



Operation Manual

PRODUCT NAME

Flow sensor

MODEL / Series / Product Number

PFMV5##

SMC Corporation

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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), Japan Industrial Standards (JIS)^{*1)} and other safety regulations^{*2)}.

- *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 10218-1992: 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.

Caution

1. 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.*³⁾
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.

*3) 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

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).

Operator

- ◆ This operation manual is intended for those who have knowledge of machinery using pneumatic equipment, and have sufficient knowledge of assembly, operation and maintenance of such equipment. Only those persons are allowed to perform assembly, operation and maintenance.
- ◆ Read and understand this operation manual carefully before assembling, operating or providing maintenance to the product.

■ Safety Instructions

Warning

- Do not disassemble, modify (including changing the printed circuit board) or repair.
An injury or failure can result.
- Do not operate the product outside of the specifications.
Do not use for flammable or harmful fluids.
Fire, malfunction, or damage to the product can result.
Verify the specifications before use.
- Do not operate in an atmosphere containing flammable or explosive gases.
Fire or an explosion can result.
This product is not designed to be explosion proof.
- Do not use the product for flammable fluid.
A fire or explosion can result.
Only air and N₂ are applicable.
- Do not use the product in a place where static electricity is a problem.
Otherwise it can cause failure or malfunction of the system.
- If using the product in an interlocking circuit:
 - Provide a double interlocking system, for example a mechanical system.
 - Check the product regularly for proper operationOtherwise malfunction can result, causing an accident.
- The following instructions must be followed during maintenance :
 - Turn off the power supply
 - Stop the air supply, exhaust the residual pressure and verify that the air is released before performing maintenance work.Otherwise an injury can result.

Caution

- Do not touch the terminals and connectors while the power is on.
Otherwise electric shock, malfunction or damage to the product can result.
- After maintenance is complete, perform appropriate functional inspections and leak tests.
Stop operation if the equipment does not function properly or there is a leakage of fluid.
When leakage occurs from parts other than the piping, the product might be faulty.
Disconnect the power supply and stop the fluid supply.
Do not apply fluid under leaking conditions.
Safety cannot be assured in the case of unexpected malfunction.

■NOTE

- Follow the instructions given below when designing, selecting and handling the product.
 - The instructions on design and selection (installation, wiring, environment, adjustment, operation, maintenance, etc.) described below must also be followed.
- *Product specifications
- The direct current power supply used should be UL approved as follows
 - Circuit (class 2) of maximum 30Vrms (42.4 V peak) or less, with UL 1310 class 2 power supply unit or UL 1585 class 2 transformer.
 - The product is a  approved product only if it has a  mark on the body.
 - Use the specified voltage.
 - Otherwise failure or malfunction can result.
 - Insufficient supply voltage may not drive a load due to a voltage drop inside the product.
 - Verify the operating voltage of the load before use.
 - Do not exceed the specified maximum allowable load.
 - Otherwise it can cause damage or shorten the lifetime of the product.
 - Applicable operating fluid depends on the product.
 - Check the details of the specifications before using.
 - Before designing piping confirm the pressure loss at the sensor from the pressure loss graph.
 - Confirm pressure loss of the sensor from the characteristics data.
 - For the details of compressed air quality, refer to ISO 8573-1, 1.1.2 to 1.6.2.
 - Use the specified measurement flow rate and operating pressure.
 - Otherwise it can cause damage to the product or inability to measure correctly.
 - Reserve a space for maintenance.
 - Allow sufficient space for maintenance when designing the system.

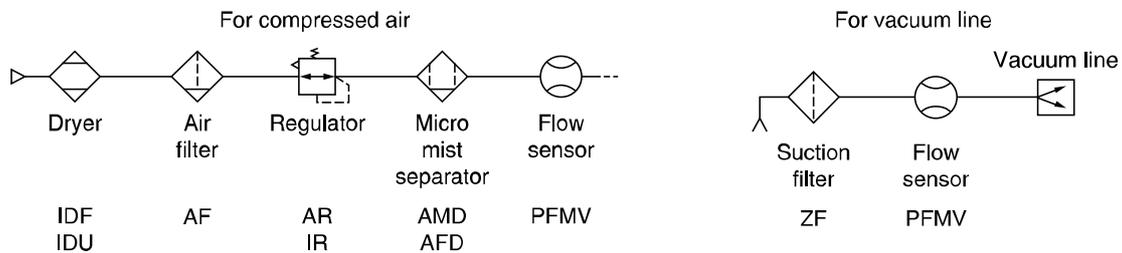
●Product handling

*Installation

- Tighten to the specified tightening torque.
If the tightening torque is exceeded the mounting screws and brackets may be damaged.
If the tightening torque is insufficient, the product may be displaced and the mounting screws may come loose (Refer to page 14 "Mounting and Installation".)
- Ensure that the FG terminal is connected to ground when using a commercially available switch-mode power supply.
- Do not drop, hit or apply excessive shock to the product.
Otherwise damage to the internal parts can result, causing malfunction.
- Do not pull the lead wire forcefully, or lift the product by the lead wire. (Tensile force 49 N or less)
Hold the product body when handling, to prevent damage, failure or malfunction
- When connecting the piping, hold the specified part of the body with a spanner.
Hold the product body when handling, to prevent damage, failure or malfunction
- Any dust left in the piping should be flushed out by air blow before connecting the piping to the product.
Otherwise it can cause damage or malfunction.
- Refer to the flow direction of the fluid indicated on the product label for installation and piping.
- Do not mount the body with the bottom facing upwards.
Retention of air can cause inability to measure accurately.
- Do not insert metal wires or other foreign matter into the piping port.
This can damage the sensor causing failure or malfunction.
- Never mount a product in a location that will be used as a foothold.
The product may be damaged if excessive force is applied by stepping or climbing onto it.
- If there is a risk of foreign matter entering the fluid, install and pipe a filter or the mist separator at the inlet to avoid failure and malfunction.

Refer to the figure below for the recommended pneumatic circuit.

Recommended pneumatic circuit



*Wiring

- Do not pull the lead wires.

In particular, never lift a product equipped with fitting and piping by holding the lead wires. Otherwise damage to the internal parts can result, causing malfunction.

- Avoid repeatedly bending or stretching the lead wire, or placing heavy loads on it. Repeated bending stress or tensile stress can cause damage to the sheath, or breakage of the wires. If the lead wire can move, fix it near the body of the product.

The recommended bend radius of the lead wire is 6 times the outside diameter of the sheath, or 33 times the outside diameter of the wire insulation material, whichever is larger.

Replace any damaged lead wire with a new one.

- Wire correctly.

Incorrect wiring can damage the product.

- Do not perform wiring while the power is on.

Otherwise damage to the internal parts can result, causing malfunction.

- Do not route wires and cables together with power or high voltage cables.

Otherwise the product can malfunction due to interference or noise and surge voltage from power and high voltage cables.

- Confirm proper insulation of wiring.

Poor insulation (interference from another circuit, poor insulation between terminals, etc.) can lead to excess voltage or current being applied to the product, causing damage.

- Keep wiring as short as possible to prevent interference from electromagnetic noise and surge voltage.

Do not use a cable longer than 10 m.

Wire the DC (-) line (blue) as close as possible to the power supply.

- When analogue output is used, install a noise filter (line noise filter, ferrite element, etc.) between the switch-mode power supply and this product.

*Environment

- Do not use the product in area that is exposed to corrosive gases, chemicals, sea water, water or steam.
Otherwise failure or malfunction can result.
- Do not use in a place where the product could be splashed by oil or chemicals.
If the product is to be used in an environment containing oils or chemicals such as coolant or cleaning solvent, even for a short time, it may be adversely affected (damage, malfunction, or hardening of the lead wires)
- Do not use in an area where electrical surges are generated.
If there is equipment generates large electrical surges (solenoid type lifter, high frequency induction furnace, motor, etc.) close to the product, damage or failure of the internal circuit may occur. Take measures against the surge sources, and prevent the wires from coming into close contact.
- Do not use a load which generates a surge voltage.
When a surge-generating load such as a relay or solenoid is driven directly, use a product with a built-in surge absorbing element.
- The product is CE marked, but not immune to lightning strikes. Take measures against lightning strikes in the system.
- Do not use the product in areas that are exposed to vibration or impact.
Otherwise failure or malfunction can result.
- Do not use the product in the presence of a magnetic field.
This may lead to the malfunction of the product.
- Prevent foreign matter such as wire debris from entering the product.
Otherwise failure or malfunction can result.
- Do not use the product in areas subject to large temperature cycle.
Heating/cooling cycles other than ordinary changes in temperature can adversely affect the internal structure of the product
- Do not expose the product to direct sunlight.
If using in a location directly exposed to sunlight, use a suitable protective cover.
Otherwise failure or malfunction can result.
- Keep within the operating fluid temperature and operating temperatures range.
The operating fluid temperature and operating temperature range is 0 to 50 °C.
Operation below the minimum temperature limit may cause damage or operation failure due to frozen moisture in the fluid or air.
Protection against freezing is necessary.
An air dryer is recommended for elimination of drainage and water.
Avoid sudden temperature changes even within the specified temperature range.
- Do not operate close to a heat source, or in a location exposed to radiant heat.
Otherwise malfunction can result.

***Adjustment and Operation**

- Do not short-circuit the load.

When the product load is short circuit, generated excess current lead to cause the damage of the product.

- Supply the power when there is no flow.

***Maintenance**

- Perform regular maintenance and inspections.

There is a risk of unexpected malfunction.

- Turn off the power supply, stop the supplied air, exhaust the residual pressure and verify the release of air before performing maintenance.

There is a risk of unexpected malfunction.

- Perform drainage regularly.

If condensate enters the secondary side, it can cause operating failure of pneumatic equipment.

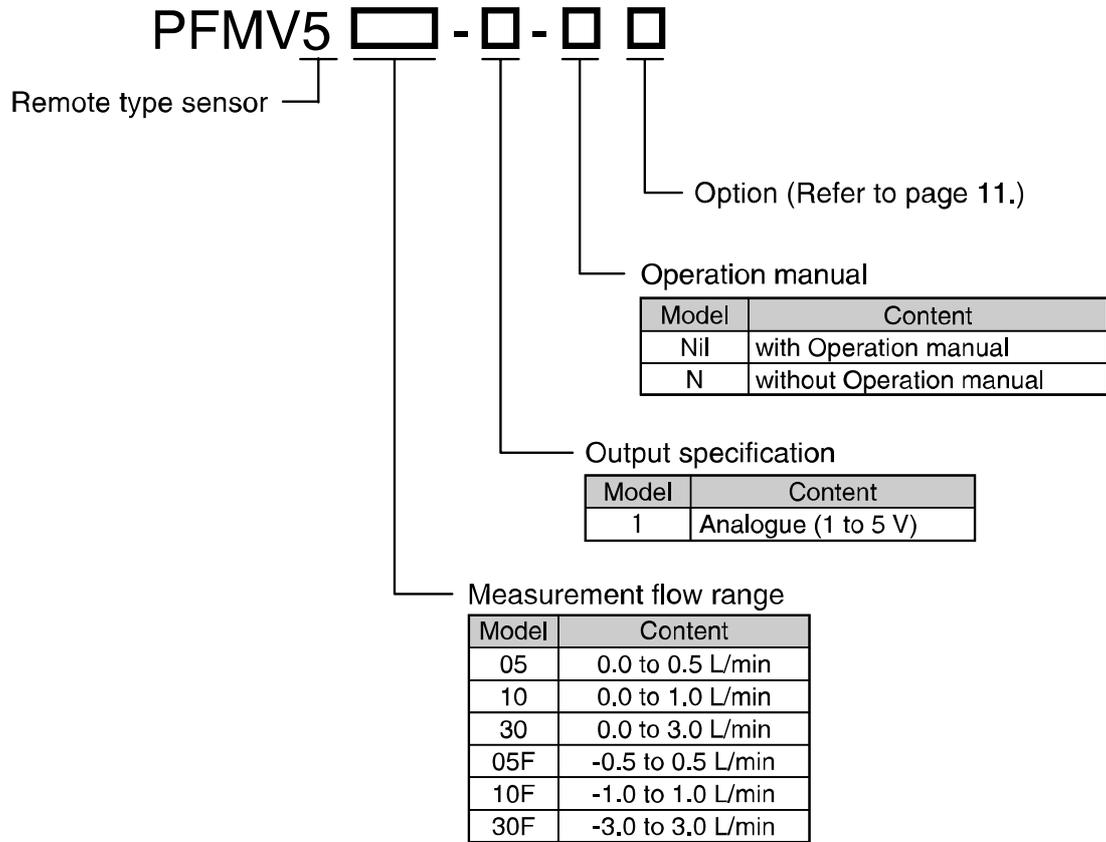
- Do not use solvents such as benzene, thinner etc. to clean the product.

They could damage the surface of the body and erase the markings on the body.

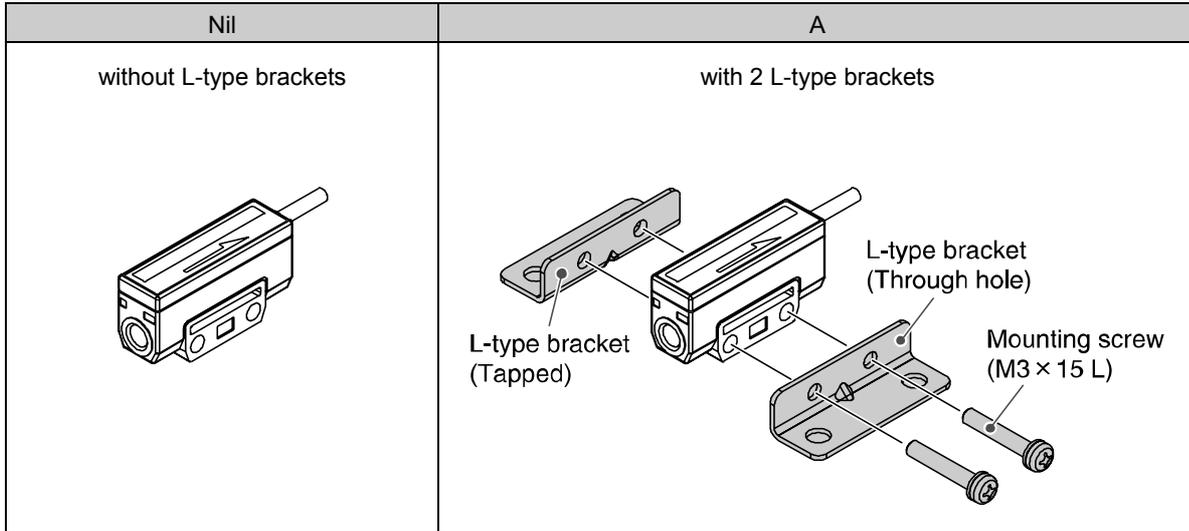
Use a soft cloth to remove stains.

For heavy stains, use a cloth lightly dampened with diluted neutral detergent, then wipe up any residue with a dry cloth.

Model Indication and How to Order



Option



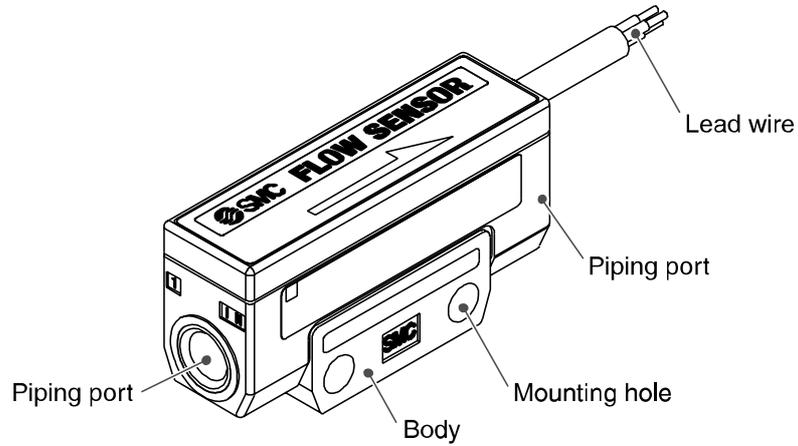
*: Each accessory is not assembled with the product, but shipped together.

Accessories / Part number

If an accessory is required separately, order using the following part numbers.

Part number	Description	Remarks
ZS-36-A1	1 station : 2 L-type brackets	With mounting screws (M3 x 15 L) 2 pcs.
ZS-36-A2	2 station : 2 L-type brackets	With mounting screws (M3 x 25 L) 2 pcs.
ZS-36-A3	3 station : 2 L-type brackets	With mounting screws (M3 x 35 L) 2 pcs.
ZS-36-A4	4 station : 2 L-type brackets	With mounting screws (M3 x 45 L) 2 pcs.
ZS-36-A5	5 station : 2 L-type brackets	With mounting screws (M3 x 55 L) 2 pcs.

Summary of Product parts



Item	Description
Piping port	Connection port for piping.
Body	The body of the product.
Mounting hole	Used to mount the product on a DIN rail or directly, to a panel.
Lead wire	Lead wire to supply power and transmit output signals.

■ Definition and terminology

	Terminology	Definition
A	Analogue output	A type of variable output that has a value proportional to the measured quantity. When the analogue output is in the range of 1 to 5 V, it will vary continuously, following the change of flow.
F	F.S. (Full span, Full scale)	Stands for "full span" or "full scale", and indicates varied analogue output range at rated value. For example, when analogue output is 1 to 5 V, F.S. = 5[V] - 1[V] = 4[V], (ref. 1%F.S. = 4[V]x1% = 0.04[V]) The maximum measuring range or change in analogue output over the maximum measurement range.
N	Non-linear output	Indicates non linear output.
O	Operating fluid temperature	The fluid temperature range within which the product will meet all published specifications.
	Operating humidity range	The ambient humidity range within which the product will meet all published specifications.
	Operating pressure range	The pressure range within which the product will meet all published specifications.
	Operating temperature range	The ambient temperature range within which the product will meet all published specifications.
P	Part in contact with fluid	A part that comes into physical contact with the fluid.
	Pressure characteristic	The amount of variation in the analogue output when the supply pressure is changed.
	Proof pressure	The pressure beyond which the product will be damaged.
R	Rated flow range	The flow range within which the product will meet all published specifications.
	Rated ressure range	The pressure range within which the product will meet all published specifications.
	Repeatability	Reproducibility of the analogue output value, when the flow is repeatedly changing.
	Response time	The time from when the flow is applied as a step input (when the flow rate changes from 0% to 100% instantaneously) until the analogue output (voltage) reaches 90% of the actual flow rate.
	Ripple	Indicates pulsation.
T	Temperature characteristic	The amount of variation in the analogue output or display value when the ambient temperature is changed.

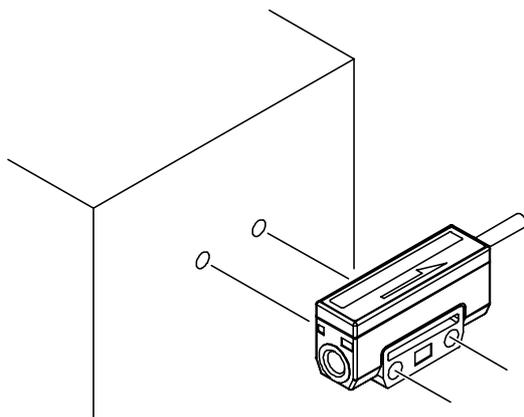
Mounting and Installation

■ Installation

When the product is installed in a vertical direction, a natural convection is generated due to the sensor characteristics around the zero flow range, so there is a possibility that an error up to approximately 3% F.S. might be generated. Install the product taking this into consideration.

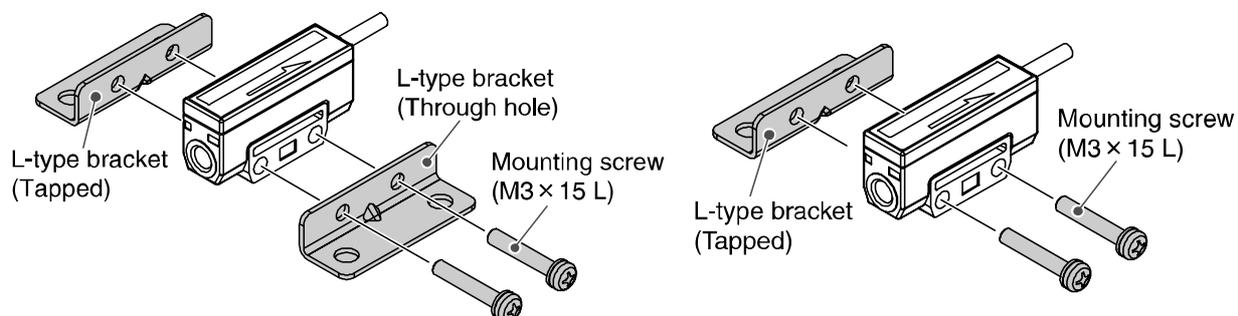
Direct mounting

- Install the product using the M3 screws (2 pcs.).



Bracket mounting

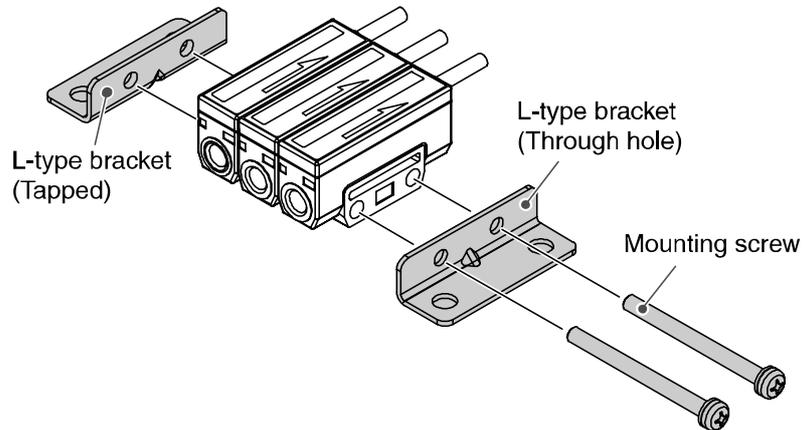
- Mount the bracket using the mounting screws (M3 x 15 L) supplied.
- The required tightening torque is 0.32 ± 0.02 Nm.



- Install the product (with bracket) using the M4 screws (2 pcs. or 4 pcs.).
- Bracket thickness is approximately 1 mm.
- Refer to the dimension drawing of the bracket (page 22) for mounting hole dimensions.

Manifold mounting

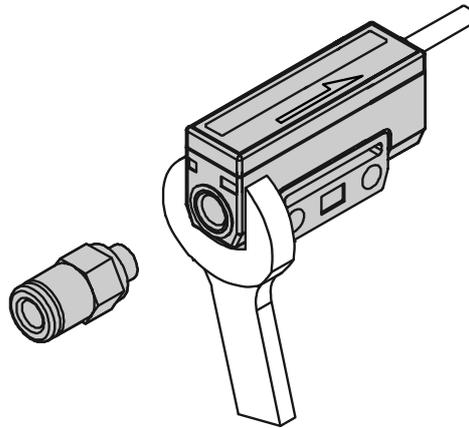
- Mount the bracket using the mounting screws supplied.
- The required tightening torque is 0.32 ± 0.02 Nm.
- Mounting in series using the mounting brackets is not suitable for all models, depending on which fitting type is used.



- Install the product (with bracket) using the M4 screws (4 pcs.).
- Bracket thickness is approximately 1 mm.
- Refer to the dimension drawing of the bracket (page 22) for mounting hole dimensions.

■Piping

- The required tightening torque of the fitting is 1 to 1.5 Nm.
- If the tightening torque is exceeded, the product can be broken. If the tightening torque is insufficient, the fittings may become loose.
- When connecting the piping, hold the specified part of the body with a spanner.
Using a spanner on other parts may damage the product.
- Avoid any sealing tape from entering inside the piping.
- Ensure that there is no leakage from loose piping.
- Avoid sudden changes in the piping size on the IN side of the sensor.
- Use this product within the specified operating pressure and temperature ranges.
- Use this product within the rated flow range.
- Proof pressure is 500 kPa.



PFMV5 series recommended fitting list

One-Touch fitting / Series KQ2

Type	Tube dimension mm	Port size	Model
Male Connector	4	M5×0.8	KQ2H04-M5
Hexagon socket head male connector			KQ2S04-M5
Male elbow			KQ2L04-M5

One-Touch mini/ / Series KJ

Type	Tube dimension mm	Port size	Model
Male Connector	4	M5×0.8	KJH04-M5
Hexagon socket head male connector			KJS04-M5
Male elbow			KJL04-M5

Miniature fitting / /Series M

Type	Tube dimension mm	Port size	Model
Barb fittings for nylon tubing	4	M5×0.8	M-5AN-4
	6		M-5AN-6

■ Wiring

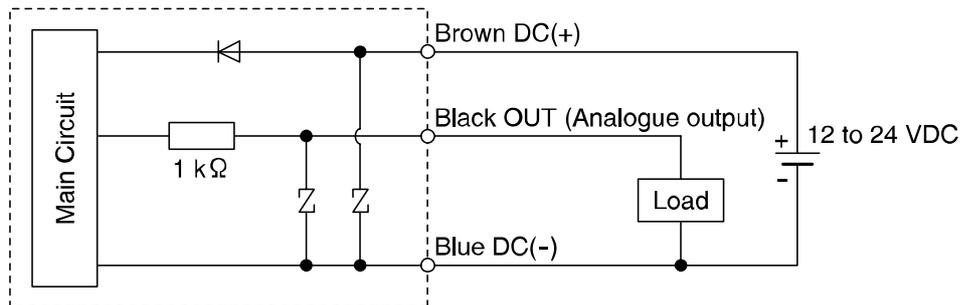
Wiring of connector

- Connections should only be made with the power supply turned off.
- Use separate routes for the product wiring and any power or high voltage wiring. Otherwise, malfunction may result due to noise.
- Ensure that the FG terminal is connected to ground when using a commercially available switch-mode power supply. When a switch-mode power supply is connected to the product, switching noise will be superimposed and the product specification can no longer be met. This can be prevented by inserting a noise filter, such as a line noise filter and ferrite core, between the switch-mode power supply and the product, or by using a series power supply instead of a switch-mode power supply.

Lead wire

Colour	Content
Brown	DC(+)
Black	OUT (Analogue output)
Blue	DC(-)

Internal circuit and wiring example



Analogue output: 1 to 5 V

Output impedance: approx. 1 kΩ

Troubleshooting

Troubleshooting

If an operation failure occurs with the product, use the chart below to find out the cause of the problem. If none of the countermeasures seem to be applicable, or a replacement product operates normally when installed, the product may be faulty. A product can be damaged by the operating environment (system configuration etc). If the product seems to be faulty, please contact SMC.

•Faults and countermeasures

Fault	Status	Possible cause	Item to check	Countermeasure
Incorrect output	No output	Incorrect wiring	Check that the brown, blue, black and white wires are connected correctly.	Correct the wiring.
		Connector is disconnected	Check the connectors.	Correct the connector wiring.
	Output is unstable	Foreign matter has entered the flow passage or adhered to the sensor	(1) Check if any foreign matter has entered the flow passage (2) Check if there is foreign matter on the mesh.	Install a filter or mist separator on the IN side.
		Mounting direction of the product and signal output direction do not match	Check that the mounting direction of the product and the analogue voltage output direction are the same as the flow direction.	Mounting direction of the product, analogue signal output direction and fluid flow direction should be the same. (Refer to page 20)
		Flow is pulsing	Check if there is any supply pressure fluctuation or pressure pulsation due to the characteristics of the source compressor (or pump).	Install an accumulator tank to reduce the pressure fluctuation. Change the pressure source to one that has less pulsation.
		Vibration	Check if there is vibration in the place where the sensor is installed.	Do not apply vibration to the sensor.
		Air leakage	Check for air leakage due to loose piping or insufficient sealant, etc.	Reconnect the piping with the specified tightening torque and re-apply the sealant tape.

Specifications

■ Specifications

Model	PFMV505	PFMV510	PFMV530	PFMV505F	PFMV510F	PFMV530F
Applicable fluid	Dry air, N ₂ (air quality class to ISO8573-1 1.1.2 to 1.6.2, JIS B8392-1 1.1.2 to 1.6.2)					
Rated flow range *1 (measurement range)	0 to 0.5 L/min	0 to 1 L/min	0 to 3 L/min	-0.5 to 0.5 *2 L/min	-1 to 1 *2 L/min	-3 to 3 *2 L/min
Repeatability	±2%F.S. max. *3					
Temperature characteristics (25 °C reference)	±2%F.S. max. (15 to 35 °C) ±5%F.S. max. (0 to 50 °C)					
Pressure characteristic (0 kPa reference *4)	±2%F.S. max. (0 to 300 kPa) ±5%F.S. max. (-70 to 0 kPa)					
Rated pressure range	-70 kPa to 300 kPa					
Operating pressure range	-100 kPa to 400 kPa					
Proof pressure	500 kPa					
Analogue output (Non-linear output)	Output voltage	1 to 5 V				
	Response time	5 ms or less				
	Output impedance	Approx. 1 kΩ				
Supply voltage	12 to 24 VDC±10%, ripple(p-p) 10% or less (with polarity protection)					
Power consumption	16 mA or less					
Environment	Enclosure	IP40				
	Operating fluid temperature	0 to 50 °C (no freezing or condensation)				
	Operating temp. range	Operating: 0 to 50 °C Stored: -10 to 60 °C (no freezing or condensation)				
	Operating humidity range	Operating, stored: 35 to 85%R.H. (no condensation)				
	Withstand voltage	1000 VAC, 1 min between battery and the body				
	Insulation resistance	50 MΩ min. (at 500 VDC) between terminals and case				
Port size	M5 x 0.8 (tightening torque: 1 to 1.5 N·m or less)					
Fluid contact material	PPS, Si, Au, SUS316, C3604 (electroless nickel plating)					
Weight	30 g (with lead wire), 10 g (without lead wire)					

*1: Converted value of volume flow at ANR (20 °C, 101.3 kPa, 65%R.H.)

*2: Analogue output shows 3 V when flow is zero. Changes to 5 V side when flow direction is IN→OUT. 1 V side when OUT→IN.

*3: %F.S. in the table takes 4 V (1 to 5 V) as a full scale.

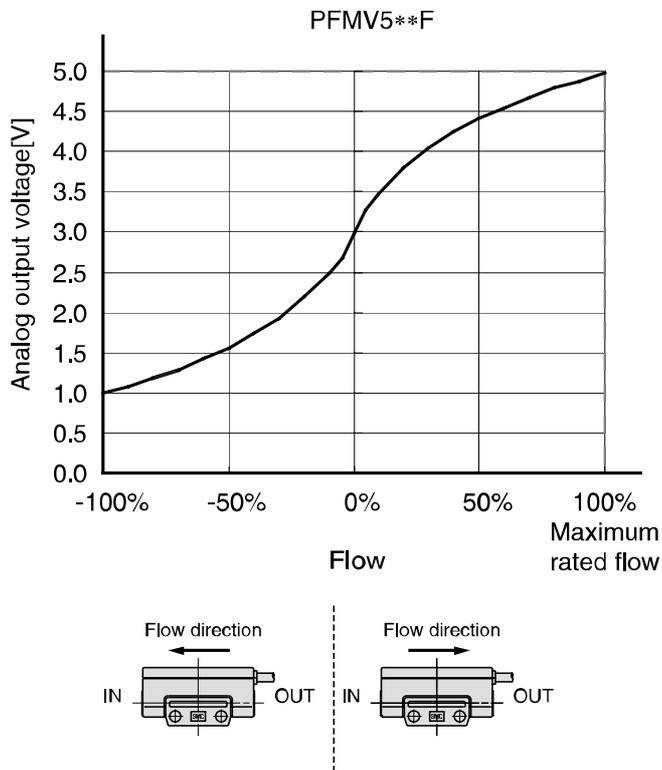
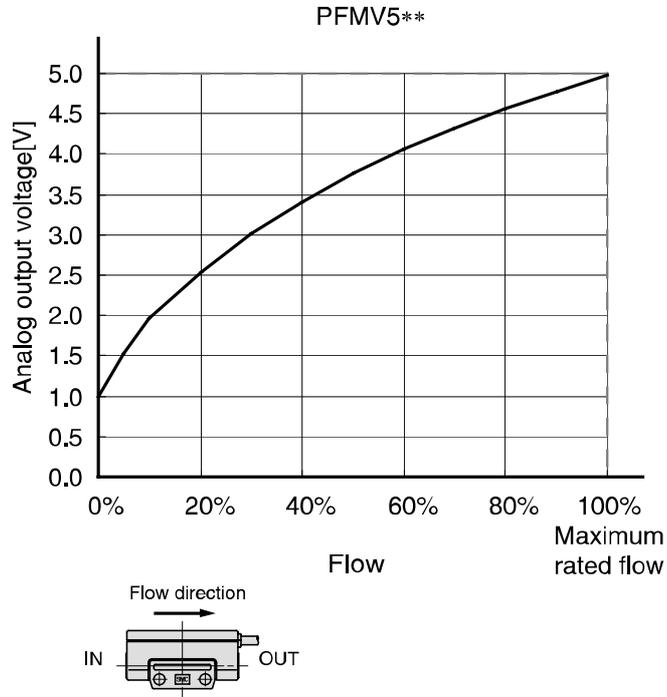
*4: 0 kPa means release to the atmosphere.

Cable specifications

Conductor	Nominal cross section area	approx. 0.15 mm ² ,
	Individual wire diameter	approx. 0.58 mm
Insulator	Outside diameter	approx. 0.88 mm
	Colours	Brown, Blue, Black
Sheath	Material	Oil-resistant, Heat resistant vinyl
	Outer diameter	approx. φ2.6 mm

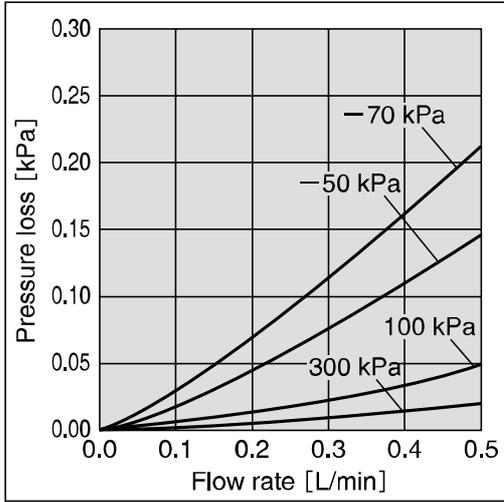
■ Characteristics data

- Analogue output characteristics (Non-linear output)

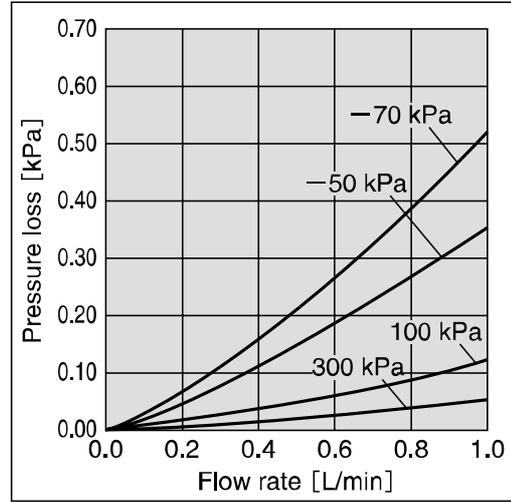


● Pressure loss

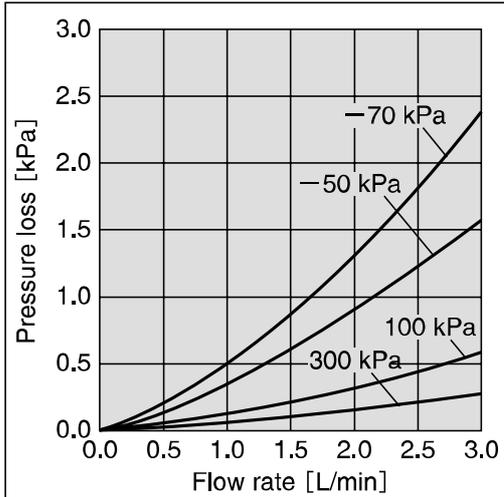
PFMV505(F)-1



PFMV510(F)-1



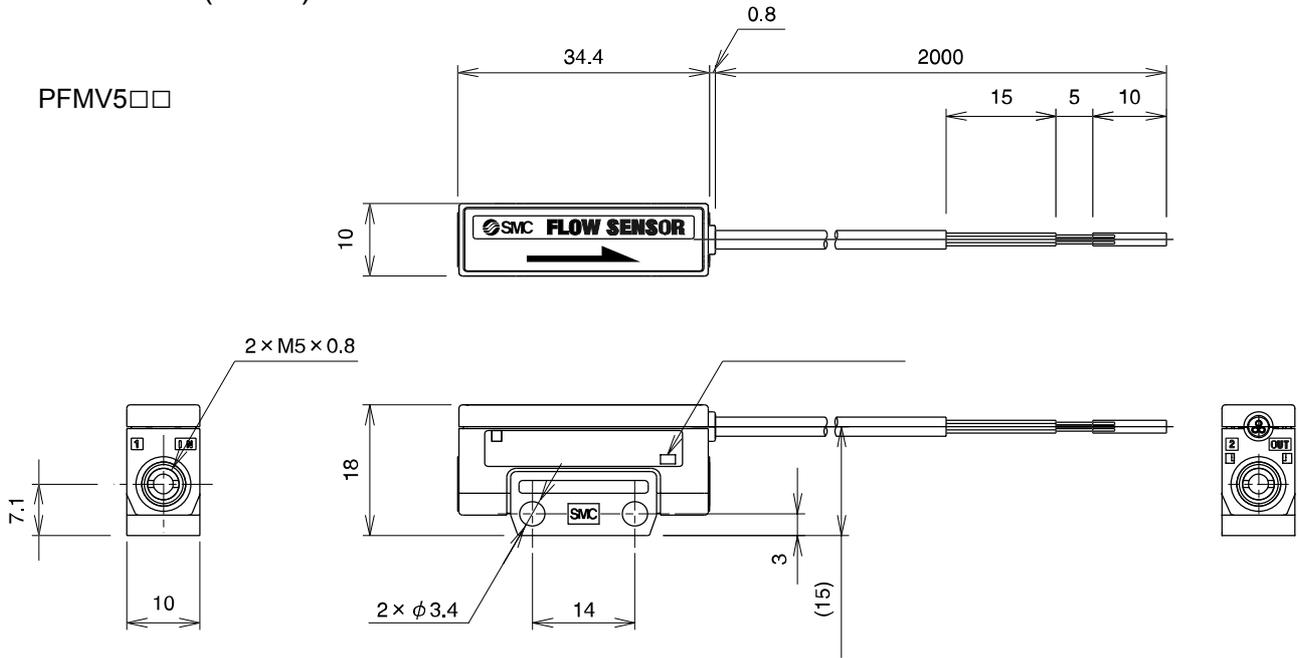
PFMV530(F)-1



- Nozzle diameter and flow characteristics (Approximate values)
Refer to catalog for details.

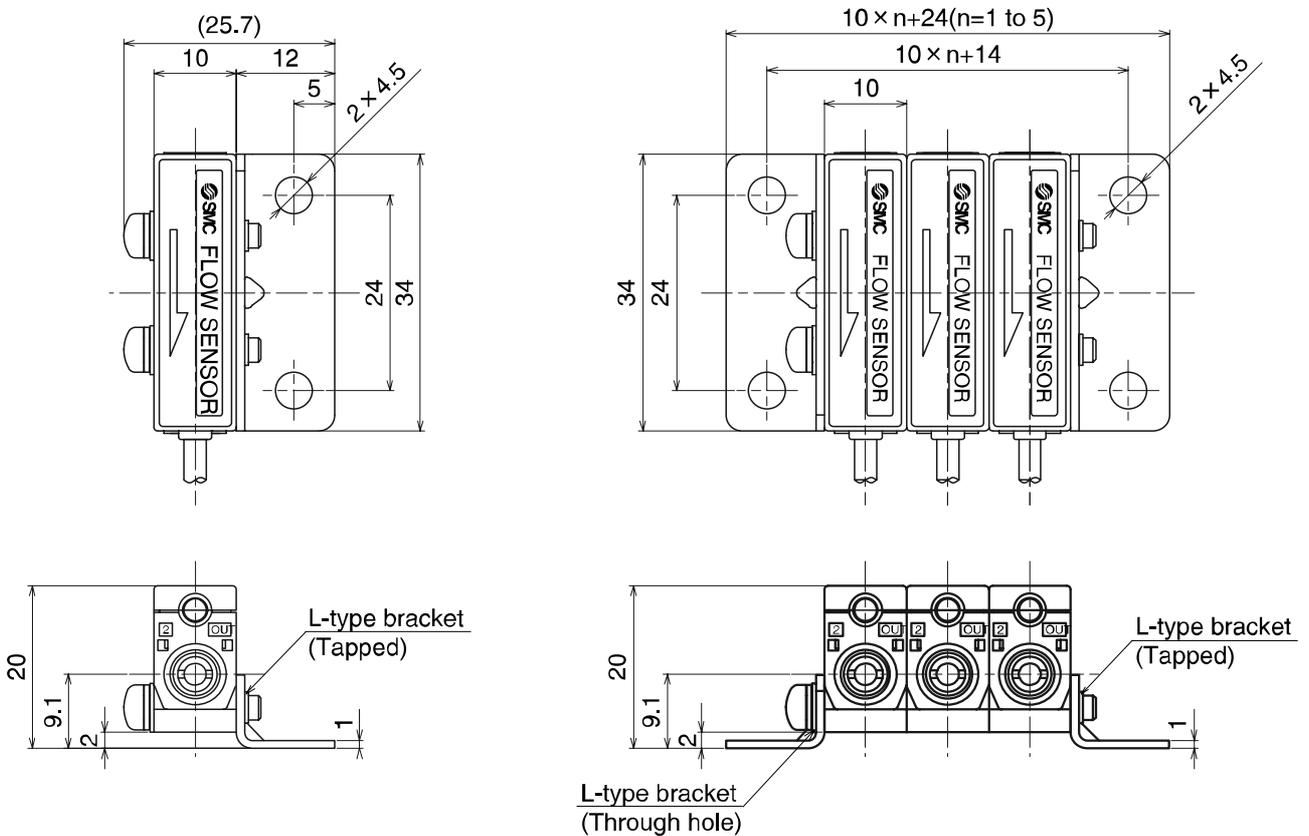
■ Dimensions (in mm)

PFMV5□□



PFMV5□□ + L-type bracket
Mount on one side

Mount on both sides



Revision history

A: Revise contents partly several.
B: Complete revision.
C: Revise contents partly several.

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