Doc. no. DOC1048409

Operation Manual

PRODUCT NAME

Flow Controller for Air

MODEL / Series / Product Number

PFCQ531 Series

SMC Corporation

Contents

1. Product Outline and Features

This product controls the flow rate of air and nitrogen gas according to the analog signal (voltage signal 1 to 5 V or current signal 4 to 20 mA) that is input from an external device such as a PLC. The following describes the main characteristics and functions of this product.

(1) Maximum controlled flow rate: 300 L/min
Note: Flow rate converted to volume at 0 °C and 1 atm (atmospheric pressure).

(2) Wide operational differential pressure range: 0.05 to 0.5 MPa

(3) High speed response: 0.5 sec maximum
Note: The time when an operational differential pressure of 0.3 MPa, temperature of 25 °C, power supply voltage of 24 V, command flow rate of a step signal from 3% to 100% is input, the flow rate is set within +/-3% F.S. of the command flow rate.

(4) Compact size 130 (L) x 31 (W) x 130 (H) (w/o including the connector); lightweight 850 g (body only)

(5) Non-grease assembly

(6) Flow rate control accuracy: Within 3% F.S.

(7) A flow rate detected by the built-in flow sensor is output to an external device with an analog signal (voltage signal of 1 to 5 V; current signal of 4 to 20 mA)

(8) The current flow rate is displayed on the connected digital flow monitor (PFG310)

(9) Improved noise immunity by isolating the digital circuit from the power supply circuit and analog circuit

(10) 24 VDC drive

(11) No dust generated from the spring seat because no spring is used

Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage.
These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)*1) , and other safety regulations.

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems.
ISO 4413: Hydraulic fluid power -- General rules relating to systems.
IEC 60204-1: Safety of machinery -- Electrical equipment of machines .(Part 1: General requirements)
ISO 10218: Manipulating industrial robots -Safety.
etc.

Caution	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
Warning	**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
Danger	**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

⚠ Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1.The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

2.When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3. An application which could have negative effects on people, property, or animals requiring special safety analysis.

4.Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

Safety Instructions

⚠ Caution

The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.
If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.
Read and accept them before using the product.

Limited warranty and Disclaimer

1.The warranty period of the product is 1 year in service or 1.5 years after the product is delivered,whichever is first.∗2)
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

∗2) Vacuum pads are excluded from this 1 year warranty.
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

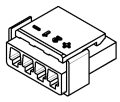
1. **The use of SMC products with production equipment for the manufacture of weapons of mass destruction(WMD) or any other weapon is strictly prohibited.**
2. **The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.**

⚠ Caution

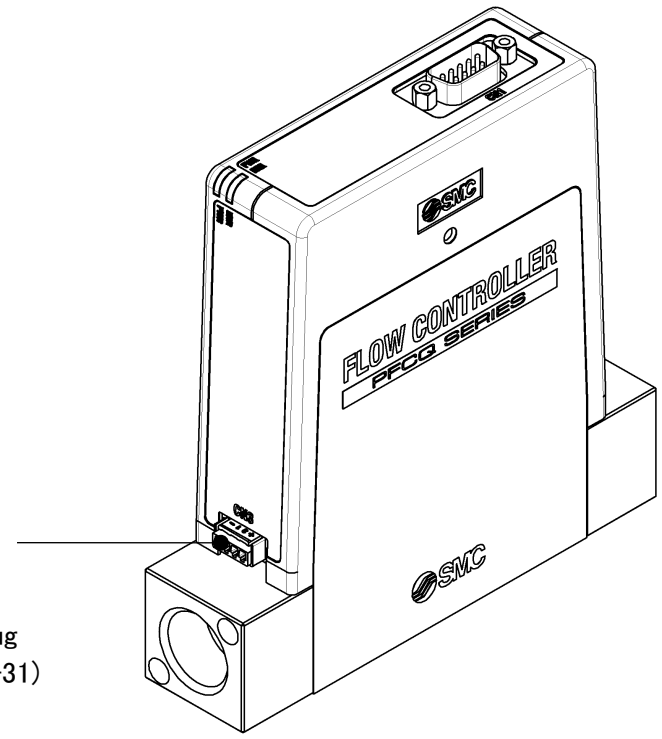
SMC products are not intended for use as instruments for legal metrology.
Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.
Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

3. Items Included in the Package

● Accessories

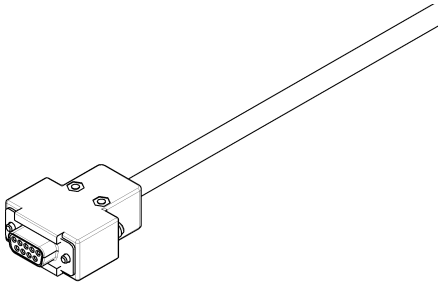


Protective plug
(PFCQP-910S-31)



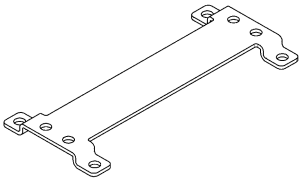
Flow controller for Air (body)

● Options (The following items are included in the package depending on the model selected for the flow controller for Air.)

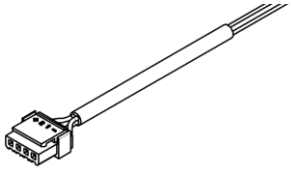


Power supply cable (PFCQ531-H1-3)

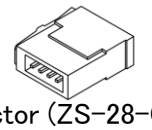
Digital flow monitor (PFG310-XY-M-Y-X105)



Bracket (PFCQ531-B1)
(with 4 x hexagon socket head cap screws)

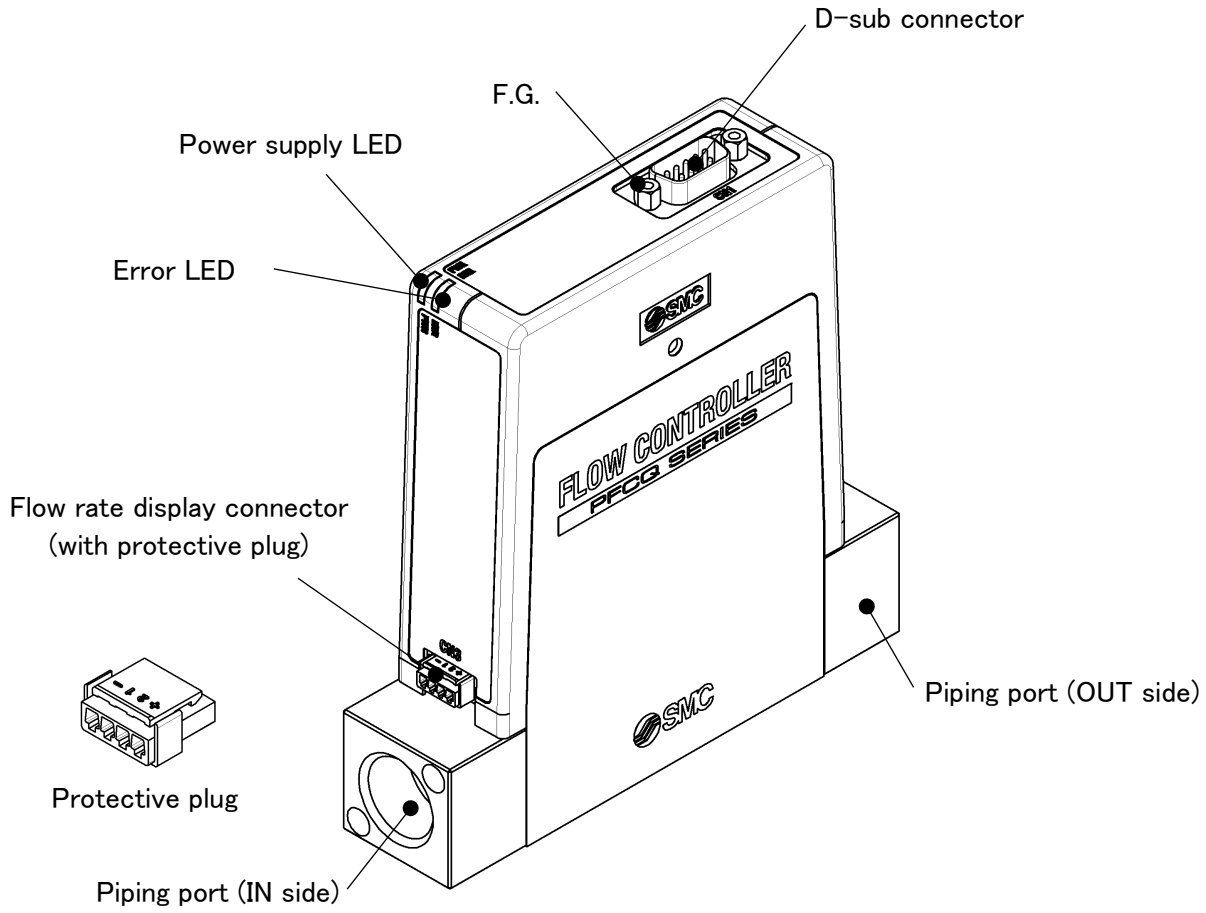


Lead wire with connector (ZS-33-D)
(for connection with the digital flow monitor)



Sensor connector (ZS-28-C-1)
(for connection with the digital flow monitor)

4. Names and Functions of Product Parts



Name	Function
Power supply (PWR) LED	When 24 V power is supplied and the system starts the operation, this LED turns ON and flashes.
Error (ERR) LED	This LED turns ON and flashes when fully open or when an error occurs.
D-sub connector (CN1)	This connector has connections for power supply, flow rate command signal, switch input signal, flow rate output signal, and switch output signal. For information on pin numbers and functions, refer to “10-4. (1) D-sub connector terminal No.”.
Flow rate display connector (CN3)	This connector is for connecting to the digital flow monitor PFG310 (optional) to display the flow rate. When not using the digital flow monitor, mount the protective plug on the connector.
Piping port	This port is a connection port for piping. The IN side is for inlet and the OUT side is for outlet.
F.G.	Frame ground. A grounding cable must be connected to the F.G.

*CN2: A communication connector (Scheduled to be included in the lineup separately.)

5. How to Order

PFCQ5 31 – 04 - A1 C - S M

Flow controller
(Display separate type)

Rated flow range (flow rate range)

31	9 to 300L/min

Port size

04	Rc1/2

Input/Output specifications
(See the Input/Output Specification Table.)

Option 1 (Power supply cable)

Nil	None
C	Power supply cable (3 m)

Note: Optional parts are not mounted to the product. They are shipped together with the product.

Option 2 (Bracket)

Nil	None
S	Bracket

Provided with 4 x hexagon socket head cap screws

Option 3 (Digital flow monitor)

Nil	None
M	Digital flow monitor

When this option is selected, the following items are shipped together with the product.
- Display: Digital flow monitor
  PFG310-XY-M-Y-X105
- Lead wire: Lead wire with connector (2 m)
  ZS-33-D
- Connector: Sensor connector
  ZS-28-C-1

The Operation Manual and certificate for the digital flow monitor are not included in the package. If you need them, please place an order separately.

○ Input/Output specification table

Symbol	IN1	INA	OUT1	OUTA
A1	Common for NPN and PNP	Analog 1 to 5 V	NPN	Analog 1 to 5 V
A2	Common for NPN and PNP	Analog 4 to 20 mA	NPN	Analog 4 to 20 mA
A3	Common for NPN and PNP	Analog 1 to 5 V	PNP	Analog 1 to 5 V
A4	Common for NPN and PNP	Analog 4 to 20 mA	PNP	Analog 4 to 20 mA

6. Specifications

6-1. General specifications

Model		PFCQ531-04-A*
Fluid	Applicable fluid	Dry air, N2 (Air quality classes: JIS B8392-1 1.1.2 to 1.6.2; ISO8573-1 1.1.2 to 1.6.2[*1])
Flow rate specifications [*2, *3]	Detection type	Hot wire anemometer
	Rated controlled flow rate range[*4]	9 to 300 L/min
	Set controlled flow rate range[*5]	3 to 300 L/min
Pressure specifications	Standard operational differential pressure	300 kPa
	Operational differential pressure range[*6]	50 to 500 kPa
	Operating pressure range[*7]	50 to 800 kPa
	Withstand pressure	1.0 MPa
Mounting orientation		Downward orientation not allowed
External leakage		10 cm^3/min or less
Environmental resistance	Protection class	IP40
	Withstand voltage	1000 VAC for 1 minute, between terminals and housing
	Insulation resistance	50 MΩ or more between terminals and housing (with 500 VDC megger)
	Operating temperature range	Operation: 5 to 45°C (Guaranteed accuracy: 15 to 35 °C) Storage: -10 to 60 °C (No condensation or freezing)
	Operating humidity range	Operation and storage: 35 to 85 %RH (No condensation)
Standards		CE, UKCA, RoHS
Piping port		Rc1/2
Main materials of parts in contact with fluid		PPS, FKM, SUS303, SUS304, SUS316, electroless nickel plating, Si, Au, GE4F, DLC
Weight	Body	850 g
	Power supply cable	210 g
	Bracket	30 g

*1: Refer to “Examples of recommended pneumatic circuits” described in “10-2. Air supply”.
*2: Flow rate converted to volume at 0oC and 1 atm (atmospheric pressure).
*3: For the relationship between the operational differential pressure and the controllable flow rate, refer to “6-3. Functional characteristics (3) Controllable range”.
*4: The accuracy may not be satisfied outside of the rated controlled flow range because the flow rate control is unstable.
*5: The set controlled flow rate range is the settable flow rate range.
*6: The operational differential pressure range is the differential pressure required for this product to operate normally.
*7: The operating pressure range is the pressure range that can be applied to the primary side (IN side) of the product.

6-2. Electrical specifications

Model			PFCQ531-04-A*
Power supply specifications	Power supply voltage		Main power supply: 24 VDC +/-10% Signal power supply: 24 VDC +/-10%
	Current consumption		Main power supply: 0.5 A or less Signal power supply: 0.05 A or less
	Protection		Polarity protection
Control specifications	Valve driving actuator		Linear motor
	Control accuracy		+/-3% F.S. (at an operating differential pressure of 0.3 MPa and temperature of 25 °C)
	Repeatability		+/-1% F.S.
	Temperature characteristics*1		+/-2% F.S. (15 to 35 °C; 25 °C basis) +/-5% F.S. (0 to 50 °C; 25 °C basis)
	Pressure characteristics*2		+/-2% F.S. (Standard operating differential pressure basis)
	Settling time*3		0.5 s or less
	Control command method		Analog input
	State when de-energized*4		Closed (Normally closed)
Analog input	Input mode		Flow rate command signal
	Voltage	Input type	1 to 5 V
		Input impedance	Approx. 1 MΩ
	Current	Input type	4 to 20 mA
		Input impedance	250 Ω or less
Analog output	Output mode		Flow rate output signal
	Voltage	Output type	1 to 5 V
		Output impedance	Approx. 1 kΩ
	Current	Output type	4 to 20 mA
		Load impedance	50 to 600 Ω
Switch input	Input type		1 point (photo coupler isolation)
	Input mode		Valve fully open command
	Internal resistance		5 kΩ
Switch output	Output type		1 point (NPN open collector, PNP open collector)
	Output mode		Error output
	Switch operation		Inverted output
	Maximum load current		80 mA
	Maximum applied voltage (NPN only)		30 VDC
	Internal voltage drop (Residual voltage)		1.5 V or less (at 80 mA load current)
	Delay time		5 ms or less
	Protection		Switch output polarity protection Over current protection
Flow rate display output	Output mode		For connection with the digital flow monitor PFG310
	Output type		4 to 20 mA
	Load impedance		50 to 600 Ω
Display	LED indicator		2 points (power supply, error)

*1: Indicates the amount of fluctuation in the control accuracy when the temperature changes within the operating temperature range.

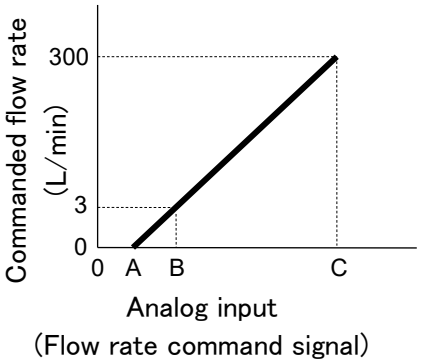
*2: Indicates the amount of fluctuation in the control accuracy when the pressure changes within the specified pressure range.

*3: The time when an operational differential pressure of 0.3 MPa, temperature of 25 °C, power supply voltage of 24 VDC, command flow rate of a step signal from 3% to 100% is input, the flow rate is set within +/-3% F.S. of the command flow rate. The settling time may be longer in other operating conditions.

*4: This product is not suitable for applications which require the flow to be shut off completely.
If it is necessary to completely shut off the flow rate, install a stop valve, etc. separately.

6-3. Functional characteristics

(1) Analog input (flow rate command signal)

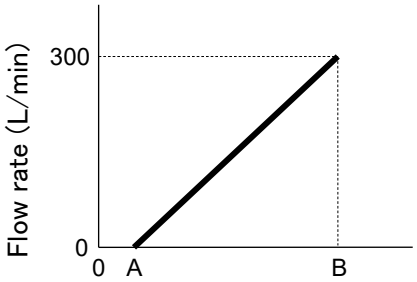


(Flow rate command signal)

Input type	Flow rate command signal range		
	0 L/min: A	Set controlled flow rate Minimum value: B	Set controlled flow rate Maximum value: C
Voltage input	1 V	1.04 V	5 V
Current input	4 mA	4.16 mA	20 mA

Note: A signal smaller than the minimum value of the set controlled flow rate turns off the current to the linear motor, which closes the valve.

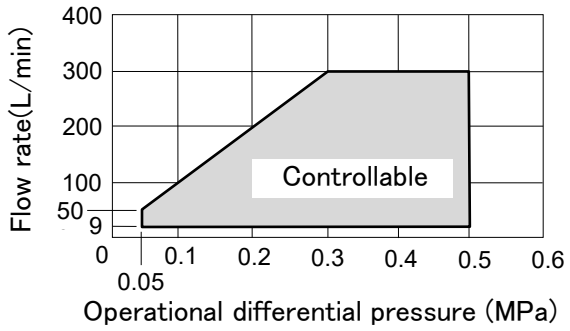
(2) Analog output (flow rate output signal)



(Flow rate output signal)

Output type	A	B
Voltage output	1 V	5 V
Current output	4 mA	20 mA

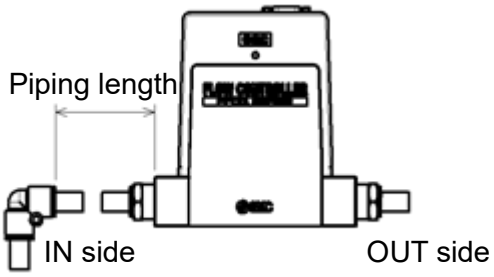
(3) Controllable range

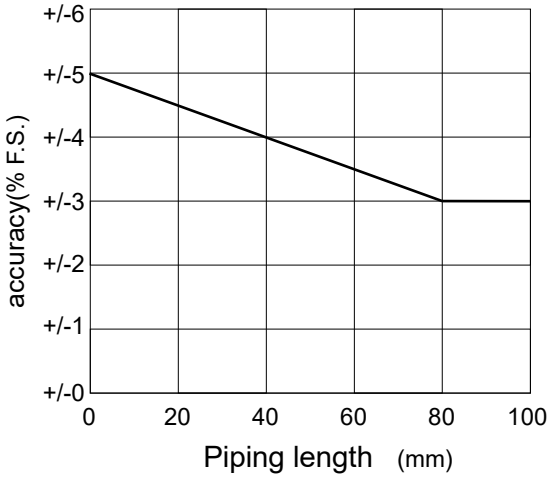


⚠Caution
Be sure to use the product within the controllable range. Outside of the controllable range, the accuracy in the control specification may not be satisfied, the flow rate may be low, flow rate control may be unstable, vibration may be caused, the product temperature may be high and so on.

(4) IN side straight pipe length and accuracy (reference value)

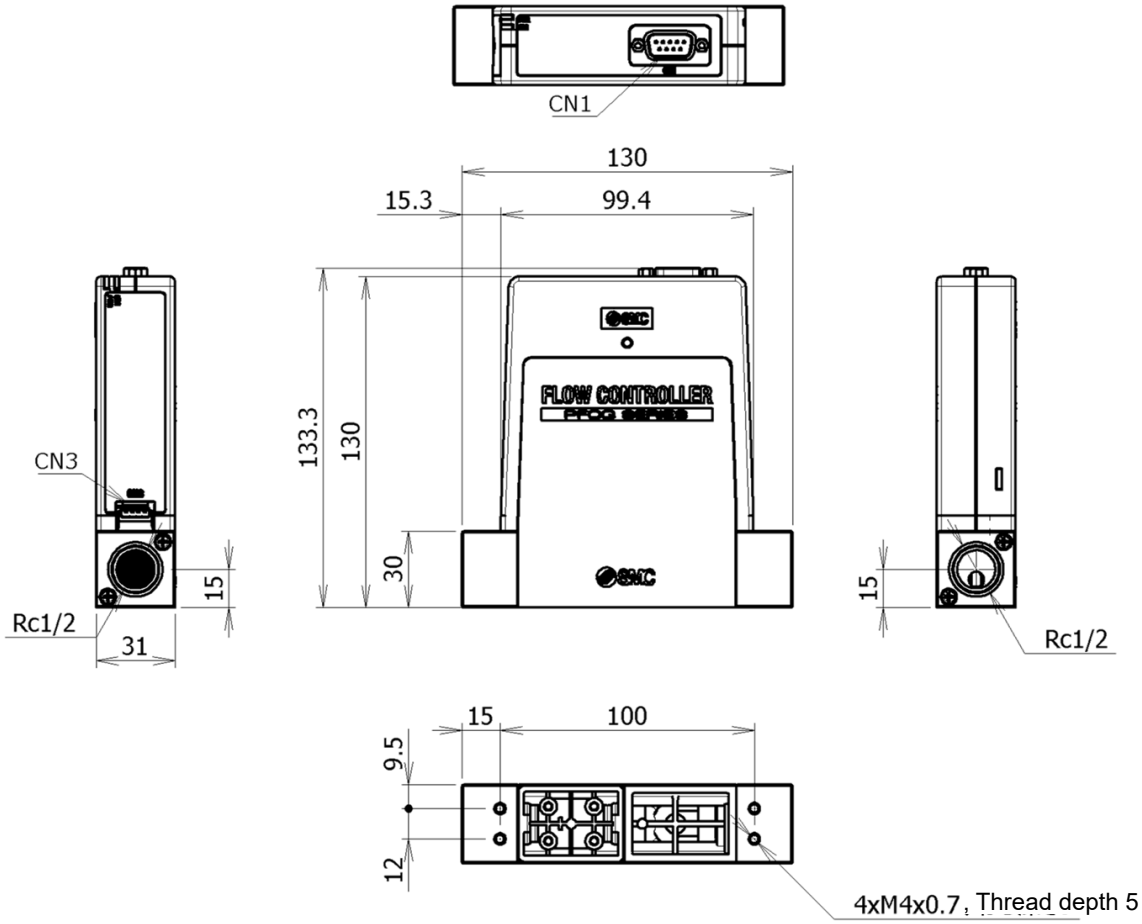
- The smaller the piping size, the more the built-in flow sensor is susceptible to the length of straight pipe.
- The lower the flow rate, the less the product is susceptible to the length of straight pipe.
- To maintain the specified +/-3% F.S. accuracy, set the length of straight pipe to at least 80 mm.



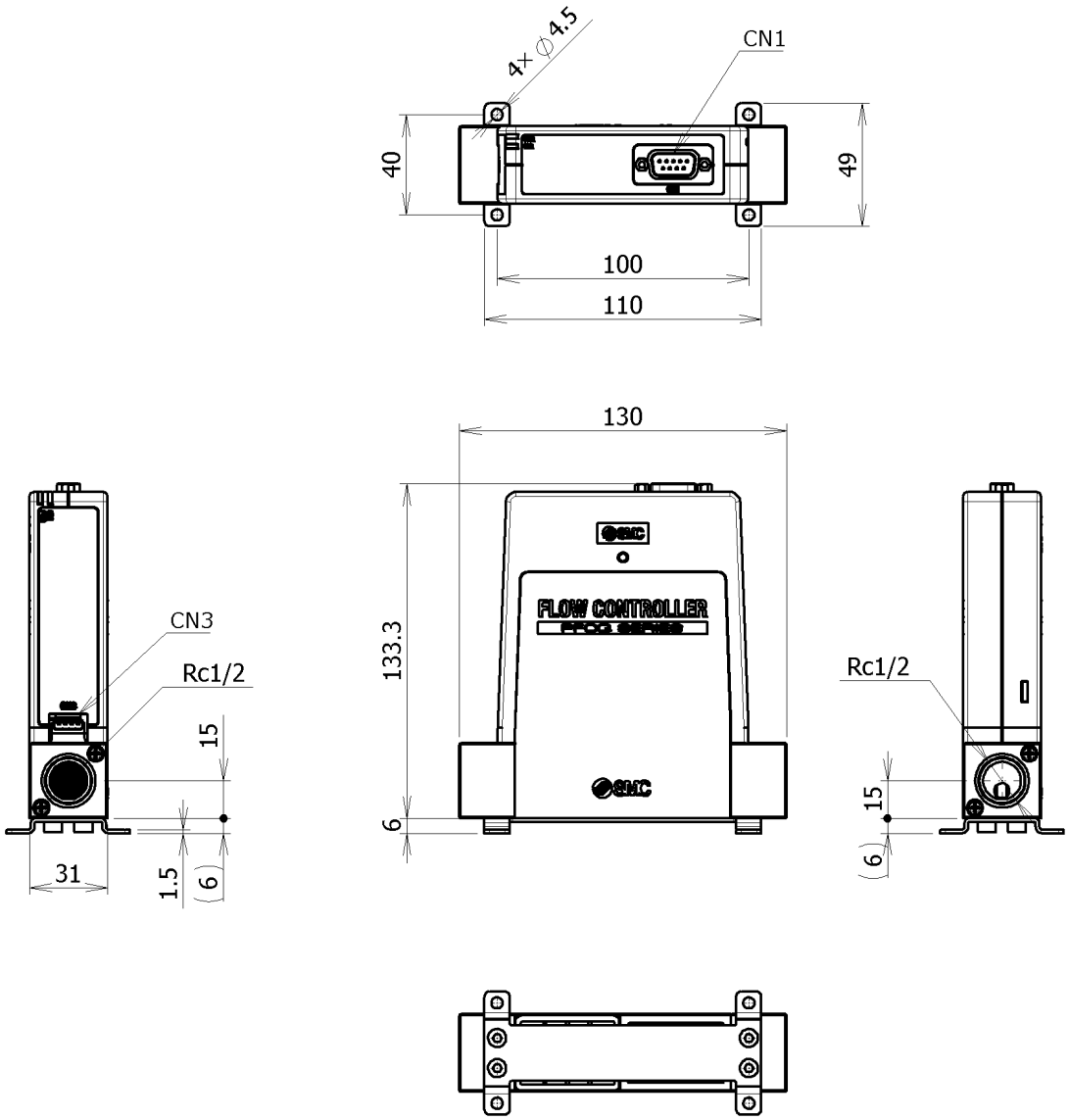


7. Dimensions

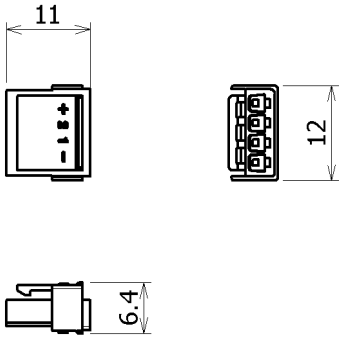
PFCQ531-04



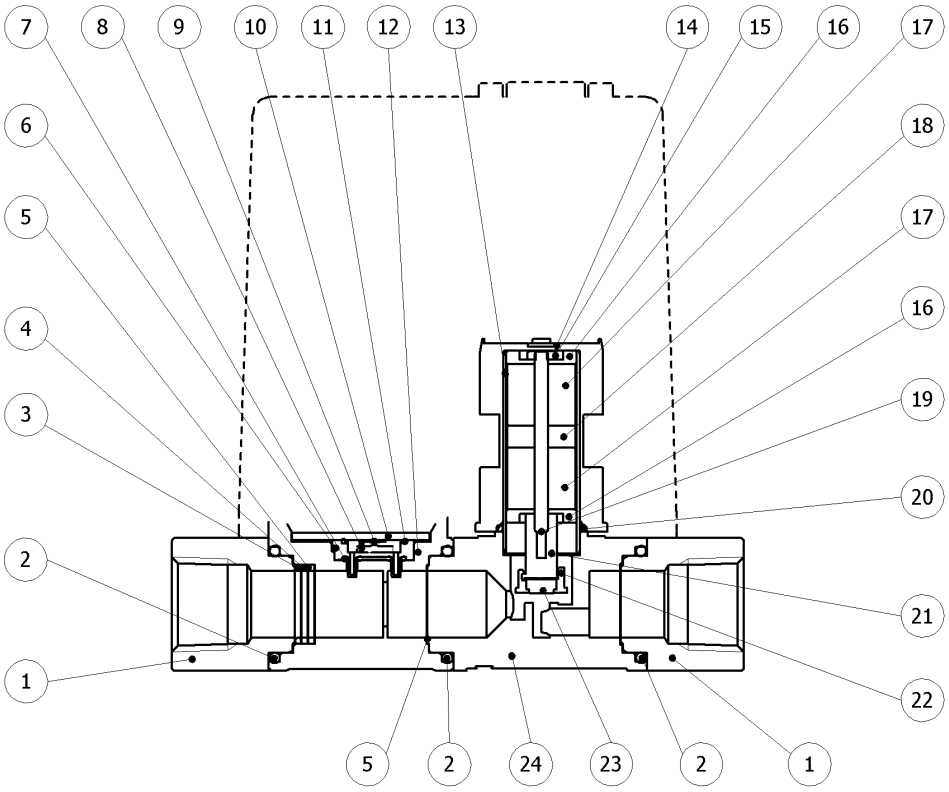
PFCQ531-04
with bracket



PFCQP-910S-31
Protective plug



8. Component Drawing of Parts in Contact with Fluid and Parts Names



Components

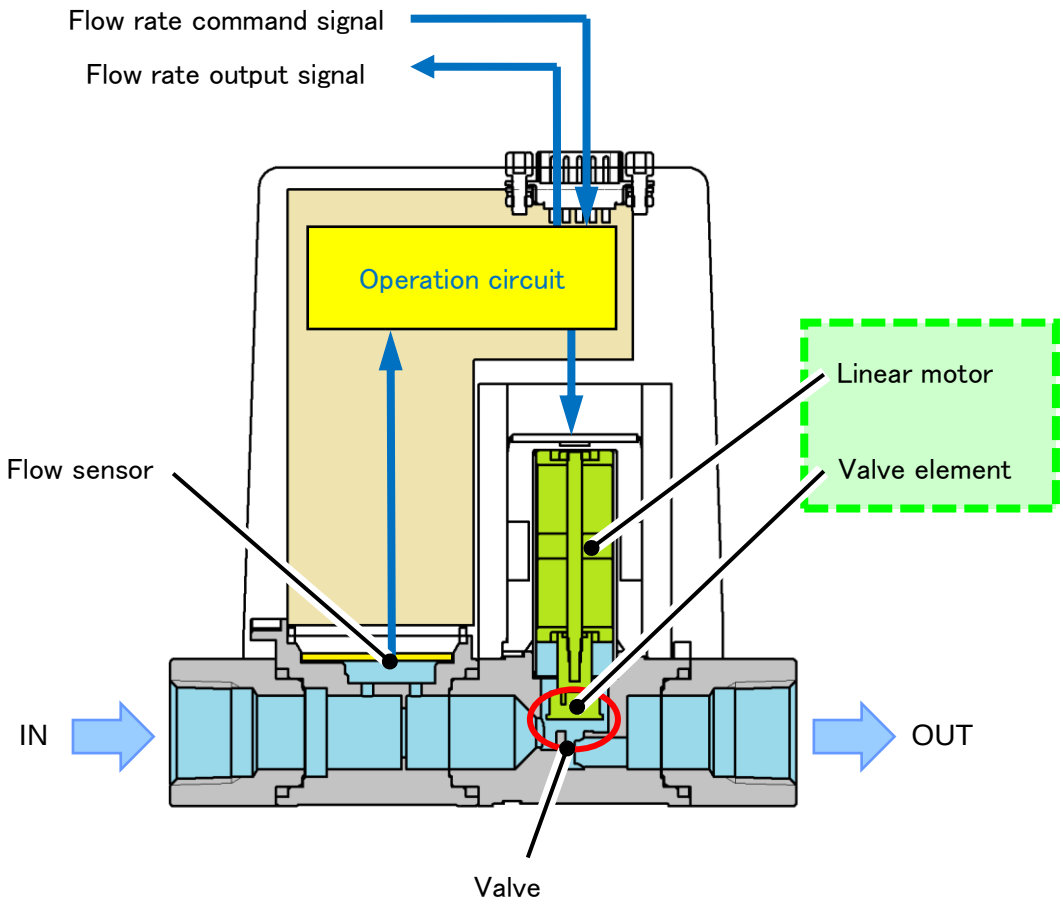
No.	Name	Material	Remarks	No.	Name	Material	Remarks
1	Attachment	Stainless steel		13	Tube	Stainless steel	
2	O-ring	FKM		14	Motor body	Resin	
3	O-ring	FKM		15	Nut	Stainless steel	
4	Spacer	Resin		16	Wear ring	Stainless steel	DLC
5	Mesh	Stainless steel		17	Magnet	Rare earth magnet	Ni plating
6	Sensor body	Resin		18	Ring	Carbon steel	Ni plating
7	Gasket	FKM		19	Shaft	Stainless steel	
8	Rectification mesh	Stainless steel		20	O-ring	FKM	
9	Sensor chip	Silicon		21	Valve	Stainless steel	
10	Circuit board	GE4F		22	Retainer	Resin	
11	Gasket	FKM		23	Poppet	FKM	
12	Body	Resin		24	Valve body	Resin	

9. Working Principle

This product has a built-in linear motor which changes the valve opening by moving the valve element mounted to the linear motor, and thereby adjusting the flow rate inside the valve.

When the flow rate command signal is input to the product, the internal operation circuit performs a comparison calculation with the flow rate measured by the flow sensor. The product drives the linear motor based on that value to control the flow rate.

When the linear motor is de-energized, the valve is closed by the attractive force of the permanent magnet mounted to the linear motor (Normally closed).

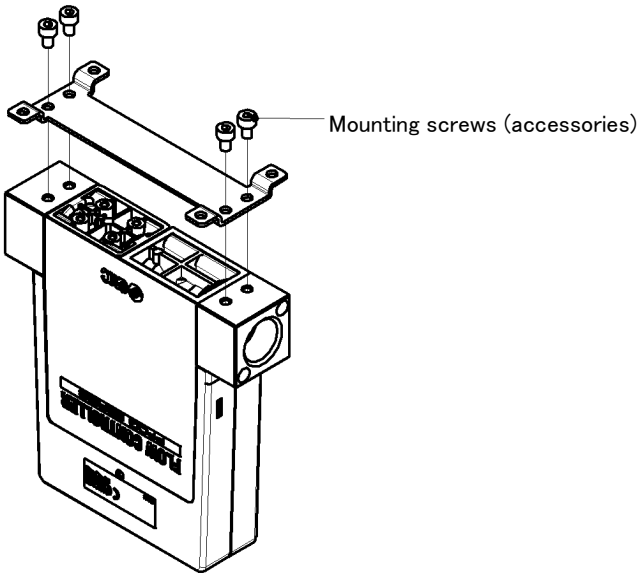


10. Installation

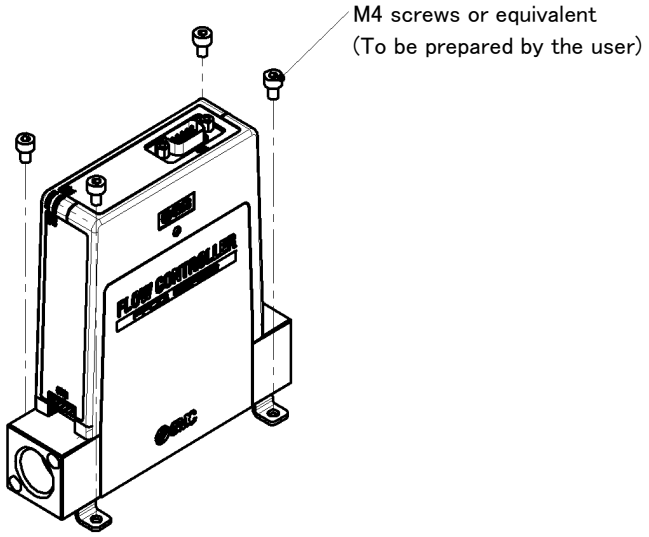
10-1. Installation

Mounting the bracket

- Mount the bracket using hexagon socket head cap screws (4 pcs.).
- Apply a tightening torque of 1.4 to 1.6 N.m.

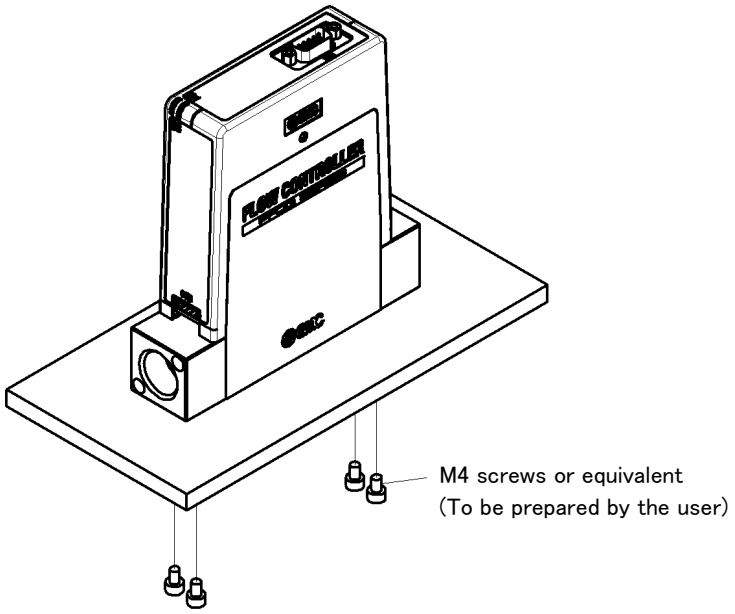


- To mount the product with a bracket, use M4 screws or equivalent (4 pcs.).
- The screws should be prepared by the user.
- Refer to “7. Dimensions” for the bracket thickness and the mounting hole locations.



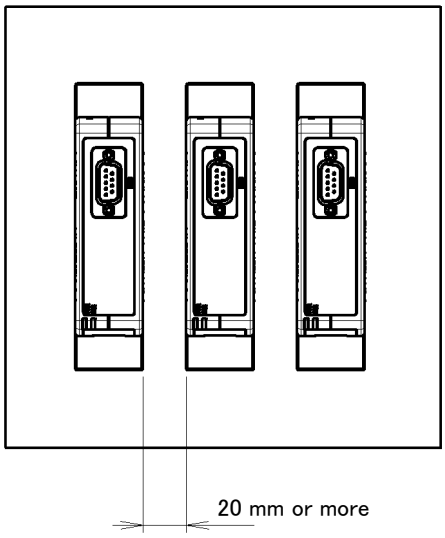
Direct mounting

- Use M4 screws or equivalent (4 pcs.) for mounting.
- The screws should be prepared by the user.
- See “7. Dimensions” for the threaded hole locations and depth.



Mounting location

- Give consideration to the size of the control panel and the installation method so that the surrounding of the product will be 45 °C or below (or 35 °C or below when using the product within the guaranteed accuracy range).
- When mounting the products side by side, be sure to take measures against overheating by providing a 20 mm or more space between them.

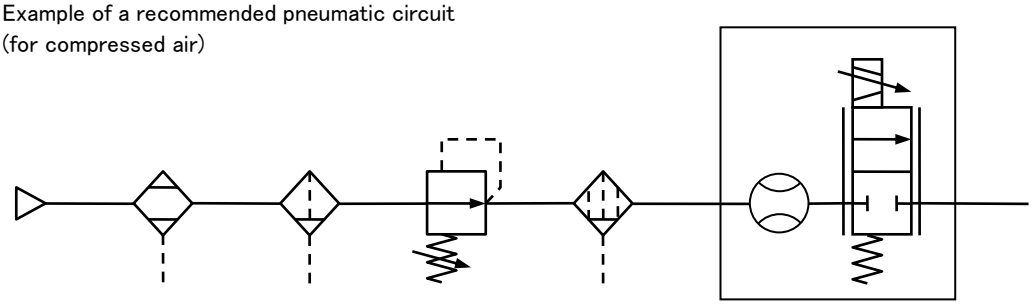


10-2. Air supply

- Use fluid that is compliant with JIS B 8392-1 1.1.2 to 1.6.2, ISO8573-1 1.1.2 to 1.6.2.

Using the following pneumatic circuit satisfies the air quality class described above.

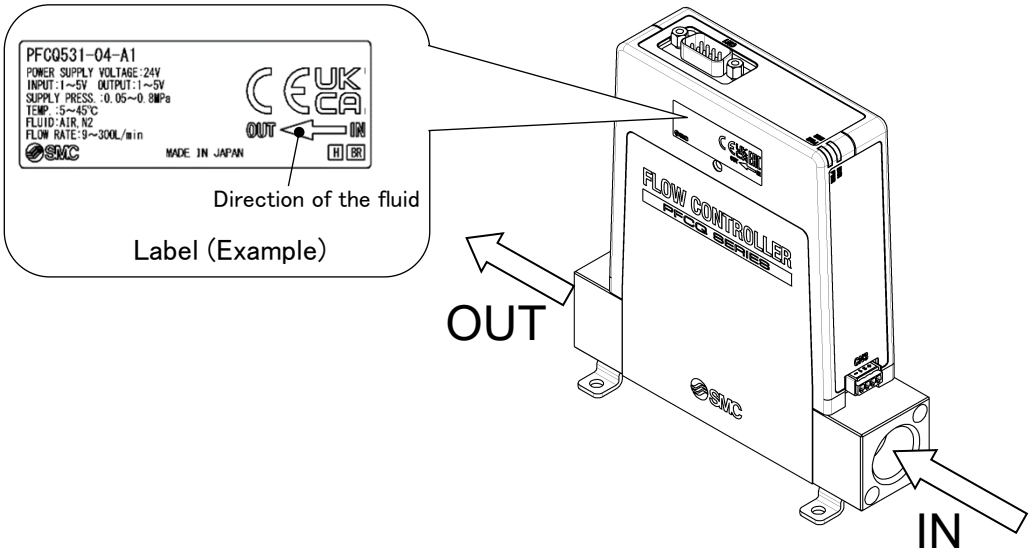
Example of a recommended pneumatic circuit
(for compressed air)



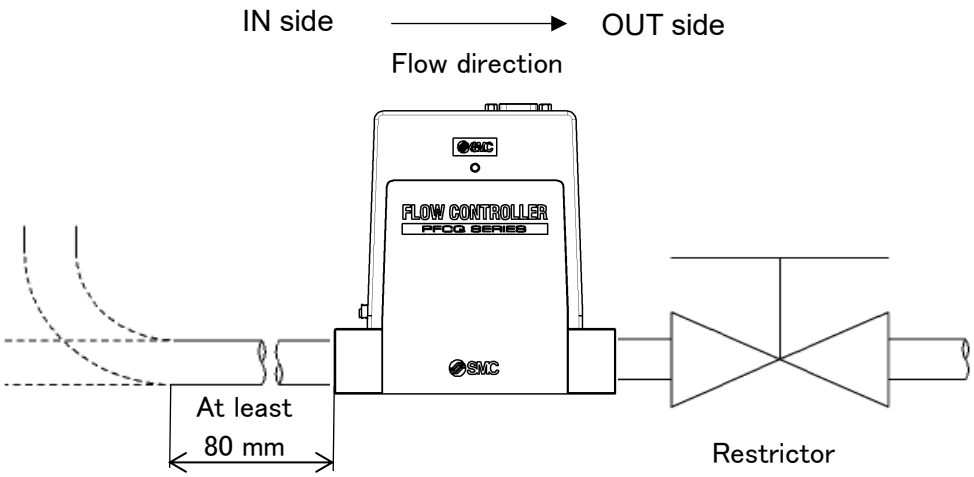
Dryer	Air filter	Regulator	Micro mist separator	Flow controller for Air
IDF IDU	AF	AR IR	AMD AFD	PFCQ

10-3. Piping

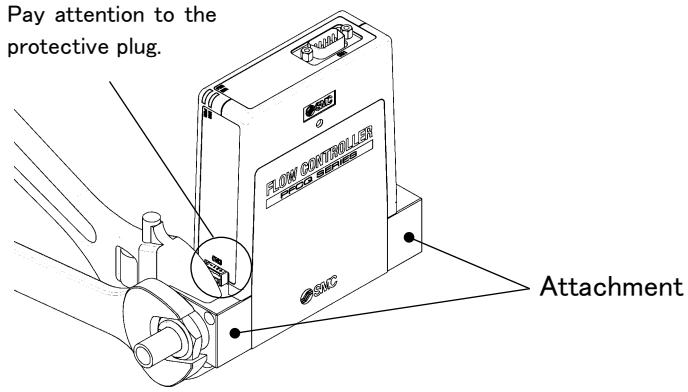
- Mount the product so that the fluid flows in the direction indicated on the label on the side of the product.

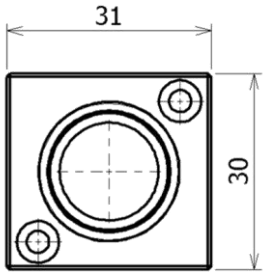


- Do not mount the product in an orientation with the product bottom surface facing upward (upside down).
- The piping on the IN side must have a straight piping section with a length of at least 80 mm. Otherwise, the product accuracy may vary.
- Avoid sudden changes to the piping size on the IN side of the product.
- Do not release the OUT side piping port of the product directly to the atmosphere without a piping connection. Otherwise, the accuracy may vary.



- Apply the correct tightening torque when mounting the product. Refer to the following table for the required torque.
- Use a wrench suitable for the required torque. Do not use a wrench with an overall length of 400 mm or longer.
- If the screw is tightened at a torque exceeding the tightening torque range, the product may be damaged.
  If the screw is tightened at a torque less than the tightening torque range, the connection thread may loosen.
- Make sure that sealant tape does not enter the flow path.
- After completing the piping, confirm that there is no leakage.
- When mounting a fitting, apply a wrench or adjustable wrench at the metal part (attachment) to mount the fitting. Applying the wrench at other parts may cause damage to the product. Specifically, make sure that a wrench or other tools will not be applied to the flow rate display connector or the protective plug mounted to the flow rate display connector. If a lead wire with connector is mounted to the flow rate display connector, remove the wire first before performing the piping.





Cross section dimensions of the attachment

Nominal thread size	Proper torque
Rc1/2	28 to 30 N m

Port size	Width across flats of the attachment
1/2	See the figure above.

When using a one-touch fitting:
- Use a tube with an internal diameter of 9 mm or more for piping on the IN side.

If a tube other than the above is used, the accuracy may vary.

⚠ Caution

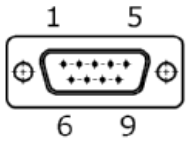
Make sure that the piping is connected so that the fluid flows from the IN side to the OUT side.

Piping in the opposite direction may lead to product malfunction, causing the internal valve to open and the measurement of the flow rate to fail, or the product to be damaged.

10-4. Electrical Connection

- Be sure to turn off the power before performing wiring.
- Use individual wiring routes. Using the same wiring route as a power line or high voltage line may cause malfunction due to noise.
- When using a switching power supply, be sure to ground the frame ground (FG) terminal. Also, insert a noise filter, such as a line noise filter and a ferrite, between the product and the switching power supply. Otherwise, switching noise may be superimposed, failing to meet the product specifications. If switching noise is a problem, replace the switching power supply with a series power supply.

(1) D-sub connector terminal No.



D-sub connector
(9 pins, plug)
#4-40UNC

Pin number	Input/Output	Name	Description
1	Input	IN1	Refer to the details of the switch input IN1.
2	Output	OUTA	Flow rate output signal
3	Input	DC1(+)	Main power supply （24 VDC）
4	Input	DC1(-)	Main power supply 0 VDC *1, *2
5	Input	DC2(+)	Signal power supply 24 VDC
6	Input	INA	Flow rate command signal
7	Input/Output	COM	INA and OUTA 0 VDC *1, *3
8	Input	DC2(-)	Signal power supply 0 VDC *2, *3
9	Output	OUT1	Refer to the details of the switch output OUT1.

*1: The main power supply 0 VDC side (Pin No. 4) and the INA and OUTA 0 VDC side (Pin No. 7) are insulated inside the product.

*2: The main power supply 0 VDC side (Pin No. 4) and the signal power supply 0 VDC side (Pin No. 8) are insulated inside the product.

*3: The signal power supply 0 VDC side (Pin No. 8) and the INA and OUTA 0 VDC side (Pin No. 7) are connected inside the product.

Details of switch input IN1

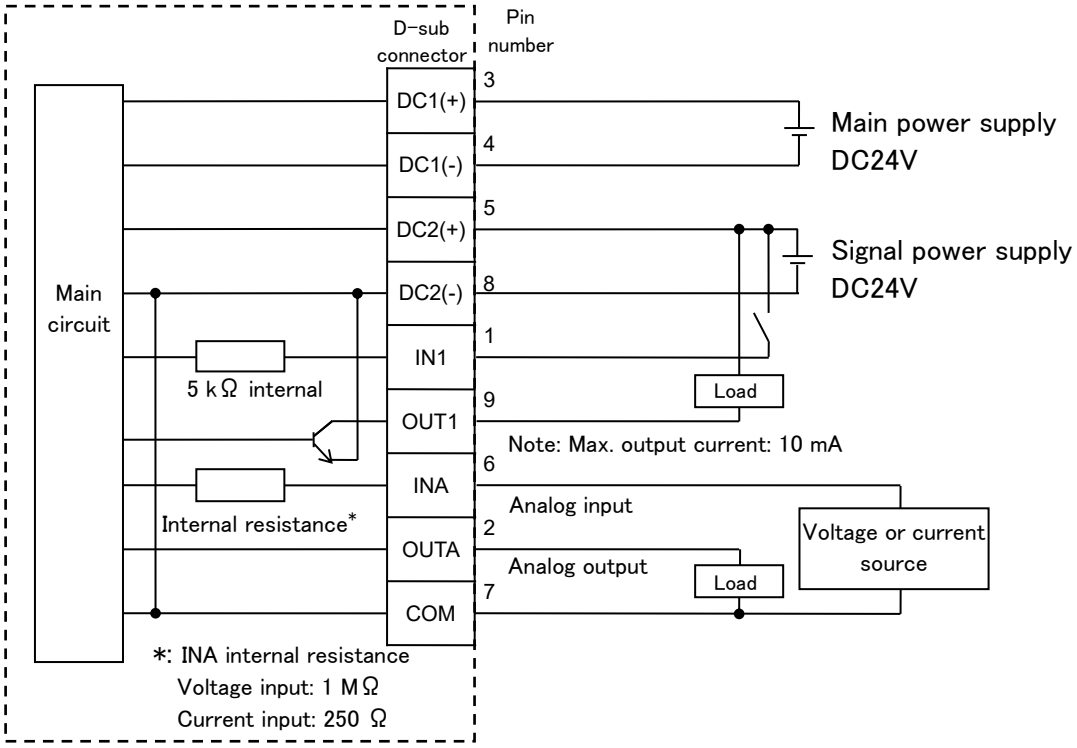
Name	Description
OPEN	Valve fully open command

Details of switch output OUT1

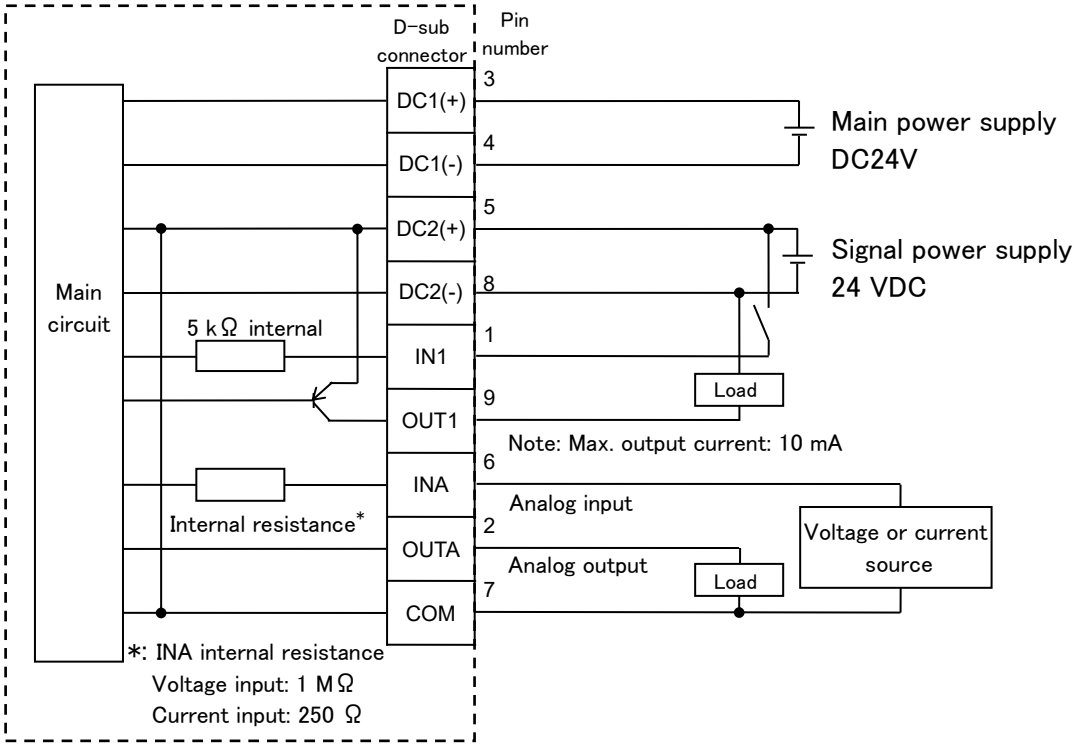
Name	Description
ERROR	At normal state: ON in the event of an error: OFF

(2) Example of D-sub connector wiring

- NPN output specifications



- PNP output specifications

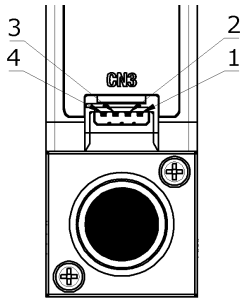


⚠ Caution
Be sure to prepare the main power supply and the signal power supply separately. If one power supply is shared between them, malfunction due to noise may be caused or the specified characteristics may not be satisfied.
Do not short-circuit the main power supply 0 VDC (DC1(-)) and INA and OUTA 0 VDC (COM). Otherwise, the specified product accuracy may not be satisfied due to the effect of the current flowing through the main power supply.

(3) Flow rate display connector terminal No.

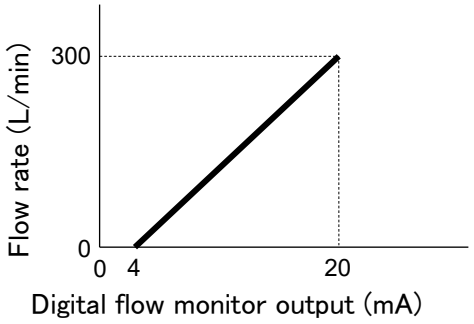
The dedicated output for the optional digital flow monitor PFG310-XY-M-Y-X105. When using the digital flow monitor, connect the digital flow monitor PFG310-XY-M-Y-X105 using the optional lead wire with connector (part number ZS-33-D) and the sensor connector (part number ZS-28-C-1).

When not connecting the digital flow monitor, mount the protective plug (accessory).

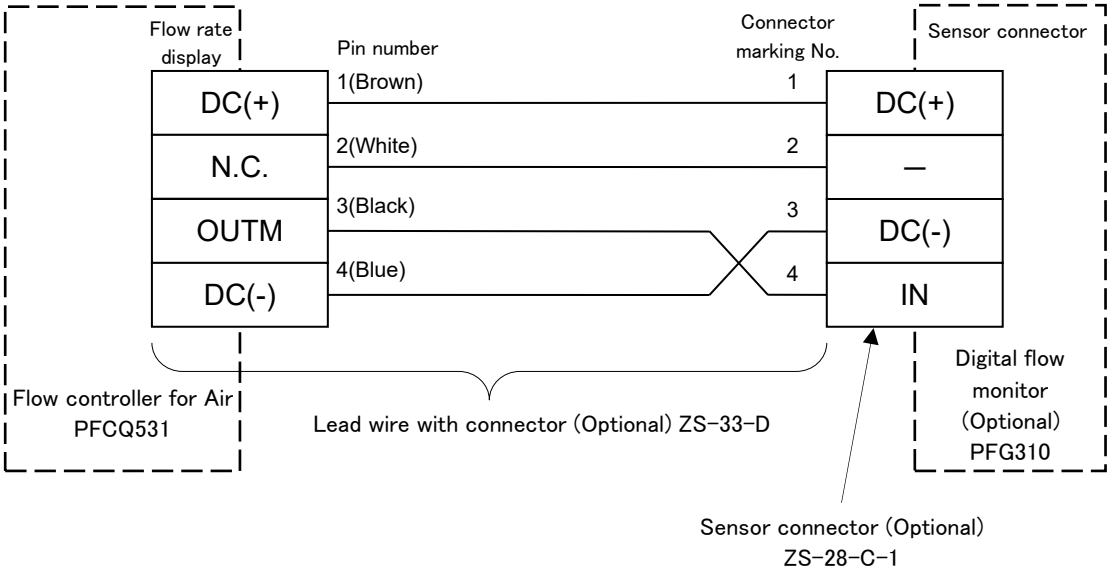


Pin number	Input/Output	Name	Description
1	Output	DC(+)	Power supply 24 VDC side for the flow monitor
2	-	N.C. *	Unused
3	Output	OUTM	Output for the flow monitor
4	Output	DC(-)	Power supply 0 VDC side for the flow monitor

*: Do not input the power or signal.



(4) Wiring between the flow rate display connector and the digital flow monitor



For details of the options, refer to “12. Options”.

11. Operation

11-1. Types of operation

This product can perform the following operations:

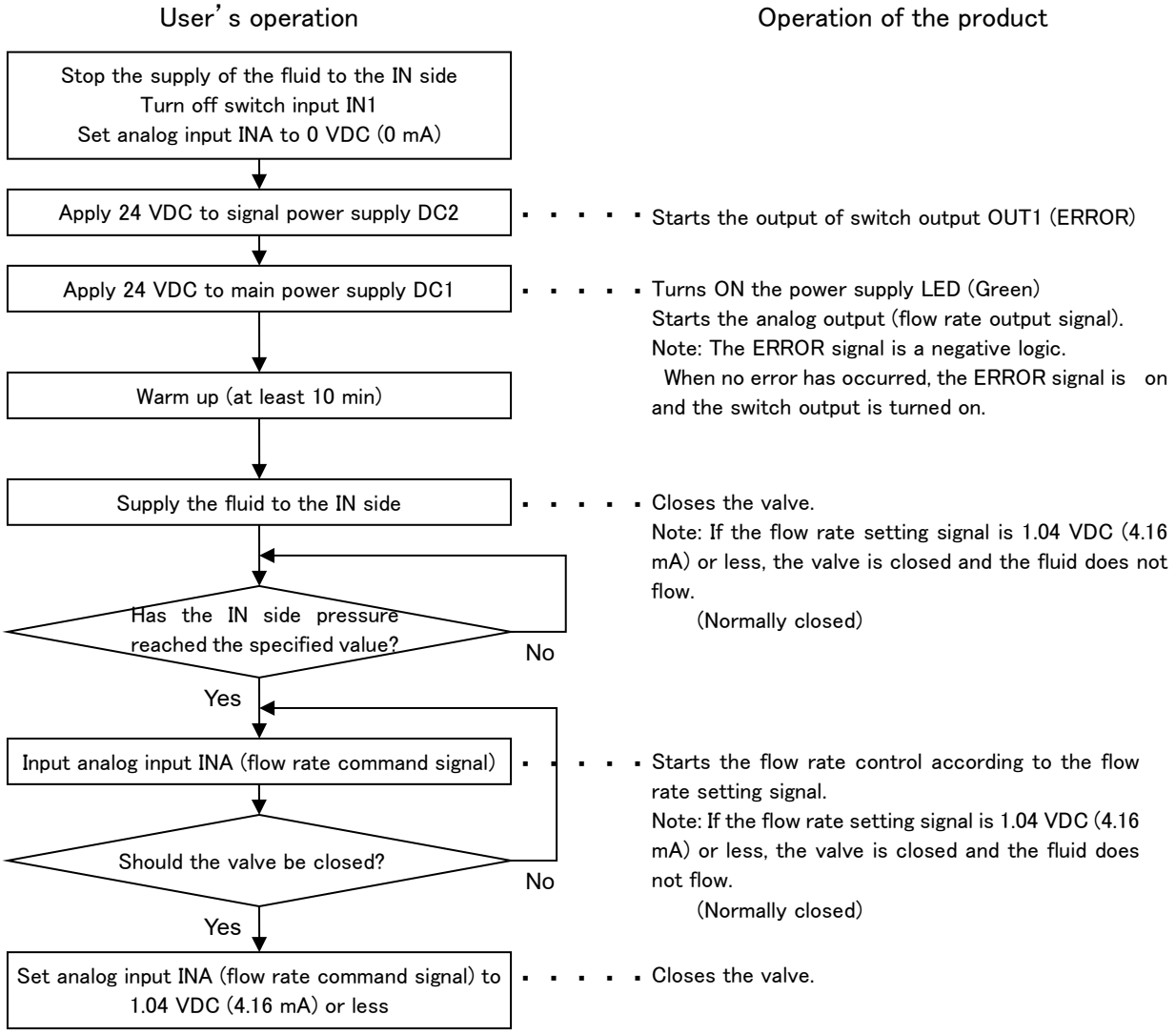
(1) Analog input operation: The flow rate is controlled according to the analog input INA (flow rate command signal).

(2) Valve closed: When the analog input (flow rate command signal) is smaller than 1.04 V (4.16 mA), current to the linear motor is turned off and the valve is closed.

(3) Valve fully open operation: When the switch input IN1 is turned on when the valve is closed, the valve is fully opened.
During an analog input operation, the valve fully open operation is not available. In that case, set the analog input (flow rate command signal) to 1.04 VDC (4.16 mA) or less and turn on the switch input IN1.

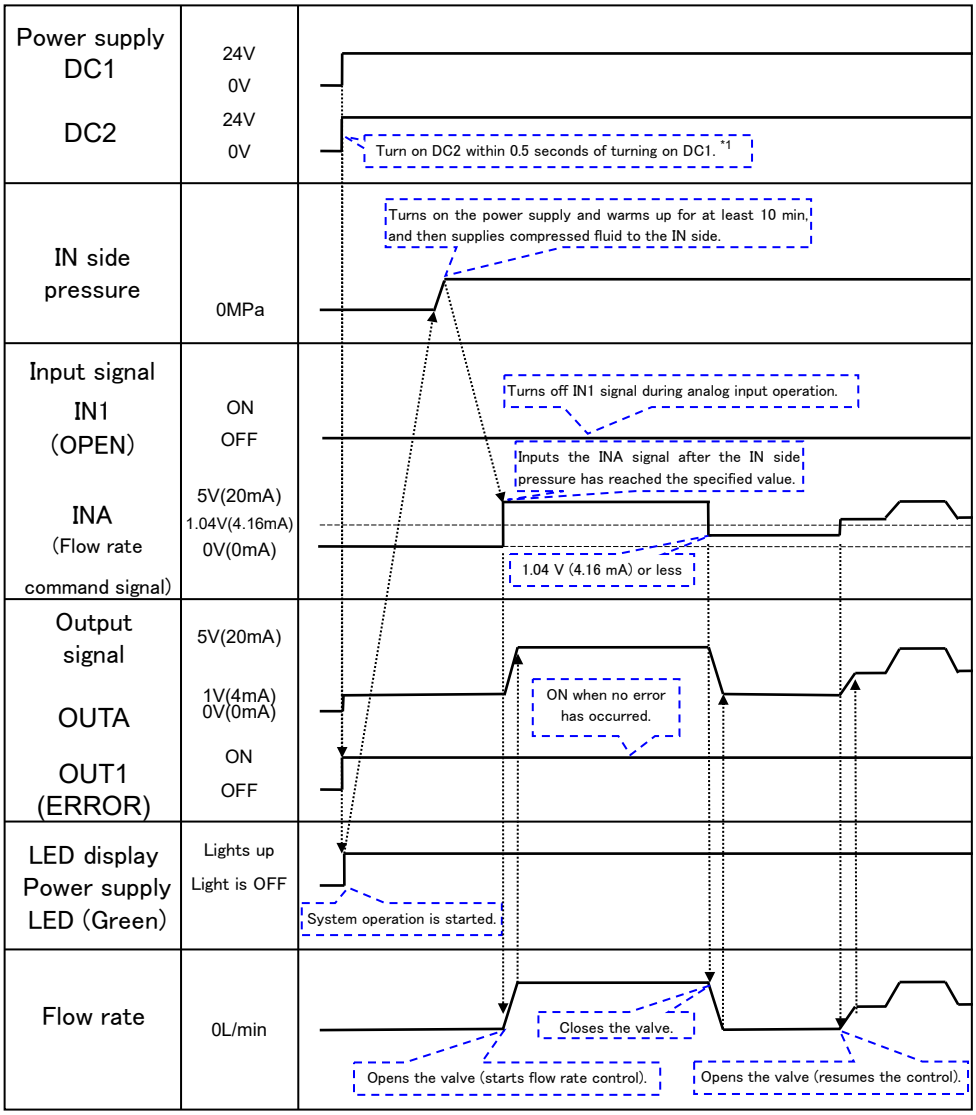
11-2. Analog input operation

When the analog voltage (or current) is input in the following procedure, the product controls the flow rate according to the flow rate command signal.



—Timing chart—

Analog input operation



∗1: If DC2 is not supplied within 0.5 seconds after DC1 is supplied, an error (out of signal power supply range) will occur.

∗2: This timing chart is applicable to the voltage input specifications. For the current input specifications, refer to the values inside the parentheses.

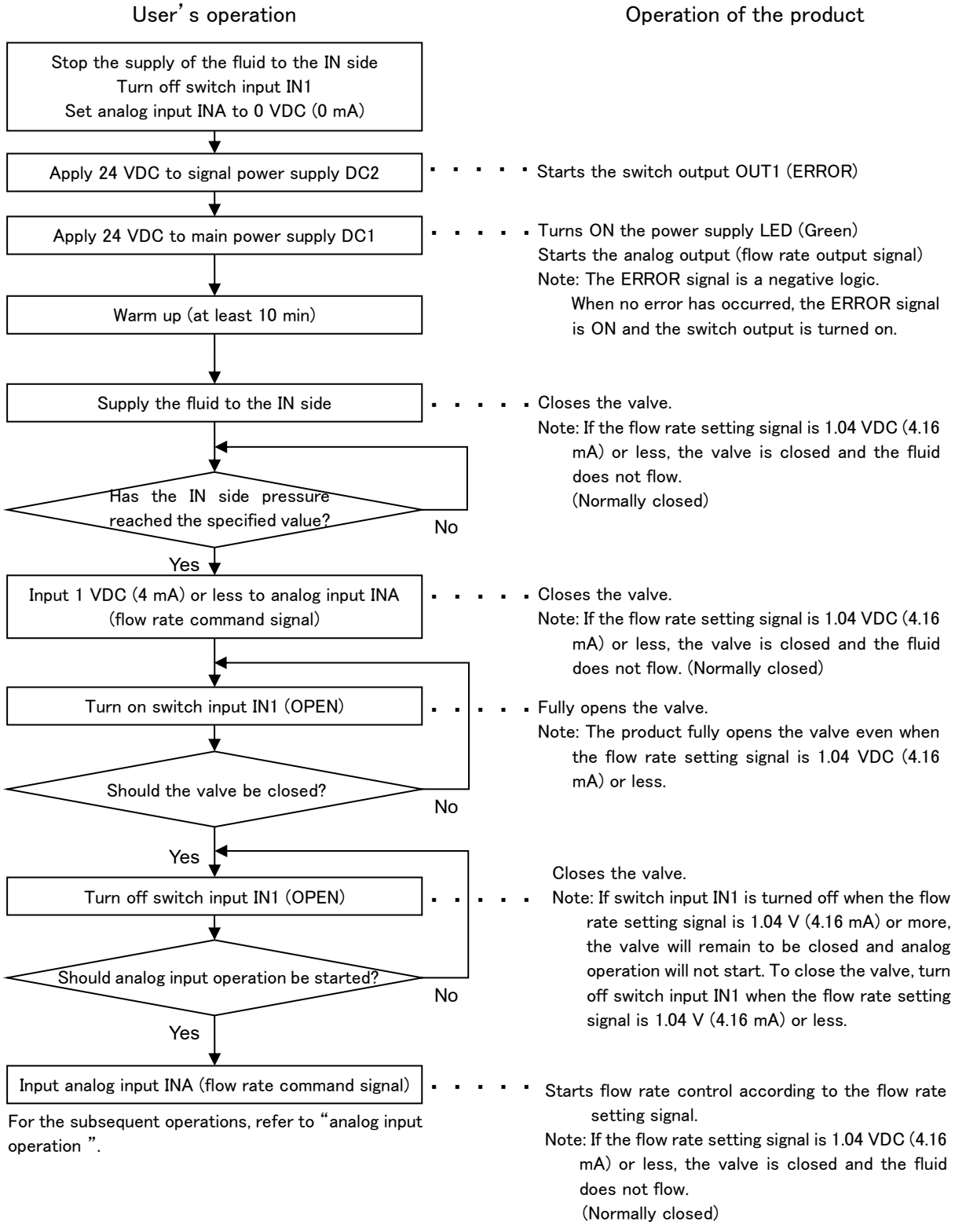
⚠ Caution
Do not apply a voltage or current outside of the specification range . Failing to do so may cause a product failure.
Turn on the signal power supply without supplying compressed fluid to the IN side, and then turn on the main power supply.
Allow the product to warm up for at least 10 minutes after the power supply is turned on. Without warming up, a vibration may be caused or the specifications may not be satisfied.
Supply fluid at a pressure and flow rate within the controllable range to the IN side. If the pressure or flow rate is insufficient, fluid according to the flow rate command signal will not flow. Such a condition may also cause a product failure.
After the warm-up is completed, input the flow rate command signal. If a signal of 1.04 VDC (4.16 mA) or more is input to the flow rate command signal before or at the same time the power supply is turned on, the valve will remain closed for safety reasons and the analog input operation cannot be started (Refer to “14-3. LED indication and error measures”). To start the analog input operation, set the flow rate command signal to 1.04 VDC (4.16 mA) once and then input any flow rate command signal.
Be sure to input the flow rate command signal after the IN side fluid pressure has reached the specified value. Otherwise, a vibration may occur or the specified accuracy may not be satisfied.
If the pressure on the IN side or the OUT side varies, the flow rate may vary.
When the flow rate command signal is 1.04 VDC (4.16 mA) or less, the internal valve is closed. When the flow rate command signal is 1.04 VDC (4.16 mA) or less, flow rate control is terminated for safety reasons and current to the valve is turned off (Normally closed).
Do not repeatedly set the flow rate command signal to 1.04 VDC (4.16 mA) or less within a short period of time. Otherwise, a vibration may occur or the specified accuracy may not be satisfied.
This product is not suitable for applications which require the flow to be shut off completely. If it is necessary to shut off the flow completely, install a stop valve, etc. separately.

11-3. Valve fully open operation

When the switch input IN1 is input in the following procedure, the valve is fully opened.

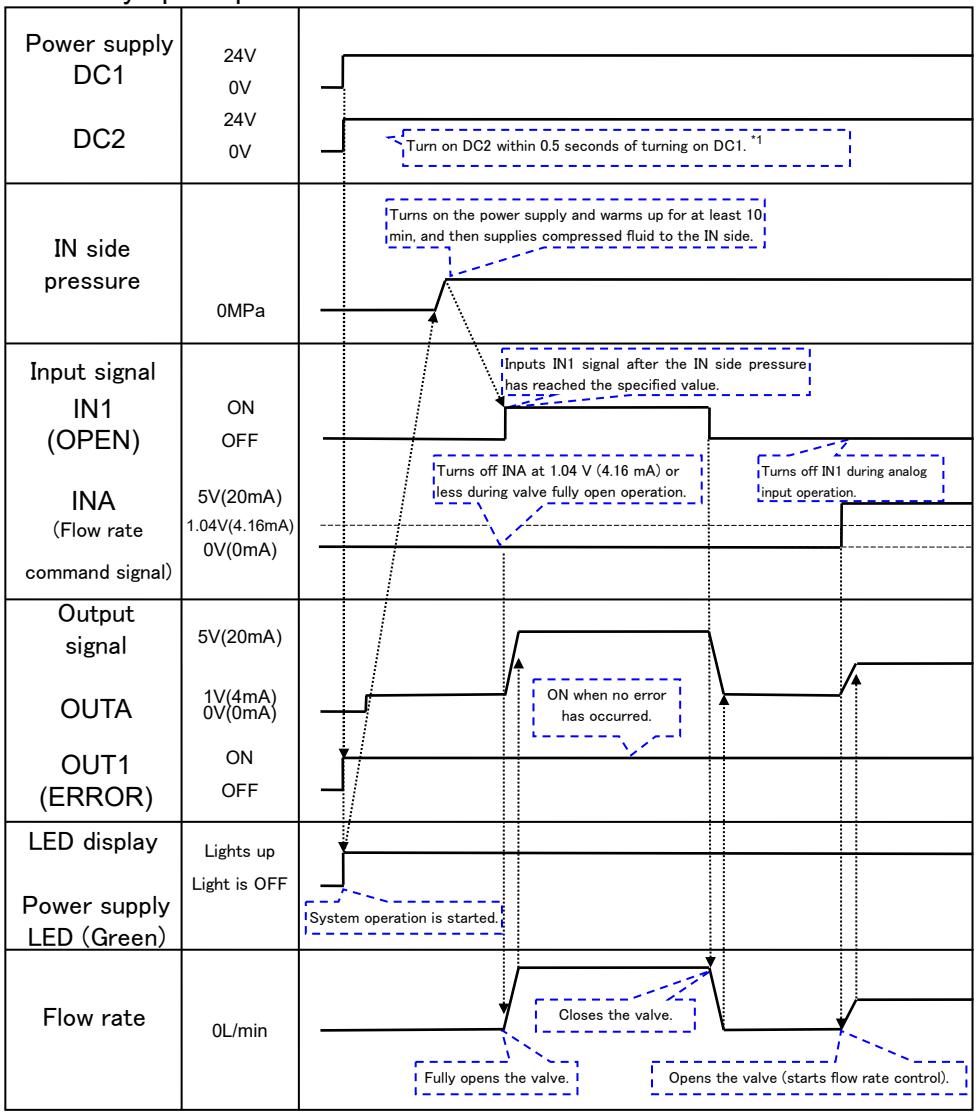
When the valve is closed, if the switch input IN1 is turned on, the valve is fully opened or the valve is closed if the switch input IN1 is turned off.

During an analog input operation, the valve fully open operation is not available. Terminate the analog input operation and close the valve before starting the valve fully open operation.



—Timing chart—

Valve fully open operation



*1: If DC2 is not supplied within 0.5 seconds after DC1 is supplied, an error (out of signal power supply range) will occur.

*2: This timing chart is applicable to the voltage input specifications. For the current input specifications, refer to the values inside the parentheses.

⚠Warning

Take into account the behaviour when the valve is fully open.

In the valve fully open operation, a high flow rate may be applied depending on the operating conditions. Before performing the valve fully open operation, be sure to confirm that there will be no injury to human bodies or damage to devices and equipment.

⚠Caution

Wait for at least 1 sec after turning on the power supply before turning the switch input IN1 to ON.

Even if the switch input IN1 is turned on before or at the same time as the power is turned on, the valve fully open operation will not start for safety reasons (Refer to “14-3. LED indication and error measures”). Turn off the switch input IN1 once and then turn it on again.

12. Options

12-1. Power supply cables

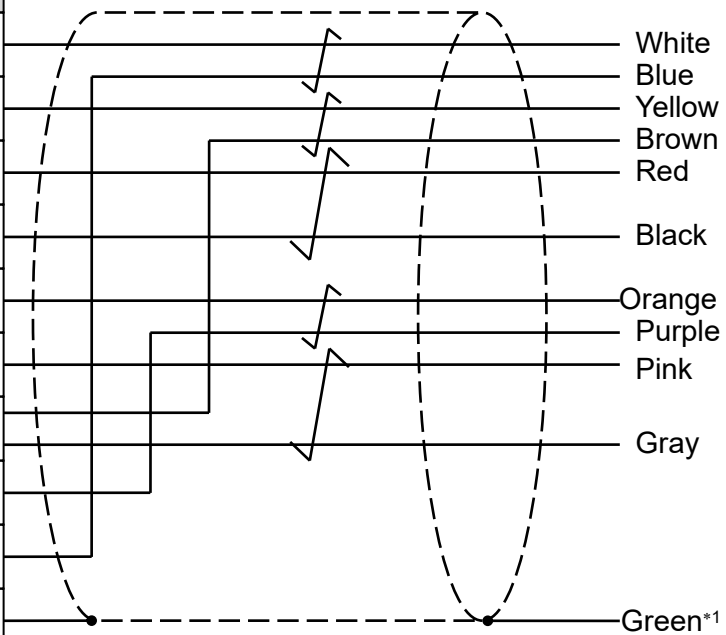
PFCQ531-H1-3

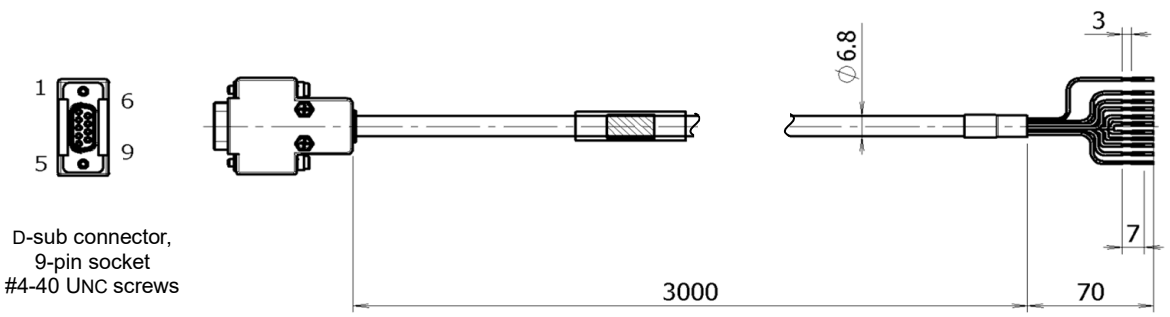
Specifications

Items	Description
Connector	D-sub connector, 9-pin socket #4-40 UNC screws
Sheath outside diameter	Φ6.8 mm
Minimum bending radius	54 mm
Number of cores	10 cores (5 x 2P)
Nominal cross section of the conductor	Equivalent to AWG26
Insulator outside diameter	1 mm

D-sub connector

Pin number	Name	Lead wire
1	IN1	White
2	OUTA	Yellow
3	DC1(+)	Red
4	DC1(-)	Black
5	DC2(+)	Orange
6	INA	Pink
7	COM	Brown, Gray
8	DC2(-)	Purple
9	OUT1	Blue
FG	FG	—





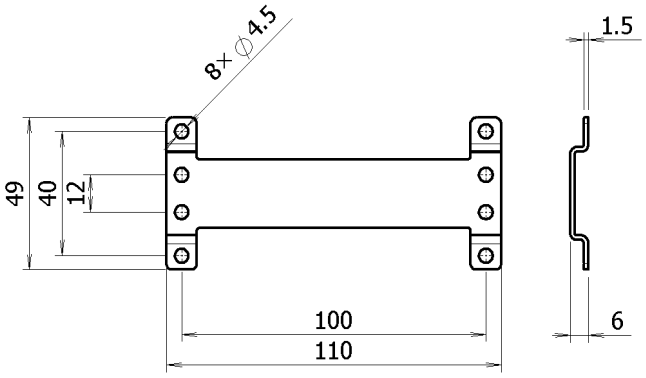
□*1: be sure to ground the FG wire (green).

12-2. Brackets

PFCQ531-B1

Items	Description
Material	Stainless steel
Weight	30 g
Screws for mounting the body[*1]	M4 (4 pcs.)
Screws for fixing the mounting frame[*2]	Equivalent to M4 (4 pcs.)

*1: Provided with the bracket.
*2: To be prepared by the customer.



For the dimensions after mounting the bracket, refer to “7. Dimensions”.

12-3. Digital flow monitor

Digital flow monitor: PFG310-XY-M-Y-X105

Specifications

Model			PFG310-XY-M-Y-X105
Applicable SMC flow controller	Model		PFCQ531
	Rated flow rate range[*1]		3 to 300 L/min
Flow rate specifications	Set flow rate range	Instantaneous flow	-15 to 315 L/min
		Accumulated flow	0 to 999,999,999,999 L
	Smallest settable increment	Instantaneous flow	1 L/min
		Accumulated flow	1 L
	Accumulated value hold[*2]		Every 2 minutes or every 5 minutes Saving data at power OFF can be selected
Accuracy	Display accuracy		+/-0.5% F.S.; minimum +/- display unit (Ambient temperature: Constant at 25°C)
	Repeatability		+/-0.1% F.S.; minimum +/- display unit
	Temperature characteristics		+/-0.5% F.S. (Ambient temperature 0 to 50°C; 25°C basis)
Display	Display mode		Instantaneous flow or Accumulated flow
	Unit	Instantaneous flow	L/min
		Accumulated flow	L, L x 10^6
	Displayable range	Instantaneous flow	-15 to 315 L/min
		Accumulated flow[*3]	0 to 999,999,999,999 L
	Minimum display unit	Instantaneous flow	1 L/min
		Accumulated flow	1 L
	Display method		LCD
	Number of displays		3 (main display and sub display)
	Display colour		1) Main display: Red/Green; 2) Sub display: Orange
	Displayed digits		1) Main display: 5 digits (7-segments) 2) Sub display: 7 digits (7-segments)
	Operation LED		LED ON when the switch is ON; OUT1/2: Orange
Digital filter[*4]			0.00 sec, 0.05 to 0.1 sec (0.01 sec increment) 0.1 to 1.0 sec (0.1 sec increment); 1 to 10 sec (1 sec increment) 20 sec or 30 sec
Environmental resistance	Protection class		IP40
	Withstand voltage		1000 VAC for 1 minute, between terminals and housing
	Insulation resistance		50 MΩ or more (with 500 VDC mega meter) between terminals and housing
	Operating temperature range		Operation: 0 to 50°C Storage: -10 to 60°C (No condensation or freezing)
	Humidity range		Operation/Storage: 35 to 85%RH (No condensation or freezing)
Standards			CE/UKCA marking
Weight	Body		25 g (not including the power supply and the lead wire)
	Lead wire with connector		+39 g

*1: The rated flow rate range of the applicable flow controller.

*2: When using the accumulated value hold, calculate the product life based on the operating conditions and use the product within the life period.
The maximum access limit of the memory device (electronic component) is 1.5 million cycles. If the product is energized 24 hours, the product life will be as follows.
- When data is stored every 5 min： 5 min x 1.5 million cycles = 7.5 million min = 14.3 years
- When data is stored every 2 min： 2 min x 1.5 million cycles = 3 million min = 5.7 years
Be aware that if the accumulated flow external reset is repeatedly used, the product life will be shorter than the life obtained from the calculation.

*3: The accumulated flow is displayed in 6 upper and 6 lower digits (12 digits in total). When the upper digits are displayed, "$x10^6$" is displayed.

*4: A 90% response time in relation to the step input.

*5: Although we are endeavoring to improve quality, we regard products with tiny scratches, smears, or display colour variation, brightness unevenness, and so on which does not affect the performance as conforming products.

Factory defaults

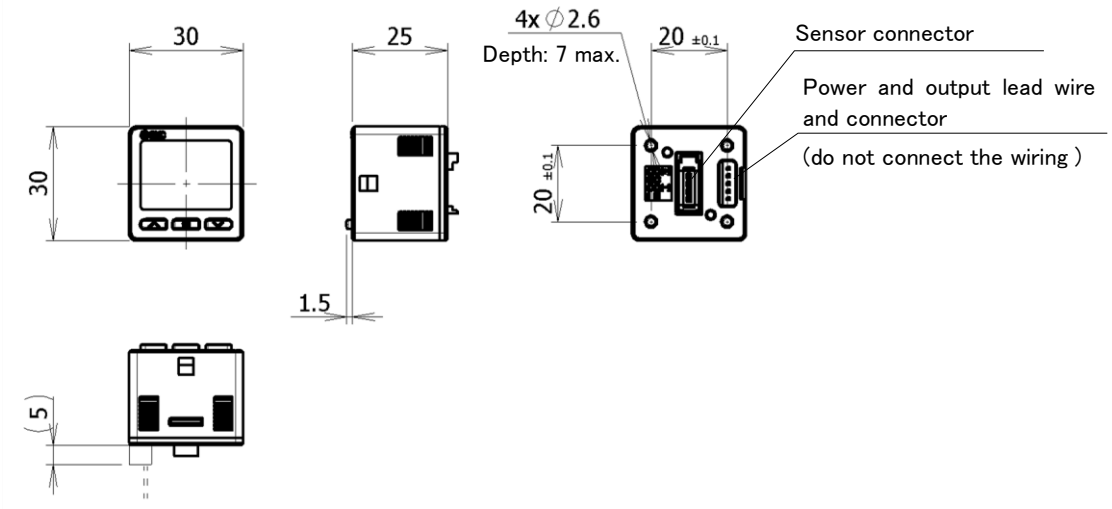
Items		Description
Flow rate range (USEr)	Rated lower limit	0 L/min
	Rated upper limit	300 L/min
OUT1	Output mode	Switch output off
	Display colour	Always: Green
OUT2	Output mode	Switch output off
	Display colour	Always: Green

For the digital flow monitor settings, refer to the Operation Manual of the "Digital Flow Monitor PFG3*0".

When the digital flow monitor is restored to the factory default, its settings are restored to the conditions shown in the above table.

If a mounting bracket is required for the digital flow monitor, order it separately (Refer to "13-1. Digital flow monitor mounting bracket").

The Operation Manual and certificate for the digital flow monitor are not included in the package. If these are required, please order separately.



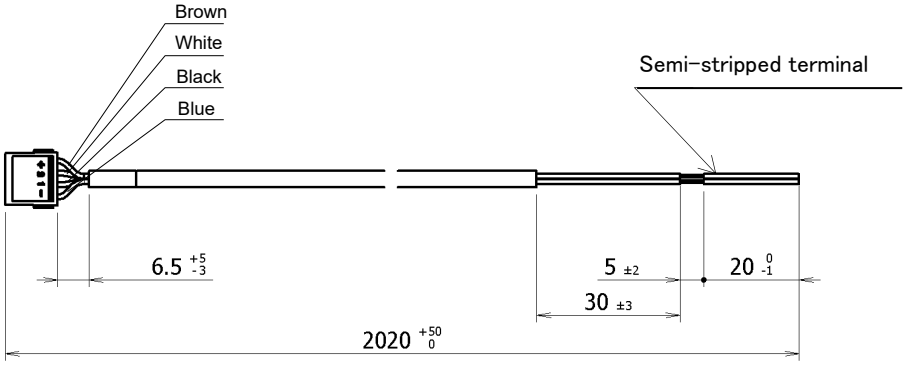
⚠ Warning

Do not connect the power and output lead wire and connector.

When connecting to the flow controller for air, do not connect the wiring to the power supply and output connectors. Failing to do so may deteriorate the accuracy or cause a vibration. In addition, be sure to use the digital flow monitor only for displaying the flow rate and do not output signals.

Lead wire with connector: ZS-33-D

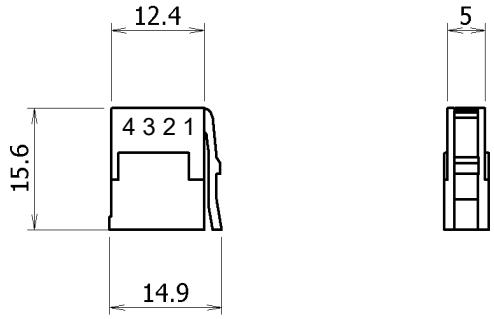
Pin number	Name	Lead wire colour
1	DC(+)	Brown
2	N.C.	White
3	OUTM	Black
4	DC(-)	Blue



Sensor connector: ZS-28-C-1

Pin number	Name	Lead wire colour*
1	DC(+)	Brown
2	N.C.	White
3	DC(-)	Blue
4	IN	Black

*: Lead wire with connector: The wire colours of the lead wire with connector used to connect with the ZS-33-D.

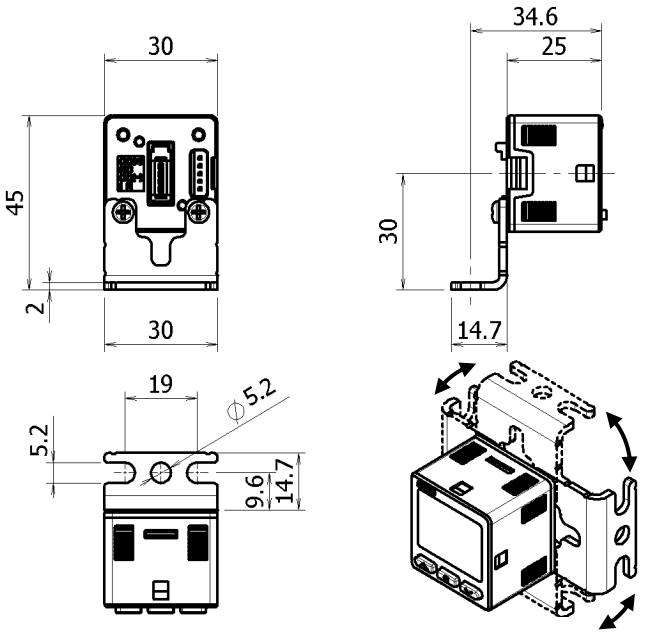


13. Separately Sold Products

13-1. Digital flow monitor mounting bracket

If a mounting bracket is required for the digital flow monitor, order it separately.

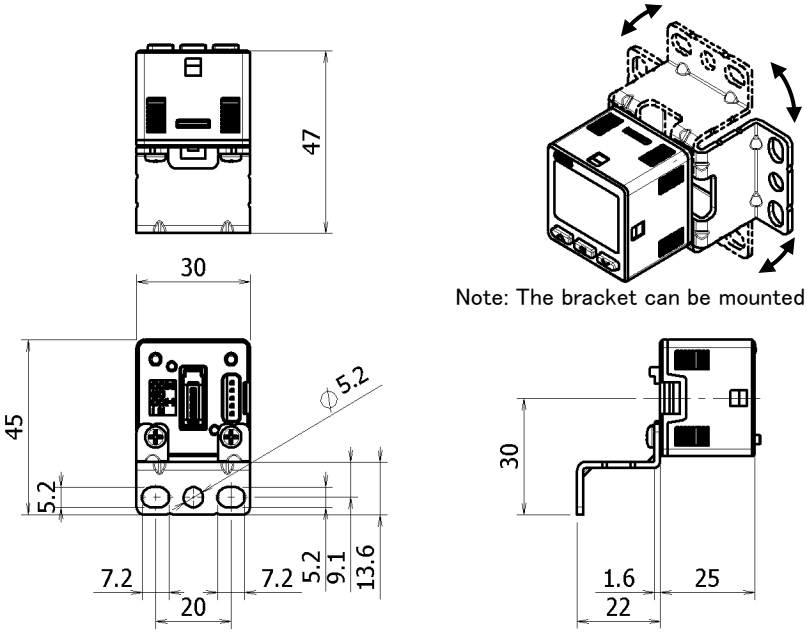
Bracket A: ZS-46-A1 dimensions



Note: The bracket can be mounted in four directions.

Note: Self tapping screw: 3 x 8L nominal diameter (2 pcs.)

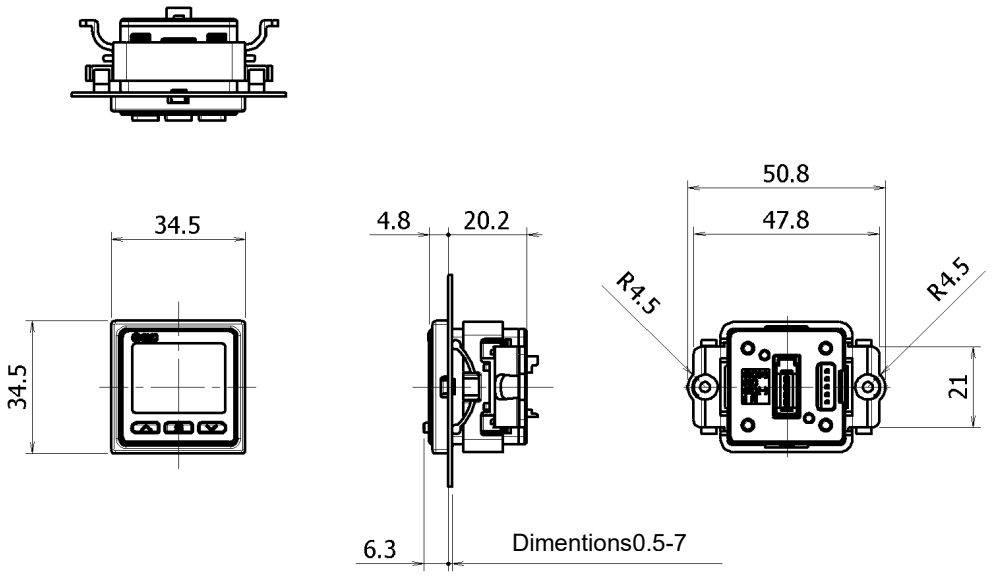
Bracket B: ZS-46-A2 dimensions



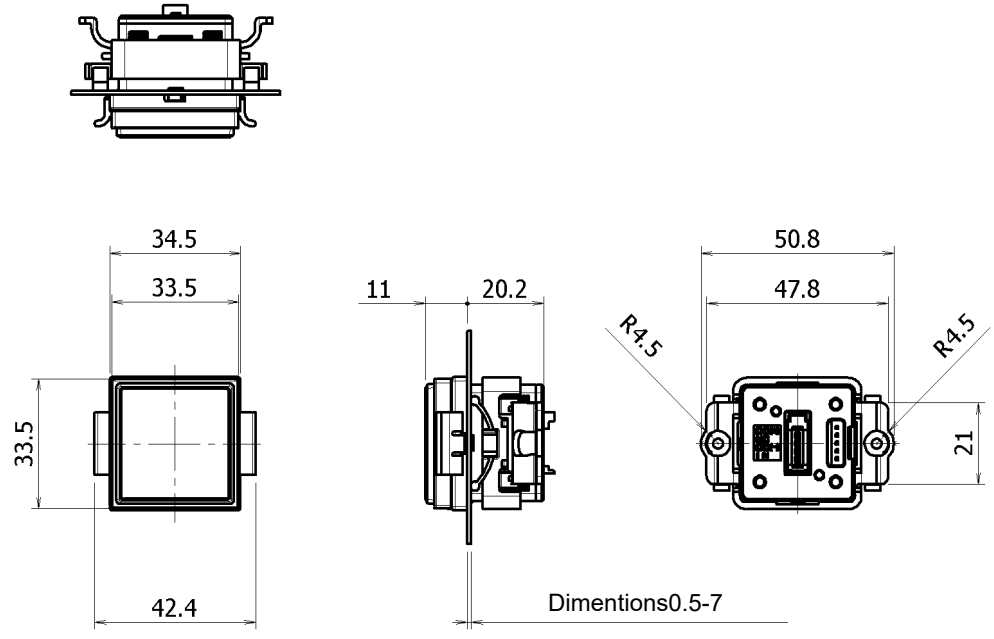
Note: The bracket can be mounted in four directions.

Note: Self tapping screw: 3 x 8L nominal diameter (2 pcs.)

Panel mount adapter: ZS-46-B



Panel mount adapter + Front protective cover: ZS-46-D



14. Maintenance

14-1. Maintenance and inspection

Check the following points and contact SMC sales representative if you find any abnormality.

(1) Daily inspection
- Lighting up and flashing of LEDs (If an abnormality is found in the lighting up and flashing of an LED, refer to “14-3. LED indication and error measures”).
- Changes in the control accuracy or response time
- Changes in the product surface temperature

(2) Regular check
- Loosening of screws for mounting the product
- Loosening of screws for mounting the connector
- Any leakage of air to the outside
- Changes in the control accuracy or response time
- Stain on the mesh (No.5 Mesh described in “8. Component Drawing of Parts in Contact with Fluid and Parts Names”)
- Whether the air filter is regularly drained

⚠ Warning
Before performing maintenance and inspection, be sure to turn off the power supply, stop supplying the fluid, exhaust the fluid inside the piping, and check that the fluid has been released to atmosphere. Failing to do so may cause an electric shock, injury, or unintended malfunction of equipment.
Do not disassemble, modify, or repair the product.
Do not allow foreign matter to enter the product or piping. Otherwise, malfunction or a failure may be caused.

14-2. Troubleshooting

In the event of malfunction, check the following corresponding condition of each problem.

If none of the causes corresponding to the condition of the problem can be found and normal conditions are restored by replacing the product, it can be assumed that the product itself is defective.

Since a product failure may also occur depending on the environment (application) used, please consult with SMC regarding measures for such cases.

(1) Operation problems

Condition of problem	Possible causes of problem	Investigation method and location of possible causes	Countermeasures
The power supply LED (Green) does not turn ON.	Main power supply failure	- Check the voltage of the main power supply connected to the product.	Input the voltage specified for the product by referring to “6-2. Electrical specifications” and “10-4. (1) D-sub connector terminal No.”.
	Wiring defect	- Is the wiring connected properly? - Is there any broken or short-circuited wiring?	Connect the wiring correctly by referring to “10-4. (2) Example of D-sub connector wiring”.
Valve leakage Leakage from the IN side to the OUT side	Piping defect	- Is the flow direction of the fluid correct?	Make sure that the fluid flows from the piping port (IN side) to the other piping port (OUT side) by referring to “ 10-3. Piping”.
	Input signal failure	- Analog input INA, switch input IN1	Set the analog input INA to 1 VDC (4 mA) or less and turn off the switch input IN1 by referring to “11. Operation”.
	A stop valve does not exist.	- Is a stop valve or similar product connected to the OUT side?	This product is not suitable for applications which require the flow to be shut off completely. If it is necessary to shut off the flow completely, install a stop valve, etc. separately.
External leakage	Piping defect	- Check the location of fluid leakage.	Repair the piping at the leakage location.
The product becomes hot.	Incorrect operating environment	- Is the product directly exposed to sunlight? - Is there a heat source near the product?	Provide shielding from the sunlight. Isolate the heat source.
	Installation defect	- Check the installation condition of the product.	Directly mount the product on a mounting frame with good heat dissipation such as one made of metal.
	The IN side pressure is high.	- Check the IN side pressure.	Reducing the IN side pressure reduces the heat generated by the product. Supply the minimum required pressure for the required flow rate to the IN side by referring to “6-3. Functional characteristics (3) Controllable range“.

(2) Flow rate control problems

Condition of problem	Possible causes of problem	Investigation method and location of possible causes	Countermeasures
No air flows. (Analog input operation)	Main power supply failure	- Check to see if the power supply LED turns ON. - Check the voltage of the main power supply connected to the product.	If the specified voltage is not input to the power supply, the power supply LED will not turn ON due to insufficient voltage. Input the voltage specified for the product by referring to “6-2. Electrical specifications” and “10-4. (1) D-sub connector terminal No.”.
	Signal power supply failure	- Check the voltage of the signal power supply connected to the product.	If the specified voltage is not input to the power supply, the flow rate command signal will not be input to the internal CPU due to insufficient voltage. Input the voltage specified for the product by referring to “6-2. Electrical specifications” and “10-4. (1) D-sub connector terminal No.”.
	Insufficient supply pressure	- Check the pressure at the piping port (IN side).	Supply fluid within the operating pressure range to the piping port (IN side) by referring to “6-1. General specifications”.
	Reverse piping connection	- Is the flow direction of the fluid correct?	Make sure that the fluid flows from the piping port (IN side) to the other piping port (OUT side) by referring to “ 10-3. Piping”.
	Wiring defect	- Is the wiring connected properly? - Is there any broken or short-circuited wiring?	Connect the wiring correctly by referring to “10-4. (2) Example of D-sub connector wiring”.
	Analog input type mismatch !DLT!	- Does the type (current, voltage) of analog input connected to the product match the input specifications of the product?	Input a signal that matches the input specified for the product by referring to “5. How to Order”.
	Insufficient flow rate command signal	- Check the analog input voltage value (or current value).	Analog input operation is not performed at 1.04 VDC (4.16 mA)or less. Input a signal equal to or greater than the minimum rated controlled flow rate value 1.12 VDC (4.48 mA) by referring to “6-3. Functional characteristics (1) Analog input (flow rate command signal)”.
	Error generation	- Are the power supply LED (Green, Red) and the error LED (Green, Red) turning ON or flashing?	Take measures by referring to “14-3. LED indication and error measures”.
	Insufficient flow rate command signal at power on	- Check that the flow rate command signal is 0 VDC (0 mA) when the power supply is turned on.	If the power is turned on when the flow rate command signal has been input, analog operation will not start for safety reasons. Turn on the power supply after setting the flow rate command signal to off (0 VDC or 0 mA) and then input any flow rate command signal.

Condition of problem	Possible causes of problem	Investigation method and location of possible causes	Countermeasures
No air flows. (Valve fully open operation)	Signal power supply failure	- Check the voltage of the signal power supply connected to the product.	If the specified voltage is not input to the power supply, the flow rate command signal will not be input to the internal CPU due to insufficient voltage. Input the voltage specified for the product by referring to “6-2. Electrical specifications” and “10-4. (1) D-sub connector terminal No.”.
	Switch input signal failure	- Are the power supply LED (Green) and error LED (Green) turning ON?	If switch input IN1 ON cannot be confirmed by the internal microcomputer, the power supply and error LEDs (Green) will not turn ON and the valve fully open operation will not start. Correctly connect the wiring and input switch input IN1 and the signal power supply by referring to “6-2. Electrical specifications” and “10-4. (2) Example of D-sub connector wiring”.
	Insufficient flow rate command signal at power on	- Check that the flow rate command signal is 0 VDC (0 mA) when the power supply is turned on.	If the power supply is turned on when the flow rate command signal has been input, the analog operation and valve fully open operation will not start for safety reasons. Turn on the power supply after setting the flow rate command signal to off (0 VDC or 0 mA) and then turn on the switch input IN1.
	Analog input operation is not performed.	- Check the voltage (current) of the analog input.	During analog input operation, valve fully open operation cannot be started even if the switch input IN1 is turned on. In that case, set the analog input to 1.04 VDC (4.16 mA) or less and turn on the switch input IN1.
	Insufficient supply pressure	- Check the pressure at the piping port (IN side).	Supply fluid within the operating pressure range to the piping port (IN side) by referring to “6-1. General specifications”.
	Reverse piping connection	- Is the flow direction of the fluid correct?	Make sure that the fluid flows from the piping port (IN side) to the other piping port (OUT side) by referring to “ 10-3. Piping”.
	Error generation	- Are the power supply LED (Green, Red) and the error LED (Green, Red) upturning ON or flashing?	Take measures by referring to “14-3. LED indication and error measures”.

Condition of problem	Possible causes of problem	Investigation method and location of possible causes	Countermeasures
There is a large error between the flow rate command signal and the actual flow rate.	Insufficient supply pressure or flow rate	- Check the pressure at the IN and OUT sides.	The error becomes greater if the operational differential pressure or the supply flow rate is insufficient. Apply sufficient pressure to the piping port (IN side) so that a differential pressure that allows the flow rate to be set according to the flow rate command signal can be obtained by referring to “6-3. Functional characteristics(3) Controllable range”.
	Inappropriate flow rate command signal	- Is the value of the flow rate command signal correct?	Input the appropriate flow rate command signal value by referring to “6-3. Functional characteristics (1) Analog input (flow rate command signal)”.
	Operation mismatch	Is the valve fully open operation set? Are the power supply LED (Green) and the error LED (Green) turning ON?	Analog input operation is not performed even if the flow rate command signal is input during valve fully open operation. Turn off the switch input (IN1) once and then input the flow rate command signal.
	Effect of peripheral devices (noise)	- Is noise influencing the flow rate command signal or the flow rate output signal?	Take measures to prevent noise from peripheral devices from entering, such as placing wiring away from such devices and insulating wiring.
	Insufficient warm-up	- Has the flow rate command signal been input after 10 min or more after the power supply is turned on?	Supply the fluid to the piping port (IN side) after 10 min or more after the power supply is turned on and then input the flow rate command signal by referring to “11-2. Analog input operation”.
The response is slow.	The operational differential pressure is small.	- Check the pressure at the IN and OUT sides.	The smaller the operational differential pressure, the slower the response. Supply the fluid to the piping port (IN side) so that the differential pressure will be 0.3 MPa.
	Power on failure	- Check the voltage of the main power supply connected to the product.	The response may be slow if the specified voltage or current is not input to the main power supply. Turn on the power supply specified for the product by referring to “6-2. Electrical specifications” and “10-4. (1) D-sub connector terminal No.”.

Condition of problem	Possible causes of problem	Investigation method and location of possible causes	Countermeasures
The flow rate varies.	Pressure fluctuation on the IN side	- Is the pressure on the IN side fluctuating?	Due to a pressure regulator mounted to the piping port (IN side), the pressure on the IN side may drop if a high flow rate is applied suddenly. Check the flow-rate characteristics of the piping and peripheral devices so that a pressure drop will not occur.
	Pressure fluctuation on the OUT side	- Is there any factor on the OUT side that causes the pressure to be applied to the piping or the flow rate to change?	If the flow rate changes due to a restrictor or solenoid valve mounted to the piping port (OUT side), the pressure on the OUT side may increase or drop. Make sure that the restrictor (effective cross section) on the OUT side will not change during analog operation.
	Wiring defect	- Is the wiring connected correctly? - Is there any broken or loose wiring?	Make sure that the wiring is carried out correctly.
	Effect of peripheral devices (noise)	- Is noise from peripheral devices influenscing the flow rate output signal?	Take measures to prevent noise from peripheral devices from entering, such as placing wiring away from such devices and insulating wiring.
	Vibration of the mounting environment	- Is the mounting frame, etc. to which the product has been mounted vibrating?	Mount the product in a place that will not be affected by vibration.

(3) Output signal problems

Condition of problem	Possible causes of problem	Investigation method and location of possible causes	Countermeasures
An analog output signal is not output.	Signal mismatch	- Are the input specifications of an external device connected to the analog output consistent with the output specifications (voltage, current) of this product?	Use an external device whose specifications match those of the product by referring to “5. How to Order”.
	Wiring defect	- Is the wiring connected correctly? - Is there any broken or short-circuited wiring?	Connect the wiring correctly by referring to “10-4. (2) Example of D-sub connector wiring”.
There is a large difference between the actually applied flow rate and the analog output.	Effect of peripheral devices (noise)	- Is noise from peripheral devices influencing the analog output (flow rate output signal)?	Take measures to prevent noise from peripheral devices from entering, such as placing wiring away from such devices and insulating wiring.
	Load mismatch	- Is the load of an external device connected to the analog output consistent with the specification of the product?	Connect appropriate load impedance by referring to “6-2. Electrical specifications". For voltage output, increase the load impedance.
There is a large difference between the flow rate command signal and the flow rate output signal.	Flow rate control failure	- Check the description given in “14-2. Troubleshooting (2) Flow rate control problems”.	Take measures provided in “14-2. Troubleshooting (2) Flow rate control problems”.
The switch output does not turn on.	Signal power supply failure	- Is 24 VDC input to the signal power supply?	Input 24 VDC to the signal power supply by referring to “10-4. (2) Example of D-sub connector wiring”.
	Wiring defect	- Is the wiring connected correctly? - Is there any broken or short-circuited wiring?	Connect the wiring correctly by referring to “10-4. (2) Example of D-sub connector wiring”.
	Error generation	- Are the power supply LED (Green, Red) and the error LED (Green, Red) turning ON or flashing?	If an error occurs, switch output OUT1 turns off. Take measures by referring to “14-3. LED indication and error measures”.

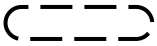
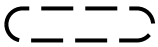
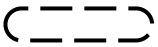
(4) Flow rate display problem

Condition of problem	Possible causes of problem	Investigation method and location of possible causes	Countermeasures
The digital flow monitor does not display images.	Wiring defect	- Is the wiring connected correctly? - Is there any broken or short-circuited wiring?	Connect the wiring correctly by referring to “10-4. (4) Wiring between the flow rate display connector and the digital flow monitor”.
There is a large difference between the actual applied flow rate and the displayed value.	Setting defect	Are the product number and the settings of the digital flow monitor correct?	Connect the correct digital flow monitor PFG310-XY-M-Y-X105. Restore the digital flow monitor to the factory default state.
There is a large difference between the set flow rate value and the displayed value.	Setting defect	Are the product number and the settings of the digital flow monitor correct?	Connect the correct digital flow monitor PFG310-XY-M-Y-X105. Restore the digital flow monitor to the factory default state.
	Flow rate control failure	- Check the description of “14-2. Troubleshooting (2) Flow rate control problems”.	Take measures in “14-2. Troubleshooting (2) Flow rate control problems”.

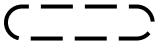
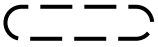
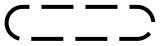
14-3. LED indication and error measures

Based on the LED colour, turning ON and flashing of the power supply LED and the error LED at the top of the product, the product status can be confirmed.

－Normal operation－

Name	Power supply LED	Error LED	Description	Measures
Analog input operation	 (Green) LED is ON	 (Green) LED is ON	During analog input operation	
Valve fully open operation	 (Green) LED is ON	 (Green) Flashes	During valve fully open operation	
Valve closed	 (Green) LED is ON	 LED is OFF	Because the analog input (INA) is smaller than 1.04 VDC (4.16 mA), the current to the motor is turned off and the valve is closed.	
Power OFF	 Light is OFF	 Light is OFF	The internal microcomputer is not operating (valve closed) because the main power supply is not turned on or the voltage of the main power supply is small (21.6 VDC or less).	Apply a voltage of 24 VDC +/-10% to the main power supply.

－Error generation－

Name	Power supply LED	Error LED	Description	Measures
Switch input error	 (Red) LED is ON	 LED is OFF	Switch input is ON at the end of the analog input operation. ⇒Turns off current to the linear motor and closes the valve.	Reset the signal. Alternatively, turn on the main power supply again when the analog input is set to 1 VDC (4 mA) or less and switch input is OFF.
Analog input error	 (Red) LED is ON	 LED is OFF	Analog input is larger than 1.04 VDC (4.16 mA) at the end of valve fully open operation. ⇒Turns off current to the linear motor and closes the valve.	Reset the signal. Alternatively, turn on the main power supply again when the analog input is set to 1 VDC (4 mA) or less and switch input is OFF.
Input error at power ON	 (Red) LED is ON	 LED is OFF	The analog input is 1.04 VDC (4.16 mA) or more when the power supply is turned on or switch input is ON. ⇒Turns off current to the linear motor and closes the valve.	Reset the signal. Alternatively, turn on the main power supply again when the analog input is set to 1 VDC (4 mA) or less and switch input is OFF.
Switch output over current error	 (Red) LED is ON	 (Green) LED is ON	The current applied to the switch output has exceeded the specified value. ⇒Turns off current to the linear motor and closes the valve.	Check the electric circuit of the switch output, take measures for the cause, and turn on the main power supply again by referring to “10-4. (2) Example of D-sub connector wiring”.
Signal power supply outside the range	 (Red) LED is ON	 (Green) LED is ON	The voltage of the signal power supply is lower than the specified value. ⇒Turns off current to the linear motor and closes the valve.	Apply a voltage of 24 VDC +/-10% to the signal power supply and turn on the main power supply by referring to “10-4. (2) Example of D-sub connector wiring”.
Temperature error	 (Red) LED is ON	 (Red) Flashes	The product temperature exceeded the specified value. ⇒Turns off current to the linear motor and closes the valve.	Take measures by referring to “14-2. Troubleshooting(1) Operation problems: The product becomes hot”. Reset the signal or turn on the power supply again after the product surface temperature has reached around the same level as the ambient temperature.
Device abnormality error	 (Red) LED is ON	 (Red) LED is ON	There is an error in parts in a device such as a sensor or motor. ⇒Turns off current to the linear motor and closes the valve.	Please contact your SMC sales representative.

－Error reset－

If an error occurs, the product turns off current to the motor and closes the valve. After taking measures described in “Measures” reset the error following the method below.

(1) Reset the signal

Turn off the analog input INA and the switch input IN1 for at least 1 sec.

(2) Turn on the main power supply again

Turn off the main power supply (for at least 1 sec) and turn it on again.

Note: When turning on the power supply, do not supply compressed fluid to the IN side.

⚠ Caution
Even if the error is reset when sufficient measures have not been taken for the error, the error will occur again. If the error cannot be reset, check the countermeasures for the generated error again.

15. Handling Precautions

15-1. Design and selection precautions

⚠Warning

(1) Be sure to read the Operation Manual.

Do not handle the product in a way not described in the Operation Manual or use it outside the specifications because doing so may lead to damage or malfunction of the product. No damage attributable to the handling of the product in a way not described in the Operation Manual or to use of the product outside the specifications will be compensated.

(2) Do not use the product outside the specifications.

Using the product outside the specification may cause the product to catch fire, malfunction, or be damaged. Check the specifications before use.

(3) Take into account the behaviour when the valve is fully open.

In valve fully open operation, a high flow rate may be applied. Make sure that the design will not cause injury to human bodies or damage devices and equipment.

(4) Take into account the behaviour in the event of an error or power failure.

If the flow rate command signal exceeds the input range, an error occurs such as the product temperature exceeding 70°C, or no power is supplied to the product due to power failure, the valve will close and the fluid will no longer flow. Make sure that the design will not cause injury to human bodies or damage devices and equipment.

(5) Take into account the behaviour when the device is restarted after an error occurrence or power failure.

Make sure that the design will not cause injury to human bodies or damage equipment by the restarting of equipment.

(6) Disconnect the product and system power supply immediately if a hazard can be expected due to abnormal heat generation, smoke or ignition of the product, etc.

⚠Caution

(1) This product is not suitable for applications which require the flow to be shut off completely.

If it is necessary to shut off the flow completely, install a stop valve, etc. separately.

(2) For details of the compressed air quality, refer to JIS B 8392-1 1.1.2 to 1.6.2 and ISO8573-1 1.1.2 to 1.6.2 and use compliant fluid.

The specifications may not be satisfied due to a failure or stains attached to the flow sensor.

(3) Use the product at the specified voltage and current capacity.

Using the product at a non-specified voltage may cause a failure or malfunction. If the current capacity is too small, the product may malfunction.

(4) Use the product at a pressure and flow rate within the specifications.

If the product is used at a pressure outside the specifications, the flow rate on the inlet side may

be insufficient or the product may malfunction or may not satisfy the specifications.

(5) If the fluid on the IN side (inlet) of the product is turbulent, accurate measurement may not be possible.

If a valve, etc. is used on the IN side (inlet) of the product, flow turbulence may be caused due to changes in the effective area, resulting in an error in the flow rate measurement. If this is the case, place the valve, etc. away from the product and provide a straight piping section with a length of at least 80 mm on the IN side of the product.

(6) Be sure to prepare the main power supply and the signal power supply separately.

If one power supply is shared between them, malfunction due to noise may be caused or the specified characteristics may not be satisfied.

(7) Do not short-circuit the main power supply 0 VDC (DC1(-)), INA and OUTA 0 VDC (COM).

Otherwise, the specified accuracy may not be satisfied due to the effect of the current flowing through the main power supply.

(8) Be aware of magnetism.

Because a strong rare-earth magnet is used, it may have a magnetic effect on items outside the product. To avoid the effect of the magnetism, place the relevant item away from the product. If an item is placed 100 mm away from the product, the magnetic flux density from the product is 1 mT or less.

(9) Make sure that the fluid in the piping on the IN (inlet) and OUT (outlet) sides of the product can be exhausted.

The product is normally closed (closed when de-energized). Provide an exhaust valve, etc. on the piping so that the fluid can be exhausted when performing maintenance.

(10) Secure space for maintenance.

Make sure the design takes into account space necessary for maintenance.

(11) SMC products are not intended for use as instruments for legal metrology.

Products that SMC manufactures and sells are not measuring apparatus or measurement instruments that have passed type certification tests or examinations relevant to the metrology (measurement) laws of each country. Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

15-2. Handling precautions

⚠ Warning

(1) Do not touch the product until its surface temperature has reached around the same level as the ambient temperature during de-energizing or after power shutdown.

The surface temperature of the product may reach around 70°C depending on the operating conditions. Energizing alone may also cause the surface to become hot. Never touch the product when the product is in operation or energized because there is a risk of

getting burned.

(2) Do not perform operations or configure settings with wet hands.

This may cause an electric shock.

(3) Do not use a damaged product or a product with missing parts.

Failing to do so may cause an electric shock, fire, or injury.

(4) Perform mounting, piping, wiring, or inspection work after checking the voltage using a tester, etc. after at least 5 minutes have passed after the power is turned off.

Failing to do so may cause an electric shock, fire, or injury.

(5) Static electricity may cause the product to malfunction or be damaged.

When you need to touch the product for maintenance work and so on, take sufficient measures against static electricity in advance.

(6) Do not apply a voltage or current outside the range of the specifications.

Failing to do so may cause a product failure.

(7) Do not apply fluid to the OUT side (outlet) with a pressure higher than the pressure on the IN side (inlet)

Failing to do so may cause the valve to open and the fluid to flow backward.

⚠Caution

(1) When not using the digital flow monitor, mount the protective plug on the flow rate display connector.

If a foreign matter such as a metal fragment enters inside the flow rate display connector, short-circuit may occur, causing the product to be damaged.

(2) Be aware of magnetism.

A strong rare-earth magnet is used. If a magnetic card, etc. is brought close to the product, the card data may be damaged. Pay attention not to bring substances which are affected by magnetism close to the product.

(3) Turn on the power supply without supplying compressed fluid to the IN side (inlet).

(4) Allow the product to warm up for at least 10 minutes after the power supply is turned on.

Otherwise, the specified accuracy may not be satisfied due to temperature drift.

(5) Be sure to input the flow rate command signal after supplying fluid to the IN side (inlet).

If fluid is supplied after the flow rate command signal is input, fluid at the flow rate range or more is applied, the specified accuracy cannot be satisfied, and control may be unstable.

(6) Be sure to use the product at a pressure and current within the controllable range.

Outside of the controllable range, the flow rate may be low, flow rate control may be unstable, the product temperature may be high and so on.

(7) Make sure that the pressure on the IN (inlet) and OUT (outlet) sides will not fluctuate.
If the pressure on the IN side or the OUT side varies, the flow rate may vary.

(8) The action of the control valve is normally closed.
When the product is in a de-energized state, the valve is fully closed.

(9) When the flow rate command signal is 1.04 VDC (4.16 mA) or less, the internal valve is closed.
To input the flow rate command signal again after setting it to 1.04 VDC (4.16 mA) or less, wait for at least 1 second before inputting the next signal.

15-3. Mounting

⚠ Warning

(1) Mount the product to a fire-proof material.
Directly mounting to a combustible material or near a flammable material may cause fire.

(2) Mount the product in a location not subject to vibration or impact.
Failing to do so may cause malfunction or failure.

(3) Mount sources of vibration such as a large electromagnetic contactor and a no-fuse circuit breaker on a separate panel from this product or away from this product.
Failing to do so may cause malfunction or failure.

(4) Mount this product on a flat surface.
If the mounting surface is distorted or not flat, an excessive force may be applied to the product, causing fluid leakage, malfunction, or failure.

(5) When mounting a fitting, apply a wrench or adjustable wrench at the metal part (attachment) to mount the fitting.
Applying the wrench at other parts may cause the product to fail.

(6) Remove dust, etc. remaining inside the piping by air blow before connecting the piping to the product.
Failing to do so may cause failure or malfunction.

(7) Do not mount the product with the body bottom surface facing upward (upside down).
Otherwise, a sensor failure or malfunction may be caused due to the mixing of drain or moisture.

(8) Do not insert metal wires or other foreign matter into the flow path.
This may cause failure or malfunction.

(9) If there is a risk of foreign matter entering the fluid, install a filter or mist separator on the IN side (inlet).

Failing to do so may cause failure or malfunction. In addition, accurate measurement and control may no longer be available.

(10) Do not mount a lubricator on the IN side (inlet) of the product.

An inflow of oil may cause failure or malfunction.

⚠ Caution

(1) Be aware of magnetism.

A strong rare-earth magnet is used. If magnetized workpieces, tools, or metallic parts are brought close to the product, they may be attracted, which could hurt operators and damage equipment. Take special care when operating the product.

(2) Use screws for mounting the body with appropriate length. Properly tighten the screws applying a torque equal to the maximum tightening torque.

Tightening the screws with a torque value higher than the limiting range may cause malfunction. In addition, insufficient tightening may cause screws to loosen or vibrate.

(3) Do not drop, hit, or apply shock to the product.

Otherwise, the product internal components may be damaged, causing malfunction.

(4) Do not pull a cable mounted to the product connector or lift the product by holding the cable.

Doing so may cause the product to be damaged, leading to failure and malfunction.

(5) Perform installation and piping according to the fluid flow direction indicated on the product label.

(6) Do not mount the product in a place that will be used as a foothold.

The product may be damaged if an excessive load is applied by stepping on it or climbing onto it by mistake.

15-4. Power supply

⚠ Warning

(1) Use a power supply with reduced noise both between power lines and between power and ground.

In case of excessive noise, connect an isolation transformer.

(2) Do not use a power supply with inrush current prevention specification for the main power supply and the signal power supply, and wire them using isolated systems.

If a power supply with inrush current prevention specification is used, a voltage drop may occur during flow rate control.

(3) Take measures against lightning surges. Isolate the grounding of the surge absorber for lightning from the grounding of the product and its peripheral devices.

15-5. Grounding

⚠Warning

(1) Make sure the product is always connected to ground to ensure noise resistance.

Failing to do so may cause malfunction or failure. Do not share the ground connection with equipment that generate a strong electromagnetic noise.

(2) Use a dedicated ground connection.

Grounding should be a D-class ground connection. (Ground resistance: 100 Ω or less)

(3) Ground at a location close to the product and make the distance between the product and ground as short as possible.

(4) In case malfunction is caused by the ground connection, do not ground the product.

15-6. Wiring

⚠Warning

(1) Be sure to turn off the power supply before wiring (including plugging and unplugging of connectors).

Otherwise, an electric shock may be caused or the product internal components may be damaged, causing malfunction.

(2) Check insulation of wiring.

Poor insulation (interference with other circuits, poor insulation between terminals, etc.) may apply an excessive voltage or current to the product, causing the product to be damaged.

(3) Avoid miswiring.

The product may malfunction or be damaged depending on the details of miswiring.

(4) Do not use the same wiring route for a power line and a high voltage cable.

Route the product wires separately from power lines or high voltage cables to prevent

noise and surge from entering the signal line from power lines or high voltage cables.

(5) Check the wiring before using the product.

Miswiring will lead to product damage or malfunction. Make sure that there is no miswiring before starting operation.

(6) Do not pull the cables or lead wires with excessive force.

Do not carry the product by pulling the cables or lead wires. Failing to do so may cause the product internal components to break, resulting in malfunction, or the connector may drop.

(7) Provide sufficiently long wiring runs and fix wires.

Unreasonable arrangement of wiring may cause broken wires, connectors, or plugs, resulting in malfunction. Avoid bending cables or lead wires in sharp angles near the connector, and take into consideration the wiring arrangement. In addition, fix cables and lead wires at the closest location where an unreasonable force will not be applied to the connectors.

(8) Keep wiring as short as possible to prevent interference from noise and surge.

Be sure to arrange the main power supply 0 VDC side as close as possible to the power supply.

(9) Insert a noise filter (line noise filter, ferrite element, etc.) between the switching power supply and this product.

15-7. Operating environment

⚠Warning

(1) Do not use the product in an atmosphere where flammable gas, and explosive or corrosive gas are present.

Failing to do so may lead to fire, explosion, and corrosion.

(2) Do not use the product in a place where dust, water, chemicals, or oil scatter or in a oil vapor atmosphere.

Failing to do so may cause failure or malfunction.

(3) Do not use the product in an area where a magnetic field is generated.

Failing to do so may cause malfunction.

(4) Do not use the product in a location where surges are generated.

If a device or equipment that generate large surges (magnetic type lifter, high frequency inductive furnace, motor, etc.) is located near the product, the product internal circuit elements may be deteriorated or damaged.

Consider countermeasures against surge sources and prevent the lines from mixing with each other.

(5) Do not use a load which generates a surge.

Otherwise, malfunction or a failure may be caused.

(6) This product is CE marked, but is not immune to lightning surge. Take measures against lightning surge in the device.

(7) Avoid radiant heat from large heat sources such as direct sunlight or hot furnaces from being applied.

Otherwise, a failure may be caused.

(8) Do not use the product in an environment subjected to cyclic temperature patterns.

Cyclic temperature patterns other than ordinary changes in temperature can have an adverse effect on the internal components of the product.

(9) Use the product within the specified ambient temperature range.

The ambient temperature range is 5 to 45°C.

Using the product under low temperatures may lead to damage or malfunction of the product due to frozen moisture in the air.

Provide anti-freeze treatment.

Installation of an air dryer for removing drainage and water is recommended.

Also avoid abrupt temperature changes even within the specified temperature range.

(10) When mounting the products arranged close to each other, the product temperature may rise, causing failure or malfunction.

Mount the products providing a space of at least 20 mm between each other.

(11) Use the product in an environment not subject to vibration or impact.

Otherwise, malfunction or a failure may be caused.

15-8. Maintenance

⚠Warning

(1) Perform maintenance periodically.

Confirm that there is no miswiring and that screws are not loose. Otherwise, devices or equipment may malfunction, causing unintended malfunction of component equipment.

(2) Before performing maintenance, be sure to turn off the power supply, stop supplying the fluid, exhaust the fluid inside the piping, and check that the fluid has been released to atmosphere.

Failing to do so may cause an electric shock, injury, or unintended malfunction of peripheral equipment.

(3) Drain periodically.

If drainage enters the OUT side, it may cause pneumatic equipment to malfunction.

(4) Do not disassemble, modify, or repair the product.

(5) Do not perform an insulation resistance test or withstand voltage test.

(6) Do not use solvents such as benzene, thinner, etc. to clean the product.

These solvents may damage the surface or erase indications on the product.

Use a soft cloth to remove stains.

For heavy stains, use a damp cloth that has been soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

(7) Do not allow foreign matter to enter the product or piping.

Otherwise, malfunction or a failure may be caused.

(8) After completing maintenance, perform appropriate functional inspections.

In case of any abnormalities, such as a device or equipment not operating normally, stop the operation. Otherwise, safety may not be ensured due to an unexpected malfunction of such a device or equipment.

Revision history

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