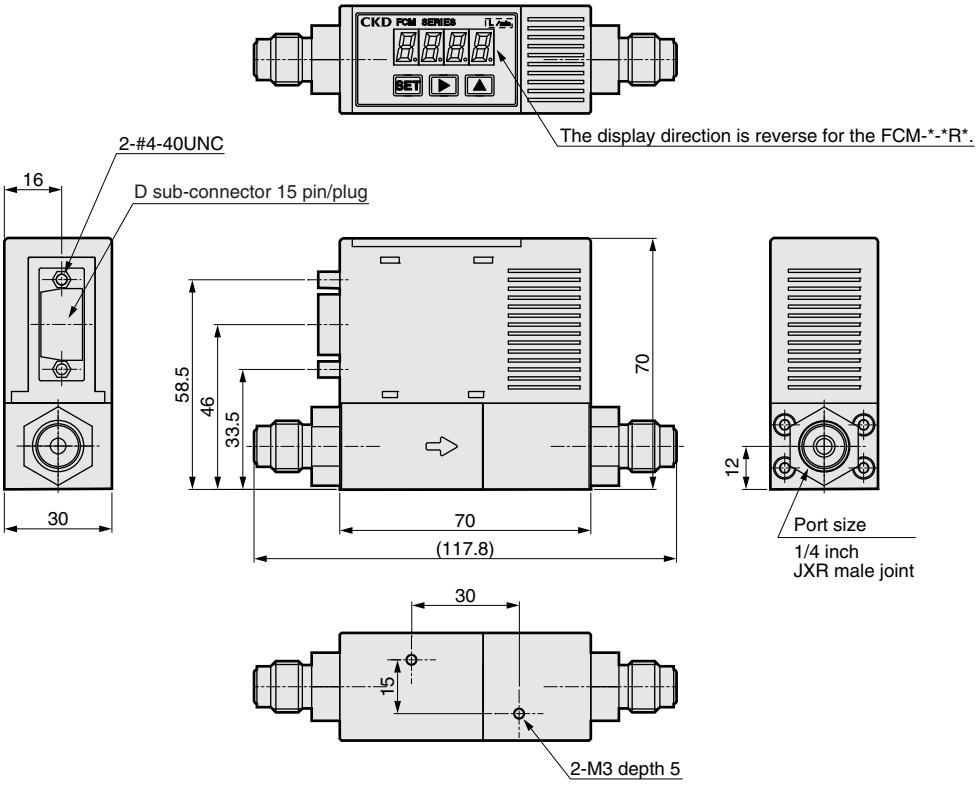
Port size: 1/4 inch double barbed joint

● FCM-*-4S



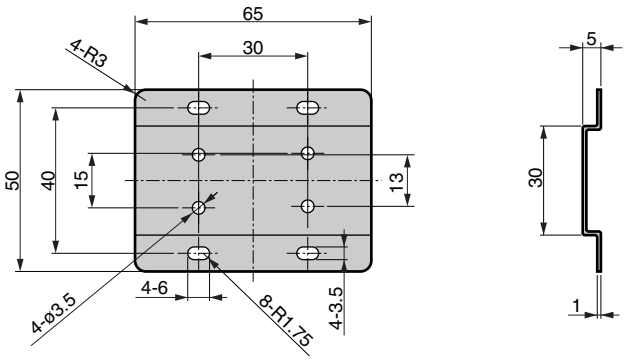
Port size: 1/4 inch JXR male joint

● FCM-*-4RM



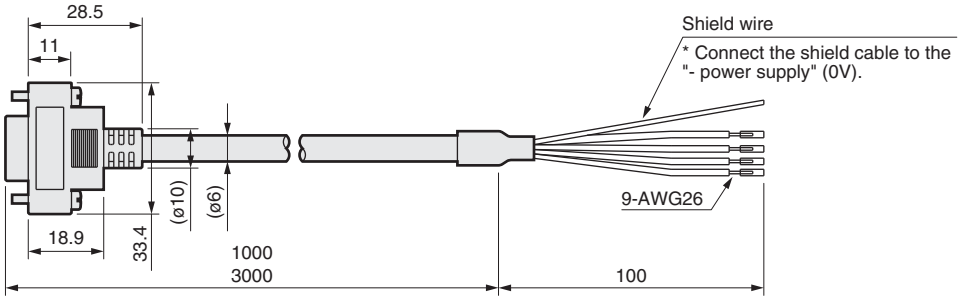
Bracket (floor installation type)

Discrete model no.: FCM-LB1



Cable optional dimensions

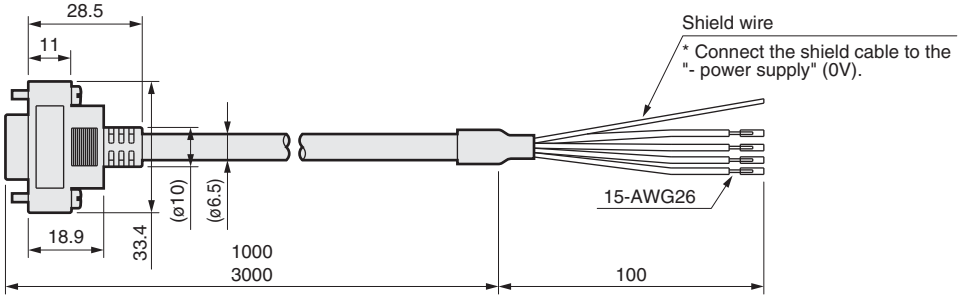
● 9-conductor cable for analog input type
Discrete option model no.: FCM-AC1, AC3



D-sub socket pin No.	1	2	3	4	5	6	7	8	9	10	11			12	13		14	15
Isolator color	Brown	Orange	Yellow	-	Red	-	-	-	-	Gray	White			-	Green		Blue	Black
Name	Pre-set input signal		Integration reset signal	Vacant	Power supply +	Vacant	Vacant	Vacant	Vacant	Common	Input signal			Vacant	Analog output	Switch output	Error output	Power supply - (0V)
Type of input	Bit 1	Bit 2			+24 VDC						0-10 VDC	0-5 VDC	4-20 mA DC	Vacant	1-5 VDC	NPN or PNP output	NPN or PNP output	

Note: The No. 1 pin common is common for the preset input and integration reset signal (No. 1 to 3 pins).

● 15-conductor cable for parallel input type
Discrete option model no.: FCM-PC1, PC3



D-sub socket pin No.	1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
Isolator 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	Parallel input signal				Power supply +	Parallel input signal				Common	Parallel input signal		Analog output	Switch output	Error output	Power supply - (0V)
Type of input	Bit 1	Bit 2	Bit 3	Bit 4	+24 VDC	Bit 5	Bit 6	Bit 7	Bit 8		Bit 9	Bit 10	1-5 VDC	NPN or PNP output	NPN or PNP output	

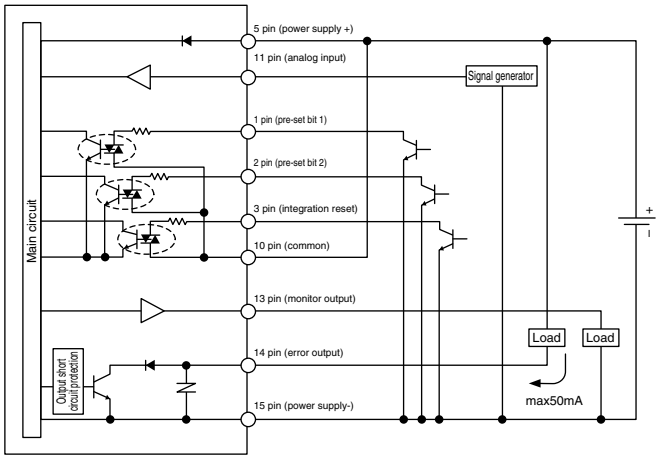
Note: The No. 10 pin common is common for the parallel input signals (No. 1 to 4, 6 to 9, 11, 12 pins).

Wiring methods

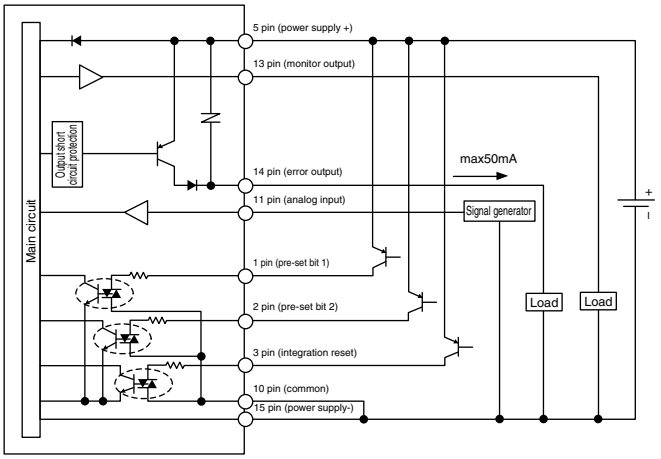
Examples of internal circuit and load connection Parallel input type

⚠ Caution: Care must be taken for incorrect wiring.

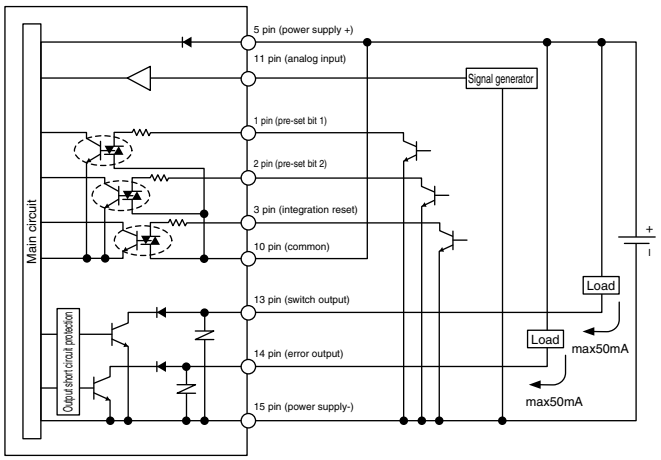
FCM-*-*0/1/2 AN*
(Analog input, analog output + error output type NPN output)



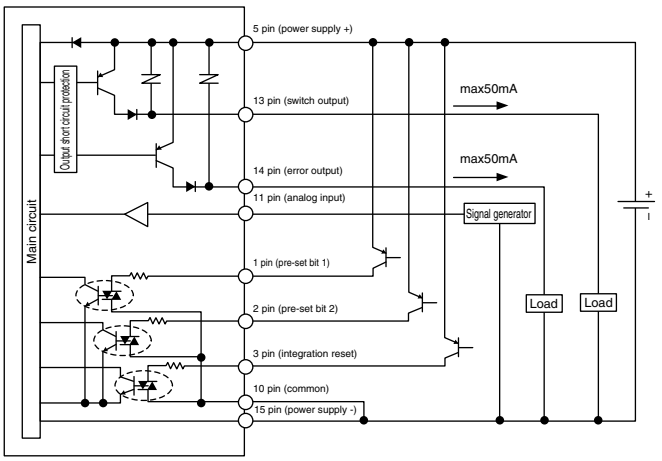
FCM-*-*0/1/2 AP*
(Analog input, analog output + error output type PNP output)



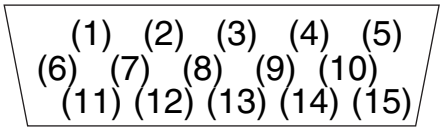
FCM-*-*0/1/2 SN*
(Analog input, switch output + error output type NPN output)



FCM-*-*0/1/2 SP*
(Analog input, switch output + error output type PNP output)



■ Connector pin arrangement (product side)
(Analog input type)

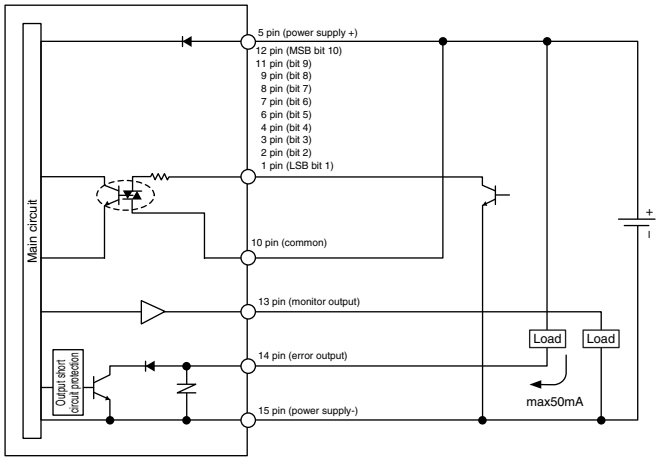


The analog input type does not have the (4,) (6), (7), (8), (9) or (12) pins.

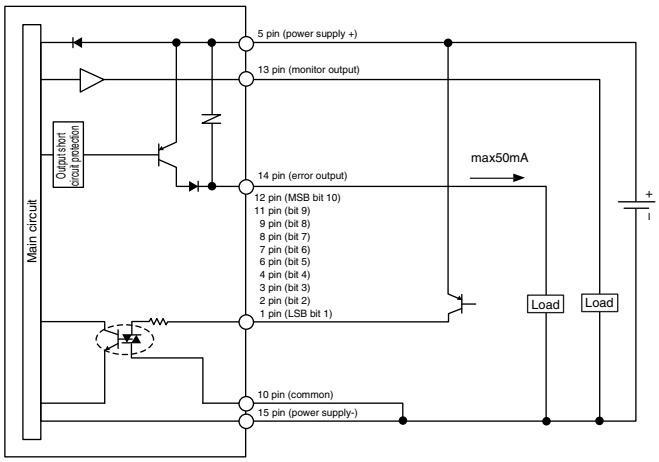
Examples of internal circuit and load connection Parallel input type

⚠ Caution: Care must be taken for incorrect wiring.

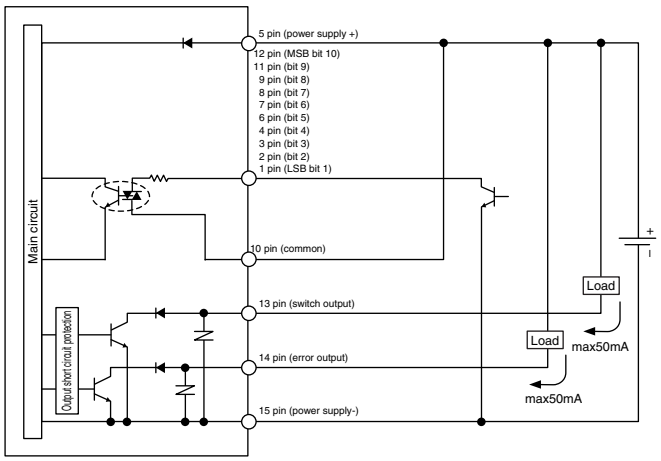
FCM-*-*PAN*
(Parallel input, analog output + error output type NPN output)



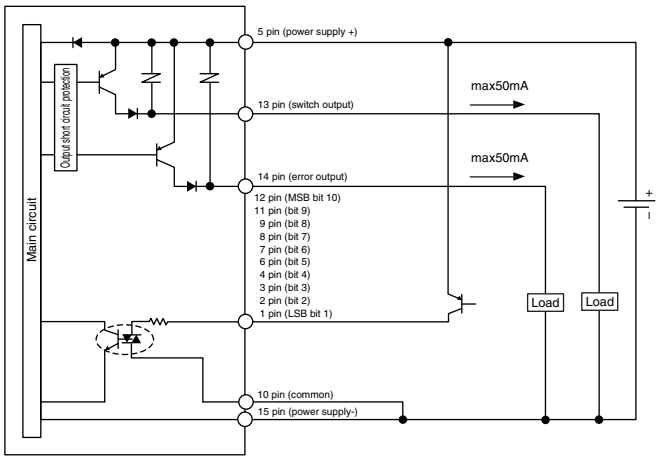
FCM-*-*PAP*
(Parallel input, analog output + error output type PNP output)



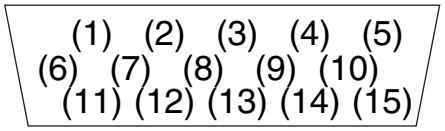
FCM-*-*PSN*
(Parallel input, switch output + error output type NPN output)



FCM-*-*PSP*
(Parallel input, switch output + error output type PNP output)

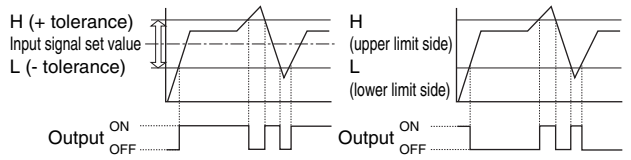
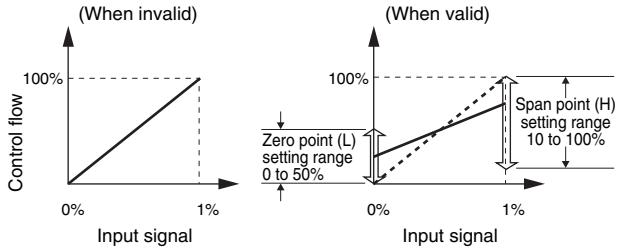


■ Connector pin arrangement (product side)
(Parallel input type)



Small size flow controller FCM Series function

Functional explanation

Function	Descriptions	Compatible models				Operation
		Analog input		Parallel input		
		Analog output	Switch output	Analog output	Switch output	
Direct memory function	The target is input with keys. Even if input signals from an external source are not used, control flow rate is freely adjusted with controller operation keys.	○	○	○	○	P1389, 1390 P1400
Pre-set input function	When four random flow rate points are set, the flow rate is controlled by inputting a 2-bit signal from an external source (signals from PLC, etc.).	○	○			P1391 P1400
Analog input function	The flow can be controlled with an analog input signal.	○	○			P1393 P1400
Parallel input function	The flow rate is controlled with a parallel 10-bit (signal from PLC, etc.). Expensive input/output devices, such as a D/A converter, are not required.			○	○	P1394 P1400
Function of integration	The flow is integrated. The following functions are used in addition to the integrated flow display. · The solenoid valve is closed and stopped at the set integrated flow. · Integrating pulse function (only switch output) Note 1 · Switch ON at set integrated flow (only switch output) Note 1 How to reset integration · Analog input type: External input, button operation · Parallel input type: Only button operation	○ (Note 1)	○	○ (Note 1)	○	P1395 P1396 P1399 P1401 P1402
Switch output	The following switch can be selected. · (1) Tolerance mode: The switch turns ON when the level is within the tolerance (randomly set) of control target. · (2) Range designation mode: The switch turns ON when the level is not within the designated flow rate range. · (3) Integrating pulse: The integrated pulse is output during integration. · (4) ON when higher than set integration: The switch turns ON at the set integrated flow. (Mode 1: Tolerance mode) (Mode 2: Range designation mode)  (Mode 3: Integrating pulse) (Mode 4: ON when set integration value and over) Refer to pages 1343 and 1345 for pulse output rate. Set integration		○		○	P1396 P1397 P1398 P1401
Input signal zero/span adjustment function	The input signal's zero point and span point is changed. 	○	○			P1401
Zero point adjustment	The flow output zero point is adjusted.	○	○	○	○	P1402
Automatic power off	The flow rate display turns OFF if there are no operations for one minute. (Control does not stop when the auto power OFF function activates.)	○	○	○	○	P1401
Error display function	The error state is displayed. The following functions are used for the error display. · Error output is turned ON if an error occurs · Control stops automatically an error occurs	○	○	○	○	P1388 P1402
Error automatic shutoff	If an error occurs, control is stopped, the valve is fully opened, and error output is turned ON.	○	○	○	○	P1402
Key lock	Setting changes are disabled to prevent incorrect operations.	○	○	○	○	P1399
Setting reset	Settings are returned to defaults. (Only input signal selection, switch output, input signal zero/span adjustment or auto power off)	○	○	○	○	P1399

Names and functions of display and operation section

Output display (red)

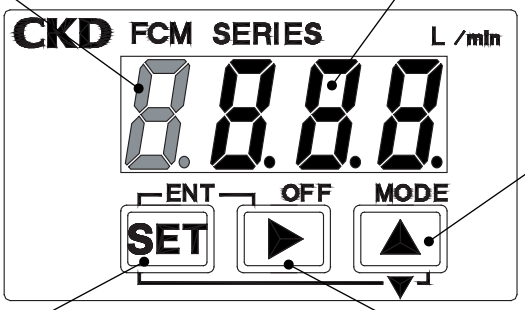
- "F" is displayed when confirming the function setting.
- "–" is displayed when switch output is ON. (Only switch output)
  * Blinks when overcurrent is detected.
  * The display does not blink with integrated pulse output.
- E is displayed when error output is ON.
  * Blinks when overcurrent is detected.

* If an upper/lower limit applies when setting the function, or when displaying both the high-order digit and low-order digit of the integrated flow display, H or L is displayed.

3-digit LED display (green)

- The instantaneous flow rate display and function setting details are displayed in the RUN mode (instantaneous flow rate display).
  * The setting mode No. and setting details are displayed when displaying details of function settings.
- Values, etc., are displayed when setting each data.
- The error code No. is displayed when the error is displayed.

(Instantaneous flow rate display) 5.00
(Setting details display) F1.R0 — Setting details / Setting mode no.
(Error output) E01 — Code No.
(Invalid display) F2.-- — Setting details / Setting mode no.



UP key (MODE key)

- Press to count up the value, etc.
- Press to change the setting mode.
- Press to change the setting item.

SET Key

- Press to set the setting mode.
- Press to set the setting item.
- Press to change to the display of integration.

Shift key (OFF key)

- Press to select the digit for a number, etc.
- Press to restore operation from the forced OFF state, when forced OFF (control stop) is executed.

SET + Key (ENT key)

- Press to set the value.
- Press to unlock the key lock.
- Press to execute integration reset.

SET + Key (DOWN key)

- Press to count down the value, etc.
- Press to lock keys.

+ Key

- Press to initialize values.

Error code table

Error display	Cause	Countermeasures	Errors subject to error automatic shutoff (Note 1)
E.01	The supplied power voltage is not within the rating. (Detected at 19.5VDC or less, detection accuracy ±10%F.S.)	● Check controller power specifications, set power voltage within the rating range, and turn power ON again.	○
E.02	The input signal exceeds the rating range. (Detected at input 110% F.S. or more, detection accuracy ±1%F.S.)	● Check the controller input signal type, set the input signal within the rating range, and turn power ON again.	○
E.03	An error occurred during EEPROM reading or writing.	● Contact your nearest CKD Sales Office or dealer.	
E.04	An error occurred during memory reading or writing.	● Contact your nearest CKD Sales Office or dealer.	
E.05	The flow rate did not reach the setting for five or more consecutive seconds. (If the setting value and control value difference is ±20% or more, the detection accuracy is ±6%F.S.)	● Check the primary pressure, supply pressure within the rated operating differential pressure range, and turn power ON again. ● Check that there are no leaks from piping, joints, or other devices, correct connect pipes, and turn power ON again. ● Contact your nearest CKD Sales Office or dealer.	○
E.06	An output error is occurring in the sensor.	● Stop the supply of fluids to the controller, set the flow rate to zero, and turn the controller power ON again. If this error occurs again, contact your nearest CKD Sales Office or dealer.	○ (Note 2)
E.08	Switch output overcurrent protection circuit is activated.	● Check whether load current exceeds the rating, correctly connect the controller, and turn power ON again.	

Errors are basically automatically reset. However, if the error is not reset, turn power OFF, check the cause and correct the error. Then, turn power ON again.
Note 1: The default is error automatic shutoff set to OFF (valve fully closed if an error occurs). Refer to page 1402 for details.
Note 2: OFF (valve fully closed at error) regardless of the error automatic shutoff setting.

Controlling the flow rate

(1) Controlling the flow rate with direct memory

The target is input with keys. Even if input signals from an external source are not used, control flow rate is freely adjusted with controller operation keys.
Direct memory has two operation modes.

- Direct memory (1): Settings are applied when the value is changed. (Even if the value is not set, the flow rate is adjusted by changing the value. This is handy for finely adjusting the flow rate. Set the setting value once the flow rate is determin.ed.)
- Direct memory (2): Changes are applied when the value is set. (The flow rate does not change unless the value is set.)

<How to operate direct memory (1)>

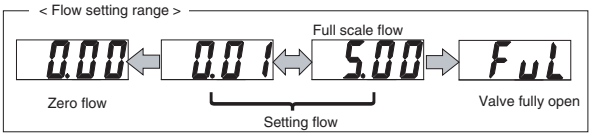
(1) Turn power ON. The instantaneous flow rate is displayed.

(2) When the ▲ key is pressed, the <F1: Input signal confirmation> screen is displayed.
The current input signal setting state is displayed.
The current input signal type and input are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

(3) "F1.dr" blinks when the SET key is held down for 2 seconds.

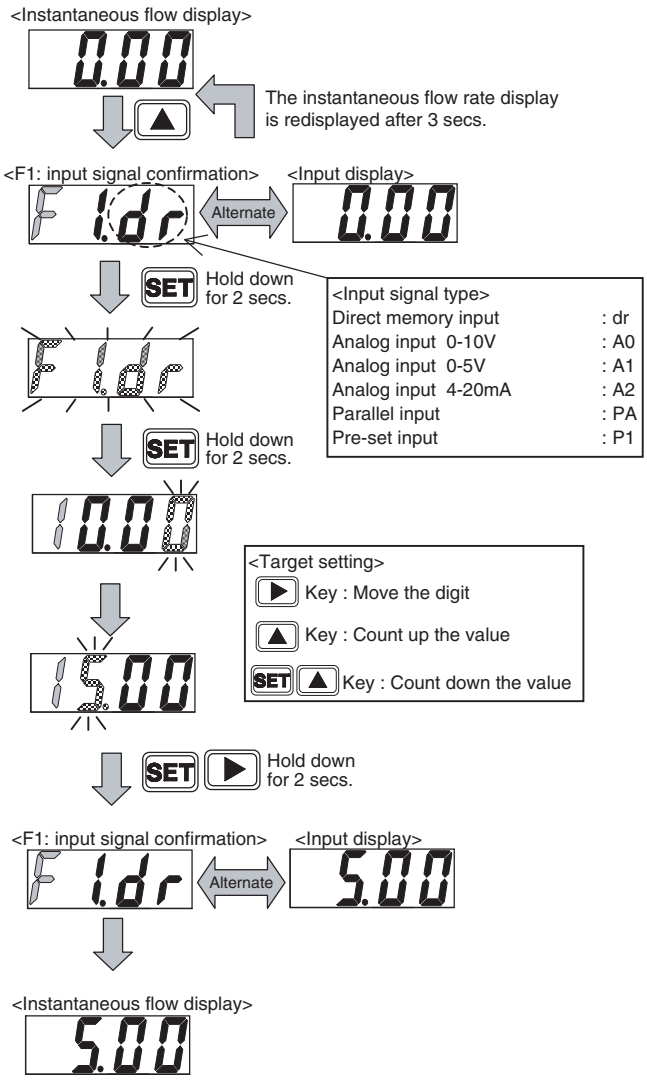
(4) Hold down the SET key for 2 seconds and open the <Direct Memory 1 Setting screen>.

(5) The flow rate changes when the value is change. The flow rate is adjusted by changing the value even if the value is not set.



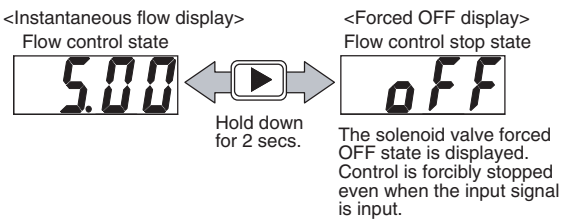
(6) Hold down the and SET ▶ keys simultaneously for 2 seconds, and set the value.
The <F1: input signal confirmation> screen is displayed.

(7) The instantaneous flow rate display is redisplayed after 3 seconds.



Forced OFF (flow rate zero)

The controller is forcibly stopped (flow rate zero) by holding down the ▶ key for 2 seconds in the flow control state (instantaneous flow rate display). The flow control state is entered again by holding down the ▶ key for 2 seconds in the flow control stopped state (forced OFF).



Controlling the flow rate

<How to operate direct memory (2)>

(1) Turn power ON. The instantaneous flow rate is displayed.

(2) When the ▲ key is pressed, the <F1: Input signal confirmation> screen is displayed. The current input signal setting state is displayed.
The current input signal type and input are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

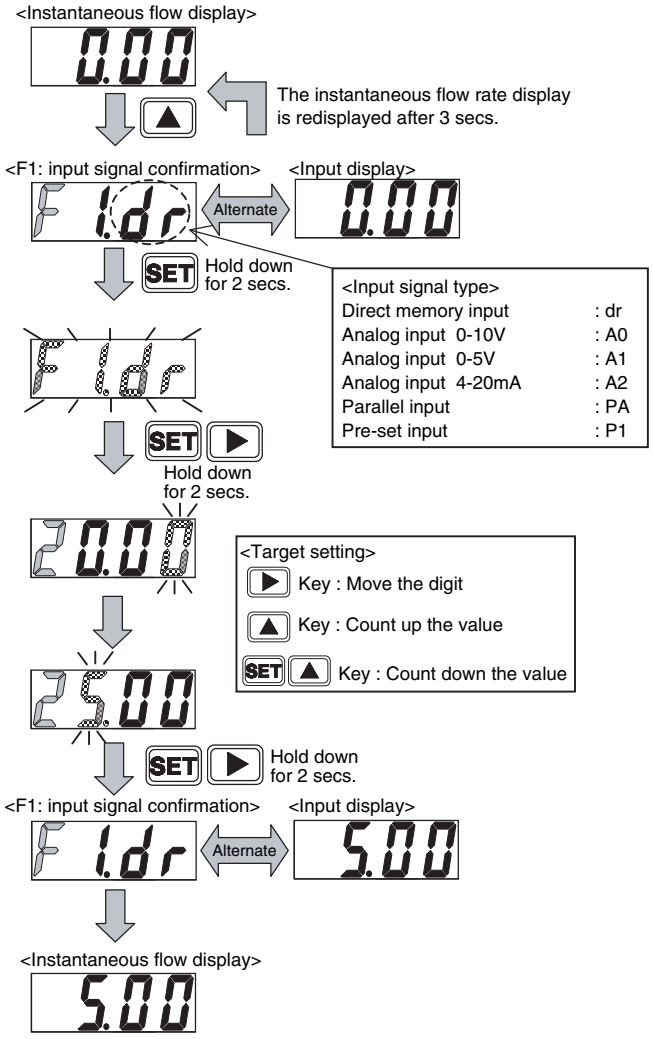
(3) "F1.dr" blinks when the SET key is held down for 2 seconds.

(4) Hold down the SET ▶ key for 2 seconds and open the <Direct Memory 2 Setting screen>.

(5) Change the value.
(The flow rate does not change unless the value is set.)

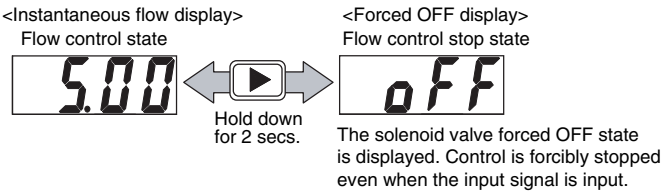
(6) Hold down the SET and ▶ keys simultaneously for 2 seconds, and set the value.
The <F1: input signal confirmation> screen is displayed.

(7) The instantaneous flow rate display is redisplayed after 3 seconds.



Forced OFF (flow rate zero)

The controller is forcibly stopped (flow rate zero) by holding down the ▶ key for 2 seconds in the flow control state (instantaneous flow rate display).
The flow control state is entered again by holding down the ▶ key for 2 seconds in the flow control stopped state (forced OFF).



CAUTION

- Control does not stop while setting direct memory. Take safety into consideration, and stop control (forced stop) if necessary.
- The flow control/forced OFF state (setting) is held even if power is turned OFF.

Controlling the flow rate

(2) Controlling the flow rate with preset input (only analog input)

When four random flow rate points are set, the flow rate is controlled by inputting a 2-bit signal from an external source

E.g.) To control 0, 1, 2, and 5 ℓ/min. with preset input, select Preset Input for the input setting mode, and set each of the following:
P1: 0 ℓ/min. P2: 1 ℓ/min.
P3: 2 ℓ/min. P4: 5 ℓ/min.
When signals are input from a PLC, etc., as indicated in the table at right, the flow rate is controlled to each preset flow rate.

D-sub-socket pin No.	2	1	Pre-set memory No.
Cable option Isolator color	Orange	Brown	
Type of input	Bit 2	Bit 1	
Input signal	OFF	OFF	P1
	OFF	ON	P2
	ON	OFF	P3
	ON	ON	P4

<Controlling with the preset input signal>

(1) Turn power ON. The instantaneous flow rate is displayed.

(2) When the ▲ key is pressed, the <F1: Input signal confirmation> screen is displayed. The current input signal setting state is displayed.
The current input signal type and input are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

(3) "F1.dr" blinks when the SET key is held down for 2 seconds.

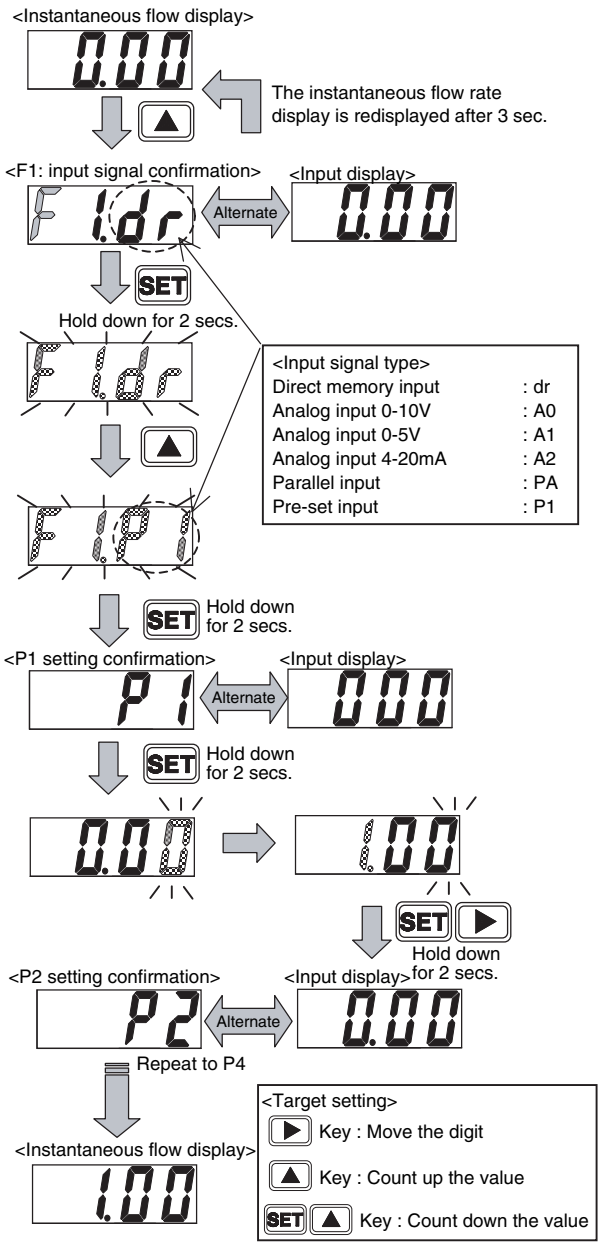
(4) When the ▲ key is pressed twice, "F1.P1" will blink.

(5) Hold down the SET key for 2 seconds, and open the P1 setting confirmation screen.

(6) Hold down the SET key for 2 seconds, and open the target input screen. Input the target.

(7) When the SET and ▶ key are held down for 2 seconds, the target is set in memory, and the P2 setting confirmation screen is displayed. Set all of the targets up to P4 with this.

(8) The instantaneous flow rate display is redisplayed after 3 seconds. The flow is controlled with preset input.



Controlling the flow rate

(3) Changing settings with shortcut keys (only when using direct memory and preset input)

When controlling the flow using direct memory or preset input, the setting change screen is opened with a single key operation.

Note: The input signal setting change screen opens the instant that the shortcut key is pressed.
(Example: The P2 setting change screen opens when controlling the flow with the preset input P2.)
This cannot be used when controlling the flow with analog input or parallel input.

<Changing the setting with a shortcut>

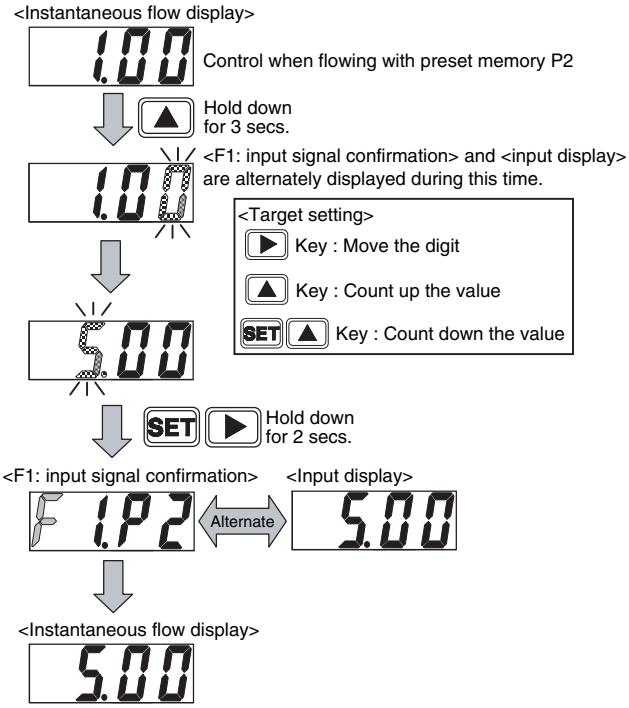
(1) Turn power ON. The instantaneous flow rate is displayed. (This is used only when controlling with direct memory or preset input.)

(2) When the ▲ key is held down for 3 seconds, and the ▲ key is pressed, the input signal setting change screen is displayed.

(3) The flow rate changes when the value is change. The flow rate is adjusted by changing the value even if the value is not set.

(4) Hold down the SET and ▶ keys simultaneously for 2 seconds, and set the value. The <F1: input signal confirmation> screen is displayed.

(5) The instantaneous flow rate display is redisplayed after 3 seconds.



Note: Do not change the preset external input while changing the setting with the shortcut key.
The setting could be set into an incorrect preset No.
Data is not saved in memory if power is turned OFF before setting the value. Set the value before turning power OFF.

Controlling the flow rate

(4) Controlling the flow rate with analog input (Only analog input)

The flow rate is controlled with analog input signals.

<Controlling with analog input signals>

(1) Turn power ON. The instantaneous flow rate is displayed.

(2) When the ▲ key is pressed, the <F1: Input signal confirmation> screen is displayed. The current input signal setting state is displayed.
The current input signal type and input are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

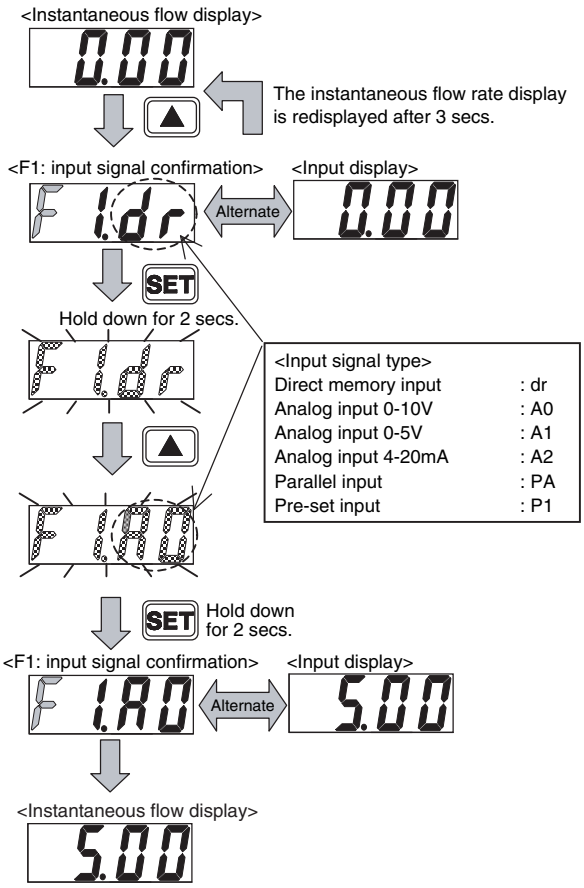
(3) "F1.dr" blinks when the SET key is held down for 2 seconds.

(4) When the ▲ key is pressed once, "F1.A 0 " will blink.
(The number shown with □ differs based on the model.)

(5) Hold down the SET key for 2 seconds and set the value.
The <F1: input signal confirmation> screen is displayed.

(6) The instantaneous flow rate display is redisplayed after 3 seconds.
The flow rate is controlled with analog input.

Note: Fully open (FUL) cannot be set with analog input.



Controlling the flow rate

(5) Controlling the flow rate with parallel input (Only parallel input)

The flow rate is controlled with a parallel 10-bit (signal from PLC, etc.). Expensive input/output devices, such as a D/A converter, are not required.
The parallel input signal is a 10-point signal so when converted to a decimal, it becomes 0-1023. A 0.1% resolution is attained.

Input signal = setting flow / full scale flow × 1023

Example) To set 300 mℓ/min. with a full-scale flow rate 500 mℓ/min.

300 (mℓ/min.) / 500 (mℓ/min.) × 1023=613.8 → 614

When 614 (decimal) is converted to binary, it becomes 1001100110. 1 sets the input signal ON, and 0 sets the input signal OFF. (Refer to the below table)

D-sub-socket pin No.	12	11	9	8	7	6	4	3	2	1
Cable option Isolator color	Green (with black line)	White	Red (with black line)	White (with black line)	Pink	Light blue	Purple	Yellow	Orange	Brown
Type of input	Bit 10 MSB	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1 LSB
Binary (For 614 [decimal])	1	0	0	1	1	0	0	1	1	0
Input signal	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF

<Controlling with parallel input signals>

(1) Turn power ON. The instantaneous flow rate is displayed.

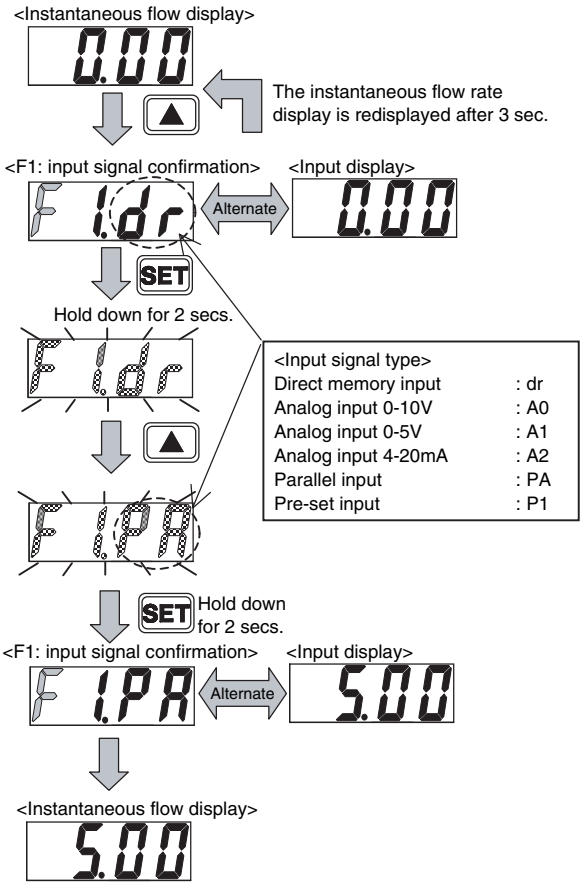
(2) When the ▲ key is pressed, the <F1: Input signal confirmation> screen is displayed. The current input signal setting state is displayed.
The current input signal type and input are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

(3) "F1.dr" blinks when the SET key is held down for 2 seconds.

(4) When the ▲ key is pressed once, "F1.PA" will blink.

(5) Hold down the SET key for 2 seconds and set the value.
The <F1: input signal confirmation> screen is displayed.

(6) The instantaneous flow rate display is redisplayed after 3 seconds.
The flow rate is controlled with parallel input.



Note: Fully open (FUL) cannot be set with parallel input.

<References>

If a high resolution is not required, the number of input points is reduced.

E.g.) If 2% resolution is acceptable, operate with a 6-point input (0-63 when converted to decimal).
Bits 5 to 1 in the above table are shorted in a bundle. When turned ON and OFF as one bit (LSB), control is executed with 6 points.

Integrating the flow rate

(1) Displaying the integrated flow

The flow rate is integrated and displayed. The display range is shown below.

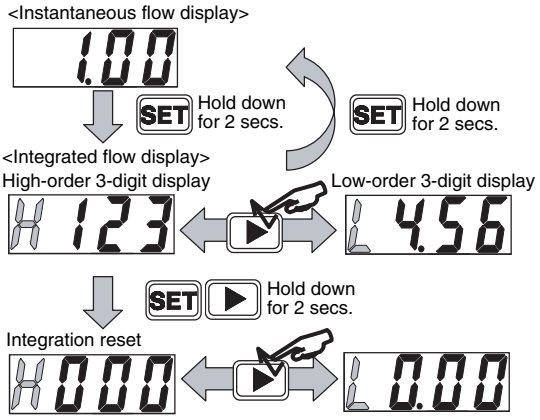
Model no. FCM-		9500 L9500	0001 L0001	0002 L0002	0005 L0005	0010 L0010	0020	0050	0100
Flow display	Display range	0 to 500 mℓ/min.	0.00 to 1.00 ℓ/min.	0.00 to 2.00 ℓ/min.	0.00 to 5.00 ℓ/min.	0.0 to 10.0 ℓ/min.	0.0 to 20.0 ℓ/min.	0.0 to 50.0 ℓ/min.	0 to 100 ℓ/min.
Function of integration	Display range	999999 mℓ	9999.99 ℓ	9999.99 ℓ	9999.99 ℓ	99999.9 ℓ	99999.9 ℓ	99999.9 ℓ	999999 ℓ
	Display resolution	1mℓ	0.01ℓ	0.01ℓ	0.01ℓ	0.1ℓ	0.1ℓ	0.1ℓ	1ℓ
	Pulse output rate	5mℓ	0.01ℓ	0.02ℓ	0.05ℓ	0.1ℓ	0.2ℓ	0.5ℓ	1ℓ

< Display of integration>

(1) Instantaneous flow rate display
Integration starts when power is turned ON.
(The integrated value is reset when power is turned OFF.)

(2) The display of integration screen opens when the SET key is held down for 2 seconds. Press the SET key for 2 seconds to return to the instantaneous flow rate display. The display digit changes when the ▶ key is pressed.

(3) Integration is reset when the SET and ▶ keys are held down for 2 seconds. With analog input type, integration is reset with the external input (No. 3 pin). Integration is also reset when power is turned OFF.



(2) Closing and stopping the solenoid valve with set integrated flow

The solenoid valve is closed and stopped when the set integrated flow is attained.
This is suitable for processes in which a set amount is supplied, etc.

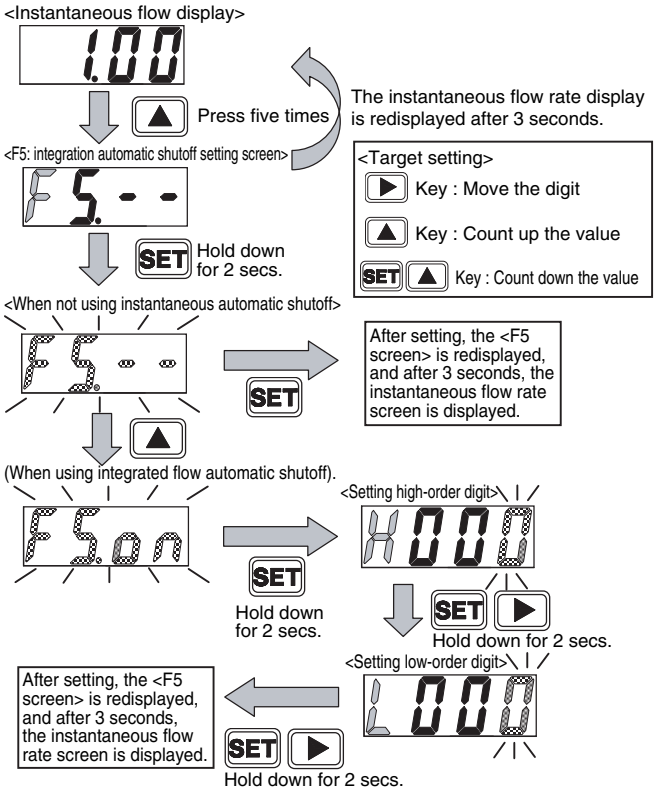
<Operation>

(1) Instantaneous flow rate display

(2) Press the ▲ key five times and open the <F5: integration automatic shutoff setting screen>.
If integration automatic shutoff is valid, "F5.on" and the current setting are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

(3) When the SET key is held down for 2 seconds, "F5.--" blinks. When not using integration automatic shutoff, hold down the SET key for 2 seconds. The <F5 screen> is redisplayed, and after 3 seconds, the instantaneous flow rate screen is displayed.

(4) To use integration automatic shutoff, press the ▲ key so that "F5.on" blinks. Then, hold down the SET key for 2 seconds.
After setting the high-order digit, hold down the SET and ▶ key for 2 seconds.
After setting the low-order digit, hold down the SET key and ▶ key for 2 seconds.
The <F5 screen> is displayed, and after 3 seconds, the instantaneous flow rate screen is displayed.



* Only in this mode, the integrated value is reset when the input signal reaches zero. (Valid only after automatic shutoff)
* The solenoid valve is automatically shut off, and this operates a switch when the set integrated flow is reached.
* If the display for automatic shutoff is "OFF", the switch output lamp does not turn ON. The flow rate display is redisplayed when the integrated value is reset (button operation or external input).
* Even if automatic shutoff is invalidated during automatic shutoff, it does not function until the integrated value is reset.
* The integrated value is reset when automatic shutoff is set to "on" and the value is set.

Integrating the flow rate

(3) Outputting the integrated pulse (only switch output)

The integrated pulse is output. Refer to the table on page 1395 for the pulse rate.
Refer to the connection method (page 1384), examples of internal circuit and load connection (pages 1385 and 1386) for details on connecting switch output.

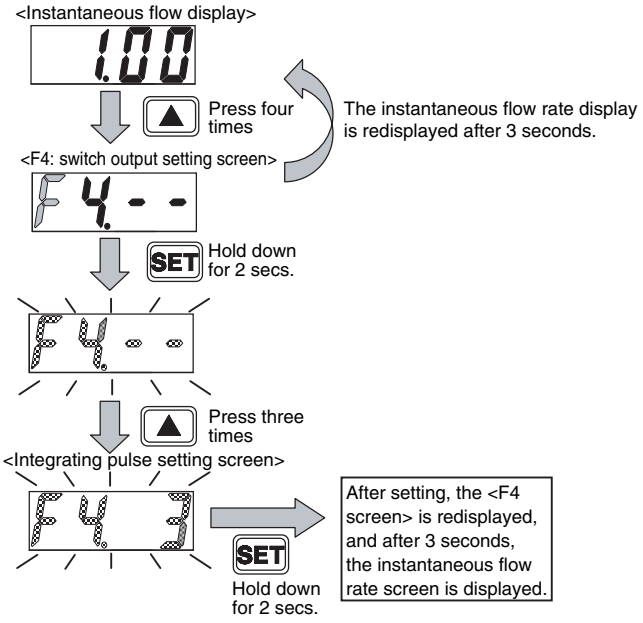
<Operation>

(1) Instantaneous flow rate display

(2) Press the ▲ key four times and open the <F4: switch output setting screen>. If switch output setting is valid, "F4.□" and the current setting are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

(3) Hold down the SET key for 2 seconds, and enter switch output setting mode.

(4) When the ▲ key is pressed three times, "F4.3" blinks.
When the SET key is held down for 2 seconds, the integrated pulse output is set.
The <F4 screen> is redisplayed, and after 3 seconds, the instantaneous flow rate screen is displayed.



(4) Turning the set integrated flow ON with a switch (only switch output)

Switch output is turned ON at the set integrated flow.
Refer to the connection method (page 1384), examples of internal circuit and load connection (pages 1385 and 1386) for details on connecting switch output.

<Operation>

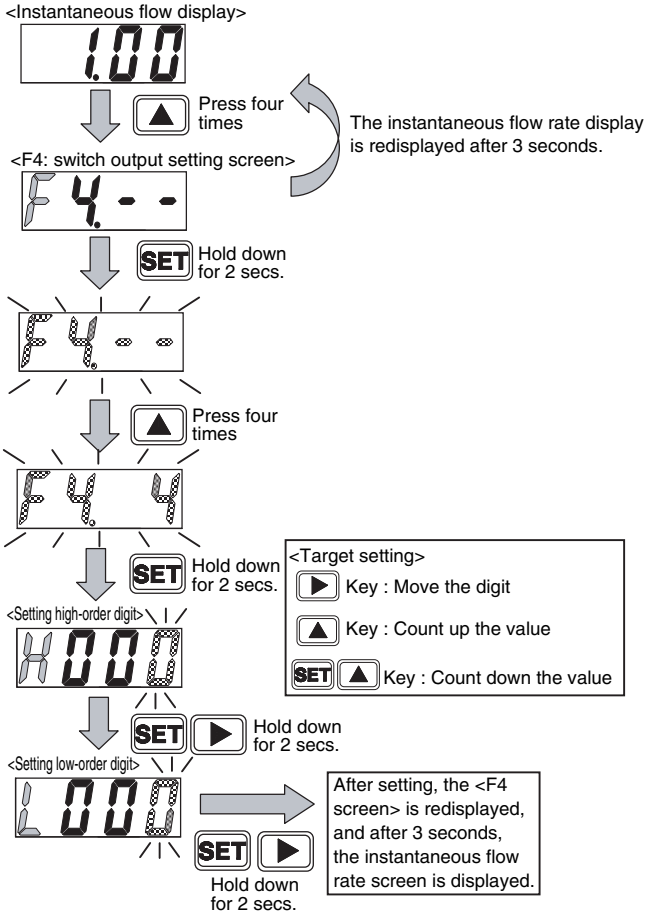
(1) Instantaneous flow rate display

(2) Press the ▲ key four times and open the <F4: switch output setting screen>. If switch output setting is valid, "F4. " and the current setting are alternately displayed.
(The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

(3) Hold down the SET key for 2 seconds, and enter switch output setting mode.

(4) When the ▲ key is pressed four times, "F4.4" blinks.
Hold down the SET key for 2 seconds, and open the target setting screen.
After setting the high-order 3 digits of the target, hold down the and SET ▶ keys for 2 seconds.
After setting the low-order 3 digits of the target, hold down the and SET ▶ keys for 2 seconds.
The integrated value is reset after the target is set.

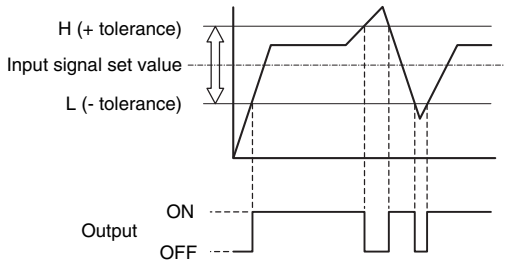
(5) The <F4 screen> is redisplayed, and after 3 seconds, the instantaneous flow rate screen is displayed.



Using switch output (only switch output)

(1) Using the tolerance mode

Switch output turns ON when the level is within the tolerance of the input signal setting.
The tolerance is set for both the plus side and min.us side as a %FS (full-scale).
Refer to the connection method (page 1384), examples of internal circuit and load connection (pages 1385 and 1386) for details on connecting switch output.



<Operation>

(1) Instantaneous flow rate display.

(2) Press the ▲ key four times and open the <F4: switch output setting screen>. If switch output setting is valid, "F4.□" and the current setting are alternately displayed. (The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

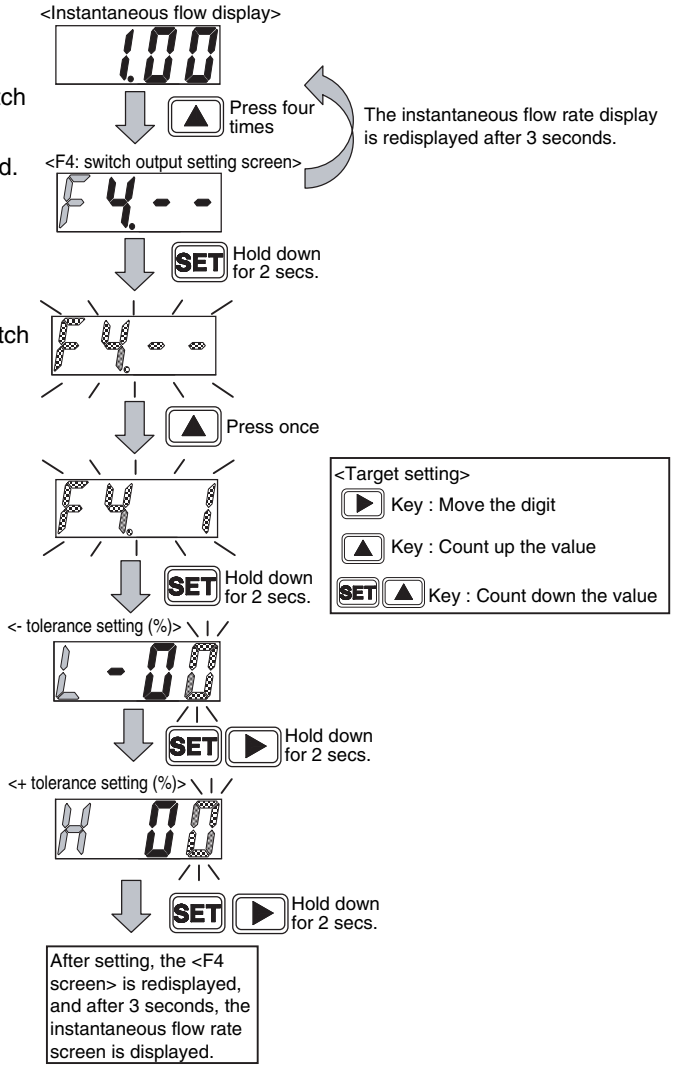
(3) Hold down the SET key for 2 seconds, and enter switch output setting mode.

(4) When the ▲ key is pressed once, "F4.1" blinks. Hold down the SET key for 2 seconds, and open the target setting screen.

(5) After setting the tolerance (minus side), hold down the SET and ▶ keys for 2 seconds.
Minus side setting range: -50 to 0%FS

(6) After setting the tolerance (plus side), hold down the SET and ▶ keys for 2 seconds.
Plus side setting range: 0 to 50%FS

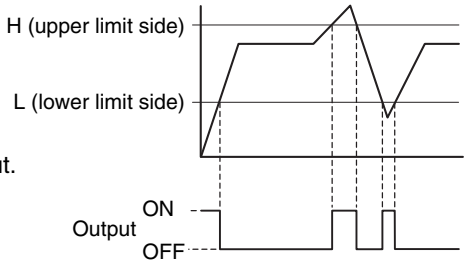
(7) The <F4 screen> is redisplayed, and after 3 seconds, the instantaneous flow rate screen is displayed.



Using switch output (only switch output)

(2) Using the range designation mode

The switch turns ON when the level is not within the designated flow rate range. The upper and lower limit values are set regardless of the input signal setting (control target).
Both the upper limit and lower limit are set as % FS (full-scale).
Refer to the connection method (page 1384), examples of internal circuit and load connection (pages 1385 and 1386) for details on connecting switch output.



<Operation>

(1) Instantaneous flow rate display

(2) Press the ▲ key four times and open the <F4: switch output setting screen>. If switch output setting is valid, "F4.□" and the current setting are alternately displayed. (The instantaneous flow rate display is displayed if 3 seconds pass without a button being pressed.)

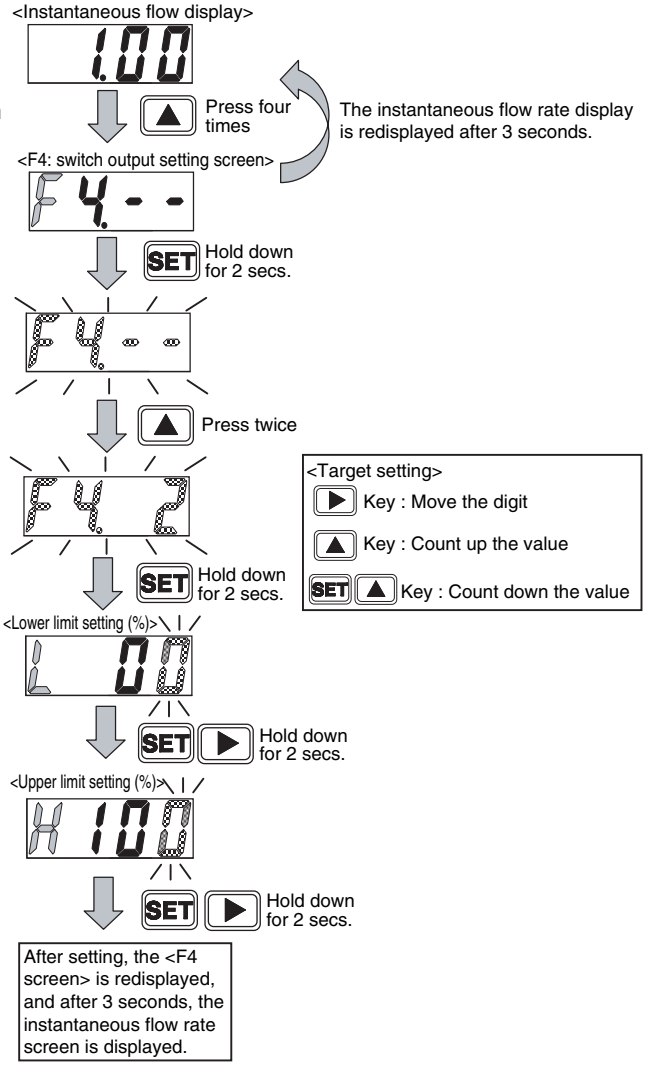
(3) Hold down the SET key for 2 seconds, and enter switch output setting mode.

(4) When the ▲ key is pressed twice, "F4.2" blinks. Hold down the SET key for 2 seconds, and open the target setting screen.

(5) After setting the lower limit value, hold down the SET and ▶ keys for 2 seconds.
Lower limit setting range: 0 to 90%FS

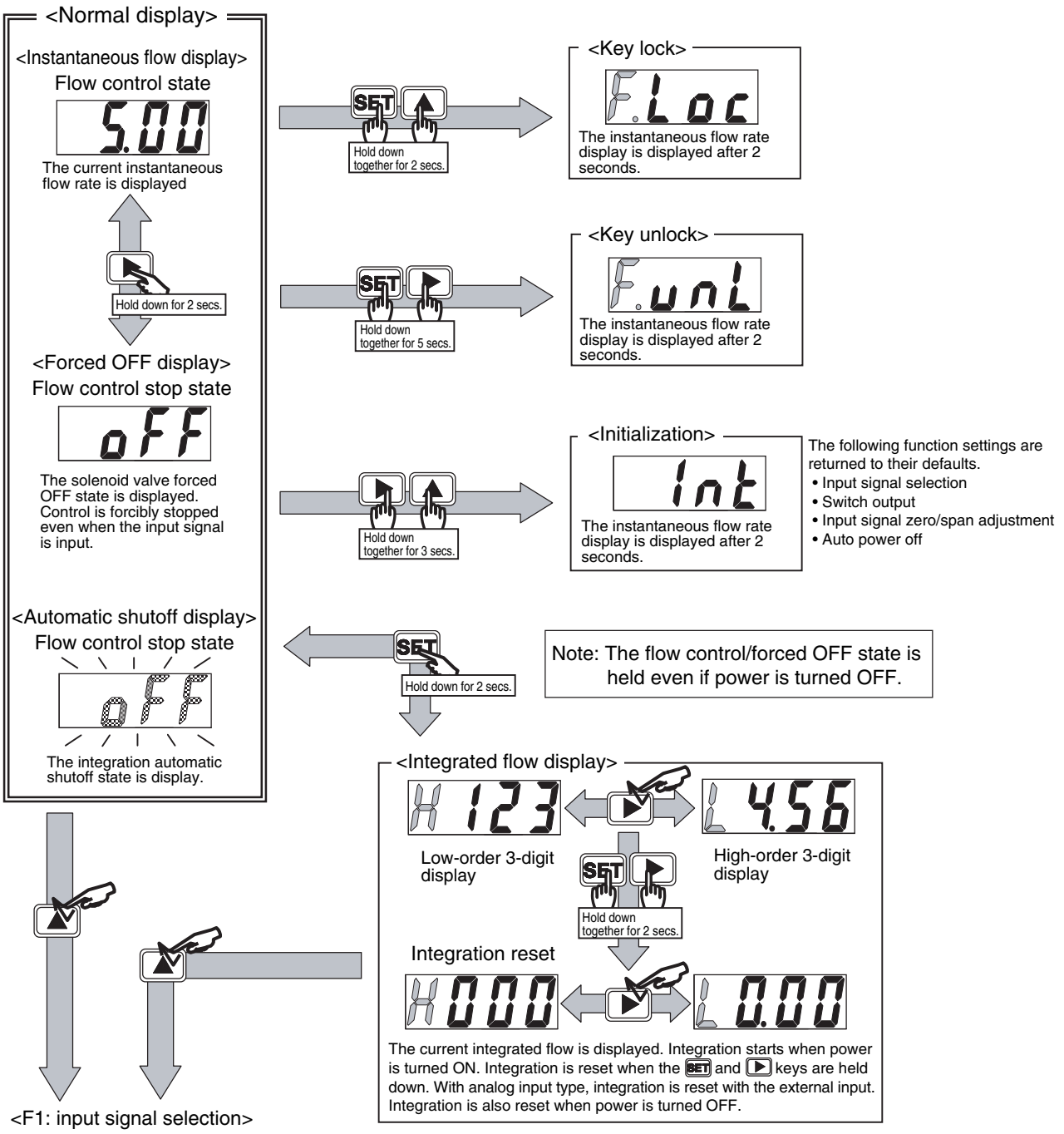
(6) After setting the upper limit value, hold down the SET and ▶ keys for 2 seconds.
Plus side setting range: 10 to 100%FS
Note that the gap between the upper and lower limits must be 10% FS or more.

(7) The <F4 screen> is redisplayed, and after 3 seconds, the instantaneous flow rate screen is displayed.



Operation (List)

CAUTION: • Keys are unlocked when the controller is shipped. Lock keys if necessary.
The key lock/unlock state is held even if power is turned OFF.
• Control does not stop during the F1: input signal selection or F2: input signal zero/span setting. Take safety into consideration and stop control (forced stop) if necessary.
• The flow control/forced OFF state is held even if power is turned OFF.



Operation (List)

<F1: input signal selection>

Select which input style to use for control.

After 3 seconds <Instantaneous flow rate display>

<F1 screen>

Alternate display

Input signal type

Input display

<Setting direct memory input>

Hold down for 2 secs.

Direct memory (1): The setting is applied when the value is changed.

Hold down together for 2 secs.

After setting, the setting mode is exited, and the <F1 screen> is displayed.

Direct memory (2): The setting is applied after it is set.

Hold down together for 2 secs.

After setting, the setting mode is exited, and the <F1 screen> is displayed.

<Target setting>

Key : Move the digit

Key : Count up the value

SET Key : Count down the value

<Analog input (parallel input) setting>

After setting to the analog input (parallel input) mode, the <F1 screen> is displayed.

<Input signal type>

Direct memory input	: dr
Analog input 0-10V	: A0
Analog input 0-5V	: A1
Analog input 4-20mA	: A2
Parallel input	: PA
Pre-set input	: P1

<Pre-set input setting> (Not used for parallel input)

P1 target display

Alternate display

Setting target

Hold down together for 2 secs.

P2 target display

Set P3 target in same manner

P4 target display

Setting mode is exited, and the <F1 screen> is displayed.

<Flow setting range>

Full scale flow

Zero flow

Setting flow

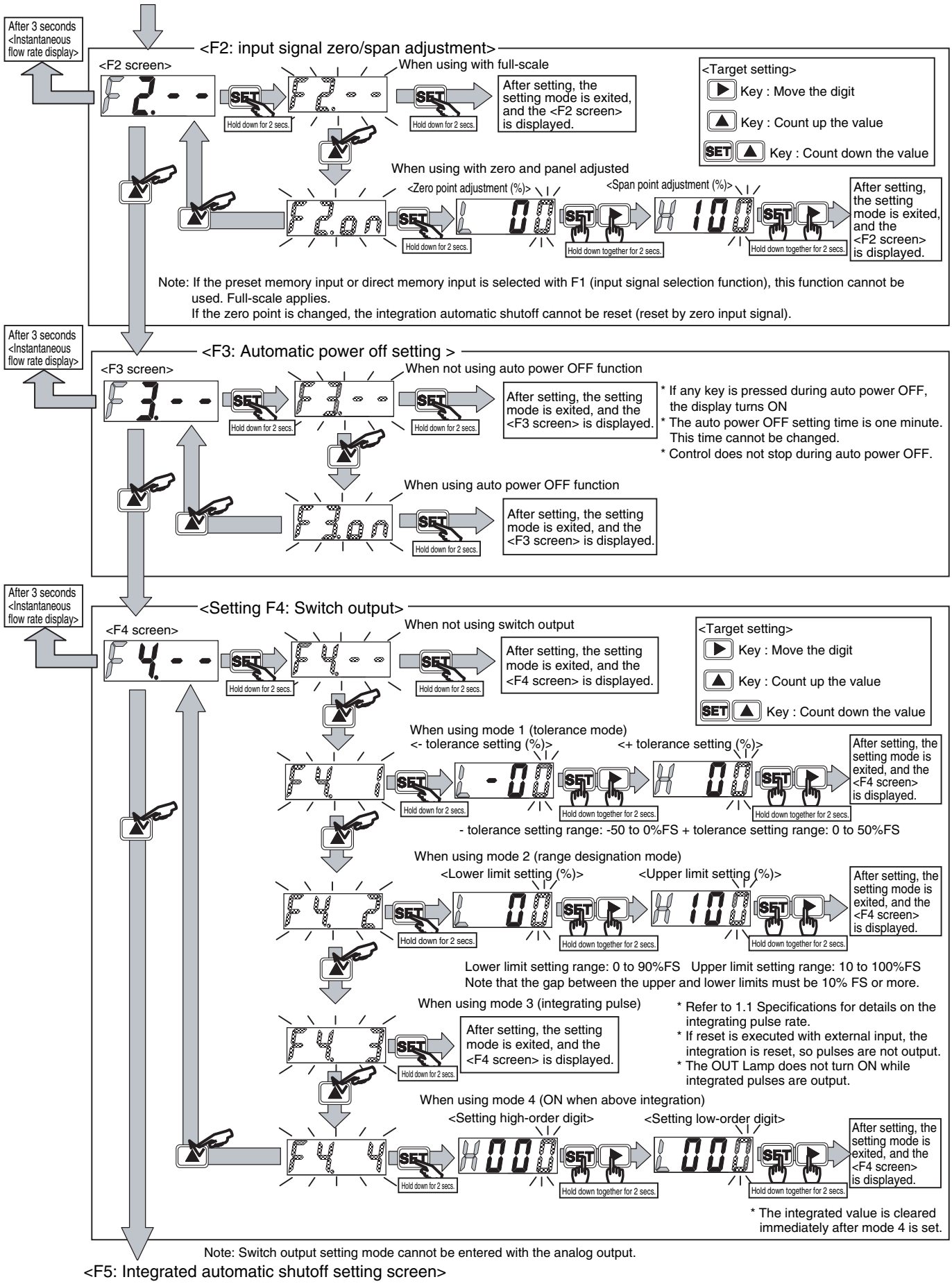
Valve fully open

Setting mode is exited, and the <F1 screen> is displayed.

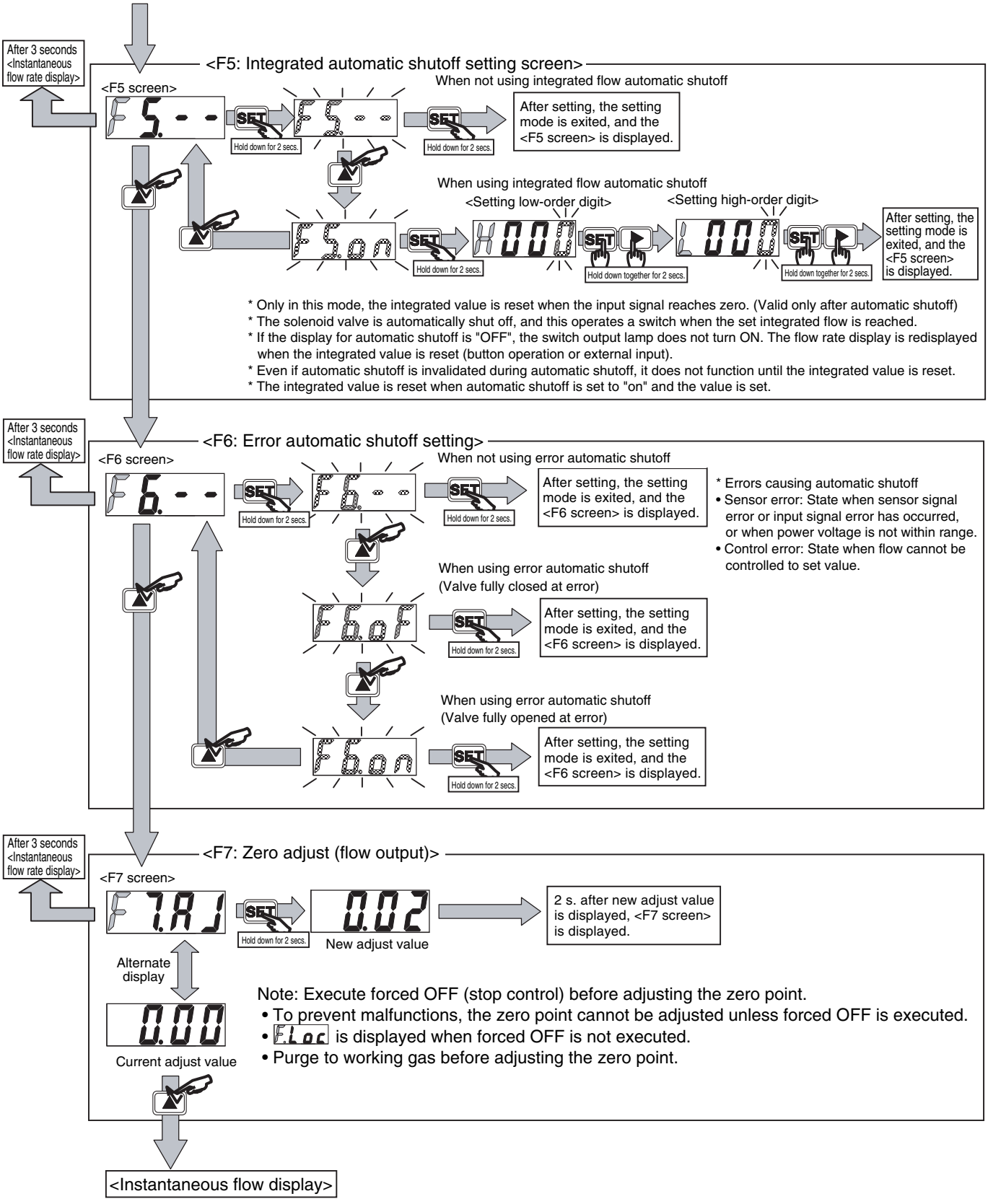
Note: Integration automatic shutdown (F5.on) does not function while the input signal is set. However, once the setting is set, the integrated automatic shutdown is applied. If the integrated flow is higher than the set value at this time, automatic shutdown will occur.

<F2: input signal zero/span adjustment>

Operation (List)



Operation (List)



FCM glossary

These terms apply to the small size flow controller FCM.

Term	Explanation
Control range	Range in which accuracy is guaranteed.
Precision	Calibration error from CDK standard.
Repeatability (repeated accuracy)	Calculated from the variation (D=max. - min.) when the 0%F.S. and 50%F.S. flow control is repeated 20 times in succession in the cycle where control is sufficiently settled. (Repeatability) = ±D/2/FS control flow x 100 [%]
Temperature characteristics	Variation in the flow rate (reference temperature 25˚C) caused by changes in the ambient temperature of fluid temperature is calculated per 1˚C and indicated. During calibration, is calculated at 25˚C.
Pressure characteristics	Indicates the fluctuations in the flow value caused by changes in the working pressure. During calibration, the standard differential pressure is used.
Standard differential pressure	Differential pressure when calibrating this product. (Secondary side is released to atmosphere.)
Operating differential pressure	Differential pressure required for this product to function correctly.
Withstanding pressure	Pressure at which this product will not break.
Display resolution	Minimum step at which display changes.
(Cumulative) pulse output rage	Cumulative flow per pulse when outputting cumulative pulse.
LSB	Indicates the minimum digit of the parallel input.
MSB	Indicates the maximum digit of the parallel input.
digit	Digit. Minimum value of digital display when decimal point is ignored.
AWG	Abbreviation of American Wire Gauge. Standard for cables.

Custom

Custom-order parts with the following function are used. Contact the CKD Sales Office for details.

8-point preset input

This type is compatible with eight preset points (3 bit). (The external integration reset signal input cannot be used.)

Oil-prohibited specifications (only stainless steel body)

Oil-prohibited specifications are available for the stailess steel type, excluding the oxygen model.