



# Operation Manual

PRODUCT NAME

Flow Sensor

MODEL / Series / Product Number

*PF3W5##*

**SMC Corporation**

## Table of Contents

Safety Instructions	2
Model Indication and How to Order	11
Summary of Product parts	13
Definition and terminology	14
Mounting and Installation	15
Installation	16
Piping	18
Wiring	20
Flow (Temperature) Measurement	21
Maintenance	22
Troubleshooting	23
Specification	26
Specifications	26
Applicable fluids	29
Characteristics graph	30
Analogue output	36
Dimensions	37
Made to order	43

## 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 10218-1: 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**

### **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. \*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.

## Operator

- ◆ This operation manual has been written for those who have knowledge of machinery and apparatus that use pneumatic equipment and have full knowledge of assembly, operation and maintenance of such equipment.
- ◆ Please read this operation manual carefully and understand it before assembling, operating or providing maintenance to the product.

### ■ Precautions

#### **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 with flammable or highly permeable fluids.  
Fire, explosion, damage or corrosion can result.
- 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 operation.Otherwise malfunction can result, causing an accident.
- The following instructions must be followed during maintenance:
  - Turn off the power supply.
  - Ensure the flow is shut off before performing maintenance.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.
- Do not touch the piping or its connected parts when the fluid is at high temperature.  
It may lead to burnt.  
Ensure the piping cools sufficiently before touching.
- 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 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 to be used should be UL approved as follows.
    - Circuit (of class 2) which is of maximum 30 Vrms (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 life of the product.
  - Confirm the pressure loss at the sensor according to the flow rate characteristics (pressure loss) graph before designing piping.
    - Confirm detection condition of sensor electrified potential.
  - The applicable fluids are water (0 to 90 °C) and ethylene glycol solution with a viscosity of 3 mPa·s (3 cP) or less.
    - Measurement accuracy is not guaranteed if other fluids are used.
    - Do not use fluids containing chemicals, synthetic oils, organic solvents, salt or corrosive gases.
    - Using such fluids can result in malfunction and damage to the product.
    - Check the details of the specifications before use.
  - Consider measures to prevent over pressure due to water hammer.
    - <Measures to reduce water hammer>
      1. Install a water hammer relieving valve.
      2. Use a flexible material for piping (such as a rubber hose) and an accumulator that can absorb impact pressure.
      3. Keep piping as short as possible.
  - Use the product within the specified operating pressure and temperature range.
  - Proof pressure is 1.5 MPa. Proof pressure could be changed depending on the fluid temperature.
    - Check the characteristics data for operating pressure and proof pressure.
  - 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, brackets and the product can be broken. Insufficient torque can cause displacement of the product from its proper position and the looseness of the mounting screws. (Refer to "Mounting and Installation" on page 15.)

- Be sure to ground terminal FG when using a commercially available switch-mode power supply.
- Do not use in a place subject to heavy vibration and/or shock.

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

- Do not pull the lead wire forcefully, not lift the product by pulling the lead wire. (Tensile force 49 N or less)

Hold the body when handling to avoid the damage of the product.

The product will be damaged, leading to failure and malfunction.

- For piping of the product, hold the piping with a spanner on the metal part of the piping (Piping attachment).

Applying the spanner to other parts may lead to damage to the product.

In particular, do not let the spanner come into contact with the M8 connector.

The connector can be easily damaged.

- Eliminate any dust left in the piping 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 model number plate or the body for installation and piping.

Residual air can cause errors in measurement accuracy.

- Avoid piping in which the piping size of the IN side of the switch changes suddenly.

If the piping size is reduced sharply or there is a restrictor such as a valve on the IN side, fluid velocity distribution in the piping will be disturbed, leading to improper measurement.

Therefore, the above-mentioned piping should be connected on the OUT side.

If the OUT side is opened, or flow rate is excessive, cavitations may be generated, which may result in improper measurement.

As a measure against this, it is possible to reduce the cavitations by increasing the fluid pressure.

Take action such as mounting an orifice on the OUT side of the switch, and confirm that there is no malfunction before handling.

If the orifice of the OUT side is fully closed to operate the pump, the switch may malfunction due to the effect of pulsation (pressure fluctuation). Ensure that there is no malfunction before usage.

- Do not insert metal wires or other foreign objects into the flow path.

Such actions can damage the sensor causing failure or malfunction.

- Never mount the product in a location that will be used as a scaffold.

The product may be damaged if excessive force is applied by stepping or climbing onto it.

- If the fluid may contain foreign matter, install and connect a filter or mist separator to the inlet.

The adherence of foreign matter to the vortex generator or detector can cause errors in measurement accuracy. A filter of approx. 40 mesh is recommended.

- Design and install the application so that the fluid detection path is always full.

- If the product is mounted vertically, let the liquid flow from bottom to top.

Trapped air bubbles can cause errors in measurement accuracy.

(If the fluid detection path is always filled with liquid, there will be no problem.)

#### \*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 or disconnection from the connector.

- Avoid repeatedly bending, stretching or applying a heavy object or force to the lead wire.

Repetitive bending or tensile stress can cause the sheath of the wire to peel off, or break the wire.

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 insulation material, whichever is larger.

Replace a damaged lead wire with a new one.

- Wire correctly.

Incorrect wiring can break 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 of noise and surge voltage from power and high voltage cables to the signal line. Route the wires (piping) of the product separately from power or 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 the 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 an environment that is constantly exposed to the splash of water.  
Otherwise failure or malfunction can result. Take measures such as using a cover.
- Do not use the product in an environment where corrosive gases or fluids could be splashed.  
Otherwise damage to the product and malfunction can result.
- Do not use in a place where the product could be splashed by oil or chemicals.  
If the product is 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 surges are generated.  
When a machine or equipment generating large surge near the product (magnetic type lifter, high frequency inductive furnace, motor, etc.), this can result in malfunction (display of incorrect value), deterioration and damage of internal elements. Take measures against the surge sources, and prevent the lines from coming into close contact.
- Do not use a load which generates surge voltage.  
When a surge-generating load such as a relay or solenoid is driven directly, use a Flow switch 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.
- Mount the product in a location that is not affected by vibration or impact.  
Otherwise failure or malfunction can result.
- Do not use the product in the presence of a magnetic field.  
Such use can result in malfunction of the product.
- Do not let foreign matter, such as wire debris, get inside the product.  
To prevent malfunction or failure take measures to prevent the debris entering the product.
- Do not use this product in places where there are cyclic temperature changes.  
Heat cycles other than ordinary changes in temperature can adversely affect the inside of the product.
- Do not expose the product to direct sunlight.  
If using in a location directly exposed to sunlight, shade the product from the sunlight.  
Otherwise failure or malfunction can result.
- Keep within the specified fluid and ambient temperatures range.  
The fluid temperature range is 0 to 90 °C and ambient temperature range is 0 to 50 °C.  
If the fluid freezes, it may cause damage and malfunction of the switch, so please take measures to prevent freezing.  
When a fluid at a lower temperature than the ambient temperature is supplied, the product can break due to condensation and malfunction. Keep the product from having condensation.  
Do not install the switch piping vertically or upside-down, otherwise damage will occur in early stage of operation due to dripping of water.  
Protection against freezing is necessary.  
Avoid sudden temperature change even within specified temperature. Otherwise failure or malfunction can result.
- Do not operate close to a heat source, or in a location exposed to radiant heat.  
This can cause operating failure.

**\*Adjustment and Operation**

- Do not short-circuit the load.

Although error is displayed when the product load has a short circuit, generated over current lead to cause the damage of the product.

- Supply the power when there is no flow.
- The product is compulsory turned off for 3 seconds after the power is supplied.

**\*Maintenance**

- Turn off the power supply, stop the fluid and check the safety before performing any maintenance.

There is a risk of unexpected malfunction.

- Perform regular maintenance and inspections.

There is a risk of unexpected malfunction of components due to the malfunction of equipment and machinery.

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

They could damage the surface of the product and erase the indication on the product.

Use a soft cloth to remove stains. For heavy stains, use a cloth soaked with diluted neutral detergent and fully squeezed, then wipe up the stains again with a dry cloth.

\*Handling of flow adjustment valve

- When flow is adjusted with the flow adjustment valve, do not apply excessive force to rotate it.  
This can damage the valve mechanism.
- When fixing the valve of the flow adjustment valve, do not apply excessive force to rotate the fixing knurl.  
This can damage the knurl and valve mechanism.
- After adjusting the flow, be sure to check that there is no water leakage.  
After adjusting the flow, water leakage may occur due to the stability of the seal in the valve. If water leakage occurs, open and close the valve several times to readjust it, and check that there is no water leakage.
- The flow rate adjustment valve of this product is not suitable for applications which require constant adjustment of flow rate.  
Fluid leakage may be generated when the internal seal reaches the end of its life due to wearing. Therefore, take measures to protect peripheral equipment, ensure maintenance space and pay attention to the piping design.
- The flow rate adjustment valve of this product is not suitable for applications which require reducing the flow rate to zero completely. If it is necessary to reduce the flow rate to zero completely, install a stop valve etc. separately.
- Do not lift it by gripping the knob of the flow adjustment valve.
- Hold the body when handling to avoid damaging the product.
- If fluids with high temperature are flowed, the flow adjustment valve itself will also become hot, which leads to a burn. Therefore, use the flow adjustment valve with special care.

\*Vinyl chloride piping

- The vinyl chloride fitting (union) must be mounted and joined by an engineer with sufficient knowledge.  
Be sure to confirm that there is no leakage from the fitting after mounting and joining. If it is mounted and joined by a person who does not have sufficient knowledge and skills, it may lead to failure such as leakage.
- When selecting adhesive for the vinyl chloride fitting (union), confirm that its heat resistance and endurance are compatible with the operating temperature of the fluids used.  
Otherwise, this may cause leakage and damage.
- Do not apply excessive force to the vinyl chloride piping.  
This may cause damage.
- When the vinyl chloride piping type is used, the higher the fluid temperature, the lower the proof pressure will be. Therefore, adjust the water hammer pressure carefully so that it does not exceed the proof pressure.

# Model Indication and How to Order

PF3W5   -   -    -    -    -

Separate type sensor part

Rated flow range  
(Flow range)

Symbol	Content
04	0.5 to 4 L/min
20	2 to 16 L/min
40	5 to 40 L/min
11	10 to 100 L/min

Flow adjustment valve

Symbol	Content	Rated flow range			
		04	20	40	11
Nil	None	●	●	●	●
S	With flow adjustment valve	●	●	●	-

\*: A flow rate adjustment valve cannot be mounted onto the 100 L/min type.

Thread type

Symbol	Content	Rated flow range			
		04	20	40	11
Nil	Rc	●	●	●	●
N	NPT	●	●	●	●
F	G	●	●	●	●
U	PVC tube	-	-	-	●

Port size

Symbol	Port size	Rated flow range			
		04	20	40	11
03	3/8	●	●	-	-
04	1/2	-	●	●	-
06	3/4	-	-	●	●
10	1	-	-	-	●
25	25A	-	-	-	●

Output specification

Symbol	Analogue output (Flow)	Analogue output (Temp.)
1	1 to 5 V	-
2	4 to 20 mA	-
1T	1 to 5 V	1 to 5 V

\*: OUT2 is only available for T type (type with temperature sensor).

Made to order  
(Refer to page 43.)

Calibration certificate  
(Only flow sensor)

Symbol	Content
Nil	None
A	With calibration certificate

\*: Written in both Japanese and English.  
The temperature sensor is not calibrated.

Bracket

Symbol	Content
Nil	None
R	With bracket

Unit specification

Symbol	Instantaneous flow	Accumulated flow	Temp.
Nil	L/min	L	°C
G	gal/min	gal	°C
F	gal/min	gal	°F
J	L/min	L	°F

\*: The symbol of G, F, J are specified to order.  
Ref.: 1[L/min] ⇔ 0.2642[gal/min]  
1[gal/min] ⇔ 3.785[L/min]  
[°F] = 9/5 × [°C] + 32

Lead wire

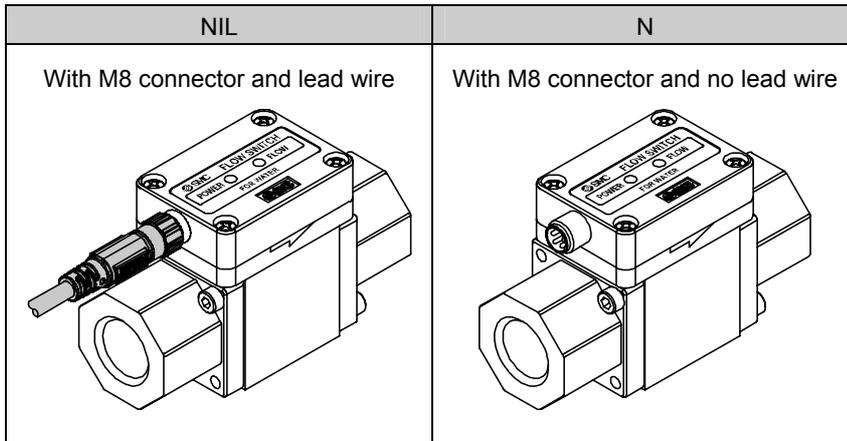
Symbol	Content
Nil	Lead wire with M8 connector (3 m)
N	None

Temperature sensor

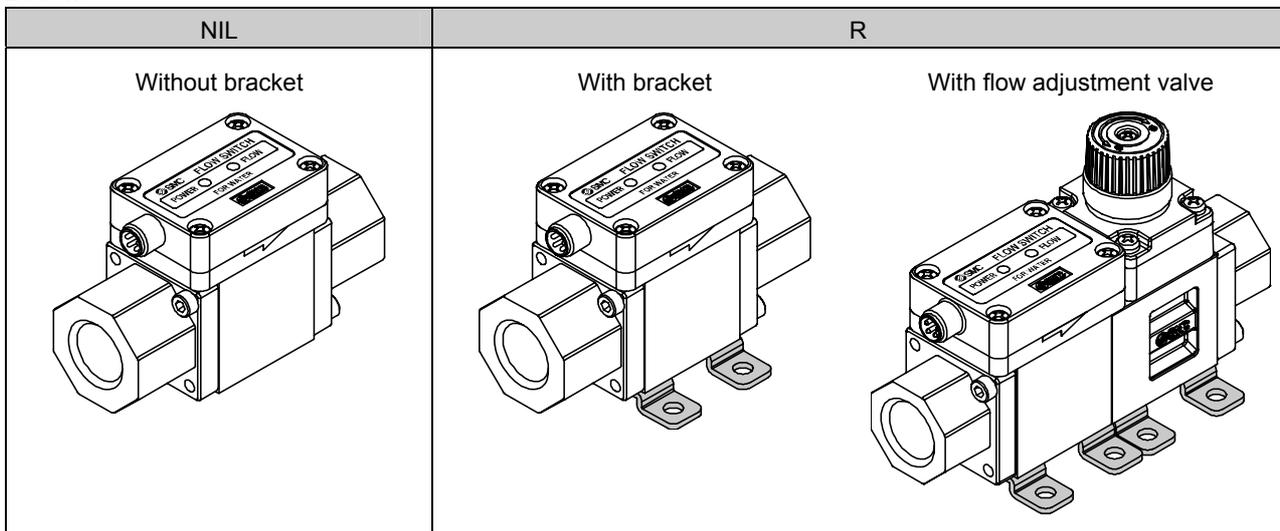
Symbol	Content
Nil	None
T	With temperature sensor

\*: The temperature sensor output is available on OUT2 only.  
It is not possible to use it with U type piping (PVC tube).

### Lead wire



### Bracket



### Options/Part number

If an option is required independently, order using the following part number.

Option	Part number	Remarks
Bracket *	ZS-40-K	Taptite screw for PF3W504/520 (3 x 10), 4 pcs.
	ZS-40-L	Taptite screw for PF3W540 (3 x 10), 4 pcs.
	ZS-40-M	Taptite screw for PF3W511 (4 x 10), 4 pcs.
Lead wire with M8 connector	ZS-40-A	Lead wire length: 3 m

\*: 2 brackets are necessary if using the type with flow rate adjustment valve.

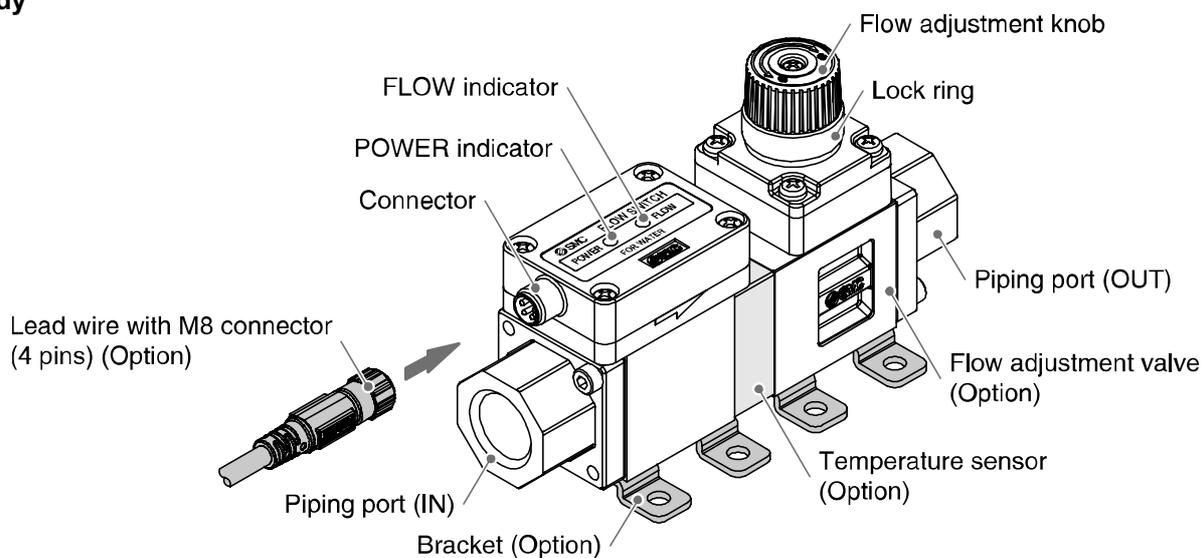
### Replacement part

Element	Part number	Remarks
PVC tube	ZS-40-U25	25A PVC tube 1 pc.
25 A Holding plate	ZS-40-U25-A	1 pc., With two hexagon socket head cap screws of M5 x 80.

\*: Accuracy may vary by 1 to 2%, if PVC tube is replaced.

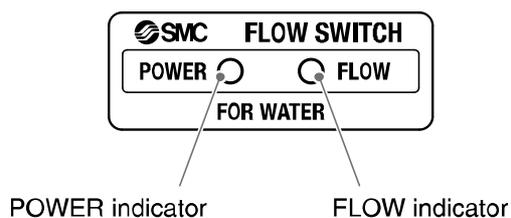
## Summary of Product parts

### Body



Element	Description
Connector	Connector for electrical connections.
Lead wire with M8 connector	Lead wire to supply power and transmit output signals.
Piping port	Port to connect the fluid inlet at IN and fluid outlet at OUT.
Bracket	Bracket for mounting the product.
Temperature sensor	Sensor for detecting the fluid temperature.
Flow adjustment valve	Restricting valve to adjust the flow rate.
Flow adjustment knob	Knob for adjusting the flow rate.
Lock ring	Ring for locking the flow adjustment valve.

### Display



Element	Description
POWER indicator	Displays the power supply and error status and confirms product specifications.
FLOW indicator	Flashes at intervals proportional to the flow rate, and displays the error status. The LED will be OFF when the flow is outside of the rated flow range.

## ■ Definition and terminology

	Terms	Meaning
A	Analogue output	Outputs a value proportional to the flow rate. When the analogue output is in the range 1 to 5 V, it will vary between 1 to 5 V according to the rate of flow. The same for analogue output of 4 to 20 mA.
	Attachment	A metal part at both sides of the product to connect piping.
C	Cavitation	A phenomenon that may occur in a fluid moving at high speed. In the parts of the fluid where the pressure is low, vapour bubbles form and then rapidly collapse. If cavitation is present for a prolonged period, exposed surfaces will be damaged; this is called cavitation damage or erosion.
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] x 1% = 0.04[V])
	FLOW indicator	Used to determine the flow rate status visually. The higher the flow rate, the faster the flashing speed will be. (It may display an error.)
	Fluid temperature	Range of fluid temperature that can be measured by the product.
I	Instantaneous flow	The flow passing per unit of time. If it is 10 L/min, there is a flow of 10 L passing through the device in 1 minute.
K	Karman vortex	When an object is placed in a fluid stream, a vortex will be created in the fluid on the downstream side. This vortex is called a Karman vortex. The frequency at which the vortices are generated is proportional to the fluid velocity, therefore it is possible to calculate the fluid flow rate by measuring the Karman vortex frequency.
M	Measured fluid	The fluid(s) that the product can measure.
O	Operating pressure range	Pressure range in which product is operable.
	Operating temp. range	Ambient temperature range in which product is operable.
P	Part in contact with fluid (wetted part)	A part that comes into physical contact with the fluid.
	POWER indicator	Used to confirm the power supply status. It turns on when the power supply is applied. (It may display the output specification)
	Pressure characteristics	Indicates the change in the display value and analogue output when fluid pressure changes.
	Proof pressure	Burst pressure at which the product is electrically or mechanically damaged.
R	Rated flow range	The flow range within which the product will meet all published specifications.
	Rated pressure range	The pressure range that satisfies the specifications.
	Repeatability	Reproducibility of the display or analogue output value, when the measured quantity is repeatedly increased and decreased.
	Response time	Time from when the target flow is applied until the flow reaches 90% of the set value.
T	Temperature characteristics	Indicates the change in the display value and analogue output caused by ambient temperature changes.
U	Union	Fitting which is connected to the vinyl chloride piping (tube piping).
W	Water hammer	A pressure surge occurring when a moving fluid is forced to stop or change direction suddenly. Water hammer often occurs when a valve is closed suddenly, and a pressure wave propagates in the pipe.

## Mounting and Installation

### Installation

- Use the product within the specified operating pressure and temperature range.
- Proof pressure is 1.5 MPa. Proof pressure could vary according to the fluid temperature. Check the characteristics data for operating pressure and proof pressure.

### Mounting

- Never mount the product in a location where it will be used as a support.
- Mount the product so that the fluid flows in the direction indicated by the arrow on the side of the body.
- Check the flow characteristics data for pressure loss and the straight inlet pipe length effect on accuracy (page 30), to determine inlet piping requirements.
- Do not sharply reduce the piping size.

## ■ Installation

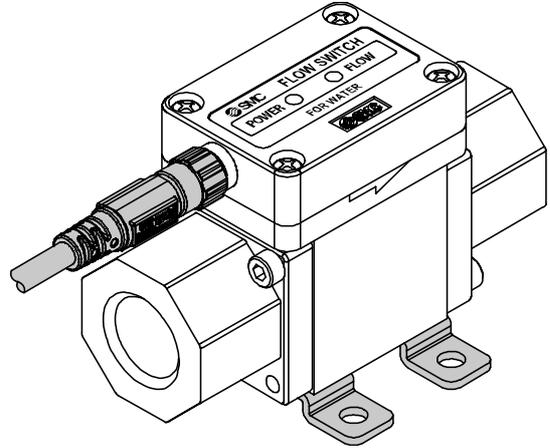
### Bracket mounting (PF3W504/520/540)

Mount the product (with bracket) using the mounting screws supplied (M4 x 4 pcs.).

For models with flow adjustment valve attached, fix using 8 mounting screws.

Bracket thickness is approx. 1.5 mm.

Refer to the outline dimension drawing (page 37) for mounting hole size.

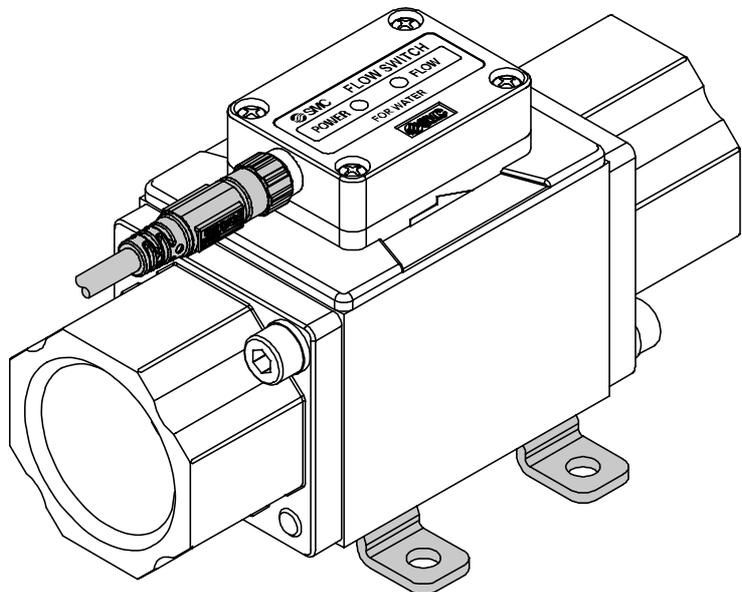


### Bracket mounting (PF3W511)

Mount the product (with bracket) using the mounting screws supplied (M5 x 4 pcs.).

The thickness of the bracket plate is approx. 2 mm.

Refer to the outline dimension drawing (page 37) for mounting hole size.



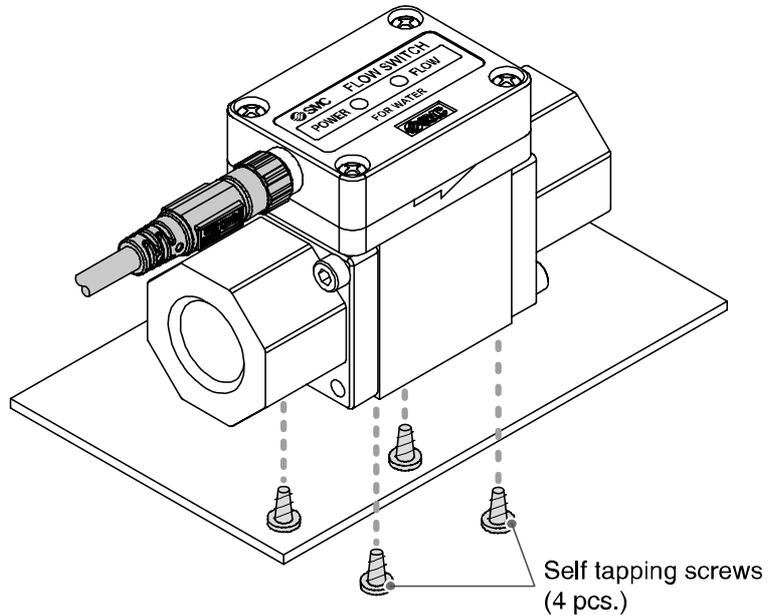
### Direct mounting (PF3W504/520/540)

Mount using the self tapping screws (nominal size: 3.0 x 4 pcs.) for installation.

For models with flow adjustment valve attached, mount using 8 self tapping screws.

The tightening torque must be 0.5 to 0.7 Nm.

Refer to the outline dimension drawing (page 37) for mounting hole dimensions. The self tapping screws should not be re-used.



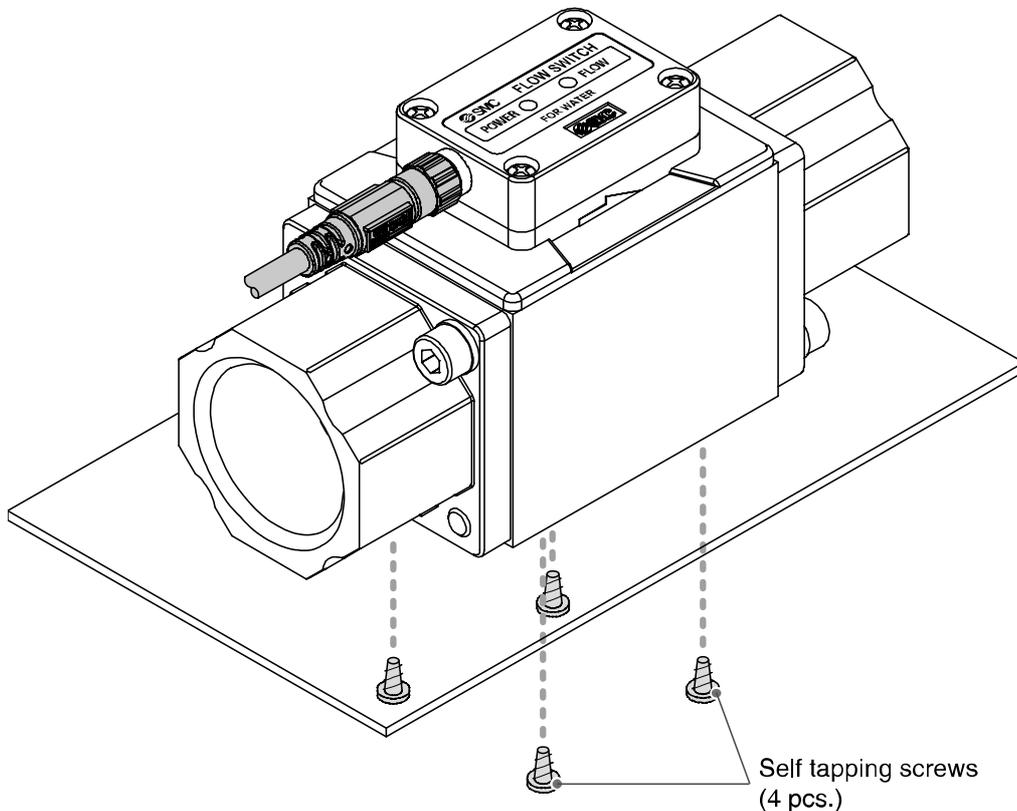
### Direct mounting (PF3W511)

Mount using the self tapping screws (nominal size: 4.0 x 4 pcs.) for installation.

The tightening torque must be 1.0 to 1.2 Nm.

Refer to the outline dimension drawing (page 37) for mounting hole dimensions.

The self tapping screws should not be re-used.

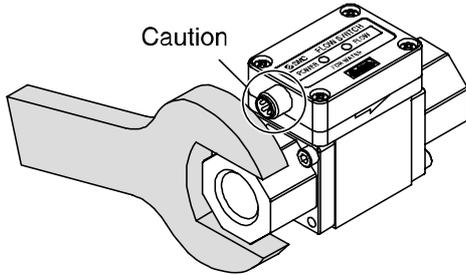


## ■Piping

When connecting piping to the product, a spanner should be used on the metal piping attachment only. Using a spanner on other parts may damage the product.

In particular, do not let the spanner come into contact with the M8 connector.

The connector can be easily damaged.



Width across flats of attachment

3/8	24 mm
1/2	27 mm
3/4	32 mm
1	41 mm

Tighten to the specified torque for piping.

The tightening torque for connection threads is shown in the table below.

Nominal thread size	Tightening torque
Rc(NPT)3/8	22 to 24 Nm
Rc(NPT)1/2	28 to 30 Nm
Rc(NPT)3/4	28 to 30 Nm
Rc(NPT)1	36 to 38 Nm

If the tightening torque is exceeded, the product can be broken. If the correct tightening torque is not applied, the fittings may become loose.

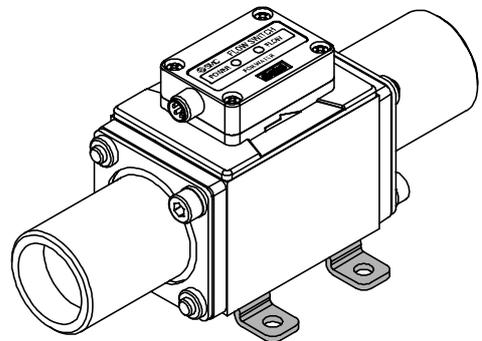
Avoid any sealing tape getting inside the piping.

Ensure there is no leakage from loose piping.

## ⚠ Caution

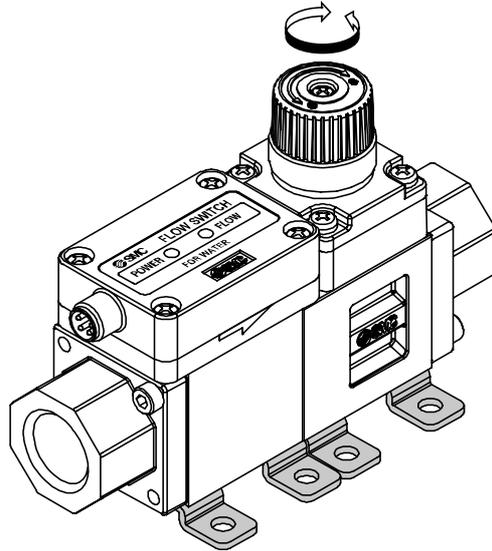
### Vinyl chloride piping

- Mounting and joining of the vinyl chloride fitting (union)  
The vinyl chloride fitting (union) must be mounted and joined by an engineer with sufficient knowledge. Be sure to confirm that there is no leakage from the fitting after mounting and joining. If it is mounted and joined by a person who does not have sufficient knowledge and skills, it may lead to failure such as leakage.
- When selecting adhesive for the vinyl chloride fitting (union), confirm that its heat resistance and endurance are compatible with the operating temperature of the fluids used.  
Otherwise, this may cause leakage and damage.



### How to adjust the flow rate (when a flow adjustment valve is mounted)

- (1) Rotate the knob of the valve to adjust the flow rate to the target value.
- (2) Be sure to confirm that there is no fluid leakage generated after adjustment.  
(When fluid leakage is generated, open and close the valve several times for re-adjustment, and confirm that there is no fluid leakage.)
- (3) Tighten the lock ring to fix the valve as necessary.



The flow adjustment valve is not designed for applications that require daily and repetitive adjustment. If the valve is adjusted frequently, fluid may leak due to wear of the internal seal.

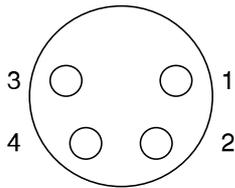
## ■Wiring

### Wiring of connector

Connections should only be made with the power supply turned off.

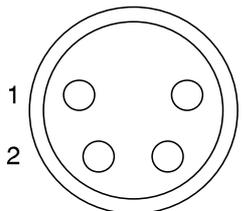
Use separate routes for the Flow sensor wiring and any power or high voltage wiring. Otherwise, malfunction may result due to noise.

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.



Pin number of the connector (On the product)

1	DC(+)
2	NC/Analogue output (temperature)
3	DC(-)
4	Analogue output (flow rate)



Pin number of the connector (On the lead wire)

1	DC(+): Brown
2	NC/Analogue output (temperature): White
3	DC(-): Blue
4	Analogue output (flow rate): Black

\*: When using the lead wire with M8 connector included with the PF3W5 series.

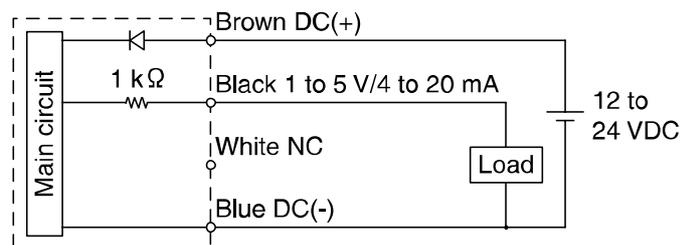
### Examples of Internal Circuit and Wiring

PF3W5□-□-1/2

1 to 5 V/4 to 20 mA output type

Analogue output 1 to 5 V  
Output impedance: 1 k $\Omega$

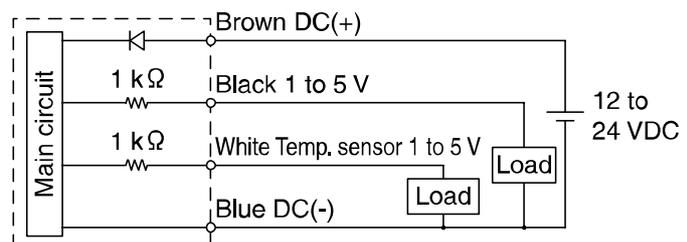
Analogue output 4 to 20 mA  
Maximum load impedance  
Power supply voltage 12 V: 300  $\Omega$   
Power supply voltage 24 V: 600  $\Omega$



PF3W5□-□-1T

With temperature sensor 1 to 5 V

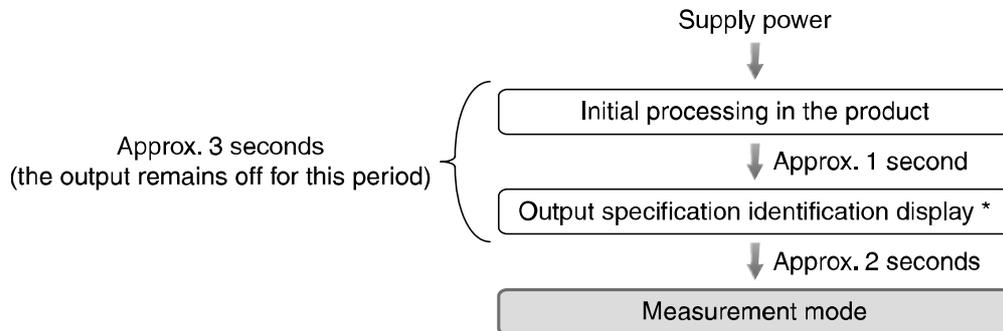
Analogue output 1 to 5 V  
Output impedance: 1 k $\Omega$



# Flow (Temperature) Measurement

## Measurement mode

The mode in which the flow is detected and the flow indicator flashes, and analogue output is operating.



\*: Green: Flashes once. PF3W5□-□-1 (Analogue 1 to 5 V type: Without temperature sensor)

Flashes twice. PF3W5□-□-2 (Analogue 4 to 20 mA type: Without temperature sensor)

Flashes three times. PF3W5□-□-1T (Analogue 1 to 5 V type: With temperature sensor)

The power LED (Green) turns on and the flow rate indicator flashes according to the flow rate.

## Maintenance

### **How to reset the product after a power cut or when the power has been unexpectedly removed**

The output condition also recovers to that before the power cut or de-energizing, but may change depending on the operating environment.

Therefore, check the safety of the whole system before operating the product.

# Troubleshooting

## Troubleshooting

Applicable Flow sensor: PF3W5 series

If an operation failure occurs with the product, use the chart below to find out the cause of problem.

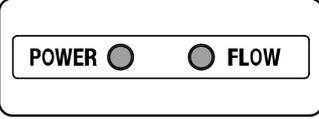
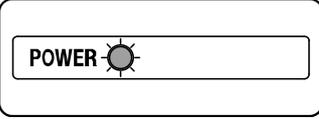
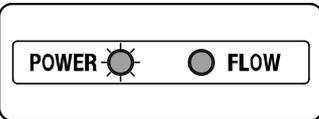
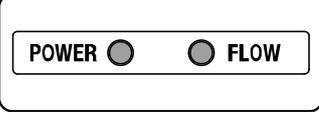
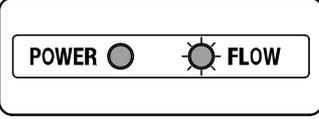
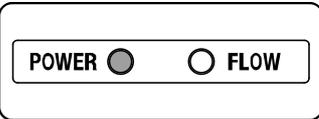
If a cause applicable to the failure cannot be identified and normal operation can be recovered by replacement with a new product, this indicates that the product itself was faulty. The damage to the product may have been caused by operating environment (network construction, etc.). Consult with SMC separately to obtain countermeasures.

### Cross-reference for troubleshooting

Fault	Detail	Possible cause	Item to check	Recommended action
Incorrect output	No output	Incorrect wiring	Check if the brown wire DC(+), blue wire DC(-), black wire(OUT1) and white wire(OUT2) are connected correctly.	Correct the wiring.
		Loose connector	Check that the connector is connected.	Connect the connector.
		The flow adjustment valve is closed.	Check the condition of the flow adjustment valve.	Open the flow adjustment valve to get appropriate flow.
	Output is unstable.	Foreign matter has entered or got stuck inside the flow passage of the sensor.	(1) Confirm whether foreign matter may enter. (2) Confirm whether any foreign matter has got stuck inside.	We recommend a filter with filtration of approx. 40 mesh. Remove foreign matter.
		Piping is connected in the wrong direction.	Confirm whether the mounting direction of the product corresponds to the flow direction.	Make the mounting direction correspond to the flow direction.
		Insufficient water supply	Confirm whether the fluid path is full.	Fill up the fluid path.
		Pulsation in the flow.	Confirm whether the supply pressure fluctuates, or whether pulsation is generated due to the characteristics of the compressor or pump used as the pressure source.	Change to a pump that has less pulsation. Install a tank to reduce the pressure fluctuation. Change the piping to elastic piping such as rubber hose.
		Liquid leakage	Check for liquid leaks due to insufficient tightening of the screw at the piping and/or improper sealing.	Tighten to the specified torque when piping and/or apply the seal tape once again.
		Noise	Confirm that there is no power line or high voltage line that can be a noise source in the wiring route.	Do not route wires and cables together with power or high voltage cables.
	Even though the flow rate is zero, it is outputted.	Operation of pump while the flow adjustment valve is closed.	Check the condition of the flow adjustment valve and pump.	Open the flow adjustment valve slightly, and let the pulsation (pressure) from the pump escape.

Fault	Detail	Possible cause	Item to check	Recommended action
Incorrect indicator	The indicator does not turn on.	Incorrect wiring	Check if the brown wire DC(+) and blue wire DC(-) are connected correctly.	Correct the wiring.
	The FLOW indicator is unstable.	Foreign matter has entered or got stuck inside the flow passage of the sensor.	(1) Confirm whether foreign matter may enter. (2) Confirm whether any foreign matter has got stuck inside.	We recommend a filter with filtration of approx. 40 mesh. Remove foreign matter.
		Piping is connected in the wrong direction.	Confirm whether the mounting direction of the product corresponds to the flow direction.	Make the mounting direction correspond to the flow direction.
		Insufficient water supply	Confirm whether the fluid path is full.	Fill up the fluid path.
		Pulsation in the flow.	Confirm whether the supply pressure fluctuates, or whether pulsation is generated due to the characteristics of the compressor or pump used as the pressure source.	Change to a pump that has less pulsation. Install a tank to reduce the pressure fluctuation. Change the piping to elastic piping such as rubber hose.
		Noise	Confirm that there is no power line or high voltage line that can be a noise source in the wiring route.	Do not route wires and cables together with power or high voltage cables.
Incorrect temp. sensor output.	Output is unstable.	Insufficient water supply	Confirm whether the fluid path is full.	Fill up the fluid path.
		Foreign matter	Check if foreign matter is stuck to the sensor.	Remove foreign matter.
Improper operation of the flow adjustment valve.	It is not possible to adjust with flow adjustment valve.	Lock the flow adjustment valve	Check the condition of the flow adjustment valve and its lock ring.	Loose the lock ring and adjust flow rate. (See page 19.)
		Insufficient supply pressure	Check flow rate characteristics of the supply pressure and flow rate adjustment valve.	Increase supply pressure.

## Error indication function

Error Name	LED display	Type	Troubleshooting
Flow rate upper limit is exceeded	 <p>POWER indicator: Green is ON FLOW indicator: Red is ON</p>	The applied flow rate is above approx. 110% of the rated flow rate.	Adjust flow to within the rated flow range.
Outside the temperature measurement range	 <p>POWER indicator: Flashing Red</p>	The fluid temperature is lower than -10°C or exceeds 110°C.	Adjust the fluid temperature to within the rated temperature range.
"Flow rate upper limit exceeded" and "Outside the temperature measurement range" occur together.	 <p>POWER indicator: Flashing Red FLOW indicator: Red is ON</p>	See above.	See above.
System error	 <p>POWER indicator: Red is ON FLOW indicator: Red is ON</p>	Internal data error has occurred.	Turn the power off and turn it on again. If the failure cannot be solved, contact SMC for repair.
	 <p>POWER indicator: Red is ON FLOW indicator: Flashing Red</p>		
	 <p>POWER indicator: Red is ON FLOW indicator: OFF</p>	The temperature sensor is damaged.	

If the error cannot be reset after the above measures are taken, then please contact SMC

# Specification

## ■ Specifications

### Specifications of body (Metal attachment)

Model	PF3W504	PF3W520	PF3W540	PF3W511
Applicable fluid	Water and ethylene glycol solution with a viscosity of 3 mPa•s(3 cP) or less * <sup>1</sup>			
Detecting method	Karman vortex			
Rated flow range	0.5 to 4 L/min	2 to 16 L/min	5 to 40 L/min	10 to 100 L/min
Fluid temperature	0 to 90 °C (No freezing and condensation)			
Accuracy	±3% F.S. max.			
Repeatability	±2% F.S. max.			
Temperature characteristics	±5% F.S. max. (reference 25 °C)			
Operating pressure range * <sup>2</sup>	0 to 1 MPa * <sup>2</sup>			
Proof pressure * <sup>2</sup>	1.5 MPa			
Pressure loss	45 kPa or less at maximum flow (Without flow adjustment valve)			
Analogue output	Response time * <sup>3</sup>	1 s		
	Voltage output	Output voltage: 1 to 5 V, Output impedance: 1 kΩ		
	Current output	Current output: 4 to 20 mA Maximum load impedance: 300 Ω for 12 VDC, 600 Ω for 24 VDC		
Indicator light	LED for power supply, LED for flow rate indicator (Flashing speed changes depending on the flow rate.), LED for other error display			
Power supply voltage	12 to 24 VDC ±10%			
Current consumption	30 mA max.			
Environment	Enclosure	IP65		
	Operating temperature range	0 to 50 °C (No freezing and condensation)		
	Operating humidity range	Operation, Storage: 35 to 85% R.H. ( No condensation)		
	Withstand voltage * <sup>4</sup>	1000 VAC, for 1 minute between external terminals and case		
	Insulation resistance	50 MΩ min. (with 500VDC) between the external terminals and case		
Standards and regulations	CE marking, UL(CSA), RoHS			
Wetted materials	PPS, SUS304, FKM, SCS13			
	Non-grease type			
Piping port size	3/8	3/8(1/2)	1/2(3/4)	3/4(1)

Model		PF3W504	PF3W520	PF3W540	PF3W511
Weight	Flow sensor only	195 g	245 g	395 g	705 g
	With temperature sensor	270 g	320 g	515 g	840 g
	With flow adjustment valve	295 g	345 g	595 g	-
	With temperature sensor and flow adjustment valve	370 g	415 g	715 g	-
	With lead wire	+85 g			

- \*1: Please refer to the chart of measurement range of ethylene glycol aqueous solution on page 30. Measurement is possible as long as the fluid does not corrode the wetted parts, and viscosity is 3mPa•s(3 cP) or less.
- \*2: The operating pressure range and proof pressure vary depending on the fluid temperature. Refer to the chart on page 32.
- \*3: The response time is when the set value is 90% in relation to the step input. (The value will be 7 s for the temperature sensor output.)
- \*4: When the temperature sensor is used, it will be 250 VAC.

### Specifications of temperature sensor

Items	Specifications
Rated temperature range	0 to 100 °C *1
Analogue output accuracy	±3% F.S.
Response time	7 s *2
Ambient temperature characteristics	±5% F.S.

- \*1: The rated temperature range is of a single temperature sensor. As a whole product, the fluid temperature range is specified as 0 to 90 °C.
- \*2: The response time is only for the temperature sensor.

### Specifications of body (Vinyl chloride piping)

Model	PF3W511	
Applicable fluid	Water and ethylene glycol solution with a viscosity of 3 mPa•s(3 cP) or less *1	
Detecting method	Karman vortex	
Rated flow range	10 to 100 L/min	
Fluid temperature	0 to 70 °C (No freezing and condensation)	
Accuracy	±3% F.S. max.	
Repeatability	±2% F.S. max.	
Temperature characteristics	±5% F.S. max. (reference 25 °C)	
Operating pressure range *2	0 to 1 MPa *2	
Proof pressure *2	1 MPa	
Pressure loss	45 kPa or less at maximum flow	
Analogue output	Response time *3	1 s
	Voltage output	Output voltage: 1 to 5 V, Output impedance: 1 kΩ
	Current output	Current output: 4 to 20 mA Maximum load impedance: 300 Ω for 12 VDC, 600 Ω for 24 VDC
Indicator light	LED for power supply, LED for flow rate indicator (Flashing speed changes depending on the flow rate.), LED for other error display	
Power supply voltage	12 to 24 VDC ±10%	
Current consumption	30 mA max.	
Environment	Enclosure	IP65
	Operating temperature range	0 to 50 °C (No freezing and condensation)
	Operating humidity range	Operation, Storage: 35 to 85% R.H. ( No condensation)
	Withstand voltage	1000 VAC, for 1 minute between external terminals and case
	Insulation resistance	50 MΩ min. (with 500 VDC) between the external terminals and case
Standards and regulations	CE marking, UL(CSA), RoHS	
Wetted materials	PPS, FKM, CPVC	
	Non-grease type	
Piping port size	25A union	
Weight	Without lead wire	270 g
	With lead wire	355 g

\*1: Please refer to the chart of measurement range of ethylene glycol aqueous solution on page 30. Measurement is possible as long as the fluid does not corrode the wetted parts, and viscosity is 3mPa•s(3 cP) or less. Refer to the "Applicable fluid list" on page 29.

\*2: The operating pressure range and proof pressure vary depending on the fluid temperature. Refer to the chart on page 32.

\*3: The response time is when the set value is 90% in relation to the step input.

## ■ Applicable fluids

### The material and fluids compatibility check list

Chemical		Compatibility
Ammonium hydroxide	40 °C or less	X
Isobutyl alcohol	40 °C or less	X <sup>*3</sup>
Isopropyl alcohol	40 °C or less	○ <sup>*1*2</sup>
Hydrochloric acid (Except fuming sulfuric acid)	Concentration 30% or less	○ <sup>*2</sup>
Hydrogen peroxide	Concentration 5% or less, temperature 50 °C or less	○
Nitric acid (Except fuming nitric acid)	Concentration 10% or less, temperature 40 °C or less	○ <sup>*2</sup>
Pure water		○
Sodium hydroxide	Concentration 50% or less	X <sup>*3</sup>
Super pure water		○
Sulfuric acid	Concentration 30% or less	○
Phosphonic acid	Concentration 50% or less	○

○: Available (available depending on the conditions)

The material and fluid compatibility check list provides reference values for reference only, therefore we do not guarantee the application to our product.

\*1: Take measures against static electricity, which it may occur.

\*2: Fluid may be permeated, affecting other material parts.

\*3: Because fluid viscosity is high, it cannot be measured by the Karman vortex method.

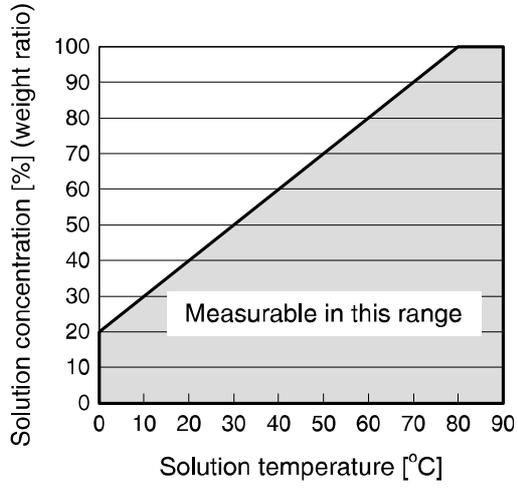
●SMC is not responsible for its accuracy and any damage happened because of this data.

### Specifications: lead wire with M8 connector (ZS-40-A)

Items		Specifications
Conductor	Nominal cross section area	AWG23
	Outside diameter	Approx. 0.72 mm
Insulator	Material	Heat resistant PVC
	Outside diameter	Approx. 1.14 mm
	Colours	Brown, White, Black, Blue
Sheath	Material	Heat/oil resistant PVC
Outer diameter		φ3.4 mm

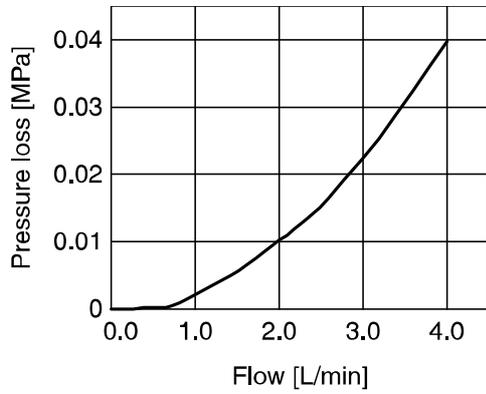
■ Characteristics graph

**Measurable range of ethylene glycol aqueous solution (Reference value)**

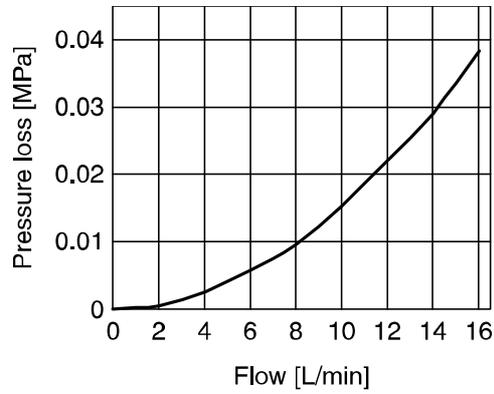


**Flow characteristics (pressure loss)**

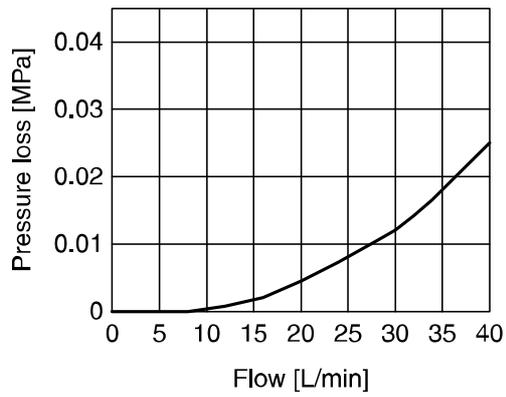
PF3W504



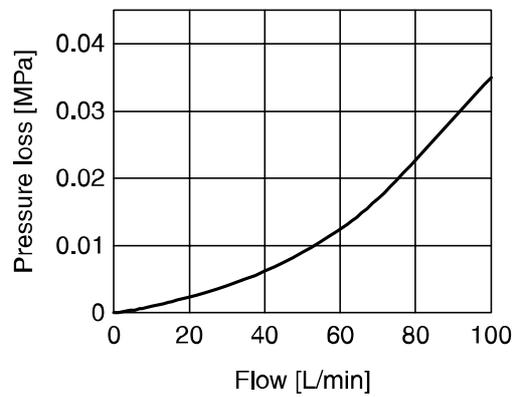
PF3W520



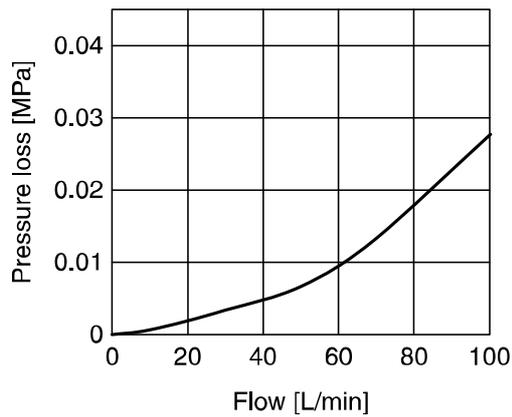
PF3W540



PF3W511 (Metal attachment)

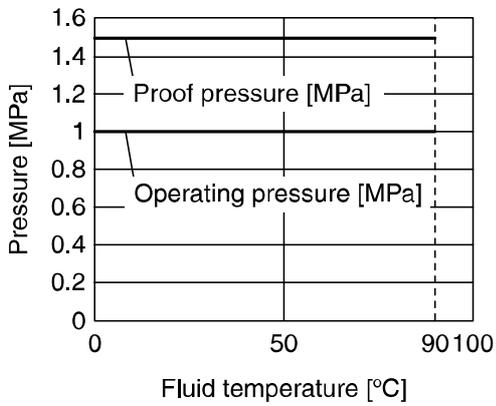


PF3W511 (Vinyl chloride piping)

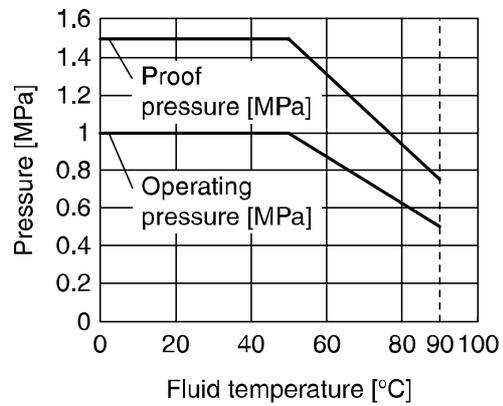


## Operating pressure and proof pressure

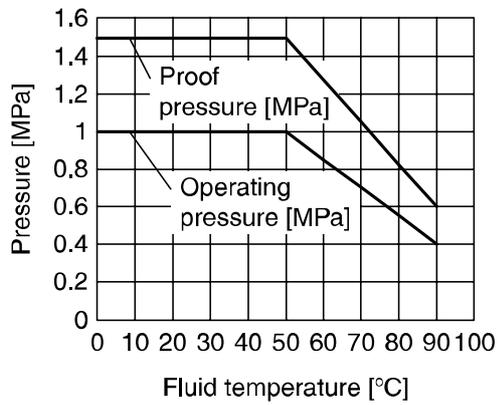
PF3W504/520/540



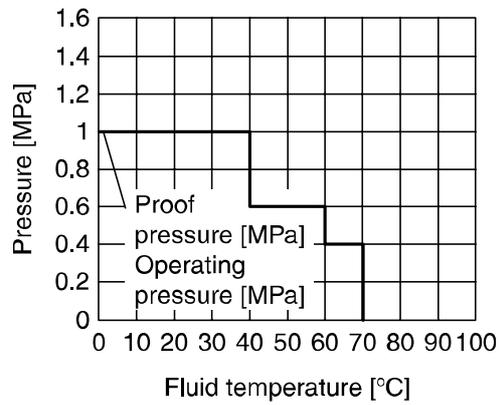
PF3W504S/520S/540S



PF3W511 (Metal attachment)



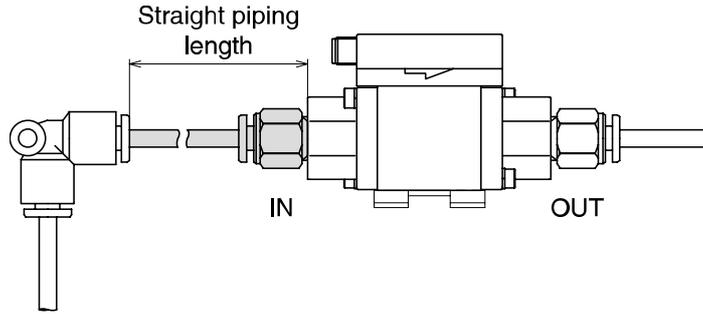
PF3W511 (Vinyl chloride piping)



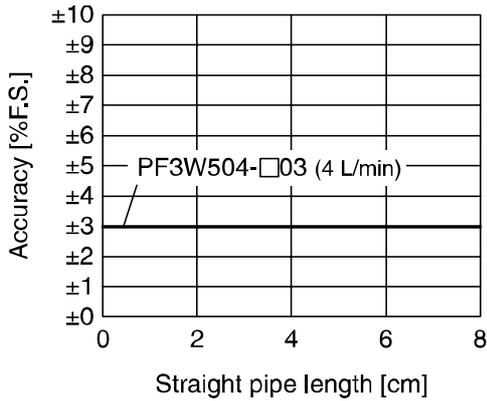
### Straight inlet pipe length and accuracy (reference value)

Metal attachment

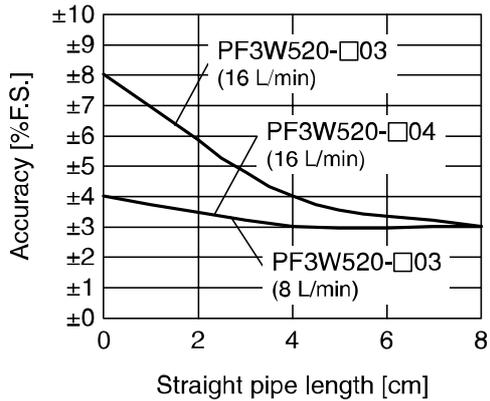
- The smaller the piping size, the more the product is affected by the straight piping length.
- Fluid pressure has almost no effect.
- The smaller the flow rate, the less the product is affected by the straight piping length.
- The straight piping length shall be 8 cm or longer in order to maintain  $\pm 3\%$ F.S. of the specification.  
(For the 100 L/min type, the piping length should be 11 cm or longer.)



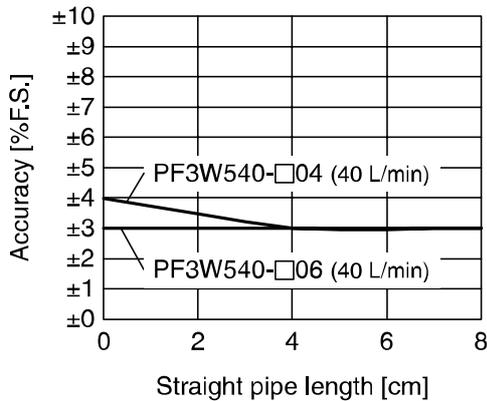
PF3W504



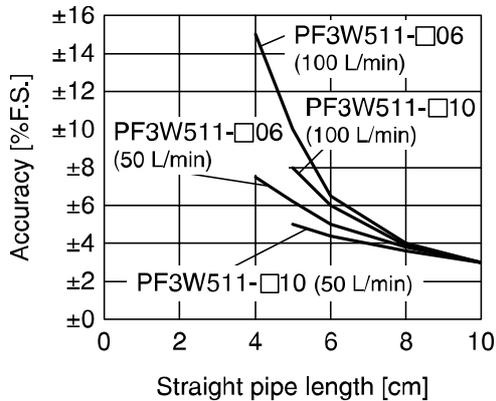
PF3W520



PF3W540

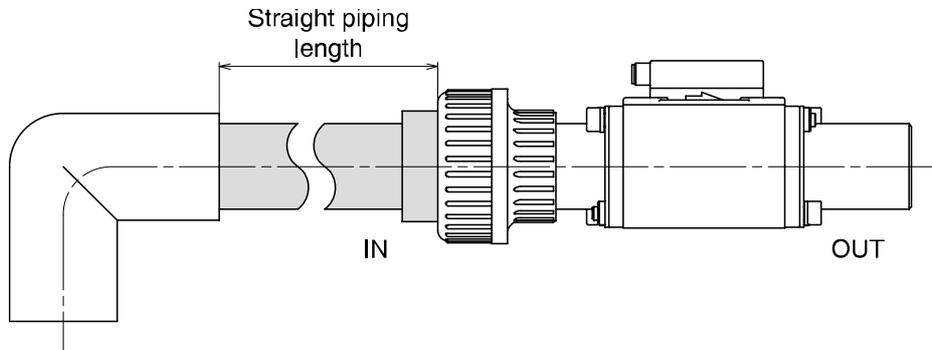


PF3W511 (Metal attachment)

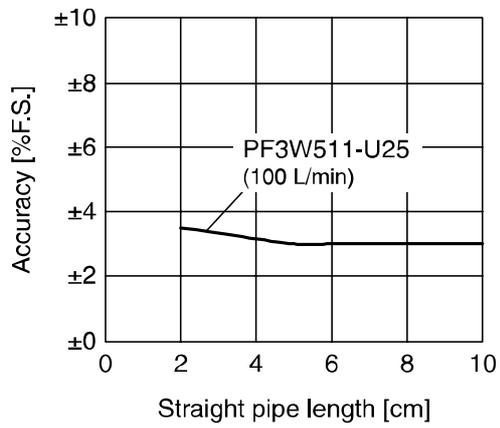


Vinyl chloride piping

- Fluid pressure has almost no effect.
- The straight piping length shall be 11 cm or longer in order to maintain  $\pm 3\%$ F.S. of the specification.

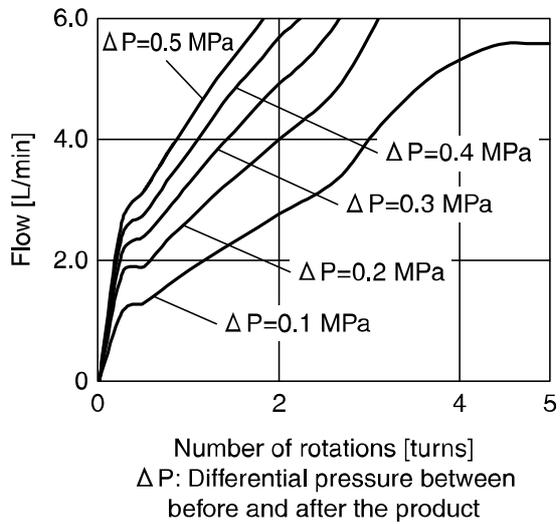


PF3W511 (Vinyl chloride piping)

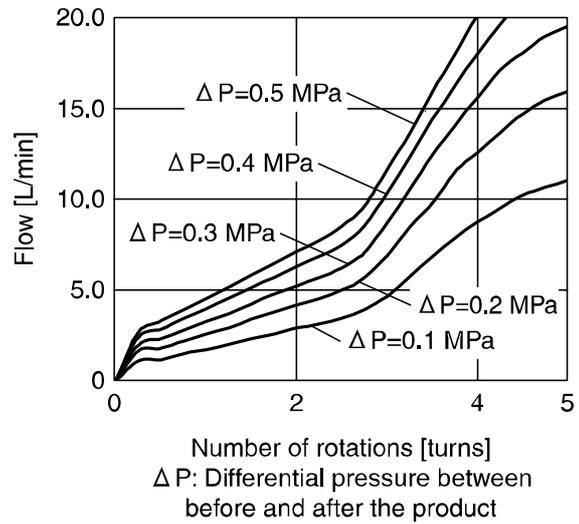


### Flow characteristics of the flow rate adjustment valve

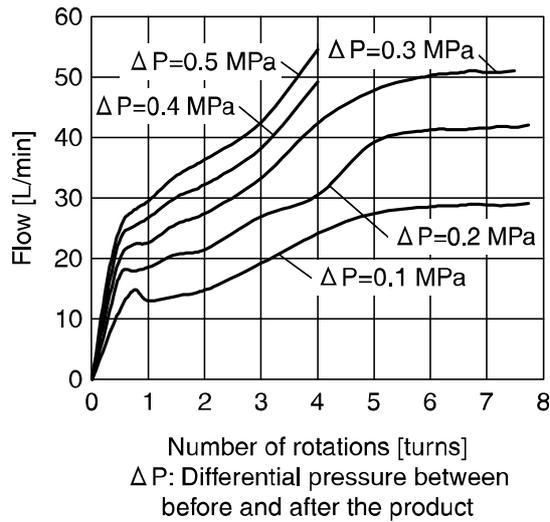
PF3W504S



PF3W520S



PF3W540S



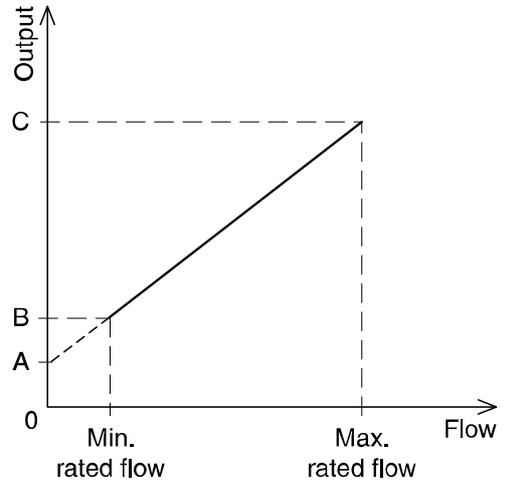
■ Analogue output

**Flow/Analogue output**

	A	B	C
Voltage output	1 V	1.5 V (1.4 V)	5 V
Current output	4 mA	6 mA (5.6 mA)	20 mA

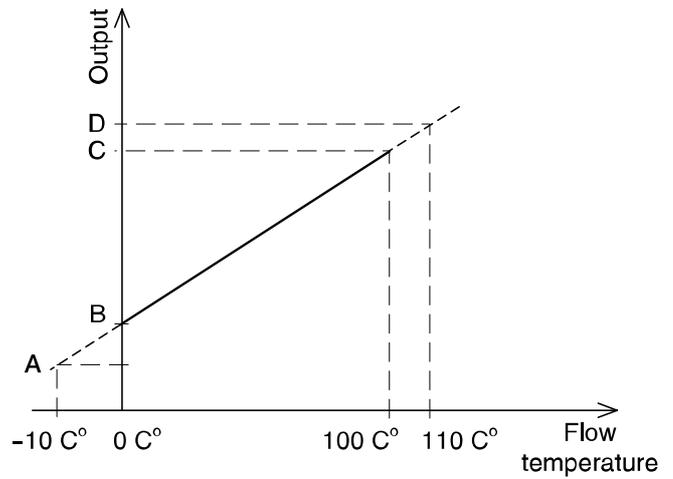
The value in ( ) is when PF3W511 is used.

Sensor model	Rated flow [L/min]	
	Minimum	Maximum
PF3W504	0.5	4
PF3W520	2	16
PF3W540	5	40
PF3W511	10	100

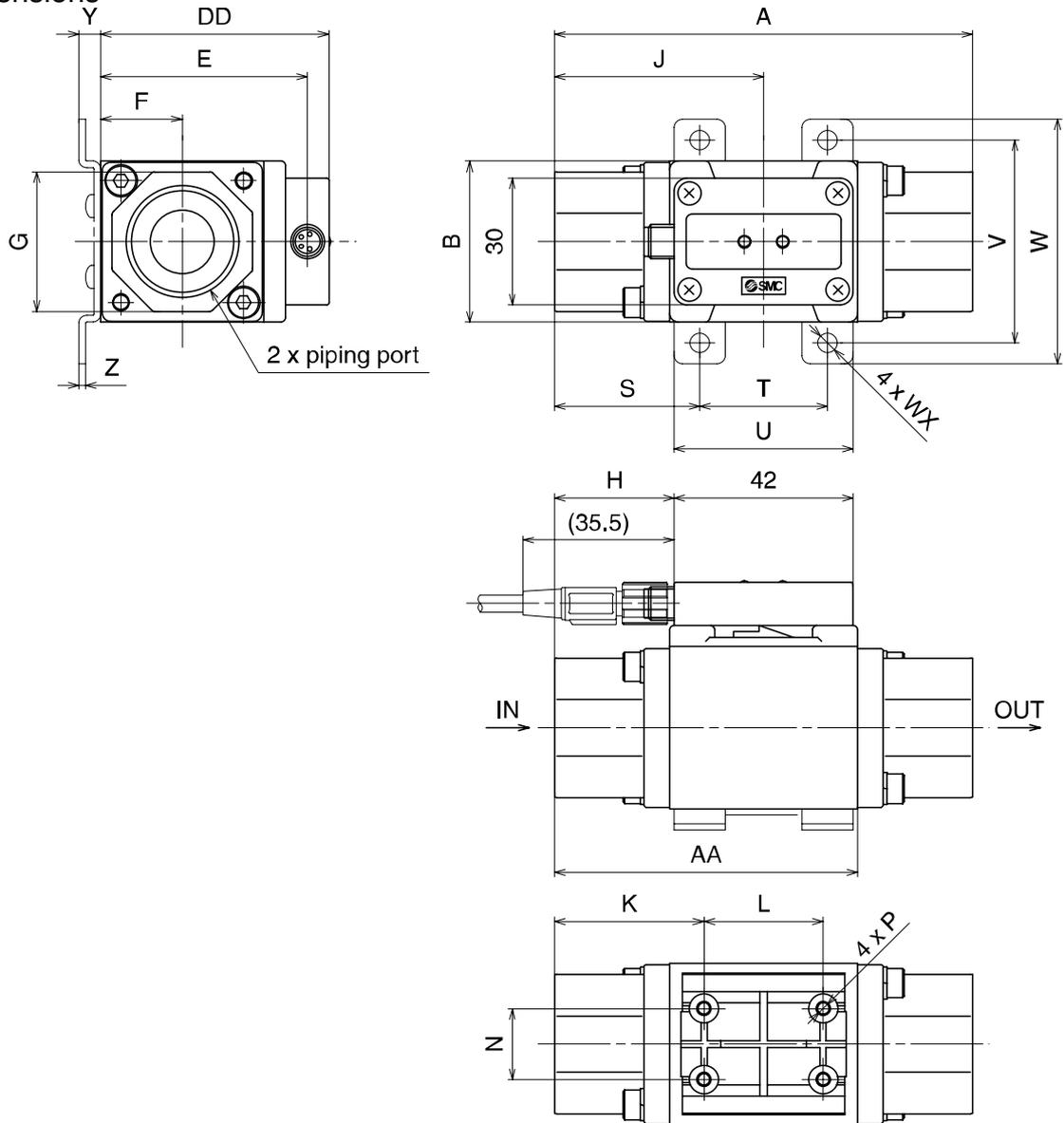


**Fluid temperature/Analogue output**

	A	B	C	D
Voltage output	0.6 V	1 V	5 V	5.4 V



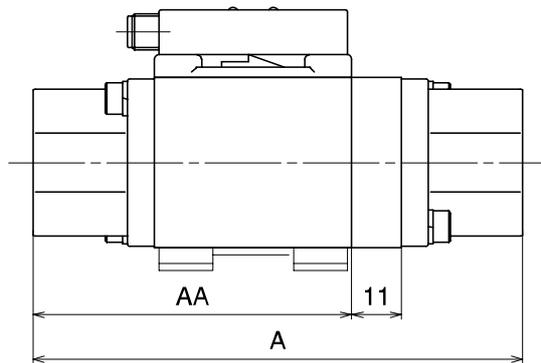
## ■Dimensions



### Basic type

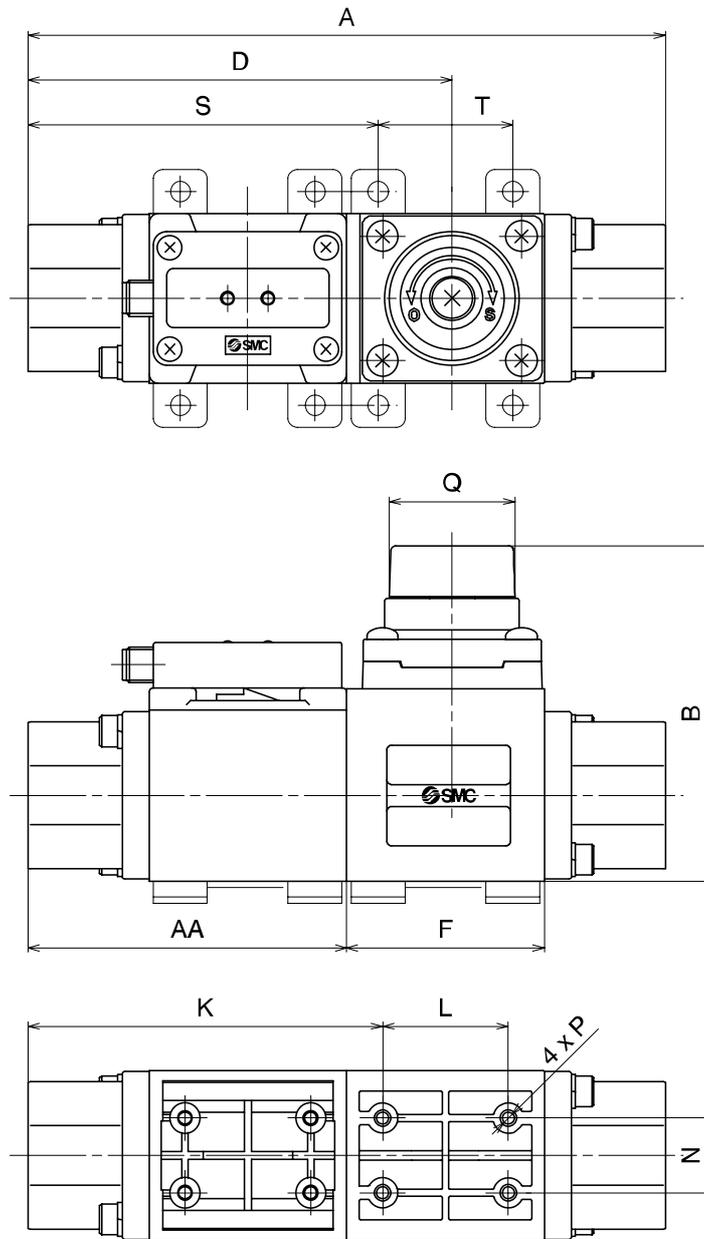
Symbol Model	Piping port size	A	AA	B	DD	E	F	G	H	J	K	L	N	P
PF3W504	3/8	70	50	30	45.6	40.6	15.2	24	14	35	26	18	13.6	φ2.7 depth 14
PF3W520	3/8, 1/2	78	54	30	45.6	40.6	15.2	27	18	39	30	18	13.6	φ2.7 depth 12
PF3W540	1/2, 3/4	98	71	38	53.6	48.6	19.2	32	28	49	35	28	16.8	φ2.7 depth 12
PF3W511	3/4, 1	124	92	46	62.6	57.6	23	41	42	63	48	28	18	φ3.5 depth 14

Symbol Model	Bracket dimensions							
	S	T	U	V	W	WX	Y	Z
PF3W504	24	22	32	40	50	4.5	5	1.5
PF3W520	28	22	32	40	50	4.5	5	1.5
PF3W540	34	30	42	48	58	4.5	5	1.5
PF3W511	44	36	48	58	70	5.5	7	2



Temperature sensor

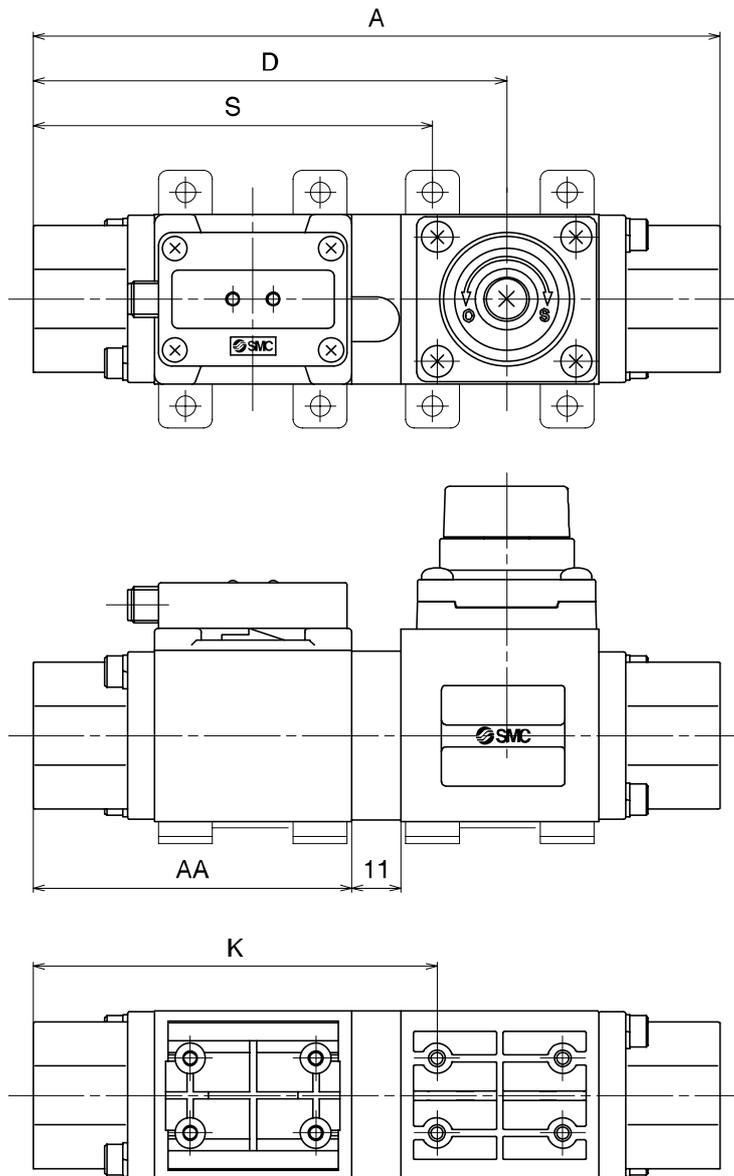
Model \ Symbol	A	AA
PF3W504-**-T	81	50
PF3W520-**-T	89	54
PF3W540-**-T	109	71
PF3W511-**-T	135	92



Basic type and flow adjustment valve

Symbol Model	A	AA	B	D	F	K	L	N	P	Q	Q: Number of rotations
PF3W504S	104	50	63.6 (Max. 68.6)	70.2	34	58.5	18	13.6	φ2.7 depth 10	φ19	6 turns
PF3W520S	112	54	63.6 (Max. 68.6)	74.2	34	62.5	18	13.6	φ2.7 depth 10	φ19	6 turns
PF3W540S	142	71	75.25 (Max. 81)	94.5	44	79	28	16.8	φ2.7 depth 10	φ28	7 turns

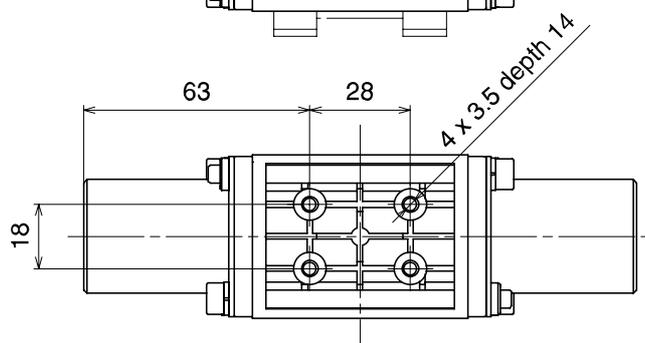
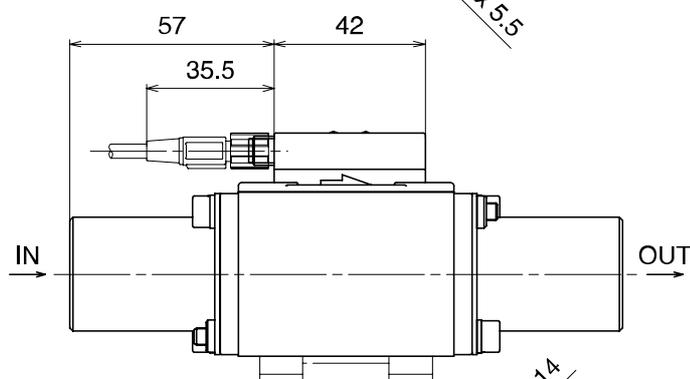
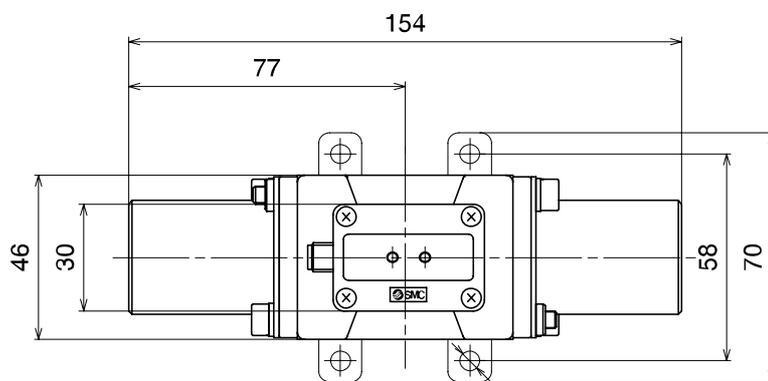
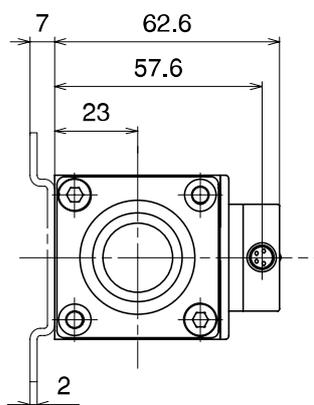
Symbol Model	Bracket dimensions	
	S	T
PF3W504S	56.5	22
PF3W520S	60.5	22
PF3W540S	78	30



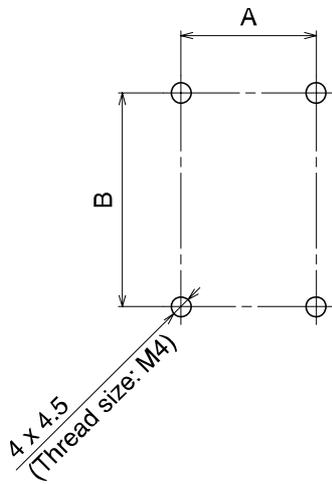
Basic type, flow adjustment valve and temperature sensor

Symbol	A	AA	D	K	S
Model PF3W504S-**-T	115	50	81.2	69.5	67.5
Model PF3W520S-**-T	123	54	85.2	73.5	71.5
Model PF3W540S-**-T	153	71	105.5	90	89

PF3W511-U\*

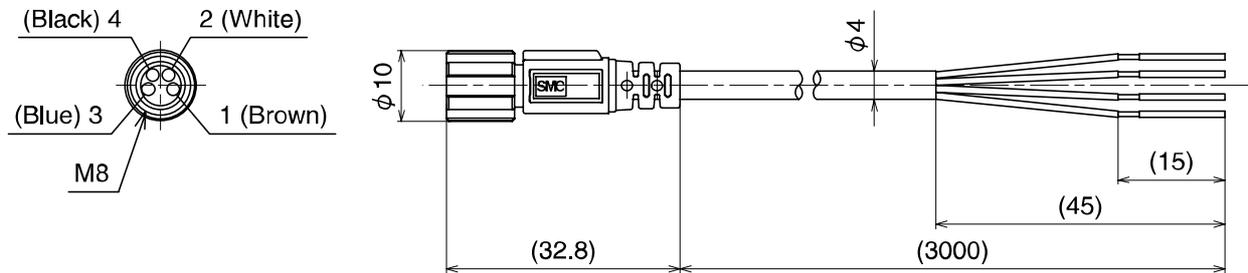


### Dimensions of machined mounting hole on bracket



Model \ Symbol	A	B
PF3W504(T)/520(T)	22	40
PF3W540(T)	30	48
PF3W511(T)	36	58

### Dimensions of lead wire with M8 connector (ZS-40-A)



## Made to order

- Change the seal material of the wetted parts to EPDM.

PF3W5 □ □ - □ □ - □ □ - □ □ □ -X109

Seal material EPDM

Refer to page 11 for details of how to order.

\*: Not applicable to the flow rate adjustment valve mounted type. Can be done as a special order.

Revision history
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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.  
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