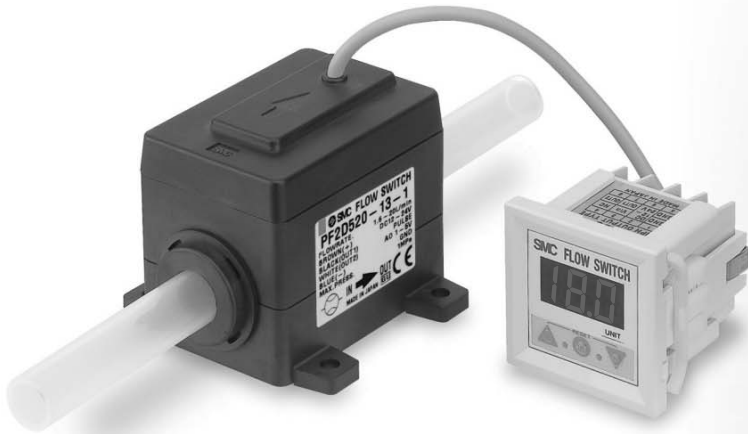


Digital Flow Switch For Deionized Water and Chemicals Series PF2D



Series PF2D

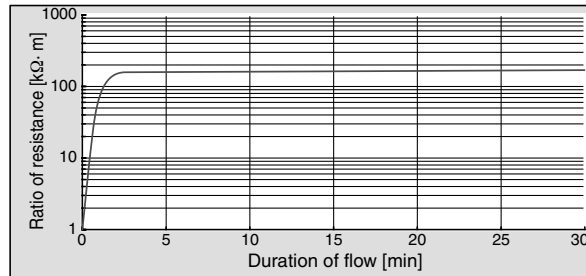
Body and sensor
New PFA
Tube
Super PFA

Three types of flow range

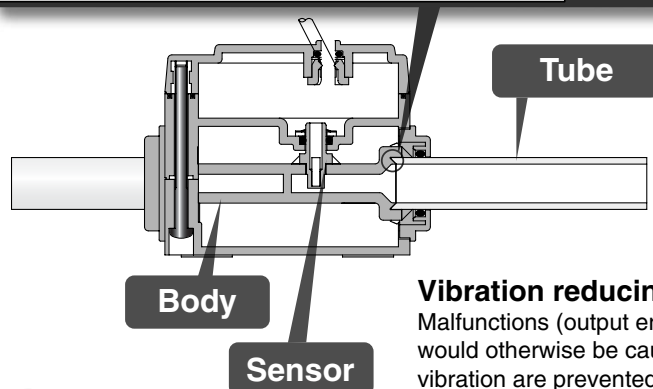
- 0.4 to 4 μmin (PF2D504)
- 1.8 to 20 μmin (PF2D520)
- 4.0 to 40 μmin (PF2D540)

Swept flow characteristics
Tapered side seal minimizes dead volume
to reduce accumulation of liquid pool.

Swept Flow Characteristics (Reference)



Fill the flow path with sulfuric acid and leave it for 30 minutes. After disposing the sulfuric acid, flush the flow path out with deionized water and measure the resistance rate of the fluid that is discharged from the downstream side. A quick recovery time indicates little liquid pool.



Vibration reducing seals
Malfunctions (output errors) that would otherwise be caused by vibration are prevented.

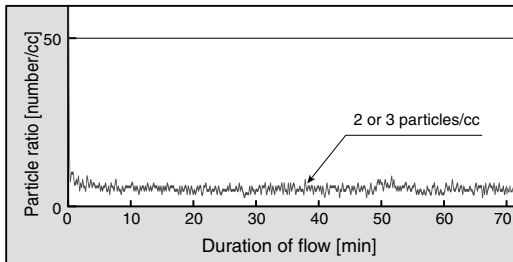
4 types of outputs available
With button operation, 4 types of output specification combinations are available.

| | 1 | 2 | 3 | 4 |
|----------|---------------|--------------------------|--------------------------|--------------------------|
| Output 1 | Switch output | Switch output | Accumulated pulse output | Accumulated pulse output |
| Output 2 | Switch output | Accumulated pulse output | Switch output | Accumulated pulse output |

Dust generation of 3 particles/cc or less
(Average number)

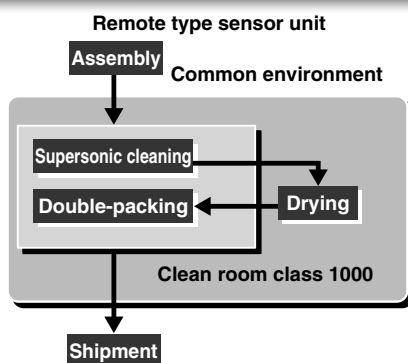
Karman vortex eliminates moving parts and allows low dust generation.

Particle Characteristics (Reference)



The data was obtained by performing an actual 10 minutes' supersonic cleaning using an average 16 M Ω -cm of deionized water at class 10000 clean room (1 μmin flow rate). The diameter of the measured particles ranges from 0.1 to 0.5 μm . The flow rate used during measuring is 100 cc/min.

Processing chart for Series PF2D



ZSE□
ISE□

PSE

ZSE3
I SE3

PS

ZSE1
I SE2

ZSP

ISA2

IS□

ZSM

PF2□

IF□

Data

Digital Flow Switch For Deionized Water and Chemicals Series *PF2D*

How to Order



Remote type
Sensor unit

PF2D5 **20** — **13** — **1**

Flow rate range

| | |
|----|-----------------|
| 04 | 0.4 to 4 ℓ/min |
| 20 | 1.8 to 20 ℓ/min |
| 40 | 4 to 40 ℓ/min |

Port size (inch)

| | | |
|----|-----|---------|
| 11 | 3/8 | PF2D504 |
| 13 | 1/2 | PF2D520 |
| 19 | 3/4 | PF2D540 |

Output specifications

| | |
|---|--|
| 1 | Output for display unit Note 1) + analog output (1 to 5 V) |
| 2 | Output for display unit Note 1) + analog output (4 to 20 mA) |

Note 1) Output for the display units of PF2D 300/301

Specifications for Sensor Unit

| Model | | PF2D504 | PF2D520 | PF2D540 |
|--|-----------------------------|--|---------------------------|---------------|
| Measured fluid | | Liquid not to corrode nor erode deionized water and/or Teflon®. Viscosity: 3 mPa·s (3 cP) or less | | |
| Detection style | | Karman vortex | | |
| Flow rate measuring range | | 0.4 to 4 ℓ/min | 1.8 to 20 ℓ/min Note 1) | 4 to 40 ℓ/min |
| Operating pressure range Note 2) | | 0 to 1 MPa | | 0 to 0.6 MPa |
| Proof pressure Note 3) | | 1.5 MPa | | 0.9 MPa |
| Operating fluid temperature | | 0 to 90°C | | |
| Linearity Note 4) | | ±2.5%F.S. or less (at 25°C water) | | |
| Repeatability | | ±1%F.S. or less (at 25°C water) | | |
| Temperature characteristics | | ±5%F.S. or less (0 to 50°C) | | |
| Output specifications | Pulse output | Pulse output, N channel, open drain, output for display unit PF2D300/301 (Specifications: Maximum load current of 10 mA; Maximum applied voltage of 30 V) | | |
| | Analog output | Voltage output Note 5) 1 to 5 V within the flow rate range Linearity: ±2% F.S. or less, Allowable load resistance: 100 kΩ or more | | |
| Current output Note 6) 4 to 20 mA within the flow rate range Linearity: ±2% F.S. or less, Allowable load resistance: 30 0Ω or less with 12 VDC, 600 Ω or less with 24 VDC | | | | |
| Power supply voltage | | 12 to 24 VDC (Ripple ±10% or less) | | |
| Current consumption | | 20 mA or less (Without load) | | |
| Environmental resistance | Enclosure | IP65 | | |
| | Operating temperature range | Operating: 0 to 50°C, Stored: -25 to 85°C in stock (No freezing or condensation) | | |
| | Voltage resistance | 1000 VAC for 1 min between external terminals and case | | |
| | Insulation resistance | 50 MΩ or more (500 VDC) between external terminals and case | | |
| | Vibration resistance | 4.9 m/s ² | | |
| | Impact resistance | 490 m/s ² to X, Y, Z directions 3 times for each | | |
| | Noise resistance | 1000 Vp-p, Pulse width: 1 μs, Standing: 1 ns | | |
| Weight | | 140 g (Without lead wire) | 225 g (Without lead wire) | |
| Port size | | 3/8 inch tube | 1/2 inch tube | 3/4 inch tube |
| Wetted material | | Body: New PFA, Sensor: New PFA, Tube: Super PFA | | |

Note 1) 1.6 to 20 ℓ/min (0.1 MPa) with viscosity of 1 mPa·s (1 cP) or less

Note 2) The operating pressure range drops according to the fluid temperature. See attached graph.

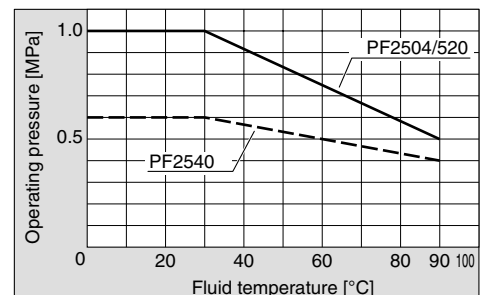
Note 3) 1.5 times of the maximum operating pressure and varying with fluid temperature.

Note 4) The system accuracy when combined with PF2D300□.

Note 5) When the voltage output is selected.

Note 6) When the current output is selected.

Note 7) The sensor unit is conformed to CE mark.



Digital Flow Switch For Deionized Water and Chemicals Series PF2D

How to Order

Remote type
Display unit

PF2D30 0 — A — M



Output specifications

| | |
|---|------------------------------|
| 0 | NPN open collector 2 outputs |
| 1 | PNP open collector 2 outputs |

Panel mounting

Unit specifications

| | |
|-----|------------------------------|
| Nil | With unit switching function |
| M | Fixed SI unit (Note 1) |

Note 1) Fixed unit:
Real-time flow rate: ℓ/min
Accumulated flow: ℓ

Specifications for Display Unit

| Model | | PF2D300/301 | | |
|--|---|---|--|-----------------------------|
| Flow rate measurement range (Note 1) | | 0.25 to 4.5 ℓ/min | 1.3 to 21.0 ℓ/min | 2.5 to 45 ℓ/min |
| Set flow rate range (Note 1) | | 0.25 to 4.5 ℓ/min | 1.3 to 21.0 ℓ/min | 2.5 to 45 ℓ/min |
| Minimum setting unit (Note 1) | | 0.05 ℓ/min | 0.1 ℓ/min | 0.5 ℓ/min |
| Accumulated pulse flow rate exchange value (Pulse width: 50 ms) (Note 1) | | 0.05 ℓ/pulse | 0.1 ℓ/pulse | 0.5 ℓ/pulse |
| (Note 2) Display units | Real-time flow rate | ℓ/min , gal (US)/min | | |
| | Accumulated flow | ℓ , gal (US) | | |
| Accumulated flow range | | 0 to 999999 ℓ | | |
| Linearity (Note 3) | | $\pm 2.5\%$ F.S. or less | | |
| Repeatability | | $\pm 0.5\%$ F.S. or less | | |
| Temperature characteristics | | $\pm 1\%$ F.S. or less (15 to 35°C) $\pm 2\%$ F.S. or less (0 to 50°C) | | |
| Current consumption | | 60 mA or less | | |
| Weight | | 45 g | | |
| (Note 4) Output specifications | Switch output | NPN open collector (PF2D300, PF2W300, PF2W330) | Maximum load current: 80 mA Internal voltage drop: 1.5 V or less (With load current of 80 mA) Maximum applied voltage: 30 V 2 outputs | |
| | | PNP open collector (PF2D301, PF2W301, PF2W331) | Maximum load current: 80 mA Internal voltage drop: 1.5 V or less (With load current of 80 mA) 2 outputs | |
| | Accumulated pulse output | NPN open collector or PNP open collector (Same as switch output) | | |
| Environmental resistance | Enclosure | IP40 | | |
| | Operating temperature range | Operating: 0 to 50°C, Stored: -25 to 85°C (No freezing or condensation) | | |
| | Voltage resistance | 1000 VAC for 1 min between external terminals and case | | |
| | Insulation resistance | 50 M Ω or more (500 VDC Mega) between external terminals and case | | |
| | Vibration resistance | 10 to 500 Hz at whichever is smaller: 1.5 mm amplitude or 98 m/s ² acceleration in X, Y, Z directions for 2 hrs each | | |
| | Impact resistance | 490 m/s ² to X, Y, Z directions 3 times for each | | |
| | Noise resistance | 1000 Vp-p, Pulse width: 1 μs , Standing: 1 ns | | |
| Display | 3-digits 7-segment LED | | | |
| Indicator light | ON: when light is on, OUT1: Green; OUT2: Red | | | |
| Power supply voltage | 12 to 24 VDC (Ripple $\pm 10\%$ or less) | | | |
| Response time | 1 sec. or less | | | |
| Hysteresis | Hysteresis mode: Adjustable (can be set from 0) Window comparator mode (Note 5): Fixed (3 digits) | | | |

Note 1) The value varies depending on set flow range

Note 2) For digital flow switch with unit switching function. (Fixed SI unit [ℓ/min or ℓ] will be set for switch types without unit switching function.)

Note 3) The system accuracy when combined with PF2D5□□.

Note 4) Switch output and accumulated pulse output can be selected using the control button operation during initial setting.

| | 1 | 2 | 3 | 4 |
|----------|---------------|--------------------------|--------------------------|--------------------------|
| Output 1 | Switch output | Switch output | Accumulated pulse output | Accumulated pulse output |
| Output 2 | Switch output | Accumulated pulse output | Switch output | Accumulated pulse output |

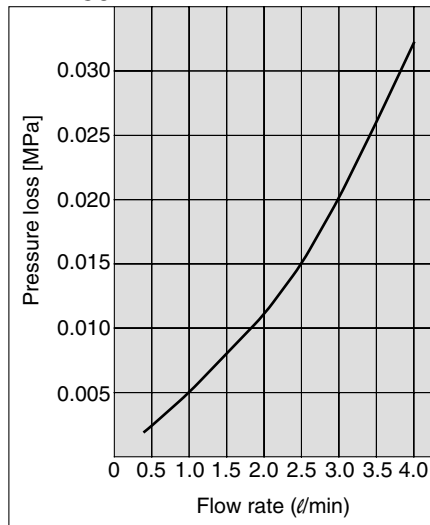
Note 5) Window comparator mode: Since hysteresis (H) will reach 3 digits, keep P_1 and P_2 or n_1 and n_2 apart by 7 digits more. (In case of output OUT2, n_1, 2 to be n_3, 4 and P_1, 2 to be P_3, 4.)

Note 6) The display unit is conformed to CE mark.

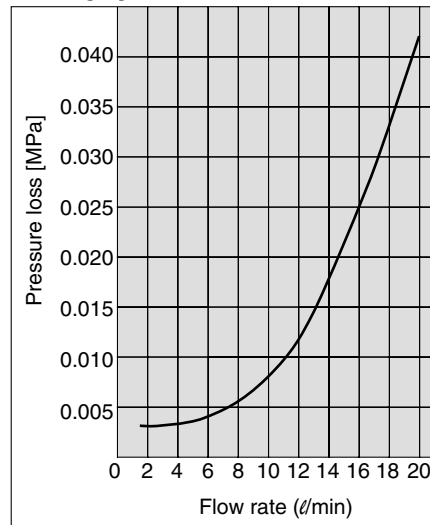
Series PF2D

Flow Characteristics (Pressure characteristics)

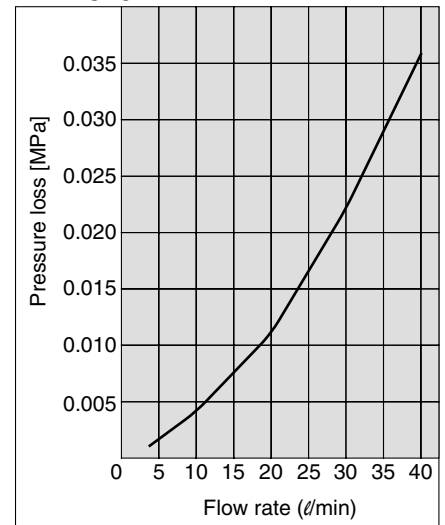
PF2D504



PF2D520

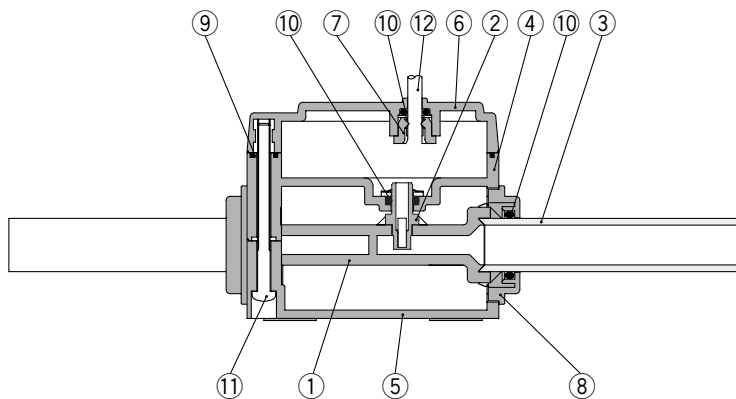


PF2D540



Construction

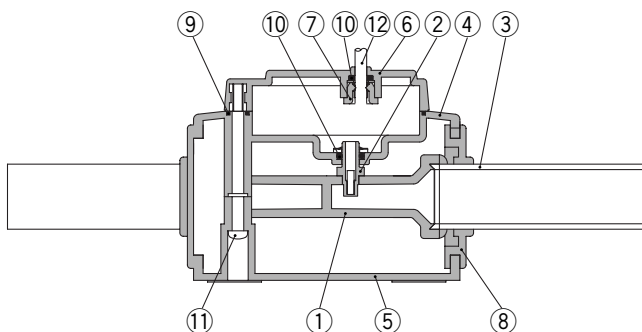
PF2D504/520



Component Parts

| No. | Description | Material |
|-----|-------------|---------------------|
| ① | Body | New PFA |
| ② | Sensor | New PFA |
| ③ | Tube | Super PFA |
| ④ | Housing A | PPS |
| ⑤ | Housing B | PPS |
| ⑥ | Housing C | PPS |
| ⑦ | Bushing | POM |
| ⑧ | Cap | PPS |
| ⑨ | Gasket | FKM |
| ⑩ | O-ring | FKM |
| ⑪ | Thread | Stainless steel 304 |
| ⑫ | Lead wire | PVC |

PF2D540

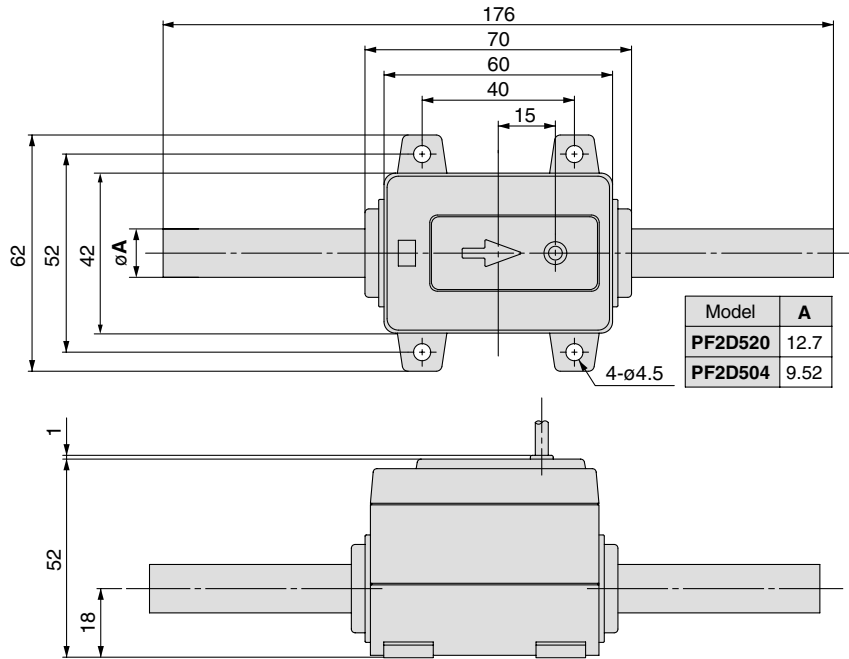


Digital Flow Switch Series PF2D

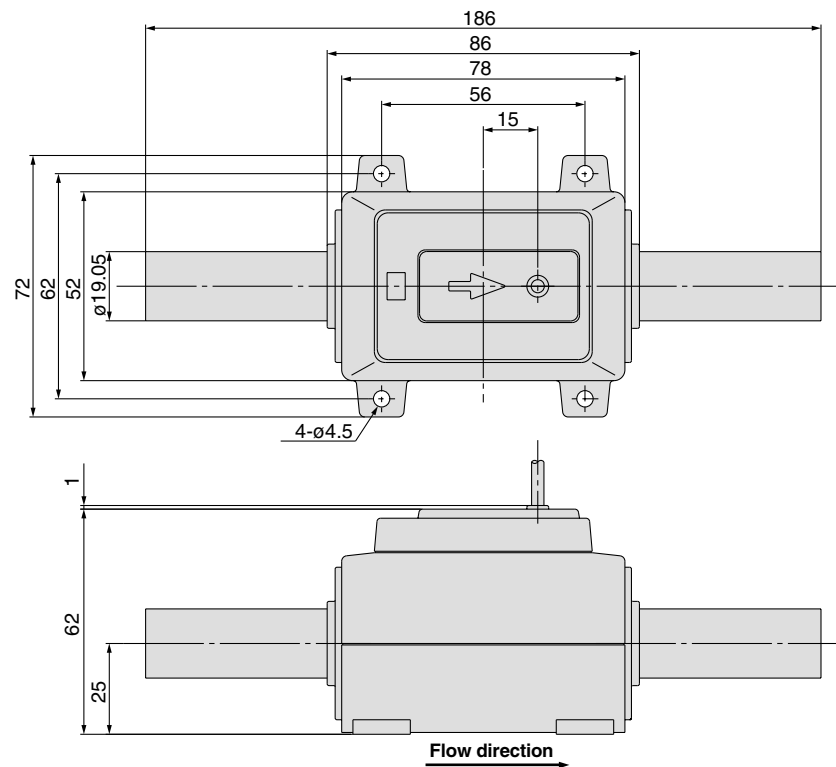
For Deionized Water and Chemicals

Dimensions: Separate Type Sensor Unit

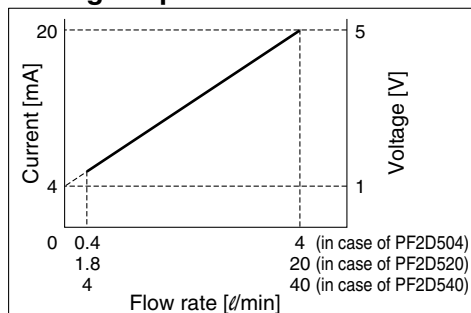
PF2D504-11/520-13



PF2D540-19

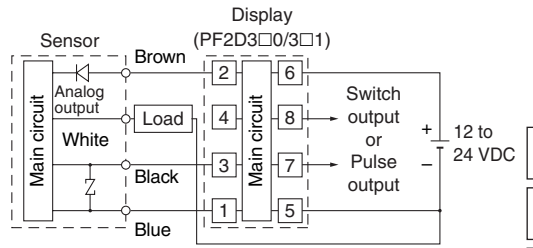


Analog Output

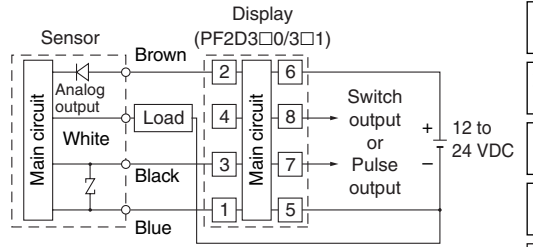


Internal circuit and wiring example

① to ⑧ are terminal numbers.

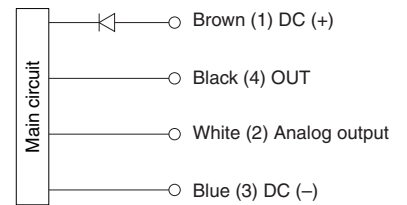


PF2D5□□-□-1



PF2D5□□-□-2

Wiring



* Use this sensor by connecting to SMC remote type display unit Series

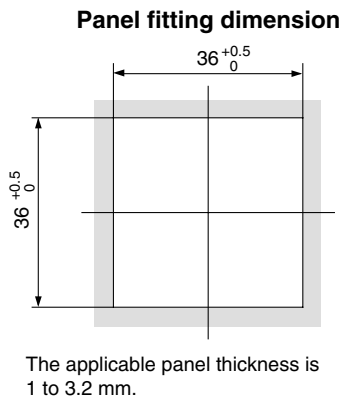
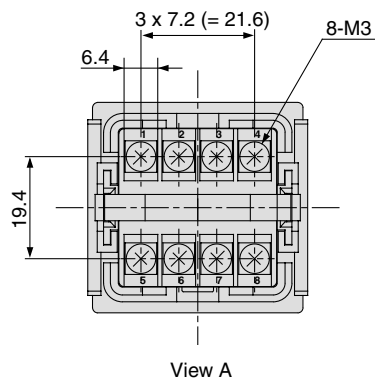
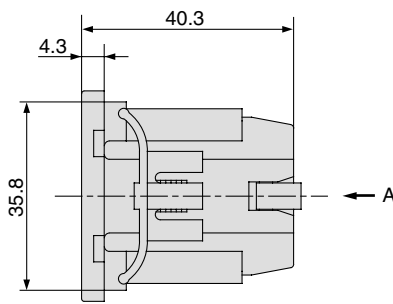
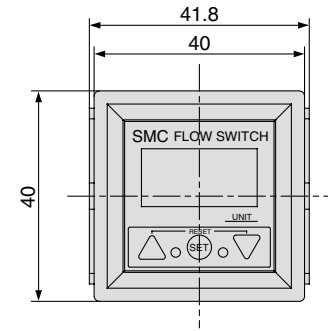
- ZSE□
- ISE□
- PSE
- ZSE3
- PS
- ZSE1
- ZSE2
- ZSP
- ISA2
- IS□
- ZSM
- PF2□
- IF□
- Data

Series PF2D

Dimensions: Separate Type Display Unit

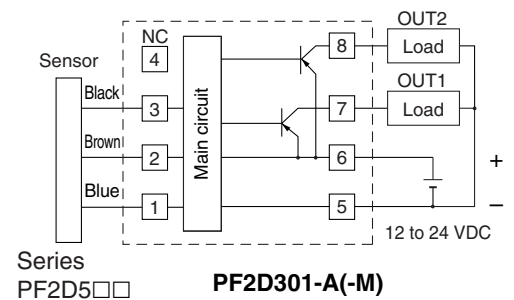
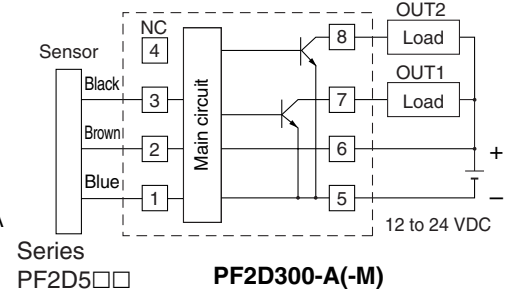
PF2D30⁰-A

Panel mounting type



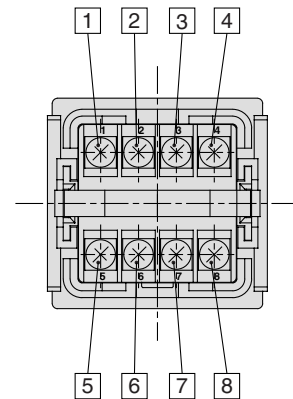
Internal circuit and wiring example

① to ⑧ are terminal numbers.



Do not connect the white wire of the sensor to ③ of the display unit.

Terminal block number



Functions/PF2D

Refer to the operation manual how to set and to operate.

Flow rate measurement selection

Real-time flow rate and accumulated flow rate can be selected.
Up to 999999 of flow rate value can be accumulated.

Unit switching

| Display | Real-time flow rate | Accumulated flow |
|---------|---------------------|------------------|
| U_1 | l/min | l |
| U_2 | GPM | gal (US) |

GPM = gal (US)/min

Note) Fixed SI unit (l/min, l, m³ or m³ x 10) will be set for the type without the unit switching function.

Flow rate measuring unit confirmation

This function allows to confirm the accumulated flow rate when real-time flow rate is selected and to confirm the real-time flow rate when accumulated flow rate is selected.

Error correction

| LED display | Contents | Solution |
|-------------|--|---|
| E-1 | A current of more than 80 mA is flowing to OUT1 | Check the load and wiring for OUT1 |
| E-4 | The setting data has changed for whatever reasons. | Perform the RESET operation, and reset all data again. |
| - - - - | The flow rate is over the flow rate measurement range. | Reduce the flow rate until it is within the flow rate range, using an adjustment valve. |

Key lock

This function prevents incorrect operations such as changing the set value accidentally.

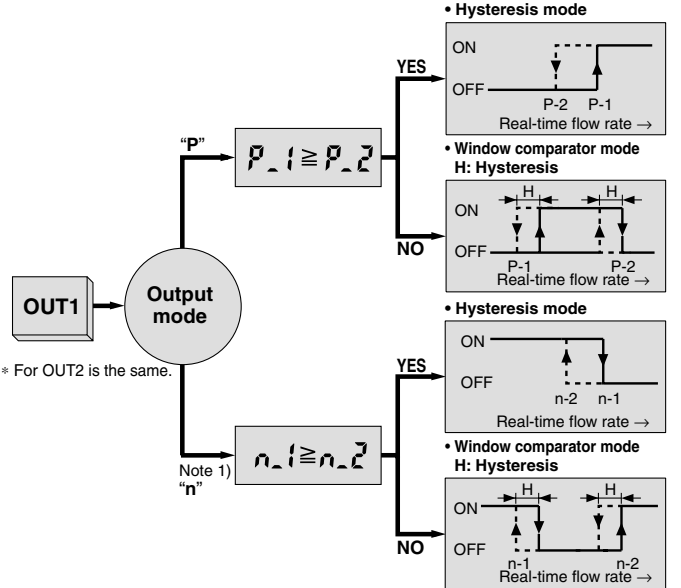
Accumulation clearance

This is to clear the accumulated value.

Output types

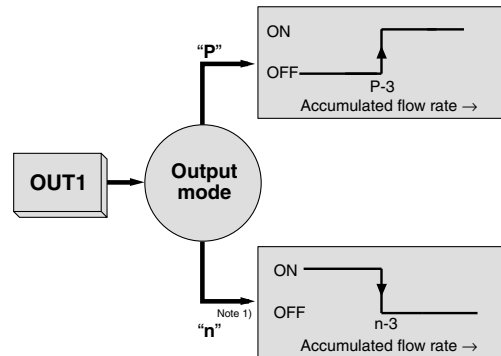
Real-time switch output, accumulated switch output, or accumulated pulse output can be selected as an output type.

Real-time switch output (OUT 1, 2)



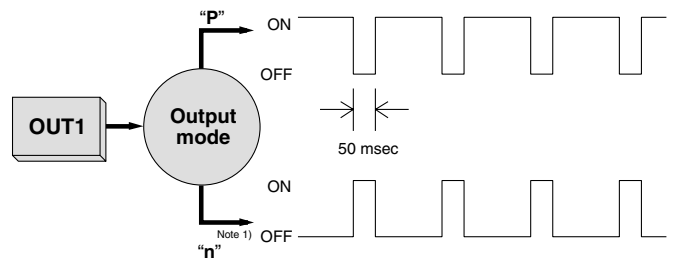
Note 1) Output mode is set to inverted output at the factory before shipment.

Accumulated switch output (OUT 1, 2)



Note 1) Output mode is set to inverted output at the factory before shipment.

Accumulated pulse output (OUT 1, 2)



Note 1) Refer to the specifications of display unit for the flow rate value per pulse.

- ZSE
- ISE
- PSE
- ZSE3
- PS
- ZSE1
- ZSE2
- ZSP
- ISA2
- IS
- ZSM
- PF2
- IF
- Data



Applicable Fluid

Compatibility check list: Materials of digital flow switch for deionized water and chemicals and fluid

| Chemical | Compatibility | |
|---|--|---|
| Acetone | ○ | |
| Ammonium hydroxide | ○ | |
| Isobutyl alcohol | X | |
| Isopropyl alcohol | ○ | |
| Hydrochloric acid | ○ | |
| Ozone | X | |
| Hydrogen peroxide | Concentration 50% or less 50°C or less | ○ |
| Ethyl acetate | ○ | |
| Butyl acetate | ○ | |
| Nitric acid (Except fuming nitric acid) | Concentration 10% or less | ○ |
| Deionized water | ○ | |
| Sodium hydroxide | X | |
| Ultra deionized water | ○ | |
| Toluene | ○ | |
| Hydrofluoric acid | Concentration 50% or less | ○ |
| Sulfuric acid (Except fuming sulfuric acid) | Concentration 20% or less | ○ |
| Phosphoric acid | Concentration 30% or less | ○ |

Note 1) The material and fluid compatibility check list provides reference values as a guide only.

Note 2) Please consult with SMC for made to order specifications such as: Teflon coated threads to prevent rust/corrosion when in contact with strong acid or alkali.

- Compatibility is indicated for fluid temperatures at 100°C or less.
- Please consult with SMC regarding fluids other than the above.
- Please consult with SMC regarding operating conditions.
- The product is not explosion proof. Please be sure to take measures to guard it from explosive gas when using explosive fluid.

Table symbols ○ : Can be used
○ : Can be used under certain conditions
X : Cannot be used



Series PF2D

Specific Product Precautions 1

Be sure to read before handling.

Design and Selection

⚠ Warning

1. Operate the switch only within the specified voltage.

Use of the switch outside the range of the specified voltage can cause not only malfunction and damage of the switch but also electrocution and fire.

2. Do not exceed the maximum allowable load specification.

A load exceeding the maximum load specification can cause damage to the switch.

3. Do not use a load that generates surge voltage.

Although surge protection is installed in the circuit at the output side of the switch, damage may still occur if a surge is applied repeatedly. When a surge generating a load such as a relay or solenoid is directly driven, use a type of switch with a built-in surge absorbing element.

4. Be sure to verify the applicable fluid.

The switch does not have an explosion proof rating. To prevent possible fire hazard, do not use with flammable gases or fluids.

5. Monitor the internal voltage drop of the switch.

When operating below a specified voltage, it is possible that the load may be ineffective even though the pressure switch function is normal. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

$$\text{Supply voltage} - \text{Internal voltage drop of switch} > \text{Minimum operating voltage of load}$$

6. Use the switch within the specified flow rate measurement and operating pressure.

Operating beyond the specified flow rate and operating pressure can damage the switch. Avoid especially the application of pressure above specifications through a water hammer.

<Examples of pressure reduction measures>

- Use a device such as a water hammer relief valve to slow the valve's closing speed.
- Absorb impact pressure by using an accumulator or elastic piping material such as a rubber hose.
- Keep the piping length as short as possible.

7. Design the system so that the fluid always fills the detection passage.

Especially for vertical mounting, introduce the fluid from the bottom to the top.

8. Operate at a flow rate within the flow rate measurement range.

If operated outside of the flow rate measurement range, the Karman vortex will not be generated and normal measurement will not be possible.

9. Never use flammable fluids and/or penetrable fluids.

These can cause fire, explosion or corrosion.

* Refer to MSDA (material safety data sheet) when using chemicals.

Design and Selection

⚠ Caution

1. Data of the flow switch will be stored even after the power is turned off.

Input data will be stored in EEPROM so that the data will not be lost after the flow switch is turned off. (Data can be rewritten for up to one million times, and data will be stored for up to 20 years.)

Mounting

⚠ Warning

1. Monitor the flow direction of the fluid.

Install and connect piping so that fluid flows in the direction of the arrow indicated on the body.

2. Remove dirt and dust from inside the piping using an air blower before connecting piping to the switch.

3. Do not drop or bump.

Do not drop, bump, or apply excessive impacts (490 m/s²) while handling. Although the external body of the switch (switch case) may not be damaged, the inside of the switch could be damaged and cause a malfunction.

4. Hold the body of the switch when handling.

The tensile strength of the cord is 49 N. Applying a greater pulling force on it can cause a malfunction. When handling, hold the body of the switch—do not dangle it from the cord.

5. Do not use until you can verify that equipment can operate properly.

Following mounting, repair, or retrofit, verify correct mounting by conducting suitable function and leakage tests after piping and power connections have been made.

6. Never mount a switch in a place that will be used as a scaffold during piping.

7. Be sure to allow straight pipe length that is minimum 8 times the port size upstream and downstream of the switch piping.

When abruptly reducing the size of piping or when there is a restriction such as a valve on the inlet side, the pressure distribution in the piping changes and makes accurate measurement impossible. Therefore, flow restriction measures such as these should be implemented on the outlet side of the switch.

When used with the outlet side open, be careful of the cavitation that is prone to occur.

ZSE
ISE

PSE

ZSE3

PS

ZSE₁
ISE₂

ZSP

ISA2

IS

ZSM

PF2

IF

Data

Series PF2D



Specific Product Precautions 2

Be sure to read before handling.

Wiring

⚠ Warning

1. **Verify the color and terminal number when wiring.**
Incorrect wiring can cause the switch to be damaged and malfunction. Verify the color and the terminal number in the instruction manual when wiring.
2. **Avoid repeatedly bending or stretching the lead wire.**
Repeatedly applying bending stress or stretching force to the lead wire will cause it to break.
3. **Confirm proper insulation of wiring.**
Make sure that there is no faulty wiring insulation (contact with other circuits, ground fault, improper insulation between terminals, etc.). Damage may occur due to excess current flow into a switch.
4. **Do not wire in conjunction with power lines or high voltage lines.**
Wire separately from power lines and high voltage lines, avoiding wiring in the same conduit with these lines. Control circuits including switches may malfunction due to noise from these other lines.
5. **Do not allow loads to short circuit.**
Although switches indicate excess current error if loads are short circuited, all incorrect wiring connections such as power supply polarity cannot be protected. Take precautions to avoid incorrect wiring.

Usage

⚠ Warning

1. **When using a switch for high temperature fluid, the switch itself also becomes hot due to the high temperature fluid. Avoid touching the switch directly as this may cause a burn.**

Operating Environment

⚠ Warning

1. **Never use in the presence of explosive gases.**
The switches do not have an explosion proof rating. Never use in the presence of an explosive gas as this may cause a serious explosion.
2. **Mount switches in locations where there is no vibration greater than 98 m/s², or no impact greater than 490 m/s².**
3. **Do not use in an area where surges are generated.**
When there are units that generate a large amount of surge in the area around pressure switches, (e.g., solenoid type lifters, high frequency induction furnaces, motors, etc.) this may cause deterioration or damage to the switches' internal circuitry. Avoid sources of surge generation and crossed lines.
4. **Switches are not equipped with surge protection against lightning.**
Flow switches are CE compliant; however, they are not equipped with surge protection against lightning. Lightning surge protection measures should be applied directly to system components as necessary.
5. **Avoid using switches in an environment where the likelihood of splashing or spraying of liquids exists.**
Switches are dustproof and splashproof; however, avoid using in an environment where the likelihood of heavy splashing or spraying of water and/or oil exist. Since the display unit of the remote type switches featured here is not dust or splash proof, the use in an environment where water and/or oil splashing or spraying exists must be avoided.

Maintenance

⚠ Warning

1. **Perform periodical inspections to ensure proper operation of the switch.**
Unexpected malfunctions may cause possible danger.
2. **Take precautions when using the switch for an interlock circuit.**
When a pressure switch is used for an interlock circuit, devise a multiple interlock system to prevent trouble or malfunctioning. Verify the operation of the switch and interlock function on a regular basis.
3. **Do not disassemble or perform any conversion work on flow switches.**
4. **Check the following during regular maintenance to avoid damage and loss because of chemicals.**
 - a) Do not touch the remaining chemicals in piping and/or digital flow switch.
 - b) Verify the names and characteristics of using chemicals and treat them accordingly.



Series **PF2D**

Specific Product Precautions 3

Be sure to read before handling.

Measured Fluid

Warning

1. Check regulators and flow adjustment valves before introducing the fluid.

If pressure or flow rate beyond the specified range are applied to the switch, the sensor unit may be damaged.

2. Be sure to take preventive measures not to expose the switch to inflammable and/or explosive gases when using inflammable fluid.

3. Place the filter on the upstream side when extraneous material can be infected.

Accurate measurement cannot be fulfilled when extraneous material is adherent to the vortex generator and the vortex detector of the switch.

Others

Warning

1. Since switch output remains OFF while a message is displayed after the power is turned on, start measurement after a value is displayed.

2. Perform settings after stopping control systems.

When the switch's initial setting and flow rate setting are performed, output maintains the condition prior to the settings. Output turns OFF when the switch's initial setting and flow rate setting are performed.

Set Flow Rate Range and Rated Flow Rate Range

Caution



Set the flow rate within the rated flow rate measuring range.

The set flow rate range is the range of flow rate that is possible in setting at the controller side.

The flow rate measuring range is the range that satisfies the specifications (accuracy, linearity etc.) on the sensor.

Although it is possible to set a value outside the flow rate measuring range, the specifications will not be guaranteed.

| Sensor | Flow range | | | | | |
|---------|------------|-----------|-----------|----------|----------|----------|
| | 0.4 ℓ/min | 1.8 ℓ/min | 4 ℓ/min | 10 ℓ/min | 20 ℓ/min | 40 ℓ/min |
| PF2D504 | 0.4 ℓ/min | | 4 ℓ/min | | | |
| | 0.25 ℓ/min | | 4.5 ℓ/min | | | |
| PF2D520 | 1.8 ℓ/min | | 20 ℓ/min | | | |
| | 1.3 ℓ/min | | 21 ℓ/min | | | |
| PF2D540 | 4 ℓ/min | | 40 ℓ/min | | | |
| | 2.5 ℓ/min | | 45 ℓ/min | | | |

 Rated flow rate range of sensor
 Set flow rate range of sensor

ZSE□
ISE□

PSE

ZSE3

PS

ZSE1
ZSE2

ZSP

ISA2

IS□

ZSM

PF2□

IF□

Data